Lessons Learnt
And Case Studies
In Technology Transfer
In African Countries
Under the Montreal Protocol
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Sixteen years after the signing of the Montreal Protocol on Substances that Deplete the Ozone Layer, and more than 10 years after the Rio Summit, the results of international co-operation for the transfer of environmentally-friendly technologies to phase out ozone depleting substances (ODS) are now becoming widely visible. While there is still work to be done, the international community has made substantial progress in achieving the goal of protecting the stratospheric ozone layer.

As of today, industrialized countries have largely stopped the production of CFCs, halons, carbon tetrachloride and methyl chloroform, except for some few thousand tonnes per year of essential uses for which no acceptable substitutes are yet available. Developing countries are now the major users of ODS in the world, hence they are becoming the focus of the ODS phase out efforts. The Montreal Protocol allowed developing countries a ten-year time lag before having to meet phase out targets. Now that time is over and developing countries are in the “compliance period.” Attention is now focussed on cooperation between developed and developing countries to eliminate production and reduce consumption of ODS in developing countries according to a strict timetable. The Multilateral Fund, created in 1990 by the Parties to the Montreal Protocol to provide financial and technical assistance to Article 5 Parties to ensure compliance with the control measures set out under the Protocol, has provided the essential means and catalyst to enable developing countries to comply with the Protocol.

This document is a compilation of case studies gleaned from technology transfer successes under the Multilateral Fund in Africa. These examples should serve as a tool to encourage effective technology transfer, share knowledge and promote co-operation between countries not only in Africa, but in other regions as well.

UNEP commends the governments and industries of these African nations for the great efforts they are putting forth to protect the ozone layer, despite the other pressing environmental, economic and societal challenges.

I would like to express my sincere thanks to the Multilateral Fund of the Montreal Protocol, its Executive Committee, Secretariat, the other implementing agencies and bilateral donors for the work done in assisting developing countries to comply with the Protocol and protect the ozone layer. The fight is far from over, and much work remains to be done. We must continue to learn, share knowledge, and join hands for the improvement of our environment.

UNEP extends its sincere appreciation to the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T), the Commonwealth Science Council (CSC) and the Asian and Pacific Centre for Transfer of Technology (APCTT) for their excellent partnership in organising the workshop that formed the basis for this booklet.

DR. KLAUS TÖPFER
Executive Director, UNEP
Since the establishment of the Montreal Protocol in 1987, 51 African countries have ratified the Montreal Protocol and 45 the London Amendment reflecting some 85 percent of the African countries. The only countries that are still non-Parties are Equatorial Guinea and Eritrea.

This strong support and commitment to the protection of the ozone layer by African countries is in spite of the fact that most of them except South Africa and Egypt are non-producers of ODSs and equipment using ODSs.

African countries have been successful in reducing their consumption of ODSs and complying with the Protocol’s targets and obligations and many have met the 1999 freeze on CFC consumption. Some 90 percent of African countries have also complied with the reporting requirements of the Montreal Protocol. To achieve this, African countries required a high level of resolve and determination. It required commitment to the principles of conserving the ozone layer.

It needed putting in place legal and institutional mechanisms for enforcing and facilitating implementation of the Montreal Protocol and its amendments. It also required mounting intensive and sustained public awareness campaigns to inform nationals about the importance of the ozone layer, substances that endanger it and potential solutions and alternatives. It required setting aside financial and other resources for this purpose. African countries have been able to do this despite their meagre resources and other pressing high priority national obligations.

Success stories would not be told without the enabling financial assistance from the Multilateral Fund of the Montreal Protocol for the protection of the ozone layer. The Fund approved some US$ 145.7 million to African countries over the period 1991 to 2004 reflecting 10% of the total Multilateral disbursements to developing countries (“Article 5 countries”) for ODS elimination.

In this regard the Implementing Agencies (UNEP, UNIDO, UNDP and the World Bank) have played a significant role in implementing projects funded through the Multilateral Fund. Similarly, cooperation with bilateral partners in the developed world facilitated technology transfer during phase out.

This document provides findings of a survey on lessons learnt and case studies as experienced by several key partners in the implementation of technology transfer during phase out of ODSs in African countries. Further, the findings of a regional Workshop for Southern African Countries and Implementing Agencies held in Blantyre, Malawi in May 2002, provide an excellent opportunity to understand and document the lessons learnt during project implementation.

These experiences are analysed and recorded here.

Total elimination of ODSs has not been achieved either in Africa or in many other Article 5 countries given that there are numerous barriers and difficulties in phase out and technology transfer. Hence experiences of African countries and the lessons learnt as cited in the various case studies will be useful to emulate in the global effort to achieve total phase out of ODSs.

These lessons will apply equally to the Fund, Implementing Agencies, Governments and National Ozone Units (NOUs), bilateral partners, recipient enterprises and in some cases non-governmental organisations and civil society. It is hoped that this document will receive wide publicity and readership amongst the different stakeholders and contribute to a rapid and smooth process of technology transfer during phase out of the remaining ODSs.
Multilateral Fund Support To Phase Out Projects In Africa

The Multilateral Fund for the Implementation of the Montreal Protocol is the largest supporter of projects to phase out ODSs for the protection of the ozone layer in the world.

In Article 5 countries, the Multilateral Fund finances all eligible projects except for some contributions from bilateral sources. In Africa, numerous successful phase out projects involving technology transfer, would not have taken off without the injection of financial and technical support by the Multilateral Fund. Since its establishment in 1991, the Fund has provided US$ 145.7 million for implementation of phase out projects in 50 African countries representing 10% of the Fund’s global portfolio for Article 5 countries of the world. The Multilateral Fund allocated some 68% of funds given to African countries to investment portfolio compared to 32% provided to non-investment activities such as institutional and capacity building, training, information exchange, project preparation and technical assistance.

The following charts and tables show that the refrigeration and foam sectors received the largest share of Multilateral Fund assistance, approximately 73%, for about US$ 73 million (with refrigeration getting 39% and foam some 34% of the funds). Aerosols received 4% whilst the fumigants received 11% and solvents 1.5%.

### Multilateral Funds approved for investment projects

<table>
<thead>
<tr>
<th>Sector</th>
<th>Projects</th>
<th>US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigeration</td>
<td>69</td>
<td>38,686,968</td>
</tr>
<tr>
<td>Foam</td>
<td>143</td>
<td>33,871,314</td>
</tr>
<tr>
<td>Aerosol</td>
<td>27</td>
<td>4,026,762</td>
</tr>
<tr>
<td>Fumigation</td>
<td>13</td>
<td>10,482,061</td>
</tr>
<tr>
<td>Solvent</td>
<td>11</td>
<td>1,530,388</td>
</tr>
<tr>
<td>Phase-out</td>
<td>8</td>
<td>10,733,142</td>
</tr>
<tr>
<td><strong>SUB TOTAL</strong></td>
<td><strong>271</strong></td>
<td><strong>99,370,656</strong></td>
</tr>
</tbody>
</table>

### Multilateral Funds approved for non-investment projects

<table>
<thead>
<tr>
<th>Sector</th>
<th>Projects</th>
<th>US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Strengthening</td>
<td>124</td>
<td>11,242,810</td>
</tr>
<tr>
<td>Country Programmes</td>
<td>54</td>
<td>2,297,396</td>
</tr>
<tr>
<td>Demonstration</td>
<td>113</td>
<td>3,435,791</td>
</tr>
<tr>
<td>Project Preparation</td>
<td>233</td>
<td>5,257,896</td>
</tr>
<tr>
<td>Technical Assistance</td>
<td>156</td>
<td>19,139,155</td>
</tr>
<tr>
<td>Training</td>
<td>86</td>
<td>4,937,136</td>
</tr>
<tr>
<td><strong>SUB TOTAL</strong></td>
<td><strong>666</strong></td>
<td><strong>46,310,184</strong></td>
</tr>
</tbody>
</table>

**GRAND TOTAL** 937 145,680,840

Source: Multilateral Fund Inventory of Approved Projects as of March 2004
Background

Most ODS phase out activity occurred in Algeria, Egypt, Tunisia, Sudan, Nigeria and Morocco representing over 65% of the funds disbursed by the Fund. Medium level ODS phase out activity took place in Ghana, Cameroon, Ivory Coast, Kenya, Malawi, Tanzania and Zimbabwe. The remaining African member countries had smaller phase out projects amounting to less than half a million US dollars each.

Fund allocation shown on a regional perspective

- Fund allocation is shown on a regional perspective in Chart 3 (Total funds approved in Africa, by subregions”). The North African major ODS consumers received about US$ 44 million or 51% of the funds made available to African countries. West African countries got US$ 44 million or 30%. East African countries received about US$ 9.4 million or 6% of the funds and the South African region acquired about US$ 12 million or 8% of the funds made available to African countries by the Multilateral Fund over the period 1991 to 2004. Africa-wide regional projects received US$ 5.7 million or 4%.

- This reflects the fact that Northern African countries are more developed industrially and consequently have more investment projects than the rest of the countries which are mainly low volume consuming countries.

- Thus, Africa has received about 10% of global funding for ODS phase out from the Multilateral Fund. Some 32% of the global funds were spent on institutional building and training projects. These capacity building projects have been dubbed “software” projects as opposed to investment (“hardware”) projects involving equipment change in industries. UNEP has played a major role in implementing most of the “software” projects.
Role of Implementing Agencies and Bilateral Partners

Implementation of phase out projects and transfer of technologies for ODS alternatives using financial resources from the Multilateral Fund has been effectively done in African countries by the implementing agencies. These agencies have long experience and in-house capacity for specialised phase out activities such as technology transfer, capacity building, training and market access. The role played by these agencies is briefly described:

**MULTILATERAL FUND APPROVALS TO IMPLEMENTING AGENCIES**

Globally the Multilateral Fund provided more than US$ 1.5 billion from 1990 to 2004 in funding for projects implemented by Implementing Agencies and bilateral partners. Chart 5 below (“Total funds approved in Africa, by Agencies”) shows the breakdown of funding by agency for projects implemented in Africa. The implementing agencies spent financial resources received form the Multilateral Fund in implementing their roles as follows:

- **UNITED NATIONS ENVIRONMENT PROGRAMME**
  
  UNEP’s support activities in ODS phase out in African countries has been provided through its DTIE OzonAction programme. Through this Programme, UNEP has successfully implemented the following non-Investment projects in Africa:

  - Preparation of Country Programmes for 39 countries,
  - Implementation of Institutional Strengthening Projects in 42 countries,
  - Carrying out capacity building,
  - Implementing targeted training projects at regional and national level,
  - Facilitating information exchange.

Through these projects, African countries have been prepared to implement investment phase out activities for ODS in each country. Hence, UNEP’s role not only assists them to prepare for investment activities but through its capacity building and training programmes, phase out activities and technology transfer is made sustainable and assumes a level of permanency.

- **UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION**

  As an Implementing Agency UNIDO carries out investment related activities in African countries including the following:

  - Implementing 108 investment projects worth US$ 44 million,
  - Assisting in the phase out of some 5,500 ODP tonnes,
  - Providing access to cost effective state of the art ODS technologies,
  - Providing reputable experts,
  - Providing appropriate training for skill upgrade,
  - Ascertaining compliance with international standards,
  - Ensuring modern safety controls and eco-labelling of products.

- **UNITED NATIONS DEVELOPMENT PROGRAMME**

  UNDP activities in Africa have covered the following areas:

  - Institutional Strengthening,
  - Training and provision of technical assistance,
  - Implementing some 163 projects worth US$ 28 million in 22 countries,
  - Implementing 125 investment projects,
  - Assisting in the phasing out of some 7,000 ODP tonnes in various sectors.

- **THE WORLD BANK**

  The World Bank participation in ODS phase out and technology transfer in African countries has included the following areas:

  - Contributed some US$ 7 million from its own funds,
  - Development of long term strategic plans for ODS phase out,
  - Facilitating regional co-operation and co-ordination.

- **BILATERAL PARTNERS**

  The following countries have actively participated in ODS phase out activities and technology transfer in Africa:

  - Germany,
  - Canada,
  - Netherlands,
  - France,
  - Switzerland,
  - Denmark
  - Finland
  - Australia
  - Japan
  - South Africa

  Assistance and contributions from these countries have gone mainly to supplement activities of UNEP’s Regional Office for Africa in supporting National Ozone Units, operationalising Refrigerant Management Plans, Recovery and Recycling Projects, Data and Progress Reporting and compliance with the Montreal Protocol in general.
ODS Consumption by African countries

The figure above shows the aggregate consumption of CFCs as reported by 45 African countries from 1986 to 2003. The most significant ODSs used in African countries besides the CFCs are halons, methyl bromide and HFCs. From 1995 to 1998, the average ODS consumption by African countries was in the range of 14,000-15,000 tonnes per year. In 1999-2000, the consumption of ODSs in Africa fell to about 12,000 tonnes. It fell to around 11,000 tonnes in 2001-2002 and to 8,000 tonnes in 2003. For 2003, consumption is expected to be higher, once all parties report their data.

It is clear that African countries consume small amounts of ODSs compared to other Article 5 countries. Their consumption of CFCs was only about 12 per cent compared to the rest of the world. These small quantities of CFCs are of course very important to African countries as they are necessary for refrigeration, fire fighting, public health, foam and in agricultural and store fumigation.

ODS phase out by African countries

ODS phase out in Africa or indeed meeting the compliance would have been and impossible task without financial resources provided by the Multilateral Fund. The Multilateral Fund has approved a total of US$ 145.7 million from 1991 to March 2004 to finance ODS phase out projects in Africa. About 68% of these funds were spent on investment projects and the balance of about 32% went for non-investment projects.

The Executive Committee from 1990 up to 2004 approved 937 projects in Africa. Some 535 projects or 57% of these projects have been completed. In approving these projects, the Executive Committee had expected 14,250 ODP tonnes to be phased out (directly). In fact, 8,369 ODP tonnes or 59% have successfully been phased out by African countries. This is a remarkable achievement given Africa's numerous and endemic problems requiring higher government attention and priority. In global terms, by March 2004, African countries had phased out some 7% of the total ODP tonnes phased out by the rest of Article 5 countries in the world.

The Executive Committee approved some 14,250 ODP tonnes for phase out in Africa as shown in Annex 1. North African countries had the largest share of ODPs to be phased out, some 8,311 ODP tonnes or (58%) covering Egypt, Algeria, Tunisia, Sudan, Mauritania, Morocco and some others. West African countries of Nigeria, Ghana, Cameroon and others were required to phase out 31% of the approved tonnage i.e. 4,454 ODP tonnes. Eastern African countries of Kenya, Uganda, Tanzania, Ethiopia, Madagascar, Seychelles, Madagascar and others were expected to phase out about 643 ODP tonnes or 5% and the various Southern African countries had some 752 ODP tonnes or 5% to phase out, with the major actors being Zimbabwe, Zambia, Namibia, Malawi, Lesotho and Swaziland.

However, the actual ODP tonnage phased out by African countries is shown on a regional basis in Chart 2 (“ODP tonnes phased out in Africa, by subregions”). Of 8,369 tonnes phased out in Africa, the major consumers of North Africa phased out some 5,101 ODP tonnes or 62%. The West African region phased out 2,623 ODP tonnes or 31%; the Eastern African region phased out 440 ODP tonnes i.e. 5% and the Southern African region phased out 205 ODP tonnes equivalent to 2% of the total tonnage phased out in Africa.

Alternative technologies transferred to Africa under approved multilateral fund projects

Africa’s success in phase out of ODSs and technology transfer can also be demonstrated by the number of environmentally sound technologies transferred to Africa under the approved Multilateral Fund projects since the meeting of 36th Executive Committee. The table below shows that 32 environmentally sound technologies have been transferred to Africa since the 42nd Executive Committee meeting in March 2004. This is an outstanding success for all the parties involved in the phase out projects in Africa. The majority of the technologies were in the foam sector (11) followed by 6 technologies in the refrigeration sector. Aerosols had 3 technologies transferred and fumigants had 6 technologies. The solvent sector had 3 technologies transferred and the halons had one technology transferred.

The successful transfer of these technologies demonstrates a very promising development in the elimination of ODSs in African economies. New technologies have been introduced using Ozone friendly substances and appropriate equipment. The challenge now is to ensure the sustainability of these processes and procedures. It is essential to guarantee supply of spare parts for the new equipment in the industry. It is necessary to ensure appropriate training of staff and technicians to run the plants in the industry. Availability of the new ozone friendly chemicals and substances must be assured.

Above all, the new processes must remain market driven, commercially
competitive and economically viable if sustainability of these ventures is to be ascertained. It thus seems imperative that the various stakeholders and key partners in the conservation of the ozone layer must continue to work together. Governments, NGOs and the communities have a vital continuing role to play. The Multilateral Fund, Implementing Agencies and bilateral partners have an important part to play in assisting Governments sustain the momentum generated over this period. It is clearly necessary for the key partners now to indulge in articulating the various roles to be played by all stakeholders after the freeze period and after all parties have achieved compliance. Thus, some kind of a monitoring plan needs to be put in place after compliance and phase out. A mechanism to finance this activity will need to be formulated.

Complying with the freeze period

The Montreal Protocol and its amendments set a schedule for freeze and reduction in ODS according to the Table below. For article 5 countries, CFC consumption was to be frozen in July 1999. The halons and methyl bromide (MBr) consumption were frozen in 2002. The methyl chloroform (MCF) freeze was in 2003. For CFCs and halons will be reduced by 50%, MCF by 30% and carbon tetrachloride (CTC) by 85% by 2005. Further, Article 5 countries will have to reduce their CFC consumption by 85% in 2007. There will be 100% phase out of CFCs by Article 5 countries by 2010 and a reduction of MCF by 70%. Furthermore, 100% phase out of MCF will take place in 2015. On the other hand, for the hydrochlorofluorocarbons (HCFCs), there will be a freeze at the baseline figure of the year 2015. A total phase out of the HCFCs will occur in 2040.

Montreal Protocol Compliance Schedule for ODS Substance

<table>
<thead>
<tr>
<th>Substance</th>
<th>ARTICLE 5 COUNTRIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFCs</td>
<td>Freeze July 1999</td>
</tr>
<tr>
<td>Halons</td>
<td>Freeze 2002</td>
</tr>
<tr>
<td>Methyl bromide</td>
<td>Freeze 2002</td>
</tr>
<tr>
<td>Methyl chloroform</td>
<td>Freeze 2003</td>
</tr>
<tr>
<td>CFCs</td>
<td>50% reduction 2005</td>
</tr>
<tr>
<td>Halons</td>
<td>50% reduction 2005</td>
</tr>
<tr>
<td>Methyl chloroform</td>
<td>30% reduction 2005</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>85% reduction 2005</td>
</tr>
<tr>
<td>CFCs</td>
<td>85% reduction 2007</td>
</tr>
<tr>
<td>CFCs</td>
<td>100% phase out 2010</td>
</tr>
<tr>
<td>Methyl chloroform</td>
<td>70% reduction 2010</td>
</tr>
<tr>
<td>Methyl chloroform</td>
<td>100% phase out 2015</td>
</tr>
<tr>
<td>Methyl Bromide</td>
<td>100% Phase out 2015</td>
</tr>
<tr>
<td>Hydrochlorofluorocarbons</td>
<td>Freeze at baseline figure 2015</td>
</tr>
<tr>
<td>Hydrochlorofluorocarbons</td>
<td>100% phase out 2040</td>
</tr>
</tbody>
</table>

Source: Ozone Secretariat

Therefore in considering Africa’s level of compliance with the Montreal Protocol and its amendments, it is necessary to keep the above compliance time frame in mind. It is seen that African countries have showed great resolve to phase out ODSs in their developing economies. By the freeze year in 1999, the aggregate consumption of ODSs in Africa was well below the freeze baseline. Many African parties are therefore fully compliant with the 1999 freeze for CFCs and many countries have also met the 2002 freeze for Halons and Methyl bromide. Africa’s progress towards full compliance with the schedule of CFCs is best illustrated by consumption trends in Mauritius and Ghana in the following graphs.
The above shows that Ghana reduced its consumption of ODSs by 70% from 1990 to 2003 alone whilst Mauritius reduced its consumption by 94% between 1992 and 2003. All together, some 44 African countries have met their CFC freeze in 2003. This is remarkable success. However, African countries must meet a 50% reduction in their CFC consumption by the year 2005 and a complete phase out by the year 2010. There is reason from the above experience to believe that Africa will meet this target.

EXPERIENCES AND LESSONS LEARNT IN TECHNOLOGY TRANSFER FOR ODS PHASE OUT IN AFRICAN COUNTRIES

A) STAKEHOLDER EXPERIENCES ON BARRIERS TO TIMELY AND EFFECTIVE IMPLEMENTATION OF PROJECTS

Stakeholders have noted barriers that have tended to impede smooth and rapid technology transfer in ODS phase out projects in African countries. These were seen to occur at the following levels:

I Government or in-country Level
II Implementing Agencies Level
III Multilateral Fund Level
IV Industries or Enterprise Level

I Government or Country-Level Barriers
The following country-level barriers have often impeded the smooth transfer of technology during implementation of ODS phase out projects in several African countries.

◗ Divergence of goals, objectives, views and interests between various players;
◗ Lack of commitment and effective ownership of projects by the Government;
◗ Lengthy Government bureaucracy for access to funds for implementation of activities;
◗ Lack of ODS legislation and policy and weak enforcement mechanisms;
◗ Limited technical capacity to adjust to new technologies;
◗ Insufficient recognition and facilitation of NOUs;
◗ Insufficient sensitisation on the Montreal Protocol, its amendments and its implications;
◗ Lack of incentives for compliance and disincentives for controlled substances in tax regimes;
◗ Poor identification procedures for potential recipients and
◗ African delegates to the Executive Committee meetings are not sufficiently informed about project proposals for proper presentation at meetings.

II Implementing Agencies-Level Barriers
These have included the following bottlenecks at the level of Implementing Agencies and or Bilateral partners:

◗ Inadequate flexibility;
◗ Poor sourcing of technical expertise;
◗ Slow disbursement of funds;
◗ Poor appreciation of local conditions by some consultants and bilateral partners and
◗ Competition between Implementing Agencies and bilateral partners which tend to cause confusion.

III Multilateral Fund-Level Barriers
Shortcomings at the level of the Multilateral Fund have included some of the following issues:

◗ Frequent changes in policies and guidelines;
◗ Inflexibility at times;
◗ Discrepancy between estimated conversion cost vis a vis approved budget allocation and
◗ Inadequate understanding of the local environment.
IV Industries or Enterprise-Level Barriers

Impediments from recipient industries often arise from the following factors:

- Lack of willingness to share new information;
- Resistance to change;
- Lack of transparency;
- Lack of trust between beneficiary, technology supplier and implementing agency;
- Poor co-operation between the industry and the Government NOU;
- Inadequate following of the correct procedures;
- Insufficient technical capacity to absorb and disseminate technology;
- High turnover of trained staff; and
- Inability to provide counterpart funding.

B) LESSONS LEARNT DURING TECHNOLOGY TRANSFER

Various stakeholders have varying experiences in the implementation of ODS projects in Africa and have learnt many useful lessons that would relate to best practices. These have been aggregated into two broad categories:

a) Lessons Learnt by Governments and Beneficiary Industries
b) Lessons Learnt by External Partners including Implementing Agencies and Bilateral Partners

a) Lessons Learnt by Governments and Industries

From the experiences of Governments and Industries, the following 15 lessons have been noted as important reflecting best practices which will be useful to remember during planning and implementation of future similar projects. In several cases the Multilateral Fund, Implementing and bilateral agencies also have similar experiences on some of these lessons.

Some Positive Lessons

I Technology and equipment are now available in the region and "South-to-South" collaboration is now possible;
II NOUs now have the potential and capacity to understand and articulate the Montreal Protocol and phase out issues but they need to be better facilitated while being allowed time to devote to their mandates on their own;
III The solution to project implementation problems lies in cooperation and trust between all stakeholders, good training and capacity building programmes and regular flow of funds;
IV Governments have great role to play in reducing bureaucracy and adjusting to new technologies;
V All parties involved need to play their roles and be transparent and accountable;
VI There is need to synchronise all implementation activities;
VII All stakeholders need sensitisation before and during project implementation on a broad range of issues including cultural and local situations; and
VIII Good communication is essential.

Some Negative Lessons

IX The Montreal Protocol and its amendments are often poorly understood and there is need for sensitisation of the stakeholders on this;
X There is need for project implementers to appreciate Government priorities;
XI The role of Implementing Agencies is not clearly understood;
XII There is often poor communication, poor networking and mistrust amongst the stakeholders;
XIII Most projects do not focus on sustainability;
XIV There is need to remember that project implementation will always have problems and that technology transfer is often a slow and painstaking process;
XV In some instances, technology transfer tends to be too fast with inadequate research, trials and demonstrations undertaken and there is need therefore for R&D in identification and application of new technologies.

b) Lessons Learnt by Implementing Agencies and Bilateral Partners in Technology Transfer

Since the start of the phase out programme for ODSs in Africa, implementing Agencies and bilateral partners have had a major role to play in all the projects. These Agencies have gathered useful experiences regarding best practices for technology transfer in particular how to avoid bottlenecks and move projects swiftly and smoothly. This has made it possible to implement phase out projects quickly and efficiently in many African countries. Some ten lessons have been identified as common to all the Implementing Agencies and are highlighted under the following groupings:

a) Policy-Related Lessons
b) Technology Related Lessons
c) Cost Related Lessons
d) Market Related Lessons

a) Policy-Related Lessons

I Awareness of the Montreal Protocol and phase out schedules is essential;
II It is necessary to provide alternatives and options;
III NOUs need to get principles of assessing technologies;
IV It is necessary to collaborate with other Agencies to get projects off the ground;
V Networking seems restricted to Governments and requires to be broadened;
VI There is need for a handbook on how to network and implement projects; and
VII It is essential to use national experts.

b) Technology-Related Lessons

VIII New chemicals and products have often problems of inflammability, toxicity, contamination and safety.
c) Cost-Related Lessons  
New products tend to have higher investment and operational costs.

d) Market-Related Lessons  
It is essential to take cognizance of the influence of external factors on the market situation and the low awareness of the local market needs to be addressed.

**KEY INDICATORS OF SUCCESSFUL TRANSFER OF TECHNOLOGY IN ODS PROJECTS IN AFRICAN COUNTRIES**

When phase out projects have been implemented, technologies transferred and use of alternatives has been fully accomplished, what can stakeholders remember with their kind of hindsight as indicators of the success stories? There must be several indicators of success according to the different stakeholders but in general indicators can be aggregated on the basis of who is perceiving success of the projects. In broad terms, success is of interest to the following stakeholders who must have a very good sense of what factors contributed to the success of the projects. Some of these factors are narrated here as indicators of success as seen by the country and external collaborators.

### Government or In-country Level Indicators of Success

Success can be indicated by the presence of some of the following indicators:
- High degree of Government commitment and support;
- Establishment of enabling policy, institutional and legal framework;
- Readiness to adapt new technologies; and
- Willingness to reduce bureaucracy.

### Indicators of Success at the Level of International Collaborators

At the level of international collaborators, (Multilateral Fund, Implementing Agencies, bilateral agencies and consultants) indicators of success are demonstrated by the following attributes on their part:
- A willingness to adjust to new situations;
- A timely disbursement of funds;
- A willingness to co-operate with other players and interest groups; and
- A willingness to understand and appreciate local situations.

### Indicators of Success at the Level of Beneficiary Industry

At the level of industry, success can be demonstrated by the following indicators on the part of the industry:
- A willingness to contribute counterpart funds;
- A readiness to adapt new technologies;
- An ability to share information on new technologies with competitors; and
- A willingness to train and retain technical staff.
CASE STUDIES

These case studies have been selected on the basis of how they demonstrate best practices as shown in the lessons learnt and indicator criteria for success of technology transfer in ODS projects under the Multilateral Fund.

A total of 12 case studies have been selected, five from the private sector, two from Government enterprises and four from the Implementing Agencies.

Further, one case study from Lesotho has been selected to demonstrate how effectively an African Government has put in structures to implement the Montreal Protocol.

It is shown that these structures and strategies have taken root rapidly thus enabling enforcement of the phase out of ODSs in the country.

The case studies are drawn from the aerosol, refrigerant, foam and fumigant sectors.
Cases Studies

The private sector

Phase out of CFCs in the Aerosol Sector and Conversion to LPG

Project No: URT/96/016
Location: Tanzania, Dar es Salaam
Company: Mansoor Daya Chemicals Ltd
Technology Supplier: Pamasol, Switzerland
Sector: Aerosol
Funds: Multilateral Fund, US$400,000
Implementing Agency: UNIDO

Background

The Project was for conversion of 150 tonnes of CFC-11, CFC-12 to LPG in the manufacture of insecticides and air fresheners. Funds were obtained from the Multilateral Fund to the tune of US $400,000 and the project was started in 1997. The project involved installation of an open air filling station with one semi automatic machine, crimping, propellant filling and handling, a water bath for testing cans, HAP storage and purification system, explosion proof lighting, ventilation system, and an LPG storage tank. The project also included training of staff. The project was completed and commissioned in 1998.

Approach

From signing to commissioning, the Project took only two years indicating a well conceived and planned project. The beneficiary company was determined to implement the project. There was good cooperation between the Company, Implementing Agency and the Technology Supplier. Above all, there was timely flow of funds from the source.

Impact

Some 150 tonnes of CFC-11 and CFC-12 were successfully phased out and replaced with LPG. The product was well received by the market after sensitisation and public awareness on the need to shake the small container tins before use.

Lessons learnt

- Good planning is essential,
- Total commitment by the beneficiary company is a recipe for success,
- There is need for cooperation between the Company and the Implementing Agency,
- Smooth and timely flow of funds is a prerequisite for project success,
- Consumer sensitisation through public awareness is necessary for product acceptance.
**CASE Study No 2**

**ODS Phase out at Imperial Refrigeration, Zimbabwe**

<table>
<thead>
<tr>
<th>Location:</th>
<th>Zimbabwe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company:</td>
<td>Imperial Refrigeration</td>
</tr>
<tr>
<td>Technology Supplier:</td>
<td>Derby A/S of Denmark</td>
</tr>
<tr>
<td>Chemical Supplier:</td>
<td>Industrial Urethanes (Pty) Ltd. Of South Africa</td>
</tr>
<tr>
<td>Sector:</td>
<td>Foam</td>
</tr>
<tr>
<td>Funding:</td>
<td>The Multilateral Fund, US$ 310,000 (51% of project costs)</td>
</tr>
<tr>
<td>Implementing Agency:</td>
<td>The World Bank</td>
</tr>
</tbody>
</table>

**Background**

In 1995 the company started working with the World Bank acting as the Implementing Agency to transform manufacturing operations. This led to the successful change-over from using ozone depleting CFC-11 blown polyurethane to HCFC-141b blown systems. This was done in collaboration with a chemicals supplier, Industrial Urethanes (Pty) Ltd. of the Republic of South Africa. A new factory was constructed and designed to run not only on HCFC-141b Foam systems, but also to use only HFC-134a as the refrigerant for all products. This project was a joint venture project with Derby A/S of Denmark as the technical partner. The company with technical advice from the World Bank upgraded the project to incorporate equipment suitable for the safe handling and use of zero ODP cyclopentane as a foam blowing agent. It was envisaged then that Imperial Refrigeration would convert to a C-pentane foam system by 1998.

**Approach**

The new factory started operating with the HFC-134a refrigerant and HCFC-141b Foam system in early 1996. Since then the conversion to C-pentane Foam systems has not been carried out primarily because C-pentane systems are not yet commercially available in the region. At least one site has been installed in Swaziland but the unit operating costs are still relatively high because of the following factors:

- The higher capital and maintenance costs associated with storage and handling of the flammable C-pentane.
- The C-pentane is imported from outside the region and there are consequential logistics problems, exchange rate related costs and other related issues.
- At present only one chemical supplier, Bayer is offering a C-pentane system and hence the pricing may tend to be monopolistic.

**Lessons Learnt**

- In 1995, it was expected that as CFC-12 is gradually phased out throughout the world, and as HFC-134a became more readily available, the unit cost of CFC-12 would rise while that of HFC-134a would decrease until the latter was cheaper than the former. In practice this has not happened. Current purchase costs in Zimbabwe are typically CFC-12 = Z$1 360.39/kg and HFC-134a = Z$3 092.25/kg. CFC-12 still continues to be very abundant;
- Zimbabwe and most other nations in the region currently have uncertain capacity to monitor and control the importation of ODS substances or products containing them. Without such controls, local manufacturers who have shifted to non-ODS systems (which are more expensive) are at a cost disadvantage. This is especially important in poor economies where disposable incomes are low and purchase considerations are made primarily on the basis of price; and
- The company, and most of the established competing manufacturers in the region, over the last five years tried to highlight the ozone friendliness of their products as a selling feature. However, reactions from the market indicate that consumers still do not understand the meaning or significance of this campaign.
Background

Vapour compression refrigeration machines are widely used and are installed with refrigerants CFC-12, HCFC-22 (R-22) and the CFC R-502. However, R-22 (HCFC) is currently being used widely in Zimbabwe as a transitional solution. In the small to medium refrigeration plants, R-134A has been introduced since 1997. This is mainly due to the availability of the major components like compressors, which have been manufactured on R-134A, based refrigerants including driers and expansion valves. In the medium to large application, compressor manufacturers are developing new models like Bitzer, Bock and Dorin.

In Zimbabwe, the refrigeration industry was using the belt driven compressors powered by an external motor coupled with rubber vee belts. These machines had a very high impact on ozone depletion since the shaft leaks cannot be completely eliminated during the life of the compressors. In 1999 Commercial Refrigeration developed a packline modular condensing unit with a view to totally eliminating the shaft seal leaks which are normally experienced on belt driven condensing units. These units are designed for Africa’s diverse altitude and ambient temperature variation for a wide range of applications from blast freezing, supermarkets, and general refrigeration applications.

Approach to the New Technology

The new technology using the modular packline consists of an epoxy powder-coated steel sheet housing with a hermetic or semi - hermetic compressor self-contained condensing unit, complete with horizontal finned air cooled condenser with axial flow fans with a protective basket grille. The modular packline unit comes complete with the built in electrical control panel and can be stacked and multiplexed to take up minimum floor space. The above technology was adopted from the South African Refrigeration Industry through Matador Refrigeration technology transfer. The technology transfer was necessitated by the merging of TM Supermarket Zimbabwe and Pick and Pay South Africa where they required the refrigeration systems to be inline with South African supermarkets.

The initial project was carried out at Westgate one of the Zimbabwe TM Supermarket flag ship stores. The refrigeration units were powered by the packline modular units using the semi hermetic condensing units.

Lessons Learnt and Advantages of the New Technology

◗ The modular systems are easy to install, maintain and operate;
◗ Temperature regulation and defrost management is electronically controlled and are Y2K compliant;
◗ The units use Ozone friendly refrigerant gases namely:
  - HCFC- 22
  - HFC- 404a
  - HFC -507
  - HFC -134A; and
◗ The modular units offer high safety standards including space saving as opposed to the belt driven or direct driven compressor condensing units.

Project Impact

The project was very successful and it has resulted in changing the whole of the Zimbabwean refrigeration industry. The customers now demand the best and also insist on ozone friendly systems for new installations.
Phase out of CFC in the automotive industry in Nigeria

Project No: NIG/99/G61/DZG 31
Location: Tinuola Bay, Nigeria
Company: Automotive Component Industry (ACI) Ltd.
Sector: Foam
Funds: MLF, US $231,380
Implementing Agency: UNDP/UNOPS

Background

Automotive Component Industry Ltd of Nigeria was producing moulded flexible polyurethane motor vehicle seat covers using the ODS CFC-11 and consumed 37 tonnes of it annually. The project was launched in July 1999 and commissioned in October 2001. Several other companies in Nigeria have had similar successful experiences with technology transfer in the manufacture of flexible foam for example, the Diamond Foam Company, Victory Foam and the Tinuola Bay Batch ISOL Block Plant.

These projects were successful and took a short time to complete because of the following:
- There was good cooperation and understanding by all stakeholders, particularly the Government, NOU, enterprise, UNDP and the consultants;
- Enterprise technical staff were very knowledgeable about the new technology;
- There was good public awareness; and
- There was prompt release of funds.

Impediments to smooth project implementation

Some drawbacks to smooth project implementation included:
- Delays by Customs officials who were not conversant with ODS regulations; and
- Bureaucratic delays by banks to process funds.

Lessons Learnt

- Good cost benefit analysis before start of the project is beneficial;
- Carbon dioxide although taken for granted, is an effective alternative substance for ozone depleting CFCs;
- The company needs to be flexible in order to quickly match the requests of the customers;
- The company should know how to deal with foreign customers;
- The company should have clear indications of utilities and tools needed;
- The company should have a complete list of chemicals with names and addresses of suppliers of raw materials;
- The company should have in place instructions for the safe handling and stocking of chemicals;
- The company should have technicians from the machine supplier with knowledge not only on the machines but also on the process and formulations;
- The machines MUST be extremely simple with very reliable components from the primary supplier;
- Most of the spare parts must be found on the local market;
- The machine must be equipped with safety devices to avoid worker’s injuries in case of lack of electric power or incorrect manoeuvring;
- Information about the best and logical factory-layout with clear indications about the fire danger must be formulated ahead of time;
- It is essential to have complete and very comprehensive instruction manuals with magnified drawings and detailed list of parts with code numbers and descriptions to avoid confusion;
- Complete electrical, pneumatic, hydraulic and chemicals circuits must be provided;
- Detailed description of the maintenance programme for long-lasting shutdown must be provided;
- It is important to check repeatedly if the customer has really all the necessary items for the before commissioning; and
- The technology supplier must provide extra spare parts in countries where the communications are not so good or if the customer is in a remote part of the country.
CASE Study No 5

Technology Transfer for Methyl Bromide Phase out in Zambia

Location: Zambia
Sector: Methyl bromide
Implementing Agency: UNEP
Technology Supplier: Sunshine Seeds

Background

There are 108 tobacco and 35 flower farmers in Zambia. The tobacco farmers use 10-60 kg of methyl bromide per ha per year and the flower farmers 60-1500 kg. Due to the ozone depleting potential of methyl bromide, it was necessary to find alternatives that are environmentally friendly and cost effective. A local Zambian company, Sunshine Seeds, with assistance from UNEP, worked with farmers to find suitable alternatives to methyl bromide.

Approach

Through questionnaires, information on methyl bromide usage, importation, distribution, storage and handling was obtained from importers and users. Public awareness amongst farmers, distributors, suppliers, researchers and NGOs was raised through consultative meetings, field days, agricultural and commercial shows, radio programmes, farmers' magazines, brochures, farmer commodity meetings as well as meetings of the Zambian National Farmers Union.

Alternatives

The following alternatives were tried through demonstrations with farmers:
- Float trays;
- Permanent pine beds;
- Heat/Steam;
- Metham sodium;
- Basamid;
- Nemacur; and
- Uydate.

Feedback from the farmers showed that these alternatives are only 50% as effective as methyl bromide. Further, the Sunshine Plug alternative constituted with pine bark, pine back compost and seedling trays is now acceptable and is widely used as an effective alternative to methyl bromide.

- There is insufficient supply of pine bark in Zambia presently;
- Pine bark milling equipment requires high capital investment;
- The cost of raw materials is high;
- Invest in farmers who are willing and are possibly already using alternatives;
- There is need to produce pine bark commercially and locally in Zambia;
- In the short term, there is need to import pine bark from Zimbabwe and South Africa.

There is also need to experiment with other substrates and methods such as coffee hulls, forest compost and steam and heat sterilisation respectively.
Carbon dioxide; and
Hermetic storage i.e. air tight.

For stacks, the technology for application of these alternatives involved fumigation using phosphine under gas-proof sheets. The stack surfaces and perimeter are sprayed with Actellic. Fumigation sheets and handling is the same as per methyl bromide fumigation. Aluminium phosphide formulations in the forms of pellets and tablets are used. These formulations are placed on scrap bags on top of the stacks and the stack is completely sheeted. The dosage rate is 2.2 gm phosphine per tonne for 7 days. One pellet releases 0.2 gm phosphine and one tablet releases 1 gm of phosphine. Leakages are detected using silver nitrate paper which turns brown in the presence of Phosphine. Operators put on full face masks with type 89B/ST canister. After fumigation the residual products of the pellets/tablets (aluminium, phosphide, phosphates and aluminium hydroxide) are disposed of after deactivation in a water-detergent mixture.

For silos, pellets are added to bulk grain from automatic pellet dispensers during bin filling at a dosage rate of 2.2 g phosphine per tonne per 14 days. Alternatively, low pressure blowers draw a phosphine air mixture through pipes from the head space and push this into the base of the structures, forcing it to flow upwards through the grain to the headspace in a closed loop cycle for 48 hours at the dosage rate of 2.2 gm phosphine per tonne.

For nitrogen, carbon dioxide and airtight treatments, the bottom pieces of 150 mt Grain Pro cocoons were placed on 10.0m x 10.0m sand surfaces 5 cm thick. Some 50 kg maize bags were loaded into plastic cocoons to capacity but with expansion chambers (CHANNEL) for nitrogen and carbon dioxide treatments. Calculated nitrogen and carbon dioxide amounts were introduced from cylinders into stacks. Oxygen measurements were made during gas purging until the entire dosage was delivered and the outlet ports sealed for
Further, the following are recommended:

- There is need to find lighter, equally durable user friendly fumigation sheets,
- It is necessary to reduce the fumigation period,
- It is useful to find if there is pest resistance to phosphine,
- It is necessary to design quick reliable gas tightness tests in silos to ensure successful and safe fumigation.

Background

The tobacco sector in Zimbabwe uses 500 tonnes of methyl bromide per year. This is about 66% of the total usage for the whole country. Since May 1998 the Tobacco Research Board (TRB) has been carrying out extensive research to find an alternative technology to replace the use of MBr. The main objective was to develop and demonstrate the use of alternatives to methyl bromide in tobacco seedling production in Zimbabwe. Two approaches were taken. The first was to find chemicals that, in low doses, could replace methyl bromide in the conventional seedbed. The second was to adapt and adopt a non-soil technique such as the float system used in the USA or the permanent pine bark bed method from South Africa. In addition, an economic comparison of the alternatives to methyl bromide was made.

Technology selection process

The TRB embarked on a process to find a practical, sustainable and economic technology able to produce seedlings as easily as or easier than the conventional method. The main options were the float system, the permanent pine bark system and alternative fumigants. Further, use of Trichoderma in the non-soil system was tested as a form of biological control and new potential pesticides were considered for an integrated pest management (IPM) scheme, as is the case with the traditional seedling production method. Visits were made to countries that used the technologies and valuable contacts were established.
The Research Phase

(a) Alternative fumigants

Ethylene dibromide (EDB) + metham sodium (meNa), 1,3-dichloropropene (Telone II), and 1,3-dichloropropene + 35% chloropicrin (Telopic) were evaluated. Examples of the effects on tobacco germination and the level of weed control of some of the combinations of the materials are given in Table 1a and the statistical analysis in Table1b.

### Table 1a

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Tobacco</th>
<th>Broadleaf weeds</th>
<th>Grasses</th>
<th>Total weeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>111.9</td>
<td>115.0</td>
<td>81.3</td>
<td>196.3</td>
</tr>
<tr>
<td>Mbr 50 g/m²</td>
<td>196.9</td>
<td>0.6</td>
<td>1.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Burn and EDB*</td>
<td>176.0</td>
<td>1.9</td>
<td>0.6</td>
<td>2.5</td>
</tr>
<tr>
<td>EDB + meNa 15 ml/m²</td>
<td>163.1</td>
<td>24.4</td>
<td>51.9</td>
<td>76.3</td>
</tr>
<tr>
<td>EDB + meNa 25 ml/m²</td>
<td>195.6</td>
<td>2.5</td>
<td>50.0</td>
<td>52.5</td>
</tr>
<tr>
<td>EDB + meNa 35 ml/m²</td>
<td>209.4</td>
<td>3.1</td>
<td>28.1</td>
<td>31.3</td>
</tr>
<tr>
<td>MEAN</td>
<td>175.5</td>
<td>24.6</td>
<td>35.6</td>
<td>60.2</td>
</tr>
</tbody>
</table>

*EDB applied at 5 ml @ 38x38 cm spacing=35 ml/m²

### Table 1b

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Tobacco</th>
<th>Broadleaf weeds</th>
<th>Grasses</th>
<th>Total weeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>1.97</td>
<td>2.06</td>
<td>1.90</td>
<td>2.29</td>
</tr>
<tr>
<td>Mbr, 50 g/m²</td>
<td>2.29</td>
<td>0.14</td>
<td>0.33</td>
<td>0.39</td>
</tr>
<tr>
<td>Mbr + EDB</td>
<td>2.25</td>
<td>0.41</td>
<td>0.14</td>
<td>0.47</td>
</tr>
<tr>
<td>EDB + meNa 15 ml/m²</td>
<td>2.21</td>
<td>1.09</td>
<td>1.38</td>
<td>1.87</td>
</tr>
<tr>
<td>EDB + meNa 25 ml/m²</td>
<td>2.28</td>
<td>0.47</td>
<td>1.69</td>
<td>1.72</td>
</tr>
<tr>
<td>EDB + meNa 35 ml/m²</td>
<td>2.31</td>
<td>0.53</td>
<td>1.31</td>
<td>1.39</td>
</tr>
<tr>
<td>MEAN</td>
<td>2.22</td>
<td>0.78</td>
<td>1.13</td>
<td>1.35</td>
</tr>
<tr>
<td>SED t (0.05,15)=2.131</td>
<td>0.12</td>
<td>0.21*</td>
<td>-</td>
<td>0.22*</td>
</tr>
<tr>
<td>CV%</td>
<td>7.50</td>
<td>37.10</td>
<td>-</td>
<td>22.6</td>
</tr>
</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Tobacco</th>
<th>Log10 (Tobacco)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>340.0</td>
<td>2.52</td>
</tr>
<tr>
<td>Methyl bromide, 50 g/m²</td>
<td>573.8</td>
<td>2.74</td>
</tr>
<tr>
<td>Methyl bromide, 25 g/m²</td>
<td>661.3</td>
<td>2.82</td>
</tr>
<tr>
<td>Methyl bromide, 12.5 g/m²</td>
<td>658.8</td>
<td>2.80</td>
</tr>
<tr>
<td>EDB: 5 ml at 38 x 38 cm</td>
<td>738.8</td>
<td>2.87</td>
</tr>
<tr>
<td>EDB: 4 ml at 35 x 35 cm</td>
<td>598.8</td>
<td>2.76</td>
</tr>
<tr>
<td>EDB: 3 ml at 30 x 30 cm</td>
<td>608.8</td>
<td>2.77</td>
</tr>
<tr>
<td>EDB: 4 ml at 38 x 38 cm</td>
<td>595.0</td>
<td>2.75</td>
</tr>
<tr>
<td>EDB: 3 ml at 35 x 35 cm</td>
<td>503.8</td>
<td>2.70</td>
</tr>
<tr>
<td>Telone II: 5 ml at 38 x 38 cm</td>
<td>646.3</td>
<td>2.79</td>
</tr>
<tr>
<td>Telone II: 4 ml at 35 x 35 cm</td>
<td>623.8</td>
<td>2.80</td>
</tr>
<tr>
<td>Telone II: 3 ml at 30 x 30 cm</td>
<td>666.3</td>
<td>2.81</td>
</tr>
<tr>
<td>Telone II: 4 ml at 38 x 38 cm</td>
<td>715.0</td>
<td>2.84</td>
</tr>
<tr>
<td>Telone II: 3 ml at 35 x 35 cm</td>
<td>725.0</td>
<td>2.86</td>
</tr>
<tr>
<td>Telopic: 6.5 ml at 35 x 35 cm</td>
<td>898.8</td>
<td>2.95</td>
</tr>
<tr>
<td>Telopic: 4.5 ml at 35 x 35 cm</td>
<td>593.8</td>
<td>2.77</td>
</tr>
<tr>
<td>Telopic: 4.5 ml at 38 x 38 cm</td>
<td>895.0</td>
<td>2.92</td>
</tr>
<tr>
<td>Telopic: 2.0 ml at 30 x 30 cm</td>
<td>720.0</td>
<td>2.81</td>
</tr>
<tr>
<td>MEAN</td>
<td>653.5</td>
<td>2.75</td>
</tr>
<tr>
<td>SED t (0.05,51)=2.009</td>
<td>-</td>
<td>0.096*</td>
</tr>
<tr>
<td>CV%</td>
<td>-</td>
<td>4.8</td>
</tr>
</tbody>
</table>

None of the treatments adversely affected the germination of tobacco seeds. Both the Mbr and burn + EDB treatments gave excellent control of broadleaf and grass weeds. EDB + metham sodium at 35 ml/m² gave acceptable weed control although it was not as good as the burn + EDB or methyl bromide treatments.

Tables 2 and 3 show potential for the use of EDB, 1,3-D (Telone II) and 1,3-D/C-35 (Telopic) as alternative fumigants. While EDB alone has no herbicidal effect, Telone II, as well as Telopic, show some weed control. No sign of phytotoxicity was evident in any of the treatments.

NOTE: Contrast for control vs treated is significant.
(b) Alternative seedling production system

Two options were selected for non-soil techniques. The permanent pine bark and the float system (Figs 1 and 2) were tested. The permanent pine bark technique produced high quality seedlings economically but was thought to be unsustainable because Zimbabwe has limited pine bark resources. The float system appeared to meet the three criteria and a 200-cell float tray system and a non-soil mix made up of sand and pine bark in the ratio 1:1 was adopted. Practically and economically the 200-cell float tray system is the best option for the tobacco sector in Zimbabwe.

The Implementation Phase

Once the float system had been selected as the technology of choice, dissemination of this information commenced. Written articles were published in magazines with a combined readership of several thousands. All registered tobacco growers and other stakeholders such as banks, chemical companies, agricultural training centres, and extension organisations were reached through our in-house ‘Dear grower letter’ scheme. Numerous workshops were held on-station and throu-
ghout the 23 tobacco growing regions of the country. On-farm float seedbed sites were chosen together with demonstration plots located in the tobacco growing regions. During the 2000/01 season, 56 farmers from representative tobacco growing regions participated in a limited release programme. These farmers were given all the required inputs for them to test the technology. The original idea was to supervise each operation by each farmer, but in fact, only a handful was supervised because of logistical limitations. The majority of the participants were happy with the technology and many noted the ease of water and fertilizer management.

Lessons Learnt

- Although the float system technology has been well received, numerous issues need to be addressed;
- The use of alternative fumigants such as 1,3-D/C-35 will require specialised equipment;
- The additional cost associated with implementation of the new technology should be met and steps taken to make the changeover smooth;
- The majority of the respondents knew about the imminent phase out of Mbr and the existence of alternatives, but a large number, some 87%, had not tried any alternatives;
- Under warmer and faster growing conditions the number of usable seedlings drops to unacceptable levels;
- The technology works, but issues relating to adaptation have to be worked out;
- For countries with huge resources of pine bark, the pine bark bed system is very viable as used very successfully in South Africa. For most countries with limited pine bark a 50:50 mixture of sand and the pine bark or other proportions will work;
- The use of other media such as maize stover, groundnut shells, vermiculite, peat moss, composted Azolla sp. has been tested. All these materials work when mixed with sand and some work on their own; and
- From an environment point of view, polystyrene trays that are used in such large quantities do not biodegrade easily. Ways need to be found to recycle these plastic trays.

Background

Lesotho is a small African country and a low volume consumer of ODS. Implementation of the Montreal Protocol in this small but active country signifies a very good example of the determination of so many other African countries to implement the Protocol and conserve the ozone layer. Lesotho has limited resources and capacity and yet it has been able to achieve much within a short time, which is a welcome development in the history of the implementation of the Montreal Protocol.

ODS use in Lesotho is confined mainly to the refrigeration sector with the following consumption levels:

- CFC -12 5.1 tonnes in 1994
- HCFC-1211 0.5 tonnes in 1994
- CFC -12 3.4 tonnes in 1998
- CFC -12 2.4 tonnes in 2000

Multilateral Fund-assisted Projects

- Development of the Country Programme;
- Preparation of the Refrigeration Management Plan (RMP);
- Implementation of the RMP;
- Institutional Strengthening;
- Recovery and Recycling (RR) plan; and
- Implementation of the RR strategy.

Positive Experiences

- ODS Legislation put in place and enforced by the year 2000;
- Established National Ozone Office;
- Permit system for ODS equipment and chemicals made operational;
- New ODS plants banned; and
- Certification of Refrigeration Technicians formalised.

Achievements

- School curriculum on environment and ODS developed;
- Trained 15 technicians in safe RR;
- Trained 3 technicians in Germany on good practices;
- Run evening courses for the informal sector in refrigeration;
Trained Customs officers on identification and control of ODS imports;
Established a Refrigeration Recycling centre;
Placed all RR machines in one locality at the capital in Maseru;
ODS disposal tanks stored centrally in one place;
Mounted effective public awareness programmes; and
Met the 1999 freeze on CFCs and is 2005 compliant.

Future Plans

More training of Customs officers;
Implement Halon and MBr Projects;
Review the Country Programme; and
Ratify the London, Copenhagen and Beijing Amendments to the Protocol.

Drawbacks to Smooth and Rapid Implementation

Shortage of funds for sustained and continuous training;
Leakage of CFC; and
Delays in certification process.

Background

In 1999 developing countries began the phase out of CFCs. In 2000, these countries achieved compliance and some even surpassed their targets. In achieving compliance objectives, the following principles should be adhered to:
Invoke progressive phase out;
Minimise adverse effects during phase out;
Apply the pre-cautionary Principle;
Enforce the Polluter Pays Principle; and

Some Issues Still to Grapple With

Ratification of the Montreal Protocol and its amendments remains to be done by three African countries;

There is need to set and enforce policies to prevent illegal dumping of ODS equipment in Africa;
Stringent control measures need to be put in place;
There is need to comply with data reporting and control measures;
Africa’s consumption of Mbr is quite high, being 28% of global consumption;
One country in Africa will need special effort and assistance to comply; and
Some 14 African countries, though on the edge of meeting the freeze, will still need assistance for continuous monitoring.

Lessons Learnt

UNEP’s experience in technology transfer during ODS phase out is closely linked to institutional strengthening, capacity building, training, preparation of country programmes, formulation of refrigerant management plans and information exchange. These and others are highlighted as follows:

Investment projects alone are not sufficient to address global environmental issues;
Identification of focal points like NOUs with clear mandates, is key to successful implementation of the Protocol;
It is cost effective to channel assistance through NOUs;
Networks of NOUs creates a powerful setting for learning to manage environmental issues;
Participatory approach to preparation of national management plans is a very effective way to meet targets of the Protocol;
NGOs and local associations serve an important role to guide the process of environmental management;
Covering full investment costs may not ensure the desired change;
Mainstreaming of small countries can be achieved by catalyzing south to south cooperation;
It is advisable to use existing sub regional infrastructure e.g. trade unions, customs and economic settings;
Frequent changes of ODS Officers is counter productive;
ODS phase out under the Montreal Protocol presents Africa with opportunities to remain on the cutting edge of new technologies, improve on competitiveness, improve agriculture whilst protecting the environment;
Infrastructure provided under the MP can help
African countries understand and address other environmental problems; and

HCFCs are transitional substances, so their use should be avoided where alternatives exist.

Some Recommended Actions on Outstanding Issues

- African countries should expedite ratification of the MP and its amendments;
- Governments should integrate NOUs fully into the decision making process in the implementation of the MP;
- Frequent shifting of ODS and NOU Officers is disastrous and should be avoided;
- Governments should expedite policy setting and enforcement;
- Public awareness activities should be emphasized;
- Experiences and lessons learnt during ODS phase out should be transferred to other environmental conventions; and
- Complacency must be avoided.

UNEP’s Impact

UNEP’s global role has been in facilitating information exchange whilst at regional level, UNEP operationalised networks and facilitated policy and compliance workshops. At the national level, UNEP has assisted in developing country programmes, refrigerant management plans, institutional strengthening mechanisms as well as providing training opportunities. Through these activities, UNEP’s contribution to technology transfer during ODS phase out has been very significant and has contributed directly to the following impacts:

- From only 3 Institutional Strengthening (IS) projects in 1992, by 2001, some 38 projects had been implemented;
- A total of 38 Country Programmes have been prepared;
- South to South cooperation has been facilitated between many African countries;
- Some 43 African countries are in compliance with the requirements of the 1995-97 Base reporting level; and
- Some 22 African countries will be able to meet the CFC freeze but will need to maintain momentum for the next control measures.

Lessons Learnt by UNDP in Technology Transfer For ODS Phase Out

Background

UNDP has been implementing ODS phase out activities under the Multilateral Fund since 1993. Its initial role was training, country programme formulation and providing technical assistance. However, UNDP now has a stronger focus on investment projects with UNOPS as the Executing Agency. Over the period, UNDP has undertaken some 1,500 activities globally in 78 countries. Its total budget for these projects has been US$ 350 million, with some US$ 250 million already disbursed. Through these efforts, 43,000 ODP tonnes have been eliminated by 800 enterprises globally.

Lessons Learnt

Technology transfer has been successful due to some of the following positive factors:

- Active involvement of all stakeholders including national Government, NOU, and the enterprise, technology supplier;
- UNEP’s active participation as Clearing House;
- UNDP’s positive role in the country;
- Presence of national industrial association; and
- Excellent contributions from national and international consultants.

Cost-related Experiences and Factors

- There is need to factor financial considerations into long term market situation and competitiveness of the industry;
- Alternative technologies tend to be more expensive;
- Initial investment considerations are often high;
- Replacement chemicals, parts and components are expensive and lead to higher operational costs;
- Approved project funds are often limited and give rise to curtailed calculated compensation for recipient enterprises; and
- Recipient companies are oftentimes unwilling to embark on new technologies and thus not ready to release counterpart funding.
Market Related Lessons

- Technology transfer depends on market conditions;
- Competing companies need to convert more or less simultaneously;
- There is often low awareness at the level of local customers;
- There is a tendency of non acceptance for non-ODS products;
- There is some times loss of profits due to cheaper end products;
- External factors tend to be unfavourable, e.g. demand by multinationals; and
- Non-availability locally, of replacement chemicals, parts and components causes many problems.

Some Negative Lessons

- New alternative technologies often tend to have negative impact on production processes and on the quality of new products;
- New technologies tend to have technological drawbacks e.g. toxicity of methylene chloride in foam, inflammability and explosiveness of hydrocarbons in refrigeration;
- New technologies and products tend to have inferior technical performance e.g. in thermal isolation, cooling and contamination;
- New technologies tend to have serious safety concerns;
- There is no one miracle technological solution; need a basket of alternatives for several applications based on research, knowledge and experience.

How to Overcome Obstacles During Technology Transfer

- Build combination of cross-linked incentives and disincentives;
- Obtain grants for ODS-consuming enterprises;
- Mount public awareness campaigns on Eco-labelling;
- Mount and implement monitoring programmes;
- Introduce legislation and codes for enforcing banning of ODSs;
- Impart political influence in industrial associations to set technical standards and
- Impose local sales taxes on ODS based equipment.

Background

Liquefied gasses and CFCs quickly became a preferred propellant in the aerosol industry that expanded rapidly after World War II as compressed gas is of limited use as a propellant. An aerosol is a collection of tiny solid particles or liquid droplets that are finely dispersed in a gas. To disperse active ingredients of a product effectively, an aerosol propellant must evaporate quickly. These substances are generally characterised by properties such as solubility, inflammability, stability, are non-toxic and non-explosive. CFCs were widely used as propellants in the production of aerosol lacquers, deodorants, shaving foams, perfumes, insecticides, window and oven cleaners, pharmaceuticals and veterinary products, paints, glues and lubricating oils. Thus CFC-11, CFC-12 and CFC-114 (for dispersing products containing alcohol) were used as propellants in the aerosol industry.

Conversion Technologies

The most practical and commercially-available CFC replacement substances adopted for the aerosol sector are:

- Hydrocarbons (HC);
- Dimethyl ether (DME); and
- Hydrofluorocarbons (HFCs)

DME is important for certain uses such as water-based paints, hair sprays and perfumes, because of its high solvency and easy reformulation into water-based products. However, its strong solvency means that filling equipment, container material and gaskets must be resistant to dissolution or deterioration. DME is also flammable and requires additional safety precautions for handling, storage, transportation and filling and is more expensive than HCs. The above disadvantages reduced the use of DME as a CFC replacement substance to some limited applications.

Hydrofluorocarbons such as HFC-134a and HFC-227ea are used for replacing CFC propellants in the manufacture of some specific aerosol products, mainly pharmaceuticals, and some solvent cleaning sprays and
lubricants. However, these non-flammable, non-toxic liquid propellants have higher pressure relative to CFCs and in some cases require the modification of filling equipment. Moreover, being greenhouse gases HFCs are controlled in the “basket at gases” under the Kyoto Protocol.

However, hydrocarbons have become the most common substitute for CFCs in aerosol propellants because of their zero ozone depleting potential, widespread availability, low cost, low toxicity and good dispersion characteristics. They account for 96% of worldwide conversion from CFCs in this sector. The most frequently used hydrocarbons are:

- Propane,
- n-butane and
- Isobutane

Hydrocarbons are derived from liquefied petroleum gases (LPGs), which contain varying levels of unsaturated hydrocarbons, sulphur compounds, water and other impurities. For most applications, these contaminants have to be removed from the gas to various grades including aerosol grade. Hydrocarbons are widely sold as liquefied petroleum gas for use as a fuel.

However, many African countries do not have butane or propane of suitable quality to be used as a feedstock for purification to aerosol propellant grade. Thus, they have to be imported including the respective gas purification equipment.

Safety Issues with Hydrocarbons

The most serious disadvantage of hydrocarbons is their high flammability, which requires safety precautions for all aspects of their use including transportation, handling, storage and filling. Facilities must be explosion-proof and fireproof and have adequate ventilation. Employees will also require additional training in handling a flammable substance. Both gas purity and safety requirements constitute the key issues to be addressed while transferring this CFC substitute technology to the end users.

UNIDO’s Approach to Technology Transfer

UNIDO became an Implementing Agency of the Montreal Protocol in 1993 and has been active in formulation and implementation of investment projects in the aerosol sector. From a total 105 aerosol projects approved in 1992-2001, 44 projects or 42% were formulated and submitted by UNIDO. The Multilateral Fund allocated a budget of US$ 26,628,880 for implementation of these projects of which UNIDO’s share was 29.73%, or US$ 7,917,977. The cost effectiveness of UNIDO projects is higher than average for the sector and this is mainly attributed to the average size of the projects which are small to medium scale enterprises. UNIDO has been spending only US$ 2.27 to phase out one kg of ODS, which is about half the adopted threshold for the sector of US$ 4.4 /kg. Most of the approved UNIDO investment projects have been developed for Africa (Algeria, Sudan, Tunisia, Nigeria, the Ivory Coast, Kenya and Tanzania), followed by the Middle East (Syria, Lebanon, Jordan and Yemen) and Europe (Croatia, Macedonia and Romania).

The main conversion technology transferred to the end-users in Africa as well as in the above-mentioned countries was based on the replacement of CFC propellants with hydrocarbon aerosol propellants (HAPs). In a few cases, the selected CFC replacement technology combined conversion of aerosol plant to both HAP and non-flammable HFC-134a (the later was used for pharmaceutical products). The conversion to the HAP based technology involved the provision of relevant advice and services on the proper composition of aerosol products to be gassed with the ODS-free propellant, respective modification of aerosol plant layout and the required civil engineering works to be carried out at the project site. It also included the supply of eligible equipment items and safety devices as well as their installation, testing and commissioning and proper training of the counterpart personnel involved in maintenance and production operations.

Safety and Product Quality Issues

The average aerosol production line is composed of ten to twenty pieces of equipment linked together by conveyors. However, irrespective of the production capacity and the level of automation, the baseline equipment of an aerosol line always includes such components as product filling, valve crimping and propellant gassing units and interconnecting conveyors as well as propellant feedstock (cylinders or bulk storage tanks) and pumps delivering the propellant to the gassing unit. The major issue involved in the application of HAP-
based technology is the use of highly flammable hydrocarbon propellants. Therefore, conversion of an aerosol production facility to HAP always includes introduction of specific safety measures and equipment as well as special training of the personnel involved in HAP transportation, storage, handling and filling operations. To minimise the risk of an accident and to ensure safe operation of the aerosol production line, the conversion goes through the following processes:

- Modification of the aerosol plant layout and subsequent repositioning of the baseline production equipment. This requires that a gasser specially designed for gassing operations with HAP should replace the CFC propellant gassing unit. The HAP gassing operation must be placed in the space separated from the main production area where aerosol cans are filled with a product and crimped. This can be done by placing a HAP gassing machine in the Open Air Filling Room (OAFR) with sufficient natural ventilation, or in a special enclosure equipped with safety devices and ventilation system and explosion proof lighting and electrical equipment;
- Installation of additional fire fighting equipment and an automatic flammable gas detection and monitoring system placed in the HAP bulk storage area, the gassing enclosure and production area;
- Training of the project beneficiary personnel in the safe handling of the above equipment. This is indispensable;
- Reformulation of the aerosol product composition. Relevant advice on proper composition of aerosol products gassed with HAP is usually provided by UNIDO, except in those cases when a project beneficiary possesses the necessary experience and laboratory equipment to perform the required tests. Proper composition of an aerosol product is an essential element of technology transfer as it allows a project beneficiary to maintain and improve the quality of its products; and
- To ensure the required purity of HAP, beneficiary enterprises are supplied with de-stenching columns with molecular sieve filters and gas purity measuring instruments. In addition, the quality of the aerosol product is checked by placing the filled and gassed cans in the hot water test bath, which is usually also included in the scope of UNIDO delivery.

### Lessons Learnt

- It is evident that it is not sufficient to only supply components and machines certified by the manufacturers according to the applicable safety standards. The whole production cycle (storage, handling and transportation of hydrocarbons within the plant, processing and charging of them and the mixtures containing hydrocarbons into the appliances etc.) requires to be safety inspected as a system in working condition at the site after commissioning of the new technology. The hazardous situations should be prevented in the first place, i.e. safety must be built in (intrinsic) and not added on afterwards;
- Furthermore, proper operation of the system should be monitored and in case of any malfunction, automatic countermeasures need to be taken. In order to avoid unnecessary delays and extra costs, the inspection and certification process has to start right from the beginning of the equipment and process design, and follow the whole conversion process to its completion; and
- The suppliers have to prepare a safety concept and follow it through with the involvement of the recipient company and local safety authorities. One of the major components of this strategy was the training of plant technicians and operators in safe material handling, processing and maintenance. As a result of the strict adherence to this method there were no safety mishaps in any of the hydrocarbon conversion projects of UNIDO.

### Impact

- The low cost of hydrocarbon propellants results in savings in operating costs in aerosol production, and thus represents an advantage regarding aerosol plant conversion to this technology. Consequently, this provides a positive impact to the enterprise competitiveness and its ability to keep and enhance its local market share as well as an opportunity to enter international markets;
- Expertise, equipment and services provided by UNIDO to various aerosol-producing companies in the process of HAP-based technology transfer, allowed them to apply for and be certified to both ISO 9000 and ISO 14000 standards; and
- In the mid-1970s aerosol products used 432,000 metric tonnes of CFCs, which accounted for about 60% of their consumption worldwide. By the end of the decade, however, countries were beginning to ban or restrict the use of CFCs in aerosol products and after the introduction of the Montreal Protocol in 1987, CFC use in aerosol products declined rapidly. As a result, the overall consumption of CFC has been reduced to an estimated 15,000 tonnes in 1995.
GTZ PROKLIMA assisted the Government of Mauritius with the development of the Refrigerant Management Plan. Several stakeholder workshops were organised in Mauritius. During the workshops the PROKLIMA expert made contact with the general manager of Stella Industries. The manager was faced with the problem that his company was using 16 tonnes of CFCs per year. The Mauritius Government, with the help of PROKLIMA, prepared a law forcing the company to stop further usage of this ozone depleting substance. Faced with this pressure, Stella Industries and the Mauritius Governmental Ozone Office asked PROKLIMA to assist with a technology transfer project. A project document was prepared, approved by the MF and the project was successfully implemented.

Technology Search

The first question asked was, who actually produced the filling devices in use. It turned out that this was a German manufacturer. Following the thesis “The best one to solve a problem is the one who created it” the provider of the equipment was contacted. The new propellant had to be ozone friendly and offering economic advantages. The German manufacturer CZEWO analysed the old equipment and suggested new equipment operating with hydrocarbons as the propellant. Hydrocarbons are cheap but safety is an issue as this gas is inflammable.

Terms of Technology Transfer

The German project PROKLIMA promotes natural gases as replacement for ozone damaging substances. Each project focuses on the environmental and economical benefits. A win-win situation should be achieved for all stakeholders. Integrated approaches and sustainability are further indicators of good projects.

How the Project was Implemented

GTZ contracted the German manufacturer Czewo to install the following equipment and spent a total of US$ 64,500 including installation:

- Pipe system tank to gas filling station;
- Water bath for pressure measuring;
- Active agent preparation plant; and
- Safety installations.

The implementation had been delayed as the Government decided that the company had to move their production site to an unpopulated area. The Government of Mauritius feared the consequences of handling a flammable propellant in a highly populated area. This problem was solved and the new equipment finally installed. The plant has been operational since October 2001.

Status of the Project

The project was implemented successfully. Stella Industries destroyed the old CFC charging machine. Stella Industry attested and accredited the following statement: “We take this special occasion to thank you for the excellent support we received from UNEP and your organisation. The change over to more environmentally friendly propellants helped us to completely reorganise our business and to stay competitive in spite of the various investments which we made in our new green field plant.”

Impact of the Project

Stella Industries used 16t CFC as propellant for their aerosol products at a market price of US$ 32,000. The
new propellant - propane/butane mix is valued at less than US$ 10,000. As a result savings of about US$ 22,000 have been achieved. These are not the main savings in HAP projects. The main savings arise from reduced active agent. In the production with HAP the active agent (perfume, etc.) can be reduced by 30%. The active agent is the most costly factor in aerosol production. Savings of more than US$ 100,000 are possible. Stella Industry, therefore, now produce 175,000 aerosol products using hydrocarbon active propellants which are ozone friendly as substitutes for ozone depleting CFCs.

**Lessons learnt**

In order to promote technology transfer and cooperation the following attributes are essential;

- Create personal relations between distributors from the industrialized nations and the manufacturers in the developing countries;
- Involve those who have created the problem, e.g. produced the environment-damaging machine;
- Provide economic incentives for substitution of obsolete technologies; and
- There is need for good consultants who will need to combine the following skills in order to make projects successful;
  - Engineering skills,
  - Moderation skills,
  - Organisational skills,
  - Language and cultural sensibility.
## Annexe 1

Projects approved, financed and completed in African countries

<table>
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<tr>
<th>Country</th>
<th>Approved Projects</th>
<th>Completed Projects to Be Phased Out</th>
<th>Approved ODP Tonnes Actually Phased Out</th>
<th>ODP Tonnes Funds US $</th>
<th>Approved Projects</th>
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Background

The Southern African Workshop on Lessons Learnt and Case Studies in Technology Transfer for ODS phase out was organised by the Commonwealth Science Council (CSC), Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM Centre), Asia and Pacific Centre for Transfer of Technology (APCTT) and Environmental Affairs Department, Malawi. The Workshop was funded jointly by the Commonwealth Fund for Technical Co-operation (CFTC), Commonwealth Science Council (CSC), Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM Centre), United Nations Environmental Programme (UNEP) and the Environmental Affairs Department of the Government of Malawi. The Workshop ran for 3 days from 27 to 29 May 2002 at the Training Centre of the Bank of Malawi in Blantyre.

Objectives of the Workshop

The Workshop brought together technology suppliers and technology recipients represented by governments and industries from Southern African countries together with the OzonAction Programme of UNEP’s Technology, Industry and Economics (DTIE) Division and Implementing Agencies. The lessons learnt covered successes and barriers to technology transfer in Refrigeration, Aerosols, Methyl Bromide, Foam and Solvents as experienced by African Governments, recipient industries, Implementing Agencies as well as the Multilateral Fund of the Montreal Protocol.

Participants

The participants were drawn from Southern African countries which are implementing various ODS phase out projects under the Multilateral Fund of the Montreal Protocol. All the participants had practical experience in technology transfer for ODS phase out and included National Ozone Units (NOUs), scientists, engineers, environmentalists, plant pathologists, grain and seed processors, industrialists and policy makers from Malawi, Zimbabwe, Zambia, Lesotho, Namibia, Swaziland and Tanzania. Implementing Agencies represented included UNIDO, UNEP and UNDP. The Deutsche Technische Zusammenarbeit (GTZ) and FAO attended as implementing partners. Professor John Okedi attended the workshop as a Consultant to synthesise experiences and lessons learnt by African Countries. The Workshop Programme is shown in Annex 2 and the list of participants is given in Annex 4.

Opening of the Workshop

The Workshop was opened by Hon. L. Shati MP, Deputy Minister of Natural Resources and Environmental Affairs of the Government of Malawi. Mr. Rajendra M. Shende, Head of Energy and OzonAction Branch of UNEP DTIE gave the opening statement, Mr. Shande applauded the Government of Malawi for organising the Workshop and reiterated the following points in his opening statement:

- Congratulated Malawi for complying with the phase out plan and freezing CFC consumption to 1997 consumption level;
- All countries in Africa have ratified the Montreal Protocol except three countries;
- Highlighted the precautionary approach of the Montreal Protocol, the polluter pays principal and the value of common but different levels of implementation of activities,
- Reiterated the objectives of the Workshop;
- Appreciated the participation of UNDP, UNIDO, FAO, GTZ and Suppliers from Italy and South Africa;
- Thanked the Government of Malawi for organising the Workshop.

Mr Shende’s Statement is shown in Annex 4a.

Dr. J. Perera, Chief Programme Officer from the Commonwealth Science Council (CSC) explained the role of the CSC and thanked UNEP, NAM and the Government of Malawi for co-sponsoring and organising the Workshop. Dr Perera’s statement is given in Annex 4b.

Dr. A.P. Kulshreshtha, Director of the NAM S&T Centre
gave a statement at the opening and highlighted the following:

- NAM’s co-sponsorship of the Workshop;
- NAM also co-sponsored similar Workshop in Bangkok in 1999;
- NAM had co-sponsored the African Regional Workshop on Ozone Depletion and Management of ODS phase out in Small and Medium Enterprises in Pretoria in 1997;
- Explained the role, objectives and functions of NAM;
- Appealed to African Countries to join NAM and thanked UNEP, CSC and the Government of Malawi for co-sponsoring the Workshop.

Dr Kulshreshtha’s Statement is provided in Annex 4c.

Dr. C. Mwiyeriwa, Secretary for the National Research Council of Malawi made the following remarks at the opening of the Workshop.

- Welcomed Delegates to the Workshop;
- Malawi is an active member of the CSC;
- Malawi will soon join NAM;
- Malawi is seeking alternatives to Methyl Bromide;
- Requested the Hon. Minister to open the Workshop.

After the opening ceremony, the Workshop was broken into 8 functional sessions as follows:

**Session 1:** Technology Transfer under the Multilateral Fund
- Two presentations on the role of the Multilateral Fund in Technology Transfer and UNEP’s role in assisting A-5 Countries.
  Chair: Director of Environment Affairs, Malawi.

**Session 2:** Country Experiences in Technology Transfer
- With 7 Country presentations
  Chair: Professor John Okedi.

**Session 3:** Experiences in Technology Transfer with 5 presentations for Foam, Domestic and Commercial Refrigeration.
  Chair: Mr Jeremy Bazye.

**Session 4:** Experiences in the Aerosol Sector
- With 5 presentations.
  Chair: Mr Guillermo Castella-Lorenzo.

**Session 5:** Experiences in Adapting Alternatives in the Methyl bromide Sector
- With 3 presentations.
  Chair: Mr Ricardo Labrada.

**Session 6:** Lessons Learned by Implementing Agencies in Technology Transfer
- With 5 presentations from Implementing Agencies.
  Chair: Dr A.P. Kulsherestha.

**Session 7:** Lessons Learned by Implementing Agencies (continued)

**Session 8:** Round Table Discussion on the Successes and Barriers in Technology Transfer
  Chair: Professor John Okedi.

In a round table discussion at the end of the Workshop, the participants made substantial recommendations which are shown in Annexure 6. They also pointed out that there were useful lessons in technology transfer as experienced by various stakeholders during ODS phase out. The participants therefore recommended that these experiences should be collected and documented by UNEP’s OzonAction Branch with the involvement of Professor John Okedi as a Consultant.
WORKSHOP PROGRAMME
27-29 May 2002, BLANTYRE, MALAWI

MONDAY 27 MAY 2002
8:00 - Registration of Participants
8:45 - All guests get seated
9:00 - Arrival of Guest of Honour, Hon. L. Shati, MP, Deputy Minister of Natural Resources and Environmental Affairs
   - Welcome Remarks by Master of Ceremonies
   - Key Note Address by Prof. Ogun Davidson, Co-Chair Intergovernmental Panel on Climate Change (IPCC) Working Group III
   - Opening statement by Mr. Rajendra M. Shende, Head, Energy and OzonAction Branch, UNEP DTIE
   - Opening statement by Dr. A.P. Kulshreshtha, Director NAM S&T Centre
   - Opening statement by Dr. J. Perera, Chief Programme Officer, Representative of CSC
   - Remarks by the Secretary for National Research Council of Malawi, Dr. C. Mwiyeriwa
   - Remarks by Director of Administration for Ministry of Natural Resources and Environmental Affairs, Mr. E.L. Lodzeni
   - Speech by the Guest of Honour, Deputy Minister of Natural Resources and Environmental Affairs, Hon. L. Shati, MP
   - Group photograph
   - Refreshments
10:30 - Departure of Guest of Honour
10:30 - 10:50 - Coffee Break

Session 1: Plenary “Technology Transfer under the Multilateral Fund”
SESSION CHAIR: Director of Environmental Affairs, Malawi
10:50 - 11:10 Role of the Multilateral Fund in Promoting Technology Transfer and compliance with the Montreal Protocol
   Jeremy Bazye, Regional Network Coordinator, Africa Region
11:10 - 11:30 UNEP’s Role of Assisting Article-5 Countries in Technology Transfer- Mr. Rajendra Shende, Head, Energy and OzonAction Branch, UNEP DTIE

Session 2: Country Experiences in Technology Transfer
SESSION CHAIR: Professor John Okedi
11:30 - 12:30 Country Presentations by National Ozone Units
12:30 - 13:00 Open discussion
12:30 - 14:00 Lunch

Session 3: Experiences in Technology Transfer in Foam, Domestic and Commercial Refrigeration
SESSION CHAIR: Mr. Jeremy Bazye, UNEP
14:00 - 14:20 Natural Refrigerant as Alternative Technology: Hydrocarbons in Domestic Refrigerators, Presentation by UNDP
14:20 - 14:40 Domestic Refrigeration Sector: Conversion from CFCs to Hydrocarbons and HFC 134a Joint presentation by the representative of New Ltd. Nigeria, and the technology Supplier
   Country: Nigeria
   Implementing Agency: UNIDO
   Technology Recipient: New Ltd, Nigeria
   Technology Supplier:
14:40 - 15:00 Conversion to Hydrocarbons and HFCs: Experience in Small Display Commercial Refrigerators
Mr. Charles Jena, Commercial Refrigeration
Country: Zimbabwe
Implementing Agency: IBRD
Technology Recipient: Commercial Refrigeration
Technology Supplier: BOCK KALTEMASCHINEN, Germany

15:00 - 15:20 Domestic Refrigeration Sector: Conversion from CFC-123 to HFC-134a
Mr. Rueben Zinyama, Imperial Refrigeration
Country: Zimbabwe
Implementing Agency: IBRD
Technology Recipient: Imperial Refrigeration
Technology Supplier: Polya Trading, Denmark

15:20 - 15:40 Conversion in the Foam sector
Joint Presentation by Richdor S.A. and TEC MAC Macchine e Impianti industriali, Italy
Country: Morocco
Implementing Agency: UNDP
Technology Recipient: Richdor S.A
Technology Supplier: TEC MAC Macchine e Impianti industriali, Italy

15:40 - 16:00 Coffee Break

16:00 - 16:30 Screening of the UNEP video on Hydrocarbons in Refrigeration

16:30 - 17:00 Open Forum

TUESDAY, 28 MAY 2002

Session 4: Experiences in Technology Transfer in the Aerosol Sector
SESSION CHAIR: Mr. Guillermo Castella-Lorenzo, UNIDO
Country: Mauritius
Implementing Agency: GTZ
Technology Recipient: Chem-Tech Stella Industries
Technology Supplier: Czewo, Germany

09:00 - 09:20 Phase-out of CFCs in the Aerosol Sector
Dirk Legatis, GTZ

09:20 - 09:40 CFC-free Aerosol Manufacture
Chem-Tech Stella Industries, Mauritius

09:40 - 10:00 Open Forum

10:00 - 10:20 Safety Issues in aerosol conversion
Mr. Guillermo Castella-Lorenzo, UNIDO

10:20 - 10:50 Coffee Break

10:50 - 11:10 Conversion to Hydrocarbons in the Manufacture of Aerosol Products
Joint presentation by Mansoor Daya Chemicals Ltd. And Pamasol, Switzerland
Country: Tanzania
Implementing Agency: UNIDO
Technology Recipient: Mansoor Daya Chemicals Ltd.
Technology Supplier: Pamasol, Switzerland

11:10 - 11:45 Open Forum

11:45 - 12:00 Summary of the Day’s Discussions

13:00 - 14:00 Lunch
Session 5: Experience in Adapting Alternatives in the Methyl Bromide Sector
SESSION CHAIR: Mr. Ricardo Labrada, Plant Protection Officer, FAO

14:00 - 14:20 Use of Gas Proof PVC Sheets and Plastic Cocoons (storage) in Maize Cultivation
Mr. Peter Neganje (UNDP project in Zimbabwe)

14:20 - 15:00 Methyl Bromide Alternative Technology Transfer for the Tobacco Sector in Zimbabwe
Dr. Upenyu Mazarura, Head of Agronomy and Plant Physiology, Tobacco Research Board, Zimbabwe

15:00 - 15:30 Open Forum

15:30 - 15:50 Role of NGOs in Communicating Alternative Practices in Methyl Bromide phase out
Mr. T.P. Blyth Toms, Zambia

15:50 - 16:15 Open Forum

16:15 - 16:30 Coffee Break

Session 6: Lessons Learned by Implementing Agencies in Technology Transfer
SESSION CHAIR: Dr. A.P. Kulshrestha

16:30 - 15:45 UNEP DTIE
16:45 - 17:00 UNDP
17:00 - 17:30 Summary of the Day's Discussions

WEDNESDAY 29 MAY 2002

Session 7: Lessons Learned by Implementing Agencies (Continued)

09:00 - 09:20 UNIDO
09:20 - 09:40 IBRD
09:40 - 10:00 GTZ
10:00 - 10:45 Open Forum
10:45 - 11:15 Coffee Break

Session 8: Roundtable Discussion on the Successes and Barriers in Technology Transfer
SESSION CHAIR: Prof. John Okedi and Mr. Rajendra Shende, UNEP, DTIE

11:15 - 12:45 Discussion on Regional Technology Cooperation and Industry Leadership
12:45 - 14:00 Lunch Break
14:00 - 15:00 Summary of Recommendations from the Workshop
15:00 - 15:30 Closing Ceremony
Let me first applaud and thank the Government of the Republic of Malawi for organising this rather unusual regional event on Lessons Learned in Technology Transfer to Africa for the protection of the Ozone Layer. To be here in Southern Africa in this country that is locked by the lands but freed by the beauty, the country that is called as the warm heart of Africa, that is cooled by the natural rhythms of the waves of Lake Malawi is the experience that vividly demonstrates what is meant by “small is beautiful.”

But the small can be efficient as well. The Republic of Malawi deserves to be congratulated for the excellent work being done by their National Ozone Unit of the Ministry of Natural Resources and Environmental Affairs under the leadership of Hon. Minister Mr. Shati. Malawi has done tremendous work in complying with the international treaty of the Montreal Protocol so far. It has successfully met the first control measure under the Montreal Protocol i.e. freeze in the consumption of CFCs at the average consumption level of the years 1995-1997. Malawi is now getting ready for the further compliance measures that will totally phase out CFCs by 2010. UNEP is confident that under the guidance of the Hon. Minister, the Republic of Malawi will meet this challenge through the appropriate strategies and policy measures.

I call this workshop an unusual event. Normally the workshops and seminars are forward looking, announcing the new technologies and new plans, like the International Trade Fair that is taking place here in Blantyre at present. This event is reflective, self-examining and analytical. It will assess the experiences of the technology transfer that has taken place so far in the African region. And then draw the lessons for moving fast forward. The event is Past Prologue for the Future.

UNEP’s partners in this workshop, Centre for Science and Technology of Non-Aligned and other Developing Countries and the Commonwealth Science Council could not have selected a better venue than this country for this reflective and retreat exercise. I thank them for their initiative.

The concentration of most of these ozone depleting gases in the stratosphere has now stabilised indicating that the Ozone Layer recovery may begin soon.

US$1.3 billion have been allotted to the developing countries to enable them to implement the Montreal Protocol. These resources have been utilised for the technology transfer to the developing countries and in building the capacity of the developing countries to deploy these technologies and the policies for the sustained and permanent phase out of ODSs. The story for Africa is even more inspiring. Africa has done remarkable work in the implementation of the Montreal Protocol in spite of the other more pressing priorities. Nearly all countries from Algeria to Zimbabwe have ratified the Montreal Protocol.

By using the technologies from foam to fumigants they have reduced their consumption of ODSs below the freeze level required under the Montreal protocol. Many have developed and enforced the necessary policies, employed good practices and strengthened their institutions for the protection of the ozone layer. It is true that a lot is yet to be done and the real challenge is still to be met. But the political will exists and momentum has been built. This workshop is therefore very timely as it will learn from the lessons during the last 15 years since the Montreal Protocol was signed in 1987 and use them for the implementation process for the remaining 10 years.

It will also be a timely contribution for the World Summit on Sustainable Development (WSSD) that will be taking place later this year in Johannesburg. The lessons from this exercise may offer the international community hints to go forward to react to the unfulfilled promises and unfinished agenda of the Earth Summit in Rio 10 years ago.

This regional forum for dialogue on assessing the lessons learned on the technology transfer is the second in the series. The first such dialogue took place in Asia Pacific region in 1999. UNEP jointly with NAM Centre for Science and Technology and Commonwealth Science Council and Asia Pacific Centre for Technology Transfer examined 20 technologies that were transferred and that contri-
buted to the phase out of ODSs. This is the region that consumes the most ODSs. Now we are in the region that consumes the least ODSs but the impacts of the action taken here will be far reaching in terms of achieving the goals of the Montreal Protocol.

Technology transfer should not be considered as only investment projects for the conversion of the factories. It also includes the know-how to employ the good practices as in the case of the methyl bromide an ODS that is so important in the context of Africa. It is the only ODS that is so closely related to the agricultural production and lessons learned in the transfer of the technologies to phase out methyl bromide will be of crucial importance.

I therefore welcome the presence of FAO that has been in the forefront of promoting the IPM techniques. I also appreciate the participation of UNDP, UNIDO, and GTZ to convey their lessons in assisting the developing countries. I welcome the participation of the industries from African countries and technology suppliers from other continents. I would like to highlight the presence of Professor Okedi who is an environment expert and was also the representative of Uganda in the Executive Committee.

Let us over the next three days pause, ponder and assess the technology transfer experience in the presence of these experts. This small exercise has the potential to take a big leap forward by improving the effectiveness of the implementation of the Montreal Protocol as well as other multilateral environment agreements like the Kyoto Protocol and Chemical Conventions like POPs.

Statement by Dr J.A.J. Perera, Chief Programme Officer, Commonwealth Secretariat, London.

Hon Minister, CSC member for Malawi, Mr Shende, Dr Kulshreshtha, ladies and gentlemen.

It is my pleasure to be with you in Blantyre, Malawi and to be associated with you in this important event.

In 1996, an African Regional workshop on Ozone Depletion and Management of ODS Phase out in Small and Medium Enterprises was jointly organised by Commonwealth Science Council (CSC) and the NAM S&T Centre, and UNEP in Pretoria, South Africa and this will be second regional workshop on technology transfer and case studies for ODS phase-out. The earlier one was organised in Bangkok for the Asian region which has in particular taken a significant lead in phase out initiatives under the Montreal Protocol with support of Multilateral Fund, leading to significant phase out of ODS.

This activity will bring together enterprises that supplied the technologies and those who received it, highlighting the potential for replication by the other countries of the region. It is proposed to involve also the agencies executing these technology transfer projects from UN agencies, Multilateral Fund, UNEP (DTIE), World Bank, etc. who would discuss the lessons learnt from these successful case studies.

We are pleased to inform you that the CSC/STD is facilitating and co-organizing the above activity for our member countries in the Southern African region to be delivered in partnership with the Centre for Science & Technology of the non-aligned and other developing countries (NAM Centre), New Delhi, India, United Nations Environmental Programme (UNEP) the Environmental Affairs Department, Malawi.

Mr. Shende of UNEP explained in details the aims and objectives of this activity and as such I do not wish to go into detail.

I wish to thank the Malawi government and especially Hon. Minister, the CSC member for Malawi and Mr. Patrick Salifu for making arrangements to hold this activity in Malawi who is a very active member of our Science Council.

I welcome participants who came from many parts of the world and also the local participants taking time to come for the workshop.

I wish you all very best and hope the workshop will bring many results.

Statement by Dr Arun P. Kulshrestha, Director, NAM S&T Centre

I have the great pleasure to represent NAM S&T Centre today as co-sponsor of this workshop for Southern African region being held in Malawi to draw useful lessons from the implementation of the Multilateral Fund aided projects in the region to phase-out ODS under Montreal Protocol.

The Centre had the privilege of co-sponsoring with UNEP the Asian region workshop with similar objective in Bangkok in 1999, the proceedings of which were widely circulated and appreciated. Earlier in 1997 the Centre in association with CSC had organized in Pretoria an African regional meeting on ODS and Management of ODS phase out in SMEs. A similar meeting was organised in New Delhi in 1995 for the Asian region.

Southern Africa has made significant contributions to Montreal Protocol although it never produced any ODS except by South Africa. Many of the countries of the region have enacted legislation to control ODS consumption and imports. I am aware that the regulations put into force in 1998 in Malawi contain several control measures including a ban on import of second hand refri-
Annexe 4

Annex 4

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At the time of writing, the negotiations on the phase-out of ODS and the use of ozone-friendly substances are ongoing. The European Union and other developed countries are supporting the African countries in this transition. The region has been active in implementing the Multilateral Fund supported projects. In fact, Mauritius intends to complete a terminal phase out by 2005, five years ahead of target required under the Montreal Protocol.

For those who are not familiar, I would like to take this opportunity to introduce them briefly to the NAM Centre. The Centre for Science & Technology of the Non-aligned and other Developing Countries is an inter-governmental organisation set up by the Non-aligned Movement, properly known as NAM, for promotion of and cooperation in science and technology among developing countries. The present membership of the Centre consists of 40 countries spread over Asia, Africa and Latin-America. In fact, this is the only platform in world, which can boast of bringing all the developing countries together under one umbrella in resolving the problems of common relevance through the application of science and technology. In addition, under the Network Scheme of the Centre several leading S&T agencies of Bolivia (Academy of Science), Botswana (Botswana Technology Centre), Brazil (CNPq), India (Council of Scientific & Industrial Research), Nigeria (Federal Institute of Industrial Research) and Turkey (TUBITAK) are also associated with the Centre.

The Centre has been active in implementing an expanded S&T programme relevant to developing countries since 1993-94, which encompasses training programmes and courses, long-term collaborative projects, workshops and expert meetings and scientific publications and periodicals in the areas of priority identified by the Governing Council of the Centre. These areas include biotechnology including DNA fingerprinting and gene therapy etc., and Agro-technology (including tissue culture and medicinal plants), environment, microelectronics, remote sensing, rural and satellite telecom, metrology, renewable sources of energy, human settlement, drugs and pharmaceuticals, gamma irradiation etc. and also areas pertaining to science policy, commercialisation and IPR. We have so far organised 32 events in India and abroad in our member countries. As many as five workshops and courses were organised during fiscal year 2001-2002 alone on topics as diverse as Herbarium Techniques in Dhaka, Bangladesh, Food Technology at AIT, Bangkok in Thailand, Drugs & Pharmaceutical Technology in Hyderabad, India, 2nd Workshop on Microelectronics - Trends in R&D and Industry in Da Nang, Vietnam, Gamma Radiation Processing of Healthcare & Food Products at Atomic Energy Establishment in Mumbai, India and 2nd training course in DNA Sequencing & Genotyping in Hyderabad, India. For young scientists we have fellowship awards and we have recently completed a fellowship programme for hands-on training in semiconductors, which was implemented in cooperation with ICTP. Apart from UNEP and CSC the Centre has formal links with ASEAN, AIT and TWAS and is supported by the UN agencies and regional agencies for specific programmes. The Centre has launched two long-term collaborative projects relating to low cost housing technology and bio-control of pests and weeds in which a number of member countries are participating. Apart from a quarterly journal, the Centre has so far brought out 16 publications.

Let me take this opportunity to appeal to all the developing countries, who are yet not members of the NAM Centre, to join this inter-governmental institution and mutually benefit each other by sharing ideas and experiences.

I would like to thank UNEP for associating the Centre in its programmes since 1995 when the Centre first organised an Asian regional meeting on ODS phase out in SMEs. The present workshop is the fourth joint activity of the Centre with UNEP. I would also like to thank CSC who have been associated with the Centre under their CREN programme for the African region of which this meeting is the second one organised jointly by the Centre with CSC, apart from UNEP.

I am grateful to the Honourable Minister from Malawi for gracing this occasion with his august presence. I am also thankful to the Government of Malawi Department of Environmental Affairs, and Dr. Salifu in particular, for their support to organise this meeting so meticulously and for the generous local support and facilities. Malawi has not yet joined the Centre but we are in close touch with the Ministry of Foreign Affairs and hope that this meeting would provide me a chance to discuss this further with authorities here.
## WORKSHOP PARTICIPANTS
Blantyre, Malawi, 27 - 29 May 2002

<table>
<thead>
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<th>Title/Position</th>
<th>Contact Information</th>
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</thead>
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SUMMARY OF WORKSHOP PRESENTATIONS

The Workshop received papers during plenary on the basis of the themes of the 8 sessions. The presentations ran for 10 to 20 minutes per paper followed by general discussions. Highlights of experiences of various presenters are given below:

SESSION 1: TECHNOLOGY TRANSFER UNDER THE MULTILATERAL FUND
Chair, Dr. A. Kamperewere, Deputy Director, Environmental Affairs Department, Malawi

1. THE ROLE OF THE MULTILATERAL FUND IN PROMOTING TECHNOLOGY TRANSFER AND COMPLIANCE WITH THE MONTREAL PROTOCOL
By Mr. Jeremy Bazye, Regional Network Coordinator, Africa Region.

- Presented an overview of the Financial Mechanism of the MF for 1991-2010 and beyond;
- Gave total funds in pledges, payments and income as at February 2002;
- Africa represents 1% of depletion of Ozone layer;
- Gave total approvals by Sector and Implementing Agency and bilateral components;
- Gave milestones for technology transfer, capacity building, EXCOM decision making processes, business plans, monitoring and evaluation;
- Gave target period to start 2002, compliance at 50% reduction by 2005; and
- Reiterated importance of Decision 35/57, its genesis and components, fund ceiling and freezing levels.

2. UNEP’S ROLE OF ASSISTING A-5 COUNTRIES IN TECHNOLOGY TRANSFER
By Mr. Rajendra Shende, Head, Energy and OzonAction Branch, UNEP DTIE

- UNEP, under the MF, provides software and know-how;
- 4-6% of disbursement is dedicated for capacity building;
- UNEP utilized US$1.3bn in public awareness, training, networking and books;
- Objectives of the Montreal Protocol in adopting the precautionary approach
- Phase out schedule for A-5 countries as 50% reduction by 2005;
- Africa’s share of Montreal Protocol as 8% for conversions and 14% for software; and 25% funds approved for Methyl Bromide but consumption is at 28%.

SESSION 2: EXPERIENCES IN TECHNOLOGY TRANSFER: COUNTRY PRESENTATIONS
Chair, Professor John Okedi, Consultant for Environment and Development Associates.

3. METHYL BROMIDE PHASE OUT PROJECT IN THE TOBACCO INDUSTRY IN MALAWI
By Mr. A. Changaya Banda

- MB is the most abundantly used ODS in Malawi;
- Tobacco industry is the main user, about 111 tons per year for mainly soil fumigation;
- 21 ODP tons used for fumigation of maize storage units; and
- Alternatives being tried with UNDP assistance through Agricultural Research and Extension Trust (ARET) using Floating Tray System, Basamid granular and Herbifume which started in 2001.

LESSONS LEARNT

Floating Tray System
- Uses polystyrene trays with cells, composted pine bark and water as non chemical soil-less medium without fumigation; and
- Technology now available in Malawi and is expected to expand to 6.5ha of nursery by end of 2002.

Positive Attributes of the Technology include:
- Technology enables farmers use less nursery area;
- Farmers can have permanent nursery site; and
- Saves on labour.

Limiting Attributes of the Technology include:
- High cost of trays;
- Lack of equipment to pelletise seed;
- Seedlings too small and difficult to plant;
- Not easy to convince farmers;
- Needs literate farmers;
- Needs to start small and expand slowly; and
- Needs persistent information and sensitisation of farmers.

Basamid
- Ozone friendly;
- Very effective in killing nematodes and weeds;
- Basamid is too expensive;
- Application period too long; and
- Farmers tend to take short cuts resulting in poor results.
Metham Sodium Cherbifumed

- Ozone friendly;
- Longish procedures;
- Is an irritant;
- Not stable;
- Needs further tests and validation;
- Do not rush to introduce to farmers.

4. ODS PHASE OUT IN NAMIBIA
By Mr. P.L. Ungwanga, Ozone Officer

- ODS used mainly in domestic and commercial refrigeration, air conditioning, fire fighting and agriculture totaling 41.5 tons;
- Approved projects implemented by Finland and GTZ through training;
- 61 technicians and 4 customs officials trained; and
- 20 companies given R&R units.

Some Lessons

- Use existing frameworks to support projects;
- Need good public awareness; and
- Need publications.

5. EXPERIENCES FROM SWAZILAND
By Ms. Tilly Zondi, Environment Analyst

- In the refrigeration sector, R12 and R11 were becoming scarce and if available, very expensive;
- ODS consumers had no idea about the depletion of the ozone layer and were skeptical about the whole issue of ODS phase out;
- Consumers had no experience on the use of alternatives or engaging into ozone friendly practices;
- Purchasing recovery and recycling equipment proved to be too expensive especially for small businesses;
- There was lack of cooperation amongst stakeholders who were even reluctant to give consumption data.
- Though public awareness was done, people were not convinced that Ozone depletion is an issue; and
- Information on the informal refrigeration sector was not available.

With regard to recovery and recycling, the following issues were observed:

- Since technicians were only introduced to this aspect of recovery and recycling, refresher courses are necessary; and
- Technicians were becoming more marketable and this results in a high turnover which means training of new people has to be continued.

6. TECHNOLOGY TRANSFER FOR ODS IN LESOTHO
By Ms. M. Mahahabisa, Meteorologist

- ODS consumption confined to the refrigeration sector;
- Preparation of Country Programme;
- Preparation and implementation of Recovery and Recycling Project;
- Institutional Strengthening;
- Refrigerant Management Plan;
- Training undertaken for 15 technicians in safe recovery of the refrigerant using equipment supplied, 3 refrigeration trainers trained in a 3 week course in Germany on good practices in refrigeration, evening courses for refrigeration technicians;
- All recovery machines are in Maseru - no problem of transporting recovered refrigerant to recycling centre;
- After recycling, disposal tanks are stored;
- Trained 21 technicians;
- Introduced curriculum at schools;
- Reduced CFC emissions;
- Public awareness mounted;
- Established recycling center; and
- Lesotho already 2005 compliant.

Problems

- No continuous training due to lack of funds;
- CFC leakages; and
- Delay in allocation of certificates.

7. EXPERIENCE IN THE USE AND TRANSFER OF ODS PHASE OUT TECHNOLOGIES IN TANZANIA
By Mr. B.S.E Mndewa, Assistant ODS Officer

- Out of 5 investment projects, only one has been successfully completed;
- The Mansoor Daya Chemicals Ltd. aerosol phase out project was successfully completed and commissioned in March 1988 with UNIDO as the implementing Agency;
- Involved phasing out 150 ODP tons of R-11 and R-12 by conversion to LPG for manufacture of insect killer sprays and air fresheners;
- Pamasol of Switzerland supplied the technology;
- CFC-11 phase out in flexible polyurethane foam manufacture at Panafrica Ltd. under UNDP implementation, was approved in 1998, the equipment from TECMAL of Italy has not arrived yet;
- CFC-11 phase out in flexible polyurethane foam manufac-
ture at Polyfoam Industry under UNDP implementation was approved in July 2000 but equipment has not yet arrived;

- Phase out of CFC in the manufacture of refrigerators at Tanzania Domestic Appliance Manufacture, under UNIDO Implementation approved in 1995 is not complete;
- UNOPS procurement procedures unfavourable;
- Implementing Agencies and their consultants have rigid rules of procedure;
- Direct communication between Implementing Agencies and beneficiary enterprise, keeping out the Government has been detrimental;
- Budgets were rather lean for institutional strengthening;
- Customs statistics not adequate for managing ODS control;
- Customs officials not fully knowledgeable about ODS;
- No equipment at border posts for identifying ODS's;
- Consumers are rigid to change to new products; and
- Use of methylene chloride in foam sector been proved as human carcinogen.

8. LESSONS LEARNT AND CASE STUDIES IN TECHNOLOGY TRANSFER FOR ODS PHASE OUT IN ZAMBIA

By Mr. Cliff Ngwata, Senior Inspector Air and Noise, ODS Unit

- Zambia is low consumer of ODS, some 22.12 tons equivalent to 0.3 kg per capita, and 54.1 tons of methyl bromide per year;
- Country Programme and ODS regulations in place; and
- Surveys and public awareness programmes mounted.

9. EXPERIENCE OF ZIMBABWE IN TECHNOLOGY TRANSFER UNDER THE MULTILATERAL FUND

By Mr. V. Mugova, Ozone Office, Harare

- Zimbabwe is the largest user of methyl bromide in Africa using 630 tons in tobacco, 300 tons in refrigeration, 210 tons in cut flower, 20 tons in grain storage, (total 1180 tons);
- Experienced delays in arrival of equipment;
- Some equipment missing or damaged;
- Delays in clearance of equipment;
- High turn over of trained technicians;
- Unfavourable market conditions; and
- Poor communication between NOU and Implementing Agencies.

SESSION 4:

10. EXPERIENCE IN THE AEROSOL SECTOR : BILATERAL COOPERATION BETWEEN GERMANY, GTZ AND MAURITIUS

By Mr Dirk Legatis, GTZ.

The project value was US$ 90,000 through Chem-Tech Stella Industries. The project successfully replaced CFC with the hydrocarbon based propellant HAP in Chem-Tech and is now producing 175,000 environmentally friendly aerosol products per year. GTZ experiences and lessons learnt were given as follows:

- Invoke Polluter Pays Principle i.e. use producer of old product to provide the new technology;
- Use personal connections;
- Use attractive technologies;
- Need to provide economic incentives;
- Hydrocarbons have safety problems;
- Technology transfer experiences mistrust between Government and consultants; and
- Relations between Government and the private sector often tend to be difficult.

SESSION 6

LESSONS LEARNT BY IMPLEMENTING AGENCIES IN TECHNOLOGY TRANSFER

Implementing Agencies present in the workshop gave their experiences in technology transfer as follows:

11. UNEP

Mr Shende Head, Energy and Ozone Action Branch of UNEP’s DTIE provided the following observations as part of their experience in technology transfer for the phase out of ODSs.

- There is great need for awareness of the Montreal Protocol and phase out issues;
- It is necessary to provide alternatives and options;
- It is necessary to provide tools for assessing the technology and how to source it;
- NOUs need to get principles of assessing technologies;
- Need to collaborate with other Agencies to get projects off the ground;
- Networking seems restricted to Governments; and
- Need handbook on how to network and implement projects.

12. UNIDO

Mr Guillermo Castella Lorenzo Programme Manager at UNIDO pointed out the following as part of UNIDO’s experience in technology transfer.

- Success of projects depends on the full commitment of the recipient company;
- Ownership of the project by the country is necessary; and
- Large scale farmers are linked to international markets.
13. UNDP AND UNOPS
Mr Philipp von Waechter, Manager of UNDP/MPU gave an over view of lessons learnt by UNDP and UNOPS in the implementation of projects for technology transfer in the phase out of ODSs as pertaining to:

- Technological complications;
- Cost related issues; and
- Market related issues.

**Technological complications**
- Inflammability of replacement chemicals;
- Toxicity of new replacement chemicals;
- New technologies have inferior performance;
- New products tend to be contaminated; and
- New technologies have safety concerns.

**Cost related issues**
- Initial investment often considerable;
- New technologies tend to have higher operational costs;
- Recipient companies tend to be reluctant.

**Market related issues**
- Need to consider the situation in neighbouring countries;
- Are other companies in the country also converting;
- Low awareness level of local market;
- Lower profit margins;
- Influence of external factors;
- Availability of replacement chemicals locally;
- Availability of spare parts; and
- Higher prices of replacement chemicals.

14. FAO
The FAO is a collaborating Agency and Mr Ricardo Labrada Romero, Plant Protection Officer gave the following experiences on lessons learnt during the implementation of ODS phase out in regard to methyl bromide use by the farming community.

- Training is very important;
- Need to work with farmers on the farm using demonstrations on a continuous basis;
- Need to use national experts to train farmers;
- Need to know the character of the farming community; and
- Need proper diagnostic methods to identify magnitude of pest infestation on the farm.

WORKSHOP RECOMMENDATIONS
The participants deliberated on the way forward and made the following conclusions and recommendations addressed to Governments, Implementing Agencies, the Multilateral Fund and beneficiary industries.

**GOVERNMENTS**
- NOU staff should be trained in project writing and project identification;
- Ozone Committees should be constituted and empowered;
- Governments should refer more to Ozone Committees for decision making;
- Governments should mount intensive awareness campaigns about the Montreal Protocol;
- Governments should put policies and legislation in place to back up phase-out activities;
- NOU’s should hold regular briefing sessions with the relevant decision makers in the government;
- Governments should reduce bureaucracy and create incentives for compliance and dis-incentives for non-compliance;
- Governments should participate in the selection of consultants; and
- Governments should put in place procedures for identification of deserving and eligible enterprises.

**IMPLEMENTING AGENCIES (Implementing Agencies)**
- IAs, consultants and bi-lateral partners should understand and appreciate local environment and cultures;
- IAs should facilitate the country ownership of the projects;
- IAs should reduce bureaucracy and try to be flexible so as to speed up disbursement of funds and procurement; and
- Consultants should work within the agreed terms of reference in consultation with the governments.

**MULTILATERAL FUND**
- The Fund should always take into cognizance local conditions and situations; and
- The Fund should try to avoid frequent changes of policies and guidelines.

**BENEFICIARY INDUSTRIES**
- They should be more co-operative and understanding with the governments and the IAs;
- They should recruit and employ trainable staff and provide incentives to retain them;
They should be more open and more receptive to new technology; and
They need to build and maintain good working relations and communication with technology suppliers.

A BRIEF ON THE UNEP DIVISION OF TECHNOLOGY, INDUSTRY AND ECONOMICS (DTIE)

The mission of the UNEP Division of Technology, Industry and Economics is to help decision-makers in government, local authorities, and industry develop and adopt policies and practices that:

- Are cleaner and safer;
- Make efficient use of natural resources;
- Ensure adequate management of chemicals;
- Incorporate environmental costs; and
- Reduce pollution and risks for humans and the environment.

The UNEP Division of Technology, Industry and Economics (UNEP DTIE), with its head office in Paris, is composed of one centre and four units:

- The International Environmental Technology Centre (Osaka), which promotes the adoption and use of environmentally sound technologies with a focus on the environmental management of cities and freshwater basins, in developing countries and countries in transition.
- Production and Consumption (Paris), which fosters the development of cleaner and safer production and consumption patterns that lead to increased efficiency in the use of natural resources and reductions in pollution.
- Chemicals (Geneva), which promotes sustainable development by catalysing global actions and building national capacities for the sound management of chemicals and the improvement of chemical safety world-wide, with a priority on Persistent Organic Pollutants (POPs) and Prior Informed Consent (PIC, jointly with FAO).
- Energy and OzonAction (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition, and promotes good management practices and use of energy, with a focus on atmospheric impacts. The UNEP/RISO Collaborating Centre on Energy and Environment supports the work of the Unit.
- Economics and Trade (Geneva), which promotes the use and application of assessment and incentive tools for environmental policy and helps improve the understanding of linkages between trade and environment and the role of financial institutions in promoting sustainable development.

UNEP DTIE activities focus on raising awareness, improving the transfer of information, building capacity, fostering technology cooperation, partnerships and transfer, improving understanding of environmental impacts of trade issues, promoting integration of environmental considerations into economic policies, and catalysing global chemical safety.

THE UNEP DTIE OZONACTION PROGRAMME

Nations around the world are taking concrete actions to reduce and eliminate production and consumption of CFCs, halons, carbon tetrachloride, methyl chloroform, methyl bromide and HCFCs. When released into the atmosphere these substances damage the stratospheric ozone layer - a shield that protects life on Earth from the dangerous effect of solar ultraviolet radiation. Nearly every country in the world - currently 172 countries - has committed itself under the Montreal Protocol to phase out the use and production of ODS. Recognizing that developing countries require special technical and financial assistance in order to meet their commitments under the Montreal Protocol, the Parties established the Multilateral Fund and requested UNEP, along with UNDP, UNIDO and the World Bank, to provide the necessary support. In addition, UNEP support ozone protection activities in Countries with Economies in Transition (CEITs) as an implementing agency of the Global Environment Facility (GEF).

Since 1991, the UNEP DTIE OzonAction Programme has strengthened the capacity of governments (particularly National Ozone Units or "NOUs") and industry in developing countries to make informed decisions about technology choices and to develop the policies required to implement the Montreal Protocol. By delivering the following services to developing countries, tailored to their individual needs, the OzonAction Programme has helped promote cost-effective phase-out activities at the national and regional levels:

Information Exchange
Provides information tools and services to encourage and enable decision makers to make informed decisions on policies and investments required to phase out ODS. Since 1991, the Programme has developed and disseminated to NOUs over 100 individual publica-

Training
Builds the capacity of policy makers, customs officials and local industry to implement national ODS phase-out activities. The Programme promotes the involvement of local experts from industry
and academia in training workshops and brings together local stakeholders with experts from the global ozone protection community. UNEP conducts training at the regional level and also supports national training activities (including providing training manuals and other materials).

Networking

Provides a regular forum for officers in NOUs to meet to exchange experiences, develop skills, and share knowledge and ideas with counterparts from both developing and developed countries. Networking helps ensure that NOUs have the information, skills and contacts required for managing national ODS phase-out activities successfully. UNEP currently operates 8 regional/sub-regional Networks involving 109 developing and 8 developed countries, which have resulted in member countries taking early steps to implement the Montreal Protocol.

Refrigerant Management Plans (RMPs)

Provide countries with an integrated, cost-effective strategy for ODS phase-out in the refrigeration and air conditioning sectors. RMPs have to assist developing countries (especially those that consume low volumes of ODS) to overcome the numerous obstacles to phase out ODS in the critical refrigeration sector. UNEP DTIE is currently providing specific expertise, information and guidance to support the development of RMPs in 60 countries.

Country Programmes and Institutional Strengthening

Support the development and implementation of national ODS phase-out strategies especially for low-volume ODS-consuming countries. The Programme is currently assisting 90 countries to develop their Country Programmes and 76 countries to implement their Institutional-Strengthening projects.

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**Annexe 9**

**A BRIEF ON THE NAM S&T CENTRE**

The Centre for Science & Technology of the Non-aligned and the Other Developing Countries was set up in 1989 as a follow-up of the recommendations made by the Heads of the States of the Non-aligned Movement (NAM Summits) at their meetings held at Colombo (1976), Havana (1979) and New Delhi (1983). The Centre with its headquarters at New Delhi (India) has 39 countries from Asia, Africa and Latin America as members at present.

The Centre aims to promote the fullest possible and mutually beneficial collaboration among scientists regarding technological capabilities of the Non-aligned and other developing countries with a view to promote technological cooperation, transfer of technology, etc. among them, stimulate and promote joint research and development projects and training programme.

The Governing Council of the Centre has laid down the areas of priority and programmes for the Centre which at present cover bio-technology including tissue culture and medicinal plants, environment, renewable energy, micro-electronics, telecommunication, remote sensing, human settlement etc. A number of programmes are under way in these areas and a number of publications have been brought out and are being brought out including the quarterly NAM S&T Newsletter. The Centre has organised jointly with UNEP, regional workshops on ODS phase-out in SMEs and also brought out its proceedings. The Centre has close working cooperation with other international S&T organisations and specialized UN agencies including, UNIDO, Commonwealth Science Council, Third World Academy of Sciences, Asian and Pacific Centre for Transfer of Technology, Asia Pacific Telecommunity, WAITRO, COSTED, GBF of Germany, AIT and ASEAN-COST.

The membership of the Centre which is open to all the Non-aligned and Other Developing Countries is comprised of the following:

- Afghanistan
- Gabon
- Peru
- Algeria
- Guyana
- Sri Lanka
- Argentina
- Indonesia
- St. Lucia
- Bangladesh
- India
- South Africa
- Bhutan
- Iraq
- Syria
- Bolivia
- Lebanon
- Tanzania
- Burkina Faso
- Malaysia
- Togo
- Congo
- Mauritius
- Uganda
- Colombia
- Malta
- Vietnam
- Cuba
- Myanmar
- Yugoslavia
- Cyprus
- Nepal
- Zambia
- DPR Korea
- Nicaragua
- Zimbabwe
- Egypt
- Nigeria
- Ethiopia
- Pakistan

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**Annexe 10**

**ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)**

The Asian and Pacific Centre for Transfer of Technology (APCTT) is a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). It was established in 1977 with the objective of facilitating technology transfer in the Asia-Pacific region. Its programmes are coordinated with national focal points designated by the governments in member countries.

APCTT has two main areas of activities, namely: (a) Development activities to strengthen technological capabilities and technology transfer networking in Asia and the Pacific and (b) technology transfer services to facilitate business contracts among client enterprises. With its focus on environmentally sound technologies (ESTs) for sustainable development and small and medium scale enterprises (SMEs), the Centre: (1) brings out periodicals and publications that are...
read in over 70 countries; (2) updates on a daily basis its databank on international technology and business opportunities; (3) develops networks and partnership among technology transfer intermediaries; (4) organizes workshops and training programmes on technology transfer services, technology assessment, evaluation and pricing; (5) provides international matchmaking services and organizes business meets and technology missions; (6) develops mechanisms and services to deliver ESTs to SMEs in Asia and the Pacific; and (7) works towards the environmentally sound economic development of the region.

Development Activities
APCTT implements national and regional development projects through the following areas: (1) Technology Information and Transfer for SMEs by organizing training programmes on service development, pricing and marketing for technology intermediaries; developing networks; and undertaking studies on technology information and transfer mechanisms; (2) Technology Management by organizing workshops on commercialization of R&D results, technology assessment, evaluation and pricing; (3) Environmental Information and Management by developing EST information, transfer and delivery mechanisms and services for SMEs; and organizing EST transfer business meets; and (4) Women in Development by facilitating the exchange of technology information and technical training for women.

Technology Transfer Services
APCTT provides SME-oriented technology transfer services in the following areas: (1) Information on technology opportunities and new technological developments; (2) Search for and matching of prospective technology transfer partners; (3) Support services (market studies, feasibility studies, assistance in contract negotiations); and (4) Finance syndication and marketing assistance for technology transfer projects.

Apart from its website, APCTT services may be accessed by
* Visiting the APCTT Information Centre;
* Availing of APCTT international technology transfer matchmaking service for technology buyers and sellers;
* Subscribing to SME-oriented business periodicals (Asia Pacific Tech Monitor, Catalogue of International Technology and Business Opportunities);
* Joining INTET-Asia to get timely updates on international technology offers and requests and;
* Subscribing to the Value Added Technology Service (VATIS) Update on technology trends in the areas of Biotechnology, Food Processing, Non-Conventional Energy, Ozone Layer Protection, and Waste Technology.
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<th>Acronym</th>
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<tr>
<td>APCTT</td>
<td>Asian and Pacific Centre for Transfer of Technology</td>
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<td>CFC</td>
<td>Chlorofluorocarbon</td>
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<td>CSC</td>
<td>Commonwealth Science Council</td>
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<td>CTC</td>
<td>Carbon Tetrachloride</td>
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<td>DME</td>
<td>Dimethyl Ether</td>
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<td>DTIE</td>
<td>Division of Technology, Industry and Economics</td>
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<td>ExCom</td>
<td>Executive Committee of the Multilateral Fund</td>
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<td>Food and Agricultural Organisation</td>
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<td>GTZ</td>
<td>German Technical Development Co-operation</td>
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<td>Integrated Pest Management</td>
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<td>IS</td>
<td>Institutional Strengthening</td>
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<td>ISO</td>
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<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
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<tr>
<td>Mbr</td>
<td>Methyl Bromide</td>
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<td>MCF</td>
<td>Methyl Chloroform</td>
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<td>ODS</td>
<td>Ozone Depleting Substance</td>
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<tr>
<td>ODP</td>
<td>Ozone Depleting Potential</td>
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<td>POPS</td>
<td>Persistent Organic Pollutants</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium Sized Enterprise</td>
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<td>UNDP</td>
<td>United Nations Development Programme</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<td>UNOPS</td>
<td>United Nations Office for Procurement Services</td>
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<tr>
<td>WSSD</td>
<td>World Summit on Sustainable Development</td>
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