Environmental Technology Transfer to Developing Countries:

Practical Lessons Learned During Implementation of the Montreal Protocol

by

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1 INTRODUCTION

1.1 Overview

Careful analysis of the implementation of the Montreal Protocol in developing countries over the past eight years suggests a number of observations, or lessons learned, that may be applicable to a wide range of international environmental technology transfer programs. After a brief review of the Protocol's provisions and a quick summary of the data that underlie the analysis, a strategic planning framework is presented that can be used to design and implement specific programs. The framework is then used in a more general manner to evaluate activities under the Protocol. From this evaluation flow a number of lessons learned, including both strategic considerations with the potential to affect broadly the objectives and outcomes of projects and tactical considerations with an impact on a project's day-to-day operations.

1.2 Background on the Montreal Protocol

Over 150 countries have signed the Montreal Protocol, a landmark international agreement to restore the Earth's deteriorating stratospheric ozone layer. The global success of this effort to protect stratospheric ozone requires that the world's developed and developing countries eliminate emissions to the atmosphere of most ozone-depleting substances (ODS), which include chlorofluorocarbons (CFCs) and other chlorinated and brominated compounds. Achieving this goal in many economic sectors requires momentous industrial change, including the development, installation, and use of new technologies. Since many of these technologies are widely available only in a relatively few countries, and since the global market has been slow to bring these technologies to some parts of the world, deliberate and active international technology transfer programs are needed if ODS emissions are to be eliminated.

Recognizing this situation and acknowledging that a majority of developing countries with other social priorities would not invest scarce resources in programs to restore the ozone layer, the Parties to the Montreal Protocol established the Multilateral Fund. The purpose of the Fund is to ensure that "the best available environmentally safe substitutes and technologies are expeditiously transferred ... [and] that the transfers occur under fair and most favorable conditions." The Fund, which is jointly implemented by the World Bank, the United Nations Environment Program (UNEP), the United Nations Development Program (UNDP), and the United Nations Industrial Development Organization (UNIDO), offers substantial financial support for technology transfer programs. These include investment projects, feasibility studies, and training and demonstration programs. Technology transfer projects under the Montreal Protocol include, for example, efforts to replace CFC-based foam blowing machinery at developing country enterprises with new non-CFC equipment and projects to initiate the recovery, recycling, and reuse of CFCs during equipment servicing in the refrigeration and air conditioning sectors. Developed countries that contribute to the Fund, including the United States, also sponsor similar technology transfer projects and programs through bilateral assistance to developing countries.

1.3 Sources of Data

The analysis and conclusions presented in this paper reflect data gathered from a variety of sources about project implementation under the Protocol. First, the two authors are practicing consultants who have supported a number of clients on projects to transfer non-ODS technologies to developing countries. Key clients include the United States Environmental Protection Agency, the World Bank, various United Nations agencies, and developing country governments. This paper reflects the authors' experience in Mexico, Venezuela, the Philippines, Indonesia, Malaysia, and Colombia.

The second major source of data is a study conducted by ICF Consulting for the Executive Committee of the Multilateral Fund. The report, prepared pursuant to Paragraph 8 of Article 5 of the Montreal Protocol, evaluated the feasibility of adjusting the phaseout schedule for ODS in developing countries (also known as Article 5 countries) with special emphasis on the impediments to and incentives for technology transfer. The study included visits to eight Article 5 countries and interviews with over 170 individuals in-country to collect data required for the Study. Interviews were conducted with government officials, staff of the ozone protection unit (OPU), industry representatives, chemical distributors, ODS producers, and trade associations. Thirteen other Article 5 countries responded to a faxed questionnaire which addressed a variety of factors related to the feasibility of various phase-out schedules. Staff from several other organizations also provided substantial input, including the following:

- The Multilateral Fund Secretariat in Montreal;
- The Ozone Secretariat in Nairobi;
- The four Implementing Agencies of the Multilateral Fund (i.e., the World Bank, the United Nations Environment Program, the United Nations Development Program, and the United Nations Industrial Development Organization);
- Members of the Executive Committee of the Multilateral Fund, including three donor countries and five Article 5 countries;
- The UNEP Technology and Economic Assessment Panel;
- The UNEP Scientific Assessment Panel;
- Chemical and technology producers; and
- Several environmental and development oriented non-governmental organizations active on the issue of stratospheric ozone depletion.

2 ANALYTIC FRAMEWORK

2.1 Overview of Framework

Efforts to promote international technology transfer can benefit significantly from general strategic planning theories and from the lessons learned through other international development work. These theories and lessons demonstrate the need for critical thinking and a structured process to guide project development. This is especially the case with technology transfer efforts where success depends on the actions of multiple stakeholders with diverse technical, economic, administrative, political, and cultural interests and needs. This situation characterizes the majority of technology transfer projects sponsored under the Montreal Protocol.

The general purpose of strategic planning for an international technology transfer project is to anticipate in advance the actions that all critical stakeholders must take throughout the project in order to ensure long-term use of the new technology and to determine early on rather than later if the required resources are beyond their capacity. Having done so, organizers can plan the project in a way that identifies potential barriers and impediments and provides the proper incentives and resources to ensure that the stakeholders take the desired actions. To achieve this goal, the authors have found it useful to apply a consistent stakeholder analysis framework at the initiation of every technology transfer project. This framework requires the completion of three steps.

Step 1:
Process Characterization

First, each of the many stages in the process of technology transfer is identified and characterized. These stages usually begin with a decision to act on the part of recipient enterprises and countries, move onto considerations related to project design, financing, and approval, and conclude with issues associated with acquisition, adaptation, installation, and long-term use of the technologies. When characterizing the technology transfer process, it is critical to be both comprehensive and specific. Comprehensiveness is important because, if a stage is left out of the planning process, the project may grind to a halt when an unexpected hurdle emerges. Specificity is important because virtually all international technology transfer projects are in some way unique. The particular funding rules of a multilateral organization, country-specific policy or cultural dynamics, and specialized technology considerations are just three examples of factors which should be clearly understood and accounted for during project design.

Step 2:
Stakeholder Identification and Characterization

Second, a list is compiled of all the critical stakeholders who will be involved in the project in any way, either as a technology recipient, technology supplier, sponsoring agency, bridging agent, government authorizer, financial reviewer, or in a number of other capacities. In particular, because the enthusiastic support of potential local technology recipients or suppliers is a true prerequisite for project success, the importance of identifying all relevant local partners cannot be understated. Stakeholders can also be important for a number of other reasons. Often, stakeholders are important simply because their cooperation or specific action is essential during one or more stages of the project. Other actors may be key because they have the potential to serve as the "champions" of the project, energetically pursuing their role in the process. Alternatively, stakeholders can be key because they are in a position to thwart the project through an overt act to undermine it.

Once the critical stakeholders are identified, project organizers need to understand the incentives that motivate these stakeholders at each stage of the project in order to design projects that will appeal to them and maintain their commitment. In addition, an assessment should be made of the potential barriers that would impede each stakeholder from taking the desired action at each stage of the process. These impediments and incentives may be technical, financial, institutional, political, or cultural in nature. This assessment can be conducted in detail based on appropriate technology and/or market theory, or it can be made through simpler consideration of probable incentives and motives.

Step 3:
Project Analysis and Planning

Next, an assessment is made of how project organizers want each critical stakeholder to behave at each stage of the technology transfer process. Each of these stakeholders typically must take specific actions at different points in the technology transfer process in order for the effort to succeed. For example, at one stage the technology supplier needs to agree to sell the technology, and at a later stage the technology supplier may need to provide training, spare parts, maintenance, or other support services. Furthermore, delays or miscommunications between one or more of the stakeholders can cripple the entire project because the other stakeholders lose confidence or lose patience. The latter situation is especially a problem because enterprises in developing countries are often initially skeptical about the international assistance process.

A project plan is then developed, based on consideration of how the project sponsors can leverage their particular resources to make sure that the other stakeholders take the actions required at each stage of the technology transfer process. The project plan also incorporates

[1] *A complementary process for ensuring careful project planning is useful for the project organizers to assess their own objectives and motivations. This will help provide a clear focal point for participating staff and may highlight some internal discrepancies that can be resolved before interactions are initiated with external stakeholders.*

mechanisms for confronting or circumventing any impediments that were identified as potentially obstructing the stakeholders at any stage of the process.[1] This project plan facilitates communications needed to initiate the project and serves as a guide and quality control device throughout implementation.

While the process outlined above is useful for designing and executing an international technology transfer project, it can also serve as a tool for illuminating the general issues associated with the transfer of non-ODS technologies to developing countries under the Montreal Protocol.

2.2 The Process of Technology Transfer under the Montreal Protocol

While there exists some variation among projects, most efforts at transfer of new technologies under the auspices of the Montreal Protocol comprise at least twelve stages, as shown in Exhibit 1.

Each of these twelve stages can be further subdivided so as to clearly illuminate the specific activities that must be undertaken to ensure the success of the technology transfer process. Project planners will, accordingly, need to delineate those additional steps which are unique to the particular country, technology, and project participants. For our purposes, however, these twelve stages are sufficient to illustrate some of the key lessons learned during implementation of the Montreal Protocol.

2.3 Key Stakeholders in Technology Transfer under the Montreal Protocol

Once the stages of the technology transfer process have been characterized, project planners are well advised to determine each of the stakeholders with the potential to affect the outcome of each step. Some of the key actors in the efforts to phaseout ODS include the following:

- **Donor Countries:** Approximately 40 industrialized countries have made commitments under the Montreal Protocol to provide the Multilateral Fund about $645 million over the period from 1991 to 1996. This financial commitment has been instrumental in motivating developing countries to pursue their ODS phaseout.
- **Vendors of Alternatives:** Most, though not all, of the alternative technologies

Exhibit 1: Twelve Stages of Technology Transfer

An ODS-consuming enterprise decides to switch to non-ODS or ODS-conserving technologies:	
1	Enterprise becomes aware of the potential for technological change in their operations
2	Enterprise is motivated to act
Non-ODS technologies are evaluated and specific options are selected:	
3	Non-ODS technologies are identified
4	Non-ODS technologies are evaluated
5	Appropriate/preferred non-ODS technology is selected
A project is designed and financing is obtained:	
6	Project proposal is prepared
7	Project receives approval from Implementing Agency
8	Project receives approval from Executive Committee of the Multilateral Fund
9	Funds are disbursed for the project
The new technology is acquired, installed, and used:	
10	Technology is purchased or acquired
11	Non-ODS technology is delivered and installed on the "shop floor"
12	Non-ODS technology is adapted to local conditions and put into use

available to replace ODS-based equipment are not manufactured or widely sold in developing countries. Vendors play a key role in disseminating information about these technologies and assisting in their procurement, installation, and long-term operation.

- **Multilateral Fund Executive Committee:** With membership split evenly between donor countries and developing countries, the Executive Committee must approve all projects financed by the Multilateral Fund. In doing so, the Committee has set cost reimbursement rules that, depending on the circumstance, may either encourage or impede ODS phaseout.
- **Multilateral Fund Secretariat:** As the administrative arm of the Executive Committee, the Secretariat wields substantial power in evaluating projects and making recommendations for Executive Committee action. The Secretariat also routinely interacts with the Implementing Agencies, offering advice and input on their daily operations.
- **Multilateral Fund Implementing Agencies:** The four implementing agencies play a key role in working with developing countries to identify candidate ODS phaseout projects, providing in-country technical assistance to enterprises, and preparing Multilateral Fund grant applications.
- **Developing Country Governments:** As signatories to the Montreal Protocol and in-country managers of ODS phaseout policies, developing country governments play a vital role in the phaseout. Indeed, the rapid progress of ODS phaseout in some countries can be attributed primarily to the enthusiastic and very competent work of a small group of government officials.
- **Developing Country Financial Intermediaries:** The execution of Multilateral Fund projects in many countries is under the control of an in-country financial intermediary. The technical skills and organizational capabilities of these institutions can be a key determinant of the speed of ODS phaseout.

Exhibit 2: Framework for Organizing the Discussion on Policy and Institutional Issues

Stage	Decision to Switch			Selection of Technology			Project Design		Acquisition, Installation, and Use of Non-ODS Technology			
Actor	Become Aware of Situation	Be Motivated to Act	Identify Technology	Evaluate Technology	Select Technology	Prepare Project Proposal	Receive IA Approval	Receive ExCom Approval	Transfer Funds	Acquire Technology	Install Technology	Use Technology
Donor Countries		✔			✔			✔	✔			
Vendors of Alternatives	✔	✔	✔	✔	✔				✔	✔	✔	✔
Executive Committee						✔	✔	✔				
Secretariat						✔	✔	✔				
IAs	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Article 5 Governments	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
FIMs							✔		✔	✔	✔	✔
Article 5 Enterprises	✔	✔	✔	✔	✔	✔				✔	✔	✔
Consultants	✔		✔	✔		✔				✔	✔	
NGOs	✔		✔	✔								

✔ = Actor plays a key role in this stage of technology transfer.

- **Developing Country Enterprises:** Responsible for the initial acceptance and shop-floor installation of new technologies, the recipient companies are among the most important of the stakeholders. Without their sustained commitment and cooperation, successful technology transfer is simply impossible. Furthermore, there are often multiple actors within a single enterprise (e.g., managers, engineers, or accountants), each with his or her own set of priorities and concerns.
- **Consultants:** Many of the important steps in the technology transfer process are often carried out by consultants including, for example, field visits, technical analysis, and day-to-day project coordination. Accordingly, skilled consultants who are well versed in project objectives and priorities can be key to success.
- **Non-Governmental Organizations (NGOs):** Playing a key role both in supporting ODS phaseout in individual developing countries and in globally advocating more environmentally benign substitutes, NGOs are in a position, depending on the circumstance, to either accelerate or impede the technology transfer process.

The relative importance of these stakeholders varies from project to project and country to country. Nonetheless, if the interests and motivations of any one of them is omitted from the project planning process, the likelihood of unexpected obstacles and perhaps outright project failure may rise appreciably. While the set of stakeholders relevant to other, non-ODS oriented, environmental technology would undoubtedly be different, it is instructive to note that almost all such efforts entail a similar set of stakeholders, that is, recipient governments and enterprises, technology suppliers, foreign sources of funding, and bridging agents like the EPA or World Bank.

2.4 Critical Intersections of Process and Stakeholders

To complete the project planning process, then, the key is to identify critical steps in the technology transfer cycle where the support or specific actions of relevant stakeholders is needed. To do so, the list of key actors and the steps in technology transfer can be combined to create a matrix similar to the one shown in Exhibit 2.[2] The matrix can be used to determine in which steps each actor plays a significant role. Each critical intersection is identified with a check mark in the matrix. Project planners can then analyze the policy and institutional issues associated with the significant cells in the matrix. For example, use of appropriate technology or economic theory can reveal the practical impediments and incentives that will motivate that stakeholder at that particular stage in the technology transfer process.

For purposes of this analysis, the data described in Section 1.3 can be used to reflect upon the issues associated with each of the highlighted cells in the matrix and how they have affected the transfer of non-ODS technologies to developing countries. Doing so permits the experience under the Montreal Protocol to be distilled down into a series of lessons learned. While developed specifically in the context of the Montreal Protocol, these observations are intended to be sufficiently broad so as to be applicable to a wide range of environmental technology transfer projects.

3 LESSONS LEARNED: STRATEGIC CONSIDERATIONS

Experience gained during implementation of the Montreal Protocol in developing countries can be divided into general strategic considerations that broadly affect project design and more focused tactical considerations that are applicable to the day-to-day operation of any given technology transfer project. Some readers may find the strategic considerations described below to be perhaps nothing more than obvious common sense. While this may be the case, the

[2] *The matrix shown in Exhibit 2 is adapted from the study prepared by ICF pursuant to Paragraph 8 of Article 5 of the Montreal Protocol.*

authors' experience suggests that managers of technology transfer projects frequently neglect one or more of these considerations, often to the significant detriment of the project.

3.1 Successful Programs Address Critical Stakeholder Needs

International technology transfer programs tend to share several key features, including the following:

- The absence of a single focal point with the authority to command concerted action by all involved parties;
- The presence of multiple priorities that often compete for the attention of these stakeholders; and
- The inherent complexity of a multi-step process that involves several actors and that typically begins in one country and ends in another.

These features have a profound implication for project design. To be consistently successful, projects must explicitly be designed to address the needs and concerns of all stakeholders.

Project organizers must understand what motivates each stakeholder to become involved and to remain involved throughout the entire process. Since successful technology transfer involves not only the selection and shipping of equipment, but also the adaptation of that equipment to local circumstances, the training of local technicians, and the long-term upkeep and use of the equipment, it is also critical to foster genuine interest and to motivate the stakeholders for the long term. Past technology transfer projects under the Montreal Protocol have shown that these motivations can be rooted in technical, financial, institutional, political, or cultural factors pertinent to each stakeholder. Projects that ignore these factors rarely succeed in a manner consistent with initial expectations and objectives.

It is also important to note that what works in one country may not work in another. Simple duplication of a successful project model in a second country may fail because the specific set of stakeholders, their motives and incentives, and the policy environment may all differ markedly. This can be true even when the particular technology and industry setting are identical.

3.2 Successful Programs Reflect Strong Institutional Competencies in Recipient Country

The successful transfer of environmental technologies requires that recipient countries possess the requisite institutional resources and competencies. It was quickly recognized in the early days of Montreal Protocol implementation that if the host government did not have a government ozone protection unit of even minimal size to serve as an in-country focal point for ODS phaseout, then successful technology transfer efforts were virtually impossible. Recognizing this situation, the Executive Committee provided institutional strengthening grants to several developing countries. These grants allow a small number of staff to be hired and office equipment to be acquired.

In-country administrative and management talent also matters very much in ensuring successful projects. Indeed, such skills can often be more important than expertise regarding the relevant technologies and industries.[3] Effectiveness in carrying out different roles can depend on the personalities, training, and experience of the relevant government staff. Traits that affect the success of technology transfer efforts include staff organization, aggressiveness, political savvy, and willingness and ability to deal with other national and international actors in the public and private sectors. Of note is that an overly zealous in-country government unit, anxious to control every step of the technology transfer process, may impede the execution of the project when it tries to operate outside its areas of expertise.

3.3 Successful Programs Don't Fight Market Forces

Key stakeholders in the technology transfer process often include for-profit enterprises motivated primarily by market-driven eco-

[3] *The necessary technical expertise can often be found in consultants from developed countries who, despite their engineering and industry experience, may not be well suited to handle local logistical and coordinating activities.*

nomic forces. This is especially true of companies being asked to install new technologies and vendors being asked to deliver, install, and maintain the new technologies. Available evidence leaves little doubt that market forces play a key role in technology transfer programs. For example, in many developing countries, the prices of ODS are still below those of substitute chemicals. In such cases, it is unsurprising that many enterprises, most of which are for-profit entities, have been slow to implement new technologies. Conversely, several developing-country companies that serve export markets in industrialized countries expedited their transition to non-ODS technologies to comply with import regulations and customer specifications in destination countries.

It is also important to recognize that the economic and financial evaluation of a proposed investment project in a developing country may take a different perspective than in an industrialized country. The cost of capital is often quite high, leading to higher discount rates, that disadvantage projects with high up-front costs and returns realized only over the long term. Similarly, because of social and economic factors, firms may be risk averse and slow to adopt new, unfamiliar technologies. This is especially true in situations where vendors offer technologies that are more sophisticated or complex than local conditions require.

Economic considerations also tend to drive the long term sustainability of technology transfer projects. While the enthusiasm of project sponsors and an initial financial subsidy might motivate a company to adopt a new technology, only in situations where long-run cost savings persist can enterprises be expected to maintain the technology over time.[4] Similarly, if the technology vendor does not have a significant market presence in the county, it may be unrealistic to expect ongoing support and maintenance of the technology unless a specific credible commitment is made during project initiation. This is important because the past experience of many developing country enterprises makes them fearful of the maintenance and upkeep requirements of new and unfamiliar technologies from developed countries. In addition, many technology vendors are unfamiliar with developing countries, leading them to be very risk averse about making long term commitments in small, new, foreign markets.

3.4 Successful Programs Channel Information Effectively

Given the often complex nature of new technologies, of global policy initiatives, and of international technology transfer programs, accurate, timely, and authoritative information can be critical to project success. While price signals do convey information very effectively through the market, price-based information is rarely sufficient to ensure project success. First, in many developing countries, governments are unable or unwilling to put policies in place to make current practices significantly more expensive or the installation of the new technology significantly less costly. Second, while perhaps motivating companies to seek information, higher prices by themselves contain no explicit information about government policies, cost and performance of new technologies, opportunities for international support, or the long-term nature of the necessary technological change.

Enterprises often prefer to continue using known technologies that carry low risks and are reluctant to replace their current processes until they know that the alternative they are investing in will perform at acceptable quality levels and will not need to be replaced again in the near future. This is exemplified by experiences in the solvents sector, for example, where companies have often been slow to adopt new non-ODS technologies even though those technologies are less costly than the CFC technologies they replace. Firms can also be confused by the competing claims made in the marketplace by both current suppliers and vendors of alternative technologies. This means that timely adoption of new technologies will not take place if critical actors do

[4] *Cost savings may exist because the new technology creates process efficiencies, reduces input costs, or avoids potential government sanctions resulting from non-compliance.*

not receive certain information, including the following:

- Clear near-term and long-term price signals for current and new technologies;
- Authoritative data on the availability and technical and financial details of alternatives;
- Data for technology producers and suppliers on potential projects in developing countries, to encourage them to market their products and services; and
- Information about the availability of project financing.

3.5 Successful Programs Recognize that Technology Transfer Takes Time

Agencies and individuals responsible for complying with the Montreal Protocol face a complex challenge. The same is true of many efforts to implement new environmental technologies in developing countries. With limited resources, these actors must foster difficult technological transformations in diverse economic sectors. To do so successfully, they must overcome an array of technical, institutional, economic, and political constraints at the national and international levels. Furthermore, they must do so amidst many additional complications. This may include, for example, priority given to other critical social policies, varying levels of regulatory support, limited institutional capacity, sparse technical and economic data, or lack of local experts familiar with the latest developments in new technology. Accordingly, an impatient emphasis on quick results during project planning may, at best, lead to disappointing results and, at worst, may lead to a failure to build strong relationships with and among key stakeholders that are a prerequisite to project success.

4 LESSONS LEARNED: TACTICAL CONSIDERATIONS

Tactical considerations are those that are relevant to the day-to-day operation of a technology transfer project. While necessarily more narrow and focused than the strategic considerations delineated above, these tactical considerations can be equally important. Projects that are not well-designed to facilitate daily implementation rarely succeed as small, continual problems combine to undermine the project. Tactical considerations can be divided into a set of operating principles that will routinely come into play throughout a project's lifecycle and a collection of skills and talents that must be in the "project implementation toolbox" to ensure successful execution.

4.1 Operating Principles

Designing and implementing successful technology transfer projects and programs depends at least partially on the ability to respond dynamically to the unique requirements of each new situation. At least five operating principles help ensure this ability:

- **First,** maintaining clear yet flexible overall goals for ongoing project operation, for example linked to emission reductions, export promotion, or global environmental awareness, to help keep projects focused and manageable;
- **Second,** thinking critically and strategically about each new opportunity by working to identify key stakeholders, the incentives that motivate them, and the impediments that may inhibit their ability or willingness to support technology transfer efforts;
- **Third,** maintaining the capacity and willingness to act quickly and seize opportunities that arise to initiate projects or establish partnerships with other agencies or enterprises;
- **Fourth,** striving to develop and maintain positive working relationships with host governments, technical experts, equipment vendors, and representatives of international implementing agencies who will be partners in these projects; and
- **Fifth,** making deliberate decisions in each project about how narrowly or broadly to contribute to aspects of the technology transfer process that go beyond basic selection and installation of equipment, such as giving policy advice to governments, and being willing not to partici-

pate in projects if the impediments to success are clearly too significant.

In the daily flow of work with its competing priorities, confusing information, and evolving environment, it is often easy to lose sight of the core objectives of a technology transfer project. Accordingly, the principles described above are offered as guidelines for ongoing project operations that can be used to anchor routine decision making in the underlying goals and purpose of the project.

4.2 Project Implementation Toolbox

These principles for technology transfer projects rely upon the maintenance of a powerful set of resources and skills. Foremost, this "toolbox" of resources and skills must include the ability to understand and relate to the critical stakeholders who will be involved in each project. This often includes the capacity to meet with them in their own geographic or industrial setting, communicate with them about their ideas and concerns, gather technical data from them, and establish their confidence in the project. It is especially important to recognize that local biases and skepticism about international projects may exist and, therefore, the trust and confidence of key stakeholders must be cultivated through honesty, competence, sensitivity and, perhaps, a bit of humility.

The project implementation "toolbox" must also include other resources and skills. To satisfy project needs and the requests of other stakeholders, for example, readily accessible resources should include the following:

- Technical, economic, financial, and policy analysis skills relating to all aspects of the environmental technology under consideration;
- Practical engineering experience working with the new technologies;
- Ability to communicate in multiple languages;
- Familiarity and experience working with the rules and guidelines of the international implementing agencies;
- An understanding and ability to analyze the market forces that drive technology development and absorption around the world;
- Ability to produce quality documents and outreach materials;
- Ability to gather and synthesize complex quantitative and qualitative data; and
- Other similar abilities to facilitate dynamic strategic planning and successful interaction with technology suppliers, technology recipients, host governments, and international implementing agencies.

While the importance of any one of these skills and talents will vary from project to project, each is likely to be of some benefit to any project. In many cases, the absence of one or more of these implementation tools may seriously undermine a project. Accordingly, project planners will want to ensure that the requisite "toolbox" has been assembled prior to project initiation.

5 CONCLUSION

Implementation of the Montreal Protocol requires that new technologies be accepted, installed, and used in the long term by tens of thousands of enterprises in multiple economic sectors in nearly every country of the world. Furthermore, practical experience indicates that not only must these specific enterprises be identified and given the proper incentives so that they decide to use this technology, but the cooperative participation of technology suppliers, financiers, host-country governments, and other stakeholders is also required for success. Permanent ODS emission reductions will be achieved when each of these critical stakeholders is motivated to participate and make sure the non-ODS technology is used in the long term. Experience to date with implementation of the Montreal Protocol suggests several important lessons. To recap, successful programs accomplish the following:

- Address critical stakeholder needs;
- Reflect strong institutional competencies in recipient country;
- Don't fight market forces;

- Channel information effectively;
- Recognize that technology transfer takes time;
- Take a flexible and opportunistic approach during implementation; and
- Rely on a complete and broad set of implementation tools.

While each technology transfer program is unique, the lessons learned during implementation of the Montreal Protocol seem likely to be applicable to a wide range of other such international efforts.

ICF Consulting Staff and Resources

This paper was researched and prepared by David Strelneck and Peter Linquiti of ICF Consulting for presentation at the 17th Annual Research Conference of the Association for Public Policy and Management (APPAM). This conference calls each year for the development of papers that incorporate the most recent data and thinking to help address difficult social issues of our time.

As an environmental consulting firm with worldwide experience and expertise, ICF Consulting furnishes to a diverse base of international clients the same solid resources and skills that contributed to the development of this paper. ICF Consulting offers policy, economic, and program implementation services to address the broad range of environmental issues that confront policy makers and private enterprise today. Current and past clients include many environmental ministries and other government agencies in developing countries, the United Nations Development Program, the United Nations Environment Program, the United Nations Industrial Development Organization, the World Bank, the United States Environmental Protection Agency, the United States Department of Energy, private sector companies, and others.

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