EVALUATION REPORT

MOROCCO RENEWABLE ENERGY DEVELOPMENT

PROJECT #608-0159

Prepared by

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With the assistance of

Sam Schweitzer, USAID/S&T/EY
Dana Younger, USAID, NEA

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PREFACE

This report has been prepared by the outside consultants from Energy/Development International, principally Daniel F. Kohler (economist, team leader) and Frank Kreith (engineer). The valuable contributions of Sam Schweitzer and Dana Younger from USAID/Washington are gratefully acknowledged.

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EXECUTIVE SUMMARY

The USAID/Morocco Renewable Energy Project's main purpose was to build a Moroccan institution capable of pushing forward the development of renewable energy technologies in Morocco. Despite initial difficulties and numerous delays, caused in part by budgetary difficulties on the Moroccan side, and in part by extremely long procurement delays on USAID's part his purpose has been achieved and the "Centre de Developpement des Energies Renouvelables" (CDER) has been created. In this very strict sense, the project has been a success.

However, the simple question of whether an institution has been created or not, should not be the only criterion for project success. The evaluation, therefore, sougnt to ascertain to degree to which CDER is in a position to effectively promote the spread of renewable energy technologies in Morocco, and the extent to which the project contributed to this overriding sector goal. The evaluation team was also specifically asked to recommend ways in which the project could be reoriented, if necessary, to reflect the experiences gained in the renewable energy area over the last few years. Much of the evaluation is thus forward looking: knowing what we know today, where should CDER go from here.

The evaluation team has come to the conclusion that the project, and with it CDER's program ought to be redirected and better focused. At present the scope of activities pursued by CDER and partially supported by this project is very broad. At the same time, the vision guiding this project appears to have been very narrowly confined to technological questions. This relationship needs to be reversed. The project must encourage CDER to narrow the scope of its activities to concentrate on a few promising technologies, and at the same time broaden its approach to consider financial, economic, and sociological problems along with technological questions.

The primary activities of the project were to assist CDER are listed in the Project Paper as:

1. Short- and long-term training in Morocco and in the U.S.;

2. Technical assistance by two long-term and numerous short-term advisors;

3. A small projects fund through which CDER could support renewable energy activities in the private and public sectors; and

4. A series of pilot projects, most of which had originally been selected and analyzed under phase I of this project.

Of these the training component has unfortunately been lagging throughout the project. The evaluation team regrets this, as training and human capital transfer are clearly at the heart of institution

building. It must be pointed out, however, that until a little over a year ago CDER did not have a viable staff of its own that could have taken advantage of the training opportunities offered under this project. Nevertheless, once staff was hired, training should have been pursued more vigorously.

The technical assistance was provided by Research Triangle Institute (RTI) and a subcontractor, A.T. Kearney, under a host country contract. In some technical areas, such as wind, and micro-hydro, the assistance provided has been of good to excellent quality. Less commendable was the technical assistance in the photovoltaic and solar thermal areas, while the technical assistance in systems analysis, economics, and policy analysis was virtually absent. This is most unfortunate, because the evaluation team believes that the barriers to the spread of renewable energy technology in Morocco are not exclusively, nor even principally, of a technical nature. If CDER wants to pursue renewable energy development in Morocco it therefore cannot confine its attention to technical issues, but must consider economic, social and political questions as well.

The small projects fund (SPF), if used effectively, could become an important catalyst to interest private entrepreneurs in investing in renewable energy technology in Morocco. At the time of this evaluation the SPF was not yet operational. From the available documentation though it seems that the implementation of the SPF is on the right track.

The pilot projects have, unfortunately, taken up an undue amount of USAID and Moroccan resources, and have distracted from the project's primary purpose of institution building and training. Originally, pilot projects had been proposed only as a means for providing hands-on experience to CDER staff (ProAg). During phase I of the current project, though, an number of engineering firms were hired, and out of their assessments was developed a PP amendment that assigned the pilot projects a much broader role. The technological gadgetry of the pilot projects has raised CDER's visibility and has made it easier for the center to keep the momentum for renewable energy going. However, the pilot projects have also directed CDER's attention to purely technological issues, and may, in the long run, turn out to have been the least effective component of this project.

Principal Recommendations:

General and specific recommendations are listed in Section V of this report. Listed here are only those that the evaluation team considers most important:

1. CDER Must Define Its Mission.

CDER must develop a goal oriented plan for its activities. The plan documents that the evaluation team has seen are deficient. What needs to be stated clearly in CDER's plans is (a) What is CDER going to produce (e.g. what question is CDER's research going to answer)?,

(b) Why is this product important for Morocco?, and (c) How will CDER go about producing it? General statements such as "conducting research to gain more knowledge" are not sufficient.

2. CDER Must Strengthen Its Analytical Capabilities.

In cooperation with USAID and the USAID contractors CDER must find ways of introducing analytical thinking among its staff. This can be achieved only by providing additional training in fundamentals of economics and systems analysis to CDER's current staff, and/or hire additional professionals to complement the current cadre of engineers. The additional staff that CDER needs ought to be recruited from the fields of systems analysis, economics, finance, etc. At the same time, the short-term advisors should be primarily drawn from economic and systems analysis disciplines. Their primary role is to complement the long-term advisors and assist CDER in its reorientation.

3. The PACD Should Be Conditionally Extended.

The evaluation team recommends that the PACD be conditionally extended to enable CDER and its contractors to implement the recommended concentration and focusing of activities, and to allow careful planning for a possible follow-on project. However, this extension should be clearly linked to a demonstrated willingness of all concerned to implement the recommended redirection of CDER's program. Specific conditions for this extension ought to include: No new technology projects are undertaken until monitoring and analysis of the current projects are well underway, no regional centers are opened and staffed with CDER engineers, a senior engineer who can grow into the role of technical director is hired as a counterpart to the long-term technical advisor, a training plan for the current CDER staff is developed with clear-cut goals and incentives, a workplan as outlined elsewhere in this evaluation report is developed, and the CDER management agrees to consider this workplan as binding on all parties concerned. The only area where CDER could and should expand is in the social sciences, particularly economics.

4. The Project Should Be More Carefully Monitored.

The ProAg and the contract contain provisions for USAID monitoring of the project. These should be used, as far as possible, to help CDER and RTI/A.T. Kearney to redirect the project and to assert some quality control. USAID should consider the formation of a monitoring committee or a technical advisory board to assist the CDER directorate and advise its board of directors.

5. New Pilot Projects Should Be Reconsidered.

Pilot projects should not be evaluated on the basis of the energy they produce, but on the basis of the information they provide, or the training opportunities they afford, or their demonstration effects. Economic considerations based on the actual energy produced are important only in a prospective or macro sense: Is this technology economically viable for Morocco? and not in a micro sense: Does this specific project show an adequate rate of return? In practice the two

are closely related, of course, but nevertheless should not be confused. An additional important consideration under this project should be the effect that the pilot project has on CDER's other activities.

6. Improve Quality Control For CDER/RTI/A.T. Kearney Work Products.

The best way of improving the quality of the different CDER/RTI/A.T. Kearney work products (reports) is through professional peer review. RTI should make full use of the institute's renowned professional staff in North Carolina for this purpose. The services and consulting advice provided have two impacts which are both key to the successful development of CDER. The first impact relates to the particular subject and the quality of the analysis and advice. The second impact involves training and the transfer of skills through example and interaction with CDER staff. It is therefore, very important to assure that the consulting services and reports be of high quality.

I. INTRODUCTION

A. Background

The USAID/Morocco Renewable Energy Project was conceived in 1981 with the purpose of "Assist(ing) the Ministry of Energy and Mines to create a Center for Renewable Energy Development with the professional staff and facilities to carry out a wide range of applied research and pilot activities, studies and analyses to identify the most effective ways to exploit Morocco's renewable energy potential and develop programs to encourage its efficient use throughout the country." (PP, page 5.) It was thus firmly embedded in the then-current USAID thinking which emphasized "institution building." Accordingly, a parastatal organization was created, and USAID has been supporting it through this project for the past four years.

The main vehicle for this support was a host country contract between Centre de Developpement des Energies Renouvelables, the Center for Renewable Energy Development (CDER) and Research Triangle Institute (RTI). RTI also retained a number of external consultants and subcontractors. RTI reports to the director of CDER, who acts as the contract officer. USAID takes little direct influence on the project beyond financing and providing the necessary approvals.

In addition to the long-term USAID advisors and the short-term consultants sponsored under this contract, there are also some Peace Corps volunteers working at CDER. They are not part of this project, and their activities are not evaluated here. However, there are necessary interactions between the Peace Corps and this project, and they will be referred to inasmuch as they have an influence on the primary USAID project.

This evaluation was carried out in September 1985. Its purpose was twofold:

1. "To determine the extent to which the project goals and objectives are being and can be met within the remaining life of the project; and

2. Recommend ways in which the project may respond to the re-orientation of AID's renewable energy policy" (Evaluation Scope of Work, page 1).

B. Methodology

Because of the broader than normal scope of work some adjustments to the standard procedures for evaluating USAID projects were instituted. One of these changes was the addition to the evaluation team of Sam Schweitzer, from USAID's S&T/EY Bureau as an advisor, and Dana Younger, a former AAAS fellow in AID/W/Asia-Near East Bureau as a consultant. Secondly, the evaluation team was specifically asked to emphasize the broader issues raised by the change in USAID policy as it pertained to this project. Hence the traditional checklist verifying project outputs and

inputs as defined in the project logframe is somewhat thinner than usual so that the necessary resources could be devoted to addressing the broader questions. Final responsibility for this evaluation report rests exclusively with the external evaluators from E/DI, Daniel F. Kohler (economist, team leader), and Frank Kreith (engineer).

The team consulted project documents and met with RTI and USAID representatives in Washington and North Carolina in late August and early September. The team also spent two and one-half weeks in Morocco, with interviews and further study of documents. A list of the people contacted is provided in Appendix B.

C. Organization of this Report

This evaluation report is organized as follows: Section II reviews the original project design and the changes to this design that were made during the course of the past three years. The design was measured against the project's stated objectives in an effort to determine the extent to which the project, as designed, is consistent with its purpose and goal. Is supporting a parastatal, like CDER, indeed the best way, or at least a good way, for advancing the economic use of renewable energies in Morocco? In this task we profit of course from hindsight, however, some of the reservations we have to raise regarding the CDER structure should have been obvious at the time when the project was designed, or at least when design changes were undertaken.

The project achievements are discussed in Section III. We will seek to measure these achievements by two standards: First by how they correspond to the promises made in the project documents (Pro-Ag, Proposals, Contracts etc.) and second by what achievements could reasonably have been expected. This distinction is quite important, given that the evaluation team has serious reservations regarding the project design.

Section IV then addresses the manner in which the project was executed. In this portion of the evaluation we consider design only inasmuch as we feel the individuals and institutions involved (USAID, CDER, and the contractors), should have implemented design changes in line with our evolving knowledge and understanding of renewable energies in Morocco. In general, however, we measure performance against whatever objective goals can be deduced from the project documents.

Section V addresses the question of how the project fits in with the current policy reorientation within USAID. This section will be essentially forward looking, seeking to answer the operational question: where do we go from here? We review different options for CDER and draw on Sam Schweitzer's contribution to consider the extent and role of continued USAID/CDER cooperation in each. Overall conclusions and recommendations follow in Section VI.

This format deviates slightly from the one preferred by NE/DP (see NE/DP/Evaluation, "Near East Bureau Evaluation Guidelines," August 1984). However, we believe that it corresponds better to the needs of

the Mission in the present case. If it is necessary to relate the current format to the fourteen chapters suggested by the Near East Bureau's preferred format then Table 1 may be of use.

Table 1.

RELATING THE NE/DP FORMAT FOR PROJECT EVALUATION TO THE FORMAT USED FOR THIS EVALUATION

Chapter in NE/DP Format (NE/DP/Evaluation, August 1984)	Chapter in this Evaluation
I. SUMMARY	EXECUTIVE SUMMARY
II. PROJECT BACKGROUND	I. INTRODUCTION
III. EVALUATION METHODOLOGY	I. INTRODUCTION
IV. EXTERNAL FACTORS	II. PROJECT DESIGN
V. KEY PROJECT ASSUMPTIONS	II. PROJECT DESIGN
VI. PROGRESS SINCE LAST EVALUATION	III. PROJECT ACHIEVEMENTS
VII. INPUTS	IV. PROJECT IMPLEMENTATION
VIII. OUTPUTS	III. PROJECT ACHIEVEMENTS
IX. PURPOSE	II. PROJECT DESIGN
X. GOAL/SUBGOAL	II. PROJECT DESIGN
XI. BENEFICIARIES	II. PROJECT DESIGN
XII. UNPLANNED EFFECTS	III. PROJECT ACHIEVEMENTS
XIII. LESSONS LEARNED	V. CONCLUSIONS AND RECOMMENDATIONS
XIV. SPECIAL COMMENTS AND REMARKS	APPENDICES

II. PROJECT DESIGN

A. Project Purpose and Objectives

The current project represents the second of two phases. During the first phase several American consulting firms (most notably Charles T. Main) conducted a number of feasibility studies and analyses in Morocco, culminating in the proposal that USAID assist in the creation of CDER by providing material inputs for a number of pilot projects as well as technical assistance through long- and short-term advisors. No separate project identification document for phase two was ever prepared. The Project Paper amendment for phase two was developed directly on the basis of the C.T. Main study. This evaluation is not concerned with the work done under phase one of this project, and we shall refer to the C.T. Main study only where it is necessary for the evaluation of phase two.

The purpose of this project, as stated in the Project Design Logical Framework is to "create a Center for Renewable Energy Development (CDER).." (PP amendment, page 11-1). This very general and broad purpose is not further defined nor narrowed. By inference we can assume that the objectives of the project were the same as the objectives of CDER. The PP amendment (page 15) states that the objectives of CDER are to:

-- Characterize the quantity and the quality of Morocco's renewable energy resources;

-- Identify and develop renewable energy technologies best suited to Morocco;

-- Establish an objective performance measurement system for renewable energy techniques and equipment;

-- Train a cadre of engineers, scientists and managers;

-- Develop Moroccan institutional capability to manage and coordinate renewable energy research activities; and

-- Integrate renewable energy techniques into Moroccan national policy and planning. (PP amendment, pages 15/16)

This ambitious set of objectives could, of course, not all be achieved within the intervening four years. It is unfortunate that the PP amendment failed to specify a clearly defined set of objectives for CDER as well as for the project, which were realistic and which could have been useful as a guide to which activities should be undertaken as part of this project. As it stands, this wish list of objectives made it very difficult to focus on a reasonable subset and to assign priorities to CDER's activities.

B. Planned Project Activities

The PP amendment envisions four sets of activities by which CDER's, and by inference the project's objectives, could be achieved. They are:

1. Short- and long-term training in Morocco and in the U.S.;

2. Technical assistance by two long-term and numerous short-term advisors;

3. A small projects fund through which CDER could support renewable energy activities in the private and public sectors; and

4. A series of pilot projects, most of which had originally been selected and analyzed under phase one of this project.

The first three of these planned activities form a rather standard package for a typical human capital transfer project. The evaluation team feels that these activities are well thought out, and that they should make it possible to build Moroccan expertise in the renewable energy technology field. Unfortunately, by the time of this evaluation, we have to observe that the training component has been lagging, 1/ that the quality of the technical assistance is in parts open to question, and that the small projects fund is only just about to get underway.

Much of the project resources, and much of the administrative attention, was absorbed by the pilot projects component of this project. The original Phase I Pro-Ag between USAID and the Ministry of Energy and Mines (April 22, 1980) had mentioned pilot projects only as a possible means of training CDER staff and offering Moroccan engineers an opportunity to acquire some hands-on experience. The authors of the PP amendment, however, assigned a much broader role to the pilot projects. Discussion of the pilot projects takes up well over 30 pages of the PP amendment, as opposed to 2 for training. In fact, much of the activities under phase I of this project were related to studying and designing pilot projects, quite independently of their supposed training role. The training benefits of pilot projects are no longer mentioned in the PP amendment. The people involved in the planning and design of the pilot projects were almost exclusively American consultants.

The PP approval cable goes even a step further by suggesting that the contracts for the pilot projects be packaged, including installation, by the American contractor, "in order to reduce the workload on the Mission." It is obvious that pilot projects, which are pre-packaged and dropped in place by American technicians, have only limited training benefits. In Section II.D the individual pilot project designs are discussed in more detail.

1/ For example, only about 11 percent of the training budget for year two was actually spent (see Section III.A).

C. Changes in Project Direction

The evaluation team views the change in relative emphasis away from training towards technology demonstration and pilot projects to be the major design flaw of this project. However, given that the pilot projects were already underway when CDER and RTI came onto the scene it would be unfair to blame them for this shift. To RTI's credit, they were able to correct some of the excesses in the pilot project designs.

From the C.T. Main study on, the project had taken a clearly technology oriented direction. American engineers were designing systems, doing feasibility studies and planning laboratories. One example of this is the report by SERI on solar resource assessment (SERI/BATTELLE, A Plan for Solar and Wind Energy Resource Assessment in Morocco, 1983). The network of solar data collection centers proposed in that document is out of proportion with Morocco's needs. The wind resource assessment plan prepared by Battelle Pacific Northwest Lab, and contained in the same volume, is well thought out and more appropriate in meeting measurement requirements to establish viable indications for wind energy system installation.

Even the training components of the project, which originally had had substantial economic and policy content (see the definition of the program goals in the Pro-Ag) had become exclusively technology oriented. As a consequence and reflection of this emphasis, CDER was also steered in the technology direction. Renewable energy technology ran the danger of becoming an end in itself.

This redirection is the reflection of an implicit assumption that the barriers to the spread of renewable energy in Morocco are essentially technological. We do not wish to give the impression that we fail to realize the importance of technology transfer. In this particular area the project has probably made as much progress as could have been expected. However, we would like to stress that technology does not appear to be the binding constraint to the dispersion of renewable energy technologies in Morocco, and that the engineering driven approach alone cannot succeed. What seems to be needed is a systems approach that analyzes renewable energy systems in their entirety, taking into account economic, institutional, and policy considerations, along with engineering concerns.

D. Pilot Projects

When projects cannot be justified on any of the usual grounds (economic, social etc.) the constituencies interested in the undertaking tend to call them "pilot projects."2/

2/ USAID is by no means unique in this respect. Senator Ted Stevens (R-AK) attempted to get the federal government to pay for the pollution control equipment required of a lumber mill in Alaska by calling it a "pilot project."

Such abuse of the concept has given pilot projects a bad name. In fact there are many very good and defensible reasons for undertaking pilot projects under very specific circumstances:

1. Pilot projects can provide information. If a technology is only imperfectly understood, a pilot project may indeed be the lowest cost way of acquiring understanding and gathering data. In this case, a pilot project can be justified as a logical extension of experimental laboratory work. Note that for this type of pilot project, the resources devoted to monitoring often exceed the cost of the project itself.

2. Pilot projects can have demonstration effects. Skeptical decision makers may be swayed if they have an opportunity to see an actual project functioning in the field. These kinds of pilot projects will typically involve relatively mature technologies that have reached the commercialization stage in at least some countries. If technology demonstration is the main purpose of a pilot project, it must be complemented with a coherent education campaign. Furthermore, as concerns about reliability are often the source of many decision makers skepticism, such pilot projects must be scrupulously maintained and their recurring costs and continuous performance monitored.

3. Pilot projects can serve as educational tools. This was the original intent in this project. By participating in the design, implementation, maintenance and monitoring of pilot projects, students can acquire skills that will make replication feasible. The key component of pilot projects justified on these grounds is local involvement of as many individuals as possible.

This implies that a pilot project should not be analyzed in terms of the amount of energy it produces. Instead of comparing it to alternative ways of producing the same energy, it should be compared to alternative ways of obtaining the same information, 3/ or alternative ways of obtaining the same demonstration effects (e.g. site visits), or alternative ways of providing the same training. In any case it is the follow-on monitoring that will largely determine the value of a pilot project. 4/

3/ But to do this we must know beforehand which data we hope to obtain from the pilot project, and have a plan for extracting it, once the facility is installed. (See the memo by Steve Klein, October 25, 1984.)

4/ It is not until the fifth amendment to the Pro-Ag (August 3, 1984) that this realization is reflected in the project design. As an addition to Section 5.1 it states: "Each pilot project will have its own evaluation plan to monitor technical performance and real costs of operation, maintenance and repair, as well as to measure the actual socio-economic impact of the pilot vs. the projected impact."

Instead of providing a coherent justification of the pilot projects on any of the grounds outlined above, the project documents contain numerous attempts at providing economic justifications. Almost without exception, the resulting economic analyses are questionable. With the possible exception of the micro hydro project, which, given the fact that ONE is already deriving about 3 percent of its electricity generated from hydro sites, should not be viewed as a "pilot" project anyway, the pilot projects cannot be justified on economic grounds alone. Attempts to do so anyway are misleading and should be discontinued.

The last evaluation team (Sheladia, 1983) already pointed out that economic viability alone is the wrong criterion for pilot projects. Instead that evaluation team proposed the following criteria:

1. Technology should match those renewable energy resources that are plentiful in Morocco.

2. There should be a large potential market for the technology or for the energy it will produce.

3. The technology should be POTENTIALLY economically competitive with current and alternative energy technologies.(Emphasis added)

4. The engineering design should arrange proven technology components into a combination that most effectively matches the resources available to the potential demand.

5. The project should be designed to generate and retrieve precise information about the technologies performance in terms of the first four criteria (that is resources, demand, cost competative and physical effectiveness) as well as information about the social acceptability of the technology and the ability of the users to organize themselves and to manage and maintain it.

6. The project should be designed so as to be a representative sample of a technology combination that can be widely applied within a national research plan for renewable energy.

It is further stated that the end result of these selection criteria is to help renewable energy technologies penetrate the Moroccan economy - in short to have a national impact on the mainstream of development in Morocco.

The Sheladia review team applied the above criteria to the 9 projects selected and found that only the 3 micro-hydro installations and the PV water pumping project planned for CRAFA met their own criteria. 5/ The remaining 5 projects required serious review and redefinition in the view of the evaluation team in order to meet their proposed criteria.

5/ The three micro-hydro projects have since been reduced to one (see Appendix C for details).

If the Sheladia team is referring to the originally planned CRAFA project as described in the PP amendment, we would essentially agree with their judgment. However, the CRAFA project as designed in the PP amendment is considerably different from what has actually been installed, 6/ and it is doubtful whether the current project would still meet the Sheladia team's criteria.

The Sheladia team also pointed out that two of the remaining pilot projects had the potential of being good pilot projects, by their own criteria. They felt that the Ch'bani bio-digestor could be justified as a training tool if CDER was willing to go on and consider larger, industrial size digestors later, and the School of Mines PV pumping project could be viewed as a laboratory, due to its proximity to the future CDER headquarters, if it would also involve several different types of PV systems. Indeed, five different types of systems have been ordered for this project, and CDER is currently discussing industrial size digestors with some agro-industries. In this respect, the Sheladia recommendations have been heeded.

This evaluation team supports the Sheladia criteria for selecting pilot projects. They are in part reflected in the CDER/RTI document listing selection criteria for second round pilot projects (CDER/RTI R-56, March 1985). But they were never applied to the first round pilot projects, a shortcoming for which neither CDER nor RTI can be blamed since the pilot projects were already under way when phase two of this project started.

In fact, with hindsight, it is most difficult to find reasonable justifications for the first round pilot projects. Only thanks to considerable redesign by CDER and RTI can some of them be termed "acceptable." They have helped to keep the discussion of renewable energy technologies alive in Morocco, and have given CDER some good publicity and visibility. But they have contributed little to the project's original goal of transferring human capital and renewable energy technology, and may in fact, by diverting attention from this primary objective, have hindered the project's progress.

6/ See Appendix C for a discussion of the CRAFA pilot project.

III. PROJECT ACHIEVEMENTS

A. CDER as an Institution

The project has achieved one of its stated primary purposes. An institution has been built. It has a staff and a budget, and is in the process of constructing its new headquarters. Given the circumstances under which this has taken place, particularly in light of Morocco's budgetary problems, this is an achievement that must not be underestimated.

As a parastatal institution with financial autonomy, CDER appears to be poised to move forward. Having been in business for only four years, CDER has nevertheless been able to undertake various steps that in the long run have potentially large payoffs. For example, CDER's cooperative agreements with various universities can be highly recommended as means for leveraging the center's resources to reach a broad audience of young people. These contacts should be continued, even after CDER has its own facilities and is less dependent on the universities to house its equipment.

Over the past few years USAID has shifted the emphasis in its approach to development from institution building towards fostering the private sector. This shift, though amply justified by the lack of success in building viable institutions capable of igniting economic development, should not be a reason for failing to recognize that in this particular case an institution has been built, which has the potential, if properly directed by its management, to make a valuable contribution to renewable energy development in Morocco.

CDER's senior management has been in place for the last four years and appears capable of directing the center in a professional manner. Some difficulties, particularly in the personnel area, appear to be in the process of resolution with the approval of CDER's personnel statute.

The most important thing that CDER seems to be lacking today, is a clearly defined mission. As a young and growing institution CDER's primary objective to date was to keep the momentum for renewable energy going. The center achieved this by expanding rapidly in many directions simultaneously, with little regard to the need for setting priorities and making hard choices. But to become a viable mature institution, CDER cannot continue in this manner. The very first CDER document (CDER/RTI "Institutional Development Models," R-1, October 1982) points to the "lack of focus or concentration, resulting in no more than marginal or incremental progress on any one of the program objectives," as the most serious recurrent failure of renewable energy programs worldwide. To be successful, an institution like CDER needs to have a mission commensurate with the means at its disposal. The challenge to define this mission, and to make the necessary decisions to successfully undertake it, will be the current management's most difficult test.

outside of CDER despite their obvious enthusiasm and energy. This handicaps the staff, not only in its daily work, but also in its dealings with other institutions and in its relationship with the CDER management. None have sufficient status to question management directives, even if they have professionally well founded concerns, or suffiecient experience to effectively communicate their concerns.

3. The composition of the staff is heavily skewed towards Physical Scientists, to the detriment of technical disciplines and social sciences. There is an unfortunate lack of people able to analyze an energy system as a whole, to compare different types of renewable energy systems, or even to design such systems from an engineering point of view. The staff's capabilities are more oriented towards conducting research. RTI has not been able to compensate for this shortcoming with its own staff (more about that below).

4. The English language competence of the staff is minimal at present, and needs to be improved if CDER has any aspirations of following the technological developments taking place in the rest of the world. Most professional literature is in English, and if CDER should want to continue cooperating with USAID, most of the technologies they will have to deal with, will be of American origin. The lack of English language skills also makes it impossible for the staff to take full advantage of training opportunities in the U.S. offered as a part of this project.

In addition to CDER's full-time staff and the RTI/A.T. Kearney consultants, the center's activities have been supported by a group of Peace Corps volunteers (PCVs) and a number of French "cooperants." To date, the three PCVs assigned to CDER have acted more or less as full-time staff members. In fact at one time two of the PCVs have functioned as acting section chief of the biomass section. There are, however, fundamental differences in the way in which the Peace Corps stresses appropriate technology dissemination, and CDER's understanding of its own research and analysis role, which encumber this cooperation.

It is impossible to ascertain, even approximately, how CDER staff allocates its time, due to the absence of a project oriented time accounting system. 1/ It is our understanding that IMEG, a Moroccan management consulting firm, is currently designing a system that will allow allocating staff time. This is a "sine-qua-non" for the effective management of CDER.

1/ According to the RTI resident advisors, several attempts were undertaken to institute such a system. However, they all failed primarily due to resistence on the part of the CDER staff.

According to the RTI/A.T. Kearney resident advisors, about one-half of CDER's staff time and program effort is presently devoted to activities funded by the USAID project. The remainder of CDER's resources is spent on activities developed by CDER or sponsored by other donors including France, Italy, Yugoslavia, and Hungary. The RTI/A.T. Kearney consultants have no influence on MEM and CDER's decisions to accept foreign assistance from other than U.S. sources and are precluded from working on projects sponsored by East Bloc countries. More importantly, activities carried out by CDER in conjunction with other donors conflicts with RTI/A.T. Kearney's work. For example, only one CDER PV technician was available to help install the PV arrays at the CRAFA pilot project site due to the scheduling of a French funded PV installation over the same time period. Scheduling conflicts have also arisen for the training component of this project and the visits by short-term experts.

In addition to the time spent by CDER staff on USAID and other donor projects, they are also often detailed to carry out administrative duties such as answering correspondence and preparing annual reports. These functions distract them from their technical work. The presence of USAID advisors and Peace Corps volunteers has not alleviated this situation. It may have even made the situation worse by giving the impression to CDER that the American personnel can fill staff positions, thus freeing up the CDER staff for other activities.

Training

The Project Paper stated that 12 academic trainees from CDER were to receive long-term academic training in the U.S. to the master's level and that 80 person-months of short-term training was to be supplied in the U.S., Morocco and third countries if appropriate. The goal of the project's training program was to enable CDER staff to grow "from a narrow range of technical expertise, to a broader set of skills to accommodate expanding demands" (PP amendment Pg 20). The intention was that CDER's Moroccan staff "be recruited and trained rapidly enough to effectively decrease CDER's dependence on the technical assistance contractor staff well before the end of the project" (PP amendment p. 22).

As the project evolved, long-term academic training was curtailed considerably for two reasons. According to RTI's communication with the evaluation team, the CDER director indicated a desire to focus training on CDER's new recruits who possessed academic training but little practical experience. Moreover RTI states "that a good pool of trained engineers exists in Morocco but that specialization in renewable energy related subjects is necessary" (RTI communication, p. 6). Accordingly, the emphasis shifted from academic to technical training.

The evaluation team cannot support this shift wholeheartedly. While it may be true that a considerable pool of academically trained engineers and physical scientists exists in Morocco, the team has seen no evidence of similar competence in systems analysis and economic fields. Rather than shifting away from long-term academic training to short-term technical training, the nature of academic training should have been modified. The tool kit of the CDER engineers should have been

complemented with academic long-term training in economics, systems analysis and operations research. Without such training they will have great difficulty to ever evaluate renewable energy systems as a whole, and undertake the necessary cost/benefit calculations. The evaluation team feels very strongly that an opportunity for transferring this particular type of human capital, which is generally not available outside of the U.S., is slipping away.

In the area of short-term training, the total number of person-months provided through June 30, 1985 has been 32.7 person-months (personal communication, Al Himy). When the English language training at the American Language Center in Marrakech is deducted (19.2 person-months), the project has provided 13.5 person-months (pm) of technical training of which 6.3 pm was in Morocco, 4.2 pm in the U.S. and 3 pm in France and Switzerland. This is less than one-fifth of the 80 pm stipulated in the PP ammendment.

Although RTI states in its 1984 Annual Report that "the recruitment of four engineers.... will allow an active (overseas technical) training program in 1985" (p. 5), at the time of the team's visit in September, no additional overseas training was underway. In fact it appears that each year CDER and RTI start out with the best intentions of carrying out the training component of the project, but somehow fall behind over the course of the year. According to the budget figures provided by RTI the proportion of budgeted training expenses actually spent during the first three years of the project were 19 percent (82/83), 11 percent (83/84), and 34 percent (84/85). By the end of FY 84/85 just about 20 percent of budgeted training Dollars had been spent, a figure in line with the small number of person-months of training undertaken (see above).

In defense of CDER and its contractors, RTI and A.T. Kearney, it must be pointed out that CDER's inability to offer competitive salaries, which made hiring competent staff most difficult, was an important contributing factor to the lack of progress of the training component. In the very beginning CDER didn't even have any staff of its own that could have been trained. Thus, it is understandable that the training component has been lagging in the first years of this project. It is most important, however, that this lost ground be made up, now that CDER does have a good and competent staff that could profit considerably from training at an American University.

To the degree possible the evaluation team reviewed the RTI prepared educational material used in short course-type technical training in Morocco during the visits of RTI short-term advisors. It was not possible to validate the usefulness of the training courses provided in third countries (France and Switzerland). However, at least one of the third country training programs for a CDER biomass section engineer concerned design and assembly of a scrubbing device for removing hydrogen sulfide (which constitutes approximately 2 percent of evolved gas) from biogas. The evaluation team questions the importance of such an approach within CDER's biogas research program. Gas scrubbing is not a near-term priority for small or medium scale digestors planned for rural agricultural areas.

The short course materials provided by RTI and its short-term advisors was judged to be of varying quality. In general, the analytic content ranged from good to excellent, while the practical "hands-on" engineering approach designed to instruct in system sizing and installation ranged from poor to good. Of highest quality were the wind and micro-hydro course materials. The biogas materials were oriented to an understanding of biomethanation fundamentals but did not include guidance on construction, dissemination, monitoring, or economics of such systems in developing countries. These topics are well documented in available literature and could prove helpful to CDER's biogas program. The photovoltaic, solar thermal and bioclimatic architectural materials were of considerably poorer quality.

Prospects for the Future

The CDER Strategic Plan (April, 1984), the CDER Organizational Structure Description Purpose (July, 1984), and the CDER Organizational Structure Job Descriptions (April, 1985) lay out an ambitious staffing structure and recruitment plan. However, CDER at present is still understaffed relative to its organizational objectives. In particular, the Programming/Planning Division, which has the responsibility for conducting economic, financial and market assessment studies for renewable energy applications and for carrying out promotion and dissemination activities, is severely understaffed and CDER's current recruitment plan (Strategic Plan, pp 12-13) will barely make a dent in this problem. The Planning Division Staff is scheduled to be increased to less than 20 percent of its eventual total by 1987 while, the staff of CDER's technical division is slated for expansion to 64 percent of its eventual total by 1987.

Implicit in these numbers is a vision of CDER as a heavily technologically oriented institution. All these engineers are needed to carry out the technical work on current and planned pilot projects. The evaluation team feels that CDER should de-emphasize the pilot projects and instead develop its Programming/Planning Division further. The work planned for the Programming/Planning Division, especially if its staff can draw on the technical and engineering expertise that seems to be currently developing at CDER, will have a more direct impact on renewable energy development in Morocco than the continued pilot project work of the engineering staff alone.

Also lacking from CDER's staffing plans is a concept of seniority distribution of the staff to be hired. A well balanced staffing plan would take into account that junior staff need more senior people to advise them and to support them. 2/ The new strategic plan simply defines a number of slots that have to be filled with bodies.

2/ The USAID advisors try to fill that role to some extent but since they have no line responsibility, they are always somewhat on the outside of the CDER structure.

In order to staff up adequately, CDER needs a staffing plan that characterizes the kind of people to be hired. Rather than being overly concerned with labels such as "energy planner" etc., CDER should consider what kind of experience they are looking for in their staff. Has the individual been conducting or directing research? Has he or she experience in implementing projects? In working with other disciplines?

It may, of course, be difficult or even impossible to find exactly the right kind of people in Morocco. This is where USAID may have to rethink the role of its advisors somewhat. In the near term it may be unavoidable that they do partially fulfill staff functions, even though this runs counter to USAID policy. The role of the RTI resident engineer, for example, could be characterized as that of technical director. USAID should insist, however, that CDER find a counterpart who, within a reasonable time frame, is able to grow into this role. The last evaluation team already pointed out the dangers that the absence of such a counterpart poses. They state:"...the absence of technical managers at CDER may create a dependence by the CDER staff on Mr. Fabre, by default, that if not rectified soon (by mid-1984) could complicate the RTI phase-out process."

C. CDER Facilities and Equipment

CDER's development as an institution was tied at the outset of this project to completion of its own headquarters. The project paper envisioned that CDER's building would be completed by late 1983 (pg. 6). In fact, a variety of problems delayed the building's construction with consequent effects on USAID's commitment to equip the completed building under the present project.

At the time of the evaluation team's visit to Marrakech general site preparations, consistent with building construction, were underway. The team met with the architect and reviewed the building's design drawings with him at the site. The contractor selected has good references and perhaps most importantly CDER has the funds in its own account with which to pay for the building's construction. The estimated construction time was stated as one to two years.

In the Pro-Ag Amendment 5, USAID estimated that 18 months would be required for building construction, and estimated completion by July 1, 1986. Given that only general site preparation activities were underway by late September and a cornerstone ceremony was held in October, it is unreasonable to assume that the new CDER building will be completed any earlier than April of 1987, seven months after the present PACD, September 30, 1986. Using a more reasonable construction time estimate of 29 months this could be as late as October of 1987, 13 months after the present PACD.

Since transfer/installation of laboratory equipment was to occur no sooner than four months before building construction was complete, the Pro-Ag Amendment 5 date of June 1986 for installation of all equipment in CDER's new lab facilities will also be exceeded. Given the construction completion estimates presented above, equipment installation cannot occur before December 1986, three months after the current PACD and maybe as late as June 1987, nine months after the present PACD.

The delay in construction of CDER's building has created a ripple effect which in turn affects RTI's procurement of equipment, oversight of its proper installation during the project, and USAID's decisions concerning project extension and programing. However, as far as the technical achievements of the project are concerned, we do not feel that the delay in completion of CDER's building has caused undue damage.

The serious administrative issues raised by the delays in CDER's building construction on issues such as equipment procurement and project extension will be discussed further in the conclusions and recommendations section. These issues are particularly important since USAID has always envisioned the technical assistance contractor as having an important role in ensuring that the USAID purchased equipment is properly installed and functioning and that long-term maintenance requirements are provided for. This is clearly no longer possible within the time remaining until the original PACD.

The team felt strongly that the project had originated with an unrealistically broad "wish list" approach to CDER's equipment needs, a strategy further complicated by CDER's lack of defined direction and its initial interest in covering all renewable technology areas. Since the C.T. Main report was the original source for much of this equipment list the present contractor RTI/A.T. Kearney should not be faulted for carrying out its contract which appended the original list by reference. RTI/A.T. Kearney has in fact made revisions to the list that appear appropriate. The team feels that it is difficult or impossible to evaluate CDER's equipment needs and the equipment procured or planned for procurement by the project to date without reference to what CDER does as an institution. As the team is recommending elsewhere in this report the need for a refocussing of CDER's objectives and work plans, it is imperative that CDER's equipment needs be re-evaluated at the same time, to include equipment already ordered but to which RTI has not yet committed actual funds. The fact that the CDER building has been delayed in construction makes the process of equipment re-evaluation possible and the Mission should take the opportunity provided to carefully review its options concerning the project's emphasis on equipping laboratory facilities by CDER within the present project. The team is not in a position to evaluate the space requirements in the new building for CDER staff and equipment since only general plans were available and in light of what has previously been said about the impact of changes in CDER's mission and work plans on space needs. The present CDER quarters, though cramped and crowded, are being well-utilized and do not appear to be a significant factor in CDER's performance to date. The team does feel that some of CDER's present activities have already served their purpose and should be dismantled. This applies particularly to the solar oven near Rabat (Station Temara) from which staff should be reassigned to Marrakech

The utilization by CDER of the facilities of other institutions for "temporary" installation of lab and other equipment appears to be successful. The lack of available facilities has stimulated creative responses on the part of CDER. The cooperative use agreements should be reinforced and not terminated when CDER's building is completed. This cooperative approach encourages CDER to accept the reality that it cannot and should not do everything in renewable energy research or demonstration. The equipment

has value as a training tool and in some cases (i.e., solar insolation measurement) is not necessary or crucial to the other activities of CDER.

CDER appears to exercise adequate control over equipment installed and the security of their installation also appears sound. However, the team detected damage to several pieces of the installed solar measurement lab as well as poorly installed wiring and plug connections. There was also evidence of inadequate maintenance on some equipment (i.e., insufficient lubrication on moving parts).

The Solar Collector test bench was installed but had not been actually utilized to test available solar collectors. It seems to be well designed and carefully thought out. This facility will eventually be very important if CDER adopts an aggressive solar water heating program with an emphasis on certification and upgrading of locally manufactured units. It will probably prove to be the most valuable equipment owned by CDER.

D. CDER Program and Strategic Plan

Over the first few years of its existence, CDER has initiated and pursued a multitude of activities. With hindsight it may be difficult to justify all of them on economic grounds. However, they have helped CDER to draw attention to the potential of renewable energy sources and generate some public interest.

However, the time has come for CDER to start focusing its activities better. After the initial flurry of projects that CDER carried out or participated in, some hard decisions and choices will have to be made. It is time for CDER to move on in its institutional development and to become a leader in Morocco's renewable energy development.

CDER's Strategic Plan, dated April 1984, fails to lay out a viable strategy for this transition. It is an overambitious "wish list" of activities CDER would like to undertake, but lacks a firm foundation in a realistic assessment of Morocco's needs and CDER's abilities.

Its top down approach, deriving tasks to be undertaken by working backwards from the broad CDER objectives, gives the document an appearance of coherence. But a cursory review of the roughly thirty tasks outlined makes it clear that even with a full complement of staff, CDER could not possibly hope to carry out more than a few. Such a document tends to raise unrealistic expectations and sets up CDER for criticism when realism sets in and activities have to be curtailed. There is no institute anywhere that has such a broad mandate as CDER seems to accept in this Strategic Plan.

The new five-year plan for the period staring 1986 also promises an entire list of new activities that CDER will undertake, including "at least two new large pilot projects within the next three years." Even with a full complement of staff, and not allowing any further time for training, it is simply impossible to carry out all the proposed activities. Furthermore it appears that CDER is planning a geographic expansion through the creation of regional centers as well, which risks diluting the scarce manpower resources even further.

The official CDER objectives are too broad to be very useful in defining a coherent and sensible program for CDER. Rather than enumerating all the many tasks and activities that could be justified under CDER's broad mandate, the designers of the Strategic Plan and of the new multi-year plan should have asked themselves: What is it that Morocco needs and that CDER can provide in the field of renewable energy? This should have lead to the realization that Morocco does not need everything, and that CDER cannot provide everything.

For example: The evaluation team feels that there is little justification for CDER to undertake further detailed solar resource assessments throughout Morocco. This is true for both photovoltaics and solar thermal, but for different reasons. It is already known that photovoltaic pumping, for example, has potential for Morocco only in very limited circumstances. 3/ This realization is unlikely to be reversed by more detailed radiation data. Solar thermal however, does represent a viable technology that potentially has a large market in Morocco. However, the bottom line of solar thermal installations is determined by the total amount of heat supplied throughout the year, although small fluctuations can affect the outcome slightly. Therefore, whereas sophisticated and detailed data are necessary for PV systems to determine the amount of useable energy that can be obtained, rather simple instrumentation that gives the daily insolation on the horizontal surface sites is quite sufficient to map the solar thermal potential and make realistic engineering estimates of the economic viability of solar thermal systems. It follows that purchase of sophisticated equipment to collect spectro data, and a mobile laboratory with expensive equipment for solar mapping are unnecessary. Moreover, Morocco has a capable meteorological service that for years has been collecting weather data. Modeling possibilities using these available data and additional data from a few select sites are available and are sufficient to map the role of solar thermal resources for Morocco.

3/ As a rule of thumb, photovoltaic water pumping is almost certainly uneconomic in areas where the wellhead exceeds 50 meters, and/or the demand for water exceeds 50 cubic meters a day. These constraints define a very narrow envelope that covers only a modest proportion of Morocco's present needs. Even if the costs of solar cells should drop drastically, or new technologies such as thin film, amorphous silicone or other should become available, the overall reduction in costs will only be moderate. The actual solar cells represent only about 50 percent of total systems cost, and all the other components are already mass produced and unlikely to fall much in price. Thus even if solar cells were free, a solar system would not be competitive with a diesel pump of comparable power, as the PV system is currently more than twice as expensive even under the best assumptions (For cost estimates see CDER/RTI, "The Economics of Renewable Energy in Developing Countries," June 1985, Appendix Tables.)

However, in order to assess the potential of Morocco's wind resources it is necessary to have detailed records of the wind fluctuations that occur at the site over a reasonable period of time. Average wind velocities do not give a fair picture of the power factor that can be achieved and of the total amount of energy that a given wind turbine will deliver throughout the year. Thus a more detailed wind resource assessment in the few areas that show promise will be considerably more valuable to Morocco than detailed solar radiation data.

Another area where CDER can make valuable contributions is in the analysis of energy policy, particularly fiscal and price policy. 4/ It is the team's opinion that the principal barriers to the dissemination of renewable energy technologies in Morocco are not technological or even sociological. They are rather the result of an economic policy environment that heavily favors the traditional sources of energy.

This fact is recognized throughout Morocco. The newspaper "La Vie Economique" in an August 16 article called for a removal of all import duties on solar water heating equipment. Currently these duties amount to 60 percent basic import duty and a total fiscal burden of about 90 percent if the numerous additional taxes and fees are included. The same article also called on CDER to seize the initiative on this issue. This should not be interpreted to mean that CDER has been inactive in this area. CDER, in cooperation with SOCOCHARBO, has been arguing for a policy change in this area for quite some time. However, as a young and small institution CDER has very little political clout, and must, in any case, first establish its credibility by performing and publishing credible analyses of renewable energy policy issues.

But CDER's planned Division II, which should be conducting the necessary analyses to support the ongoing policy debate in that area has only one position planned for an economist. At present the entire division is staffed only with one recently graduated junior economist. Furthermore, this same division will also be responsible for interactions with the private sector, commercialization activities, and public information services. What the economist has done in fact, so far, is write chapters of the five year plan and of the annual report.

4/ The USAID supported "Cellule de Planification" in the Ministry of Energy and Mines should actually be taking the lead on energy planning and policy issues. However, it has a very small staff, and to be able to carry out its mission it will have to rely on inputs from other agencies such as CDER.

There are other areas where CDER could make very valuable contributions to the development of renewable energy in Morocco. CDER should strengthen its contacts with similar institutions in other North African and Mediterranean countries, in order to serve as a conduit for information and technology that has been proven in similar settings. CDER should expand its capacity to collect, analyze and distribute renewable energy information (names of manufaturers, experience in Morocco, etc.) and make it available to Moroccan businesses and the government. The small projects fund gives CDER the ability to back its advice to Moroccan entrepreneurs with an infusion of funds. CDER should continue supporting renewable energy programs in universities through loans of equipment, and possibly even by sponsoring thesis work by promising graduate students. In selecting among all these activities, the primary criterion should always be: How valuable is the output thus produced to Morocco? The evaluation team feels, that not very many pilot projects would pass such a test, and that some current CDER activities, such as for example the solar oven at Temara, would have to be curtailed or abandoned.

Finally, the evaluation team feels that a geographic expansion of CDER is currently not justified. The center is just about at the verge of assembling a critical mass of professionals. Setting up regional centers, staffed with some of these professionals, risks to dilute these scarce human resources unduly.

E. Technical Assistance

The Project Paper and the contract scope of work provide the basis for technical assistance activities by RTI and its subcontractors. The Project Paper indicates that resident and short-term advisors provided by RTI should assist the Director of CDER "to plan the structure, staffing, research capability, and administrative management for CDER; formulate a five year renewable energy research and development program, including sub-project activities, methodologies, timetables and budget estimates; and formulate and carry out professional training programs" (p. 22). The RTI contract includes the following items: "(1) provide long- and short-term assistance for technical and institutional development, (2) formulate and manage academic and technical training programs, and (3) provide assistance in procuring equipment for CDER facilities and demonstration projects." (p. 45).

A careful review of the technical proposal reveals that the actual experience of this team in the area of renewable energy in LDCs is rather narrow. The actual in house experience of RTI was concentrated primarily in academic areas of new high tech energy technologies in the U.S. For this project RTI had to rely to an undue amount on outside consultants, and has thus not been successful in asserting the necessary academic leadership and quality control.

It would have been desirable if RTI/A.T. Kearney had been able t provide a somewhat broader vision to CDER. While strictly within the scop of the project as designed they carried out their work in a satisfactor manner, they seemed to be unable to provide to CDER the necessary leadershi with respect to the broader concerns related to renewable energy developmen in Morocco. Similarly it would have been incumbent upon RTI to instill i the CDER staff, through example and advice, a sense of professiona workmanship in the preparation of CDER/RTI reports. The team's detaile review of technical reports prepared as part of this contract reveale important omissions or poor quality work in several of these documents (see Section III.H). At the very least the RTI home office should have insiste on having some of its top flight professional staff working in Nort Carolina review the reports and comment on their quality. Without such pee review the quality of professional work tends to decline very rapidly.

The quality of the advice provided by short-term consultants is difficult to judge. The evaluation team has only met a few of them. But based on the reports produced as well as a review of the CVs it appears to have been rather uneven. Furthermore it seems that some consultants, who in the evaluation team's opinion provided valuable inputs, were used only sparingly, while others, less qualified and less capable were repeatedly active. The choice of consultants is of course greatly affected by control decisions made by the CDER Directorate who ultimately must approve all consultant travel under the contract. More careful review of the work provided by the consultants would give a bette basis to the CDER directorate for making these decisions.

F. First Round Pilot Projects

In the first round there are six 0159 Pilot Projects: a 10 kilowatt wind generator at Sidi Boulanouar, a 7 kilowatt photovoltaic system in Agadir Province, a 3.6 kilowatt photovoltaic system at the school of Mines in Marrakech, two 5 kilowatt wind generators in Naima-Oujda Province, a micro-hydro system with 200 kilowatt capacity in Tabant, and a biogas digestor on a private farm in Ghouiba. In addition, CDER has also been cooperating with the Peace Corps and other institutions on a solar thermal hot water system at the School for the Blind in Marrakech. A brief discussion of the different pilot projects and their current status is provided in Appendix C.

All of the pilot projects mentioned above are appropriate in terms of illustrating the potential of a renewable energy technology for applications in the country. They are by and large isolated prototype projects and utilize U.S. technology, U.S. engineering, U.S. procurement methods, and U.S. technical thinking. There appears to have been fairly little local involvement, primarily due to the USAID decision to purchase the pilot projects as pre-packaged from American manufacturers (see PP ammendment approval cable). Thus even the supports for the solar panels at CRAFA were imported, rather than locally produced.

A noteable exception is the Ghouiba bio digestor, which was not only locally produced in its entirety, but also locally financed by the owner of the farm where it was constructed. It has enabled the CDER engineers to gather some experience in the construction and running of a bio-gas digestor. They have, with apparent success, been able to transfer some of this experience to the ORMVA's, particularly in Agadir province, where an increasing number of farmers, with technical advice from the ORMVA people, who in turn are backed up by CDER engineers, are constructing digestors of their own. The CDER engineers are also discussing the construction of industrial size digestors with some agro-industries. In many ways, the Ghouiba digestor has been a very successful pilot project.

The potential for replication of the remaining pilot projects, however, seems rather slim. According to ONE, the costs per KW of electricity produced by micro-hydro installations are considerably larger than the comparative costs of connection to the grid in virtually all of Morocco. It also seems most unlikely that PV systems will be cost competitive in any except the highest priority uses in remote areas (e.g., solar refrigerators for dispensaries). The potential for wind power is probably much more in the area of mechanical pumping rather than electricity generation. It thus seems unlikely that the first round pilot projects provide much lasting benefits beyond the technology demonstration.

Originally, the pilot projects had been intended to provide training opportunities for CDER staff. That this idea was abandoned is a major design flaw of this project. It is only partially being corrected by the redesign of the School of Mines pilot project in the wake of the first evaluation.

The numerous delays in the procurement of the pilot project equipment have hampered the project somewhat. Only two pilot projects have so far proceeded all the way to procurement (Sidi Boulanouar and CRAFA), and the contract for the School of Mines PV system has been signed. In all cases the delays on USAID's side have far exceeded those on CDER/RTI's side. While CDER has on average taken less than a month to evaluate the proposals and transmit its recommendations to USAID, about one year has elapsed between CDER's initial report to USAID and the release of the RFP. The evaluation team feels, however, that given similar delays in CDER's recruitment, the damage caused by these delays has been less than expected. With adequate monitoring, the pilot projects may still provide useful information.

G. Second Round Pilot Projects

CDER/RTI have prepared a set of criteria for the selection of second round pilot projects for detailed studies. These criteria are spelled out in CDER/RTI reports number R-45 and R-56. The evaluation team finds the selection criteria appropriate for a large variety of projects. However, if they are to be applied to true pilot projects, i.e., projects whose primary purpose is to generate information, or to technical and economic feasibility, or to train local engineers, the selection criteria will need to be augmented by a rating system that takes this into account. Pilot projects are a very costly method of obtaining information, for example, and the value of the information that can be gained ought to enter into the selection criteria.

At the time of this evaluation, there are not yet any second round pilot projects that have been submitted to USAID for funding approval. In fact, only one second round pilot project has been approved for detailed studies: The use of refuse derived fuel (RDF) in industrial applications. One such proposed application has been the use of RDF to replace some of the coal used by the ASMAR cement plant in Marrakech. The evaluation team has reviewed the relevant project documents and has talked to the technical director of the ASMAR cement plant, which according to the information provided to the team by the sub-contractor primarily responsible for this project, was willing to invest its own funds in the production and use of RDF in its cement plant.

In rough outline, municipal garbage collected in the city of Marrakech would, after some sorting and drying, be compressed into pellets that could be used as industrial fuel. The economic value of such RDF depends primarily on its calorific content, and the degree to which it can be burnt without any major additional investments in the facility using it. To answer the first question, a careful analysis of the composition of the refuse, as well as it availability is needed. The answer to the second question is user specific. Technical problems in the production of RDF are minimal.

To date there has only been one rather limited analysis of the composition of household refuse in Marrakech. On the basis of the description of the procedures used on the part of the CDER staff and the Peace Corps volunteers participating in the analysis, the evaluation team has serious doubt about the statistical validity of the results. None of the reports give any indication as to the observed variance in

the samples, and the large seasonal variation in the composition of household refuse is completely ignored.

It also appears, that a careful analysis of the collected data does not support the conclusion that RDF (on the basis of household refuse from the city of Marrakech) is an economically justified proposition. According to the report of the American consultant (Luis F. Diaz, James W. Fesperman, and Abdelmoula Nayssa, Feasibility of Producing RDF from Municipal Solid Waste in Marrakech, Cal Recovery Systems, July 1985), the project shows a positive rate of return for net benefits only if a ten year system life with at least 80 percent capacity utilization and no further fall in world oil prices is assumed. But even these optimistic assumptions are not enough if a shadow price for foreign exchange in excess of ten percent, a conservative estimate given Morocco's current economic condition, is assumed.

Currently, municipal waste in Marrakech is being transformed into compost. Unfortunately, the composting facilities are old, and are subject to frequent breakdowns. This is the primary reason why the composting plants cannot even cover their operating costs, and why RDF production appears so much more advantageous. However, if one compares the proposed new RDF plant at 80 percent capacity utilization to a similar new composting plant also operating at 80 percent capacity utilization, the composting plant appears much more economical, even at the low compost price of 25 DH/ton.

The second question, the suitability of RDF in cement production, has also not been investigated in a satisfactory manner. In order to convince ASMAR that RDF could be used in cement production, the A.T. Kearney sub-contractor arranged for a trip by ASMAR's technical director to a cement production facility in Great Britain that uses RDF in its production process. The trip convinced ASMAR that its own facilities were not suitable for using RDF. The primary problem is a missmatch in production technology. ASMAR uses a dry process, while the only cement plant in the world currently using RDF uses a wet process. According to ASMAR's Technical Director he explicitly raised this question with the USAID sub-contractor prior to the trip, but never received a satisfactory answer. The team was informed that as of that trip, ASMAR was no longer interested in pursuing such a pilot project further.

The subcontractor has suggested that the next step is to import a sample of U.S.-made RDF for testing in the ASMAR production process. Such a pilot or test run would be of limited value for two reasons: First, the composition of American RDF is certainly different from RDF derived from household refuse in Marrakech. As the above mentioned consultant report notes, the refuse collectors in Marrakech remove paper, the primary source of heating value in American garbage, from the refuse they collect and sell it separately to paper factories. Accordingly, RDF produced on the basis of Marrakech municipal waste has certainly a lower heating value than American made RDF. Second, the primary technical concern for the manager of the ASMAR cement plant is related to the likely clogging of filters due to the high concentration of non-combustible residues in RDF. This clogging builds up over a number of months, and uncertainty on this point could only be removed with a prolonged (at least one year) test. ASMAR considers such a

test too risky a proposition as it might require repeated shutdowns of their productions, entailing high additional costs.

All in all, the evaluation team has come to the conclusion that this second round project has so far been prepared in an extremely sloppy manner. Besides the above mentioned consultant report, the team has also analyzed three CDER/RTI/A.T. Kearney reports: "Study of Options to Treat Municipal Solid Waste in Morocco" (July 1984), "Preliminary Pilot Project Proposal" (December 1984), and "An Industrial Action Program for Renewable Energy Development" (June 1985). The numbers presented in these reports are poorly supported. Assumptions are intermingled with hypotheses and empirical findings. No sources are listed. The December 1984 document contains only one citation, and it is a misquote. It states that "municipal garbage in Marrakech is 85% organic" and gives the July 1984 report as a source. The July 1984 report in fact makes no such claim. It only states, without reference, that "solid waste constitutes up to 85% combustibles."

The slim evidence that has been presented does certainly not support the contention that producing RDF in Marrakech is an economic proposition, the generally optimistic tone of the report by Cal Recovery Systems (op. cit.) notwithstanding. The evaluation team fears that the positive conclusions of this report are not supported by the numbers contained in the same report. This is not to say that there may not be some potential for RDF in Morocco. SOCOCHARBO appears to be sufficiently interested to pursue this project somewhat further for the time being. However, the evaluation team's discussion with SOCOCHARBO's Technical Director clearly indicated that much more technical information needs to be provided before any field trials and/or pilot projects can be considered. 5/ USAID should stay in contact with SOCOCHARBO and follow their technical advice.

5/ It must also be kept in mind that the burning of refuse had been tried in Casablanca, and that the plant had to be shut down, primarily for enviromental reasons. The Moroccans are thus understandably skeptical.

H. CDER/RTI Publications

CDER, with the support of the American technical advisors has produced about 70 reports during the past three years. The evaluation team has studied about 20 of the more significant of these CDER/RTI reports. With some notable exceptions we found them to fall short of accepted professional standards.

The major shortcomings, repeated in virtually all reports are:

- o No citations or bibliographies;
- o No distinction made between assumptions and empirical findings; and
- o The analysis is not transparent.

In general, the engineering oriented reports are better than average. Some of them, especially those concerned with wind energy and biogas are quite good. However, the economic analyses are uniformly bad, a fact that may be explained by the lack of qualified economists from the technical assistance team.

Some of the reports have been reviewed elsewhere in this evaluation report: the Strategic Plan and the associated documents in Section III.C. and the reports concerned with the second round pilot project in the preceeding section (III.F.). In the remainder of this section we will review very briefly a few more documents that seem crucial to us and that are representative of the type of work carried out.

The Role of Renewable Energy in Meeting National Energy Needs (March 1984)

This report attempts to develop priorities for renewable energy applications in Morocco. It is essentially based on an analysis of market shares for energy use by sector. Its most serious shortcoming is ignoring basic economic concepts such as income and prices which determine energy demand. Without an economic paradigm the study remains a sterile exercise in gapology (i.e., the postulating of absolute "requirements" and "availabilities" to determine "gaps" that must be filled). It falls short of the "demand study" promised elsewhere in the project documents, which is doubly unfortunate, given that an interesting first draft in the form of a trip report by A. McWilliams exists. This first draft, though rough and unpolished in parts, contains more useful information and better analysis than the final product.

The Economics of Renewable Energy in Developing Countries (June 1985)

Despite its title this paper has little to do with economics. It is instead a collection of different cost estimates largely based on engineering estimates. As such it contains much data that could be useful, if properly documented. Unfortunately no sources are given, which makes interpreting the often considerable ranges impossible. All in all, however, this is one of the better and potentially more useful reports.

Contributing To the National Energy Balance: Strategy For Renewable Energy Production 1986 - 1995 (October 1984)

This is probably one of the worst documents that the evaluation team has seen. It is full of unsupported statements and hypotheses presented as facts. Analysis and reflection seems to be totally absent. This is the kind of document that is ultimately most damaging to CDER in that it raises all sorts of unjustified expectations.

Ghouiba Digestor First Year Evaluation

In general, this report is very good. Although no mention of it is made, the monitoring report appears to conform to the measurement standards for biometraration systems developed at the 1984 workshop in Thailand co-sponsored by USAID and FAO. This will facilitate ready comparison of CDER's biogas digestors to those operating in other developing countries. This may also help CDER to pinpoint operational problems more quickly. The report is a reasonable, scientific anaylsis. Confidence levels are provided for all measurement techniques and most data discrepancies are explained. An exception which bears on the report's discussion of low gas production rates over the first year of generation is the number of livestock from which manure is collected. On page 3 a total of 14 to 18 head are mentioned while on page 26 only 8 cattle are listed. While the report is sound as a monitoring document, the reader is left with no clear idea of how CDER is planning to deal with the issues raised in the discussion on page 27. Many of these are important from the standpoint of CDER's biogas program both in terms of providing research-guiding questions but also in terms of promoting commericialization and dissemination efforts. From conversation with RTI staff we understand that CDER was largely responsible for data gathering and prepering this report.

Wind Energy in Morocco: A Preliminary Analysis Based on Existing Wind Data (Wind Atlas)

This report, which was examined as a draft, is an excellent document. It principally presents an analysis of data collected by the Direction de la Meteorologic Nationale (DMN) at 17 representative weather stations throughout Morocco. Using an explicitly defined methodology in which all data weaknesses are clearly acknowledged, the authors provide a detailed analysis of selected wind data to help inform and guide those interested in wind energy system sizing. The report properly acknowledges the earlier contributions to understanding Morocco's wind regime made by the Battelle Pacific Northwest Labs in 1983 as part of A Plan for Solar and Wind Energy Resource Assessment in Morocco prepared for AID, CDER and MEM. It also acknowledges the limitations of this work and provides a useful analysis using available data in the absence of the additional supplementary wind measurement program recommended by Battelle. And eventually to be undertaken by CDER using equipment supplied by USAID. Realistic information

is also provided for helping to select properly sized wind energy systems and to evaluate wind machines for particular functions. Despite its strengths and considerable utility to those interested in better understanding the wind resources in Morocco, the report does not provide sources for all data or references. The conclusions present a clear sense of where CDER is with respect to wind resource assessment and how it proposes to proceed in the future. It should be stressed that the goal of all future measurement programs undertaken by CDER should provide sufficient data to estimate wind power factors and to estimate the yearly average output for various sized wind energy installations.

In addition to the published reports the evaluation team has also obtained drafts of two reports currently being produced by CDER staff. One concerns a pre-feasibility study for the installation of solar hot water heaters at BEFRA, an Air Force training base in Marrakech. This study offers evidence of the technical capabilities of the CDER staff. The technical design of the system does seem unnecessarily cumbersome though. There seeems little justification to use a closed system in Marrakech, and the materials (square tubing) and techniques (riveting) proposed are no longer used in most countries. A simple thermo syphon in an open system, using standard tubing and welded construction would almost certainly be less costly and more energy efficient. No foreign consultants are listed among the authors, so that we can assume that the CDER engineers did indeed have the major part in the production of this report. The other study reports the findings of some laboratory trials on the anaerobic fermentation of cow manure. The results are well documented and presented rather nicely with the help of Lotus graphs. In more ways than one this report is superior to some of the published documents prepared by the foreign consultants.

I. Small Projects Fund

The Project Paper pointed out the Small Projects Fund could be used, "to engage the interest and energy of a broad range of individuals and organizations, both private and public, in renewable energy development activities. This leverage will be particulary essential in view of the modest size of CDER's staff." (p. 26). The Project Paper envisioned the award of small grants administered by CDER under USAID guidance for, "development of small pilot projects, innovative approaches, applied research, production and market studies and diffusion of information on renewable energy methods and practices" (p. 26).

The grants were to be awarded, "based on economic, financial and technical feasibility" and projects should yield results which: "can be replicated in Morocco and are responsive to Moroccan economic and social needs; can increase the utilization of a renewable energy resource; hold the potential for being further developed and spread by the private sector" (p. 26) The projects were also to have a favorable cost/benefit ratio and employ a level of technology feasible in Morocco.

The evaluation team agrees with the project's designers that the Small Projects Fund (SPF) 6/ is an important tool available to CDER in advancing renewable energy development in Morocco and is also the first externally oriented funding component of the USAID project which CDER exerts major control over. To date no grants have been made through SPF, although an administrative structure to support the SPF has been developed by CDER and approved by USAID (in PIL No. 25 dated July 26, 1984). This despite the fact that the Mission Director in the PIL states, "we hope to begin making disbursements from the fund before the end of the year."

CDER/RTI submitted it proposal for the administration and operation of the SPF to USAID in July, 1983. [Small Projects Fund (Private Sector), June, 1983]. USAID review revealed several important issues which were unresolved including: waiver of USAID procurement regulation, acceptability of a flat grant approach, appropriateness of selection criteria, degree of beneficiary focus on Moroccan citizens, and adequacy of fund administration procedures (D. Tsitsos August 9, 1983 memo). USAID subsequently requested revisions by CDER which were completed in March, 1984. USAID subsequently approved the changes and issued the PIL in July, 1984.

USAID subsequently was informed by CDER in November, 1984, that it had requested the Ministry of Finance to open a separate account as required by the PIL. However, the bank account was not approved by the Finance Ministry until May, 1985, and not officially opened until July, 1985. Nevertheless, the SPF's selection committee, consisting of CDER, MEM, RTI, and USAID representatives has met several times and as early as November, 1984, considered possible solicitations for analysis of municipal solid wastes for RDF and solar water heaters in hotels.

The Small Project Fund as presently constructed is a complex financial mechanism which has been designed to accomplish several purposes. While the administration of the SPF appears reasonably well thought out, in the absence of actual operating experience the evaluation team has no firm basis upon which to judge it adequacy. We feel that USAID has incorporated significant safeguards into the management of the funds to prevent abuse, however, much of the direction of the Fund's activities as well as some responsibility for selection of grant recipients ultimately rests with CDER and to a lesser extent its technical assistance contractors, RTI and A.T. Kearney. The SPF may prove to be a useful vehicle for promoting private sector involvement in renewable energy development in Morocco or it may become

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6/ Fonds des Petits Projects (FPP) in French.

an instrument neglected because Moroccan entrepreneurs consider its administrative requirements excessive. 7/ The real viability of the SPF will not be known for several years.

RTI and CDER are now moving forward rapidly to begin disbursement of the SPF and the utilization of the $345,000 USAID contribution to the fund. The initial activities planned for the Fund are presently as follows: (1) solar collectors for hotels; (2) direct combustion of agricultural or food processing by-products; (3) application of solar thermal systems in agriculture (crop drying, greenhouses, etc.); (4) small farm biogas digestors (10m3) and (5) repair program for multiblade mechanical windmill water pumps. All of these activities seem to be quite appropriate and employ technologies that hold promise in Morocco.

The evaluation team is concerned that administration of SPF places a new demand upon CDER's limited staff resources. At the present time there is no qualified general project manager who can simultaneously monitor and administer SPF solicitations. While CDER is well-equipped to handle the financial accounting and fiscal control of the Fund, the general and technical management question it will present are not currently acccunted for in CDER's organizational structure.

Until the Fund is in operation and proposals are received and grants made, it is premature to judge CDER's ability to adequately manage additional SPF funds or such issues as the effectiveness of SPF publicity or monitoring of grant effectiveness. Ultimately, the success or failure of the Fund will be self-evident although the evaluation team would encourage USAID to pay close attention to such issues as matching grant contributions and selection criteria which will vary from SPF activity to activity.

7/ The evaluation team feels that the response by USAID to the first evaluation team's recommendations regarding excessive administrative burdens has been adequate, and that no further loosening of the requirements should be necessary, even though some potential recipient might still consider them too stringent to warrant their involvement in the SPF.

IV. PROJECT IMPLEMENTATION

A. Government of Morocco

Morocco faces very serious budget constraints. A persistent drought combined with escalating interest rates has squeezed the Moroccan economy from all sides. Government budgets had to be slashed drastically (up to 40 percent) over the last few years. In spite of all these difficulties, CDER has survived and today has both operating and investment budgets.

The evaluation team interprets this as a good sign of the Moroccan commitment to renewable energy in general and to this project in particular. The serious implementation difficulties which hampered the project in its early phases seem to have been resolved. According to information provided by CDER and substantiated by the Ministry of Finance, CDER has even been able to obtain its operating and investment funds in advance of commitments made to vendors.

As a result CDER has funds in its own accounts to pay the builder for the building construction, which leads one to believe that the building construction may indeed proceed without further unreasonable delays. The problems with delays in the construction of CDER's headquarters, which were one of the major problems early in the project, thus seem to have been resolved as well.

The new personnel policy, which will enable CDER to pay salaries above the rates paid to civil servants, has been signed by the Minister of Energy and Mines and the Minister of Finance and can thus become operational.

At the point of this evaluation it must be recognized that the Government of Morocco has fulfilled its commitment under the terms of the Pro-Ag, albeit with some delays. These delays probably have not seriously hampered the implementation of the project. Given the project design, CDER's apparent preferences, and the kind of technical assistance provided to CDER, it is quite likely that had more resources been available earlier, they would not have been spent in the most effective manner.

B. CDER Management

The CDER management has played a key role in the implementation of this project. Through the mechanism of a host country contract, the Director of CDER as contract officer, has had more influence on how this project was carried out than any other individual. It will be primarily up to him to implement the changes proposed in this evaluation.

In part forced by external circumstances, particularly the delays in the construction of the CDER headquarters, CDER has had to make some decisions, which with hindsight have to be commended. The evaluation team thinks here especially of the cooperation agreements that CDER has

struck with the various institutions of higher education in Marrakech. It is likely that through these cooperation agreements, the USAID provided equipment is finding a better use than was initially intended. It is providing students with opportunities to gain experience in the use of such equipment and may raise their awareness of renewable energies.

The lab equipment was originally not intended as teaching equipment, but was rather claimed to be necessary for resource assessments. The evaluation team does not share the belief, expressed in the Project Paper, as well as by CDER management and staff, that the current knowledge about Morocco's resource base is insufficient to allow informed decisions to be made in the renewable energy area. The marginal benefit of more detailed information about the solar resource base, which can be gathered with this equipment, is probably quite small compared to the training benefits it provides.

What CDER management has not provided to the project so far, or possibly not been able to provide for political reasons, is the clear definition of priorities and goals which are to be achieved. The absence of a clearly defined plan, which is binding on all parties concerned, including the CDER management, has been a serious drawback to this project.

The evaluation team has become keenly aware of the difficulties faced by the contractors in planning and carrying out their activities due to the uncertainty surrounding the availability of CDER staff. The team was told that only one CDER engineer had been available for the installation of the CRAFA PV pilot project due to the fact that a French sponsored PV project was scheduled for installation at the same time. CDER management asked RTI to restrict overseas training courses for CDER staff to one month, because permissions for longer durations could not be obtained from the Prime Minister's office. Nevertheless, over the same time period CDER staff attended longer term training courses abroad sponsored by other donors. Activities that the evaluation team considers important, such as the diesel study, have taken an unduly long time.

All of this reflects the fact that CDER management has on occasions set its priorities differently from USAID's and RTI's. This is understandable. One must not underestimate the difficulties that a new young institution like CDER must face while trying to establish itself. The political benefits of scattering a multitude of pilot projects in various locations and sponsored by a variety of sponsors must not be underestimated. One must also understand the desire by CDER to achieve, quickly, a high degree of familiarity with all sorts of renewable energy technologies.

The argument that CDER cannot write off any technologies a priori or fail to undertake any activities that might be useful has some validity in the early phases of institutional development. But this

dragnet approach to renewable energy development can take CDER only part of the way. After a period of time, CDER has to start making decisions of where to invest its efforts and resources.

The evaluation team feels that this time has come. It is time for CDER management to redirect the project and to focus CDER's activities. A first step in this direction would be the design of a reasonable and well constructed plan for the remainder of the project. As outlined in Section III.C, this plan must answer the key questions: (1) What is it that CDER is going to produce, or what questions is it going to answer? (2) Why is this product or this answer important for Morocco? and (3) How will CDER carry this out?

Another important component that CDER must provide to the project is its professional staff. CDER engineers must be available to work closely, and over long periods of time, in cooperation with the RTI consultants. As part of this effort it is most urgent that CDER provide a counterpart for the RTI resident engineer. This counterpart should be senior enough to be able to grow into the position of technical director, and will be responsible for setting the conditions under which the CDER staff can carry out its work in accordance with generally recognized priorities. Without such a person, much of RTI's contribution will be wasted.

We do not deny that not all decisions that CDER will have to take will be popular with all constituencies. But we have every confidence that the CDER leadership has the willingness and the ability to make the hard choices.

C. RTI/A.T. Kearney

1. Contractor's Management Activities

One of the most important issues in the implementation of this project is the effectiveness with which RTI/A.T.Kearney and CDER managed the technical assistance resources available under this contract. From a review of project documents it is clear that great importance was attached to management by both CDER and RTI.

According to the MEM RFP and the RTI proposal, the technical assistance contractor was to help in the establishment of CDER's work program and to manage and report on its technical assistance inputs through quarterly management reports, PERT charts, and other management tools. Unfortunately, such a system was not completely implemented to the extent one might have hoped for on the basis of the RFP and the proposal. The quarterly management reports do provide some information, but it is difficult to deduce from them which aspects of the project were delayed, and what the reasons for the delays are. Given the numerous scheduling changes, it might not have been possible to construct the PERT charts that the RFP and the proposal specifically asked for. But the problems that caused particularly the training component to lag should nevertheless have been more thoroughly documented.

This makes it difficult to fairly and completely evaluate the performance of RTI/A.T. Kearney and their various consultants. Through various discussions the evaluation team has become aware of the fact that RTI/A.T. Kearney have had to face some considerable difficulties in the implementation of this project. But possibly due to USAID's somewhat formalistic approach to this project, which tended to focus heavily on schedules and deadlines in the early phases of this project, almost to the exclusion of project content, may have made CDER and its contractors reluctant to emphasize the problems that the project was facing. The project was unable to meet the overambitious schedule of construction and training and therefore was placed on USAID's alert list. A somewhat more cooperative approach, such as has characterized USAID's more recent dealings with CDER and its contractors, might have been somewhat more conducive to soliciting candor on CDER and RTI/A.T. Kearney's part.

A second important area of managerial control concerns project budgets. To its credit RTI has done an excellent job of documenting its budgetary expenditures under the project to date. An analysis of the expenses incurred, relative to the amounts budgeted, reveals that RTI/A.T. Kearney have been able to keep essentially all project components within budget, and that only the equipment and training budgets have consistently been lagging (see Appendix E). The reasons for underspending on these two categories are discussed elsewhere in this report. In recent years expenditures on short-term consultants has also begun falling behind schedule. This is doubly unfortunate in that CDER, now finally staffed, should be in a good position to use the consultant's services.

An alternative way of considering the project budget is to compare expenditures in the U.S. to those in Morocco. The first evaluation report (Sheladia, 1983) pointed out the need for breaking out the amount of project resources spent in North Carolina separately from those spent in Morocco. It does appear to this evaluation team, that the North Carolina portion is rather large. Much of the planned home office support was originally justified with greater administrative responsibility which RTI had to accept in connection with: "technical assistance, on-the-job and academic training, procurement of laboratory equipment, specification installation of over 24 pilot projects,... and design management assistance for the Small Projects Fund." (Oct. 1, 1982 NE/TECH memo to AA/NE in connection with LOP funding increase by $2.5 million). However the equipment and training component have been lagging in this project, and the small projects fund is only just about to become operational. The workload on the home office for these administrative activities should thus have been less than anticipated.

What may have increased the workload on the home office staff was the need for RTI to produce substantial portions of CDER/RTI reports in North Carolina. However, in recent months CDER's technical staff has begun taking an increasing level of responsibility for technical work. RTI's resident advisor estimated that approximately 80 percent of

current work plans are completed directly by CDER staff. 1/ This is in sharp contrast to the early stages of the project when RTI staff prepared a disproportionate percentage of CDER technical work. This shift is consistent and bodes well for an orderly phase-out of contractor technical assistance.

According to the RTI/A.T. Kearney resident advisor plans for an orderly phase out of the technical assistance support to CDER are under preparation. They will be addressed in the proposed contract year IV budget, should USAID decide not to extend the contract past the present PACD.

2. Long-Term Technical Advisors

The long-term technical advisors present the principal input by the technical assistance contractor to this project. They have been working on this project for almost three years now, and the evaluation team does not underestimate the difficulty of the conditions under which they have been forced to operate at times. They have adapted fairly well to a supervisory situation within CDER that has sometimes been contradictory. In addition to their internal reporting relationships and managerial responsibilities to RTI, the two resident advisors are also expected to be totally responsive to the CDER directorate. To complicate relationships further, the CDER Director General, as contract officer of the host country contract, also has the responsibility of monitoring the RTI/A.T. Kearney contract overall, and is, in turn, again responsible to USAID. This diffusion of responsibilities, and occasional differences in the interpretation of what could be expected of the contractors under this contract, has not facilitated the resident advisor's job.

In spite of such difficulties, which made it very difficult for the resident advisors to adopt positions different from CDER management's, the evaluation team feels that the resident advisors have provided much useful input into the project within the framework set out by the project design. However, if the long-term advisor team had had somewhat more experience in management, finance and systems analysis, they might of their own accord have raised some concerns regarding the heavy physical science emphasis of CDER's work. As it stands, the long-term advisors did augment, rather than complement the qualifications of the CDER staff and may have been partially responsible for the heavily technology driven approach that was persued. With hindsight one has to

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1/ Nevertheless, the evaluation team could justify home office expenditures on the production of CDER/RTI reports if they were used for professional review and quality control which so far seems to be absent from many of these publications (see Section III.H).

recognize that the project as designed failed to anticipate the importance of non-technology factors in the spread of renewable energy technologies.

What the long-term advisors also have been unable to provide is a system of quality assurance with regards to CDER/RTI work products. The problems with the quality of the published reports are discussed elsewhere in this report (see Section III.H). It is the opinion of the evaluation team, that the long-term advisors ought to have had primary responsibility for instilling a minimal degree of professionalism into the work carried out at CDER.

3. Short-Term Advisors

RTI is a first rate research institution with an excellent reputation. Although its specific experience in renewable energy in LDC's might be considered somewhat thin, it cannot be denied that RTI's institutional competence qualifies them for this contract. Many individuals working at RTI are at the top of their respective professions. RTI won the award of this contract largely on the demonstrated strength and professional competence of its staff.

It is most unfortunate that this staff wound up working less on the project than might have been hoped for. Instead of using its own staff, RTI hired numerous outside consultants. The quality of inputs provided by these short-term advisors has been of widely varying quality. Unfortunately, it is difficult to relate the work carried out under the different task orders to specific work products in every case. The evaluation team's assessment of the quality of the inputs provided by the short-term advisors is therefore based largely on inferences drawn from a study of CDER/RTI reports, trip reports and personal discussions. The evaluation team also carefully reviewed the resumes of most of the short-term consultants employed by RTI.

It is most unfortunate that not even with the short-term consultants RTI/A.T. Kearney attempted to correct the heavy physical science bias of CDER. It would have been useful if some of the short-term advisors had been capable of transferring systems analysis or operations research skills to the CDER staff. What has been provided in the area of economics, finance and management on the part of the short-term advisors is sadly deficient.

In contrast many of the short-term consultants in technical areas appear to have been quite good. As pointed out elswhere, many of the technology oriented CDER/RTI reports are interesting and potentially useful. It also appears to have borne fruit. According to the long-term technical assistants the CDER staff are assuming ever larger shares in the writing of the joint reports, especially those that have a clear technical orientation.

D. USAID

By agreeing to a host country contract, USAID effectively tied its hands. USAID's influence on the project was largely confined to administrative issues (administrative approvals, schedules, budgets etc). As a result, USAID/OTP's inputs in the early phases of the project stressed formal questions such as deadlines and number of people sent to training, which was not always beneficial to project content.

The administrative implementation problems and delays which concerned USAID/OTP during the early phases have in the evaluation teams opinion not been very detrimental to the project's achievement of the overall sector goal. Given that in its early years CDER did not have a good sense of its mission, it is unclear what would have been achieved with a more timely project implementation. In fact it might have been advantageous if spending on the TA component of the project had been slowed down as well.

Over the duration of the project, USAID/OTP's approach underwent somewhat of a change and reduced what the evaluation team considers to have been an undue emphasis on implementation details. 2/ The inputs forth-coming from that office in the recent past have helped frame important issues that arose, especially regarding the Small Project Fund, contract amendments and other administrative issues.

On purely technical issues USAID/OTP pursued essentially a hands-off approach. With hindsight it might have been advantageous if USAID had taken a somewhat more detailed interest in the project's technical issues, where some guidance from outside CDER or RTI was needed. To what extent it was USAID/OTP's responsibility to provide this guidance and how any such influence could have been brought to bear under a host country contract, is unclear. A clearer assignment of responsibility and less ambiguous role definition would have been desirable.

E. Prospects for the Future

According to the law establishing CDER (law 26-80 concerning the Center for the Development of Renewable Energy, 23 July, 1981) CDER is charged with carrying out studies, specifying procedures and equipment, demonstrating the technical, economic and social benefits of renewable energy, and assuring the technical training of specialized staff. As a guide for defining the role CDER should actually play, this list is

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2/ A contributing factor in this reorientation may have been the realization that USAID's delays in procurement were at least as responsible in slowing down the project as CDER's staffing difficulties.

too broad to be useful. CDER management, in cooperation with MEM and the various donors, has to define a mission for the center that will have to be much narrower and much more specific.

Appendix F gives an overview of different types of renewable energy institutions that might be relevant to CDER, and lists the principal outputs that each of them could produce. This listing should not be understood as being exclusive, i.e. that one type of institution cannot undertake activities that are more the province of other institutions. However, it must be realized that such diversification may seriously hamper the main activities that the institution is trying to carry out.

What type of institution CDER should become will ultimately have to be a Moroccan decision. This evaluation team can only provide suggestions on the basis of experience observed in other countries, and taking into account the strengths and weaknesses of CDER as they became apparent during this evaluation mission. It must also be kept in mind that CDER's role has changed and will have to continue changing over time. The following observations are therefore time specific in that they take into account the current status of CDER.

Rather than stating which of the 9 models listed in the Appendix are best suited to Morocco, it might be easier to first exclude some that seem to be unsuited. In the evaluation teams opinion, there is little utility in CDER aiming to become a basic research institution along the lines of the Solar Research Institute (SERI) in the United States. Basic research is extremely expensive, in terms of qualified manpower and equipment, and any pay-off is far in the future. Furthermore, there is only limited demand, worldwide, for such basic research institutions. Their output, in terms of scientific papers and journals, is generally available in the public domain. Nothing can be gained by replicating the scientific effort.

For different reasons it appears unlikely that CDER could play a very effective role as an extension agency. There are rather effective institutions conducting extension type work in Morocco (ORMVAs). Having CDER involved in actual extension work would introduce an unnecessary parallelism. However, CDER should continue working with the ORMVAs, and if possible expand this cooperation, so that the extension agencies can foster the introduction of renewable energy technologies in the rural areas.

CDER is currently considering the possibility of entering in joint ventures by taking equity stakes in renewable energy projects undertaken by the private sector. The evaluation team is not convinced that such joint ventures are indeed a viable option where CDER can realize an adequate rate of return. For example, it is unclear why any bank would lend funds to CDER for a project, rather than lending to the private company directly. Any reasonable banker would probably prefer to make some project loans to a private company, which has some collateral, rather then extending what amounts to an unsecured loan to an institution, whose only collateral is an equity stake in the same project. The risks to the bank in the second case are much larger.

Morocco also has an impressive educational system. Little could be gained if CDER became actively involved in educational activities. The need for training in renewable energy technology is better handled by the various universities. CDER's input into this through those cooperative agreements is excellent and should be continued. It might be expanded along the lines of providing some support to interested graduate students through research assistantships within some CDER projects and sponsoring selected research projects by university faculty.

This leaves essentially five institutional models into which CDER could attempt to develop. Of these, the consulting services model must probably be considered to still be somewhat premature. CDER should of course be ready to provide informed advice on renewable energies to both the Moroccan Government and its parastatal institutions, as well as the private sector. However, CDER has not quite the staff yet to make this one of its main activities.

If CDER's primary role was to collect and disseminate information and to promote renewable energies through the media, its locational choice outside of the main industrial and commercial centers of Rabat and Casablanca would have to be considered a disadvantage. Repositories of information should be close to the potential users, and the largest energy users, and thus the best prospects for bringing about major savings through the use of renewable energy are mostly located in the Rabat/Casablanca area. However, other reasons justify the locational choice, and it does not imply that CDER should not aim to undertake information collection/dissemination and promotion activities. 3/

The technology testing and adaptation model should probably form the focus of CDER's activities. With the installation of the solar thermal testbench, the center has made great strides in this direction. CDER should use this equipment, along with its engineering capabilities, to assist local manufaturers in the adaptation of this well known technology. The efforts that are currently underway to develop a suitable burner for biogas go in the same direction.

However, it is the opinion of the evaluation team, that the major barriers to the introduction of renewable energy technologies in Morocco are not technological, but economic and political. For that reason the team strongly urges CDER to develop its economics and policy analysis capabilities. CDER has already entered in the policy debate concerning the import duties on imported solar equipment by joining SOCOCHARBO in

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3/ The evaluation team feels, though, that these activities should not go at the expense of the professional staff. If CDER, in order to reach a wider audience, decides to open a number of regional centers, they should be staffed by lower level employees. It is essential that CDER concentrate its precious engineering resources in one location.

its initiatives at the Ministry of Finance. But to be able to do this with credibility and effectiveness, CDER will have to be able to support its position with studies and convincing analyses. CDER should, for example, be able to quantify the amount of foreign exchange that could be saved, through reductions in oil imports, if the import duties on imported solar thermal equipment were lifted.

Note that none of these recommended institutional models require much in the way of additional pilot projects. The evaluation team feels that additional pilot projects would not be in the interest of CDER's institutional development. They would rather distract CDER staff. Especially if the needs to install pilot projects cuts into technical and academic training for CDER staff, they could be counterproductive. Furthermore, the demands for technical follow-on and information collection from the pilot projects might put a serious strain on CDER's resources. It would be preferable if CDER continued to carefully monitor the existing pilot projects, rather than taking on new responsibilities.

V. CONCLUSIONS AND RECOMMENDATIONS

It is in the nature of an evaluation that more space is devoted to those aspects of the project that the evaluation team finds disagreement with. This evaluation is no exception. A cursory review of this evaluation report might convey the mistaken impression that the project is fatally flawed. That conclusion, however, is not warranted. The evaluation team is of the opinion that there are many elements in this project that can provide the basis for further fruitful cooperation between USAID and CDER.

It is necessary, however, to be blunt and unambiguous. The project ought to be redirected and better focused. At present the scope of activities pursued by CDER and partially supported by this project is very broad. At the same time, the vision guiding this project appears to have been very narrowly confined to technological questions. This relationship needs to be reversed. The project must encourage CDER to narrow down the scope of its activities to concentrate on a few promising technologies, and at the same time broaden its approach to consider financial, economic, and sociological problems along with technological questions.

In the early phases of institutional development the dragnet approach to renewable energy technologies in Morocco, within which CDER pursued all sorts of activities related to renewable energy technology, may have had some justification in that it kept momentum going and provided some visibility for the young center. The resulting proliferation of activities has been unnecessary, but not very seriously damaging. The time has come, however, to start making the hard decisions and to use the experience gained in the early phases of the project, combined with what has been learned worldwide, to move on to the operational phase of renewable energy development. CDER cannot forever continue to be preoccupied by installing pilot projects of marginal merit and very limited replicability, or it will risk losing the goodwill of its backers.

For example it is, by now, clear to any unbiased observer that solar ovens and dual axis tracking parabolic mirrors will not provide a viable solution to the energy problem. They will not even contribute in any real sense to a solution. If CDER continues to devote a significant fraction of its resources to maintaining these kinds of installations, they will compromise other, more promising CDER activities. Even the PV installation at CRAFA may wind up only confirming that the promise of this technology, if it exists at all, still lies far in the future.

In fairness to CDER one has to point out that the Center's affinity for pilot projects has been fostered and reinforced by the design of the USAID project. The emphasis on technological gadgetry, which was introduced in phase I of this project, has been detrimental to the project's overall purpose of transferring human capital and building an institution able to spearhead the development of renewable energy sources in Morocco. There is relatively little time left in the project within which a reorientation can take place that will enable CDER to become a strong and viable force for renewable energy development in

Morocco. Without such a reorientation CDER risks becoming little more than a custodian for donated pilot projects.

In the remainder of this section we give specific recommendations concerning the three principal partners in this project, CDER, RTI/A.T. Kearney, and USAID. As will be obvious, many of the recommendations, if implemented, will require the cooperation of all parties concerned.

A. USAID

USAID will soon have to decide whether and how this project should be extended, or whether it should be terminated as scheduled at the planned PACD. If USAID decides against extending the project it will have to decide whether the equipment should be turned over to CDER, even though the building for housing it will almost certainly not be ready yet. An intermediate option would be an extension only to allow the transfer of the equipment as planned upon completion of the building, but phasing out the technical assistance as planned at the current PACD.

If the project, or at least the technical assistance component of the project, expires as planned at the current PACD, a possible follow-on project would almost certainly not be ready yet. The evaluation team feels, however, that there is scope for future cooperation between USAID and CDER, and that a new follow-on project should be given serious consideration. The evaluation team also feels that any new follow-on project ought to contain a strong technical assistance component. Any hiatus between the departure of the current technical assistance team, and the technical assistance provided under a follow-on project could be detrimental to the overall sector goal. Such considerations lead the evaluation team to favor a conditional extension of the current PACD.

But even if no new project is considered, an extension may be indicated. The reorientation that this evaluation calls for will take time to carry out. Specific recommendations of the kinds of activities that should be undertaken by CDER and RTI/A.T. Kearney in the remainder of this project are outlined below.

Extending the PACD may require the addition of new funds to the technical assistance component of the project. It would be ideal if these funds could be transferred from those components of the project that the evaluation team feels ought to be de-emphasized, particulary equipment purchases and pilot projects. Under the mechanics of a host country contract, however, USAID may have only limited influence over equipment purchase decisions, for example.

Any infusion of new funds should be modest, however. It should be essentially confined to assuring continuity in the technical assistance area and enabling the training program to catch up. Any new project should also be designed around these two components: technical assistance and training, especially in those areas that are currently lagging at CDER (i.e., financial analysis, economics, systems analysis, policy analysis).

Specific Recommendations:

1. The PACD Should Be Conditionally Extended.

In order to give CDER and RTI sufficient time to define and implement its strategy along the lines outlined in this report, the PACD should be extended. However, this extension should be clearly linked to a demonstrated willingness of all concerned to concentrate CDER's efforts on the most promising technologies in order to achieve its mission of promoting renewable energy development in Morocco. Specific conditions for this extension ought to include: No new technology projects are undertaken until monitoring and analysis of the current projects is well underway, no regional centers are opened and staffed with CDER engineers, a senior engineer who can grow into the role of technical director is hired as a counterpart to the long-term technical advisor, a training plan for the current CDER staff is developed with clear-cut goals and incentives, a workplan as outlined elsewhere in this evaluation report is developed, and the CDER management agrees to consider this workplan as binding on all parties concerned. The only area where CDER could and should expand is in the social sciences, particularly economics.

2. The Project Should Be More Carefully Monitored.

The ProAg and the contract contain provisions for USAID monitoring of the project. These should be used, as far as possible, to help CDER and RTI/A.T. Kearney to redirect the project and to assert some quality control. USAID should consider the formation of a monitoring committee or a technical advisory board to assist the CDER directorate and advise its board of directors. USAID should also insist on professional reviews of the project documents being produced by CDER and RTI/A.T. Kearney. If necessary, outsiders should be brought in to assist in this task. As far as possible under the current contract, USAID should find ways of effectively communicating its concerns to RTI directly.

3. New Pilot Projects Should Be Reconsidered.

USAID's criteria for approving new pilot projects ought to be reconsidered. Pilot projects should not be evaluated on the basis of the energy they produce, but on the basis of the information they provide, or the training opportunities they afford, or their demonstration effects. It has to be demonstrated, for example, that this information is important, and cannot be obtained in a less costly fashion, or that the economic value of the training and demonstration effects exceeds the project costs. Economic considerations based on the actual energy produced are important only in a prospective or macro sense: Is this technology economically viable for Morocco? and not in a micro sense: Does this project show an adequate rate of return? In practice the two are closely related, of course, but nevertheless should not be confused.

In considering new pilot projects for CDER an additional consideration should be the effect they have on CDER's institutional

development. Even with a noteably larger staff CDER may not have sufficient resources to adequately monitor additional pilot projects without seriously hampering its activities in other, more promising areas.

4. Reconsider Equipment Purchases.

USAID should use its influence to help convince CDER to reconsider its revised equipment lists in light of the new mission CDER defines for itself. The evaluation team feels that some solar spectrum measuring equipment is not necessary and ought to be replaced with other equipment such as possibly additional personal computers. Some equipment in list 3 also seems to have rather inflated price tags ($30,000 for a word processor? $7,000 for a micro computer?). The recently revised equipment list needs further revision.

5. Emphasize The Importance Of Training.

The importance of training for CDER staff cannot be overemphasized. However, the focus of the training should also reflect the same reorientation recommended for all aspects of the project. The disciplines in which training, including long-term academic training ought to be offered are primarily business, operations research, economics, and systems analysis. These fields are best developed in the United States, and for that reason no more waivers for third country training should be granted, except in cases where CDER staff have opportunites to visit and learn from the experience of other developing countries with viable renewable energy programs (e.g., Jordan, Cyprus). Short courses might offer the quickest impacts, however no one on the current list of RTI/A.T. Kearney consultants seems qualified to offer instruction in the relevant fields.

6. Plan A More Focused Follow-On Project.

Plans for a follow-on project should be made around two components: technical assistanc and training. The disciplines emphasized in either component should be economics, systems analysis, and policy analysis. Additional technical and engineering training and assistance should be provided as needed, but should not be the primary purpose of the project. As CDER will ultimately profit most from unbiased and uninhibited advice, it is in the Center's interest to have the new project under a mission direct contract, rather than a host country contract. To assist the mission in providing the necessary technical guidance, the formation of a professional advisory panel, including Moroccan representatives, ought to be considered.

B. CDER

This institution has come a long way since its inception three years ago. It has made considerable progress in its staffing and seems poised today to take on an important role in renewable energy development. From what the evaluation team could determine, CDER has the moral support of the relevant ministries (Energy and Mines, and

Finance), as well as the necessary material support in the form of operating and equipment budgets.

CDER must not squander this backing. The ministries may not have very clearly defined ideas of what they expect from CDER, but they certainly do have expectations. Sooner or later CDER will have to be able to show more than just isolated pilot projects for its efforts.

Specific Recommendations:

1. CDER Must Define Its Mission.

CDER must develop a goal oriented plan for its activities. The plan documents that the evaluation team has seen are deficient. What needs to be stated clearly in CDER's plans is (a) What is CDER going to produce (e.g., what question is CDER's research going to answer)?, (b) Why is this product important for Morocco?, and (c) How will CDER go about producing it? General statements such as "conducting research to gain more knowledge" are not sufficient.

This redefinition of CDER's mission will almost certainly involve de-emphasizing some current activities. The evaluation team feels, for example, that the highly detailed solar resource measurement is at best of marginal benefit to Morocco. Activities where CDER ought to increase its activities are in the area of biogas, mechanical wind machines, and solar thermal applications. Examples of the types of activities that should be undertaken in these areas are given in Section IV.6.

2. CDER Must Strengthen Its Analytical Capabilities.

In cooperation with USAID and the USAID contractors CDER must find ways of introducing analytical thinking among its staff. This can be achieved only by providing additional training in fundamentals of economics and systems analysis to CDER's current staff, and/or hire additional professionals to complement the current cadre of engineers. The additional staff that CDER needs ought to be recruited from the fields of systems analysis, economics, finance, etc.

Currently CDER reports tend to emphasize the engineering and physical science aspects of renewable energy technology. A typical report would, for example, describe the functioning of a solar flat plate collector. A systems approach would also include financial and economic, as well as social considerations. The end product would be reports that analyze how Morocco can be better off with renewable energy technology. For example CDER should be in a position to analyze and evaluate the foreign exchange costs of the current import duties on solar hot water heaters.

3. CDER Must Concentrate Its Efforts And Resources.

In the physical science area, CDER is on the verge of achieving a critical mass of young scientists, who are quite capable. If this group is augmented by a senior person, who will be responsible for creating a nurturing environment where these young people can work, they are

certainly capable of producing acceptable output. This group does not need any further additions of junior "engineers" and must be kept together, not scattered. Under no circumstances should CDER consider regional centers staffed by CDER engineers. On the contrary, the one outpost in Temara should be withdrawn.

4. Continue Cooperating With Universities.

CDER's cooperative agreements with the different institutions of higher education are among the most valuable activities that have been undertaken. These accords should be continued and possibly even expanded. It is necessary, though, to specify what each partner will contribute, and which outputs are to be expected. Both CDER and the universities should develop options for expanding the current cooperation, by undertaking joint research projects and supporting selected graduate students through research assistance type of arrangements, for example. CDER should also act as the focal point to coordinate the universities inputs into the national research agenda to assure adequate official support for renewable energy research.

5. Assign Responsibilities To Individuals.

Currently responsibility for individual projects within CDER is very diffuse which results in ultimately no one being really responsible. CDER should restructure its organization along project lines, to allow for project centered accountability. For example, one specific individual ought to be responsible for maintenance and follow-up on the solar hot water heaters at the school for the blind. This means that this individual would also be responsible for getting them cleaned (which is most urgently needed). Along with responsibility go authority and resources of course. The new organizational structure for CDER currently being designed by IMEG, a Moroccan management consulting firm, should be carefully examined to ascertain that this recommendation can be implemented.

6. CDER Must Provide Counterparts For The Long-Term Advisors.

If CDER is unable to provide at least one full-time counterpart for the long-term advisors, much of their effort will have been in vain. One very urgent staffing decision that will have to be made concerns the position of a senior engineer as counterpart to the RTI engineering consultant. This individual will have to assume a middle management position between the current group of junior engineers and the CDER management. He will be primarily responsible for creating the work environment in which the engineers can carry out their tasks.

C. RTI/A.T. Kearney

The technical assistance contractors for phase two of this project were faced with a set of choices that had largely been predetermined during phase one. The fateful decision to accord the pilot projects such large importance was an outcome of the heavy engineering emphasis

apparent in all the phase one work. To the contractor's credit they have succeeded in correcting some of the excesses and scale back most of the pilot projects.

Where they have been less successful is in directing CDER towards a more focused approach. To what extent they tried but were stymied by CDER's own interests is difficult to ascertain. Given the host country contract mechanism, RTI/A.T. Kearney had to be sensitive to CDER's specific wishes, even if that involved a proliferation of activities that the consultants, on their own, would not have undertaken. With hindsight it appears that a somewhat more assertive approach by the technical assistance advisors might, in the long run, have yielded better results.

In the technical areas the work undertaken by the consultants has been of varying quality. The engineering aspects of some technologies, such as wind and micro-hydro, for example, are treated in various CDER/RTI reports in a very competent fashion. In the solar area the work was generally of considerably lower quality. But even if all of RTI/A.T. Kearney's engineering and technical work was beyond reproach, it would be of limited use in promoting the development of renewable energy technologies in Morocco. The barriers to the spread of renewable energy sources are not exclusively, possibly not even primarily, of a technological nature. A systems analysis approach, that identifies all those barriers and recommends ways of removing them, seems to be indicated.

The evaluation team deplores the lack of systems analysis and economics competence among the short-term consultants. Not a single fully trained economist is among them, and the published reports are without exception weak in this area. Regardless of whether the project terminates as planned or whether the PACD is extended, the contractors should undertake immediate steps to remedy this shortcoming.

Specific Recommendations:

1. Keep The Current Long-Term Asssistance Team In Place.

Possibly by inclination and training, and possibly on direction of the contract officer, the long-term technical assistance team has adopted CDER's relatively narrow technological focus. It has thus augmented, rather than complemented CDER staff and has been unable to assert the necessary leadership in the area of renewable energy policy and policy analysis. But none of these concerns warrant undergoing the major disruptions which a change of long-term advisors would entail, especially in view of the fact, that the long-term technical assistance team has also been successful in establishing a good working relationship with CDER management and staff and has kept the project largely on track.

2. Shift The Emphasis On Short-Term Advisors Towards Analytical Skills.

For the remainder of the project, the short-term advisors should be primarily drawn from economic and systems analysis disciplines. Their primary role is thus to complement the long-term advisors and assist CDER in its reorientation.

3. Improve Quality Control Over CDER/RTI/A.T. Kearney Work Products.

The only way of improving the quality of the different CDER/RTI/A.T. Kearney work products is through professional peer review. RTI should make full use of the institute's renowned professional staff in North Carolina for this purpose. RTI's professional reputation risks being tarnished if some of its consultants and subcontractors should produce work of less than professional quality. The services and consulting advice provided have two impacts which are both key to the successful development of CDER. The first impact relates to the particular subject and the quality of the analysis and advice. The second impact involves training and the transfer of skills through example and interaction with CDER staff. It is therefore very important to assure that the consulting services and reports be of high quality.

4. Change The Focus Of Training.

The focus of short- and long-term training should also be shifted in the same direction. As the kinds of skills that CDER needs are more difficult to obtain in Europe than in the United States, the evaluation team feels that English training should be vigorously pursued, and that waivers for third country training be discontinued.

All in all these recommendations track quite closely what was recommended for CDER. CDER and the consultants will have to cooperate very closely to achieve the needed re-orientation of this project.

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APPENDIX B
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Appendix C
CASE HISTORIES OF SELECTED PILOT PROJECTS

This appendix provides brief descriptions of three of the first round pilot projects undertaken, the CRAFA - Taroudant PV pump, the Tabant Micro Hydro installation, and Naima - Oujda wind project. These three pilot projects were chosen as illustrations of some of the concerns this team has with the pilot project approach. The evaluation team did not have an opportunity to study the Sidi Boulanouar wind project or the School of mines PV project in any detail. The Ghouiba digestor, though cited as a pilot project by CDER and RTI did not involve the USAID pilot project fund. The team's positive assessment of this pilot project is given in the main body of the report.

CRAFA - Taroudant PV Pilot Project

The CRAFA project was originally selected as a first round pilot project as part of the C.T. Main studies in 1980-1981. The C.T. Main report states in October 1980 that CRAFA "is a good site for a solar water pumping project" (pp. 4.0 - 4.3). It was designed as a 15 kw pv system and 8.4 hp electric pump and 1,000 amp/hr. battery system to pump water from 2 irrigation wells with total heads between 50 and 60 meters, to service 5 hectare agricultural experiments involving gravity, sprinkler and drip-irrigation projects at CRAFA, a school and experimental demonstration farm for training agricultural extension workers in modern agricultural techniques operated by the Souss-Massa ORMVA.

The typical family farm in the area at which CRAFA's improved agricultural techniques were aimed, includes a 10 person household and a 5 hectare irrigated plot with an annual gross income from farming of DH10-15,000. The water supply for on-farm irrigation is generally received from government canal systems by paying a fixed yet subsidized charge. Farmers use gravity, diesel pumps or an occasional electric pump to lift the water to their fields. Pumping costs had been rising for farmers due to diesel price increases and farmers pumping water from wells were faced with dropping aquifers. In the region the water table was dropping at rates ranging from 1 m. up to 15 m. per year. The province was being forced to close wells which had dropped more than 100 m. and as a result pumping from wells had been forbidden in large areas of the province.

PV water pumping had been examined by CRAFA as early as 1976 but was abandoned as economically unjustified because an average 4-5 kw PV-pumpset package was estimated to cost DH 100,000. In reviewing the proposed CRAFA pilot project the authors of the project paper stated in October 1981 that it was, unlikely that farmers could or should be persuaded to make the $200,000 investment in the C.T. Main recommended array" (pp. 54). The authors concluded, "if a 15 kw solar PV pumping system is beyond the reach of small and medium scale producers and uneconomic even for large scale producers it would seem to be an inappropriate application for PV technology, and <u>should not be considered for a pilot project</u>" (emphasis added). The authors added that, "smaller-scale applications of PV have much greater potential for economic use, and <u>the powering of low-lift portable pumps is one of these</u>."

Thus, the PP's authors specifically concluded that the Main proposed project was uneconomic and unlikely to ever be adopted by local farmers. They did propose to substitute a pilot project based on PV-powered low-lift portable pumps which would be cheaper and more clearly linked to the needs of local farmers. "Although the cost per installed watt is the same as for larger installations, portable 250-500 watt pumping units costing $6,000 have real applications for extending irrigated areas by raising water from canal to field and from lower fields to higher fields rather than for raising water from the depths of a well. Pumping units of this type have been developed and are in use in the Middle East and Asia (see Annex I8). It is proposed to install 5 of these units at the CRAFA demonstration site and other locations to be selected in areas already under irrigation" (pp. 54 - 55).

Despite the PP's strong statements, the Mission and CDER decided to proceed with the original C.T. Main proposal to provide a "demonstration of the application of solar technology in irrigation pumping." RTI's resident advisors did reduce the size and cost of the project, eliminating the battery storage and downsizing the system from 15 kw. to 7 kw. Whether the decision to proceed with the Main designed project was due to political commitments entered into by CDER or to USAID backing is not clear from the project files. Interviews with RTI staff involved with the project suggest that both USAID and CDER continued to urge that the Main proposed project be adhered to and be implemented as soon as possible.

In a memo from mission economist Jay Smith to Robert Chase, Gary Bricker and Dianne Tsitsos (March 8, 1984), Smith concludes, "the pilot project is clearly uneconomical by a very large margin. Further refinements of economic analysis would not change this conclusion." He reiterates that the purposes of the CRAFA pilot project are: "1) to demonstrate solar energy can be a reliable source of energy for work such as pumping water for irrigation; 2) to carry out this demonstration pilot at a site where it can be observed by farmers and extension workers; 3) to do it where it can be closely (carefully) monitored to gain accurate data on operating a PV pump in Moroccan agriculture. Application is for drip-irrigation for a 2 - 3 hectare orchard producing oranges, almonds and olives. ORMVA personnel at CRAFA will be operating and monitoring the performance of the PV pumping installation."

Smith also discusses the type of monitoring which is needed. "Collection of cost data, is not sufficient." "What is missing is information ... (on the) ... quality of labor input required to operate and maintain the system." "Ultimately, it is less important to know how much the physical equipment costs to purchase, deliver and install than to know how much time ... and direct costs of equipment, spare parts, transport and labor costs [and skill levels] of repairman [are required]." Smith recommended that the pilot project be approved and requested that CDER submit to USAID a detailed monitoring plan incorporating "a full accounting of all dirham, dollar and in-kind services and equipment costs" using a "log book approach."

Mission Director Chase responded to the Smith memo on March 13, 1984 with a note to Smith and Bricker. "How uneconomic must a project be before we turn it down?" The "demonstration argument makes sense to me only if we

have reason to believe similar technologies will be cost-effective in the reasonably near future. Can we say that much?"

Bricker responded to Chase in a memo on March 14, 1984 that, "CDER and RTI are now revising selection criteria for future pilot projects. These criteria will be used to select the remaining pilot projects. They are aware of our desire to see more cost-effective projects. They have assured us that the economic indicators on a number of prospects they are considering are better than the "C.T. Main Collection." Bricker asserts that the next generation of pilot projects will only be approved if they are, "at least ... as cost-effective for their intended use and location (positive net present value, IRR above the discount rate and B/C ratio over 1.0) if projected to begin 5 years later and if full avoided cost principles and shadow pricing are used in comparative economic analysis." He further advises that USAID issue a Project Implementation Letter (PIL) "to advise CDER to emphasize economic criteria in design and monitoring of future projects."

On June 8, 1984 the Mission issued PIL #28 incorporating USAID approval of the CRAFA pilot project. In August of 1984 RFP's were issued in the Commercial Business Daily (CBD) to procure the equipment for the system. A contract was issued to Solar Engineering Services (SES) of Olympia, WA for a package to include:

- 7 kw PV array (190 Solarex SX-120 modules);
- Solarex torque tube support structures for array mounting;
- 6 _____ DC/AC inverters and switch boxes;
- 6 _____ submersible pumps with drop cables;
- grounding wires for lightning protection;
- wiring and hardware for system interconnection;
- spare parts;
- measurement apparatus for monitoring the installed system; and
- installation costs (labor and travel).

The original value of the contract was $99,946 later amended to $119,000.

The equipment was shipped to Morocco in the Spring of 1985 and SES visited Morocco between May 13 - 31, 1985 to perform the system installation. As a result of conditions at the site, the PV array was installed and certified but the submersible pumps were not. This was due to the judgement of SES engineer Tim Ball that sand in the wellwater was likely to rapidly damage the pumps.

The problems with the installation of the CRAFA PV project were the topic of a memo from Tritsos to Mission contracting officer Stan Nevin on June 6, 1985. She relates that prior to the SES team's arrival the Mission was "assured by RTI that civil works undertaken by ORMVA were complete. They based their assurances on a CDER engineer (Bendai). Ball arrived and saw sand in the water and balked due to possible equipment damage to the pumps (shortened life). RTI and CDER agreed to his judgement." Her memo also points out that the reservoir and irrigation system were also not completed. Thus, there was not storage capacity for pumped water even if the well had been properly cased. She adds, "RTI was not aware of this situation."

Due to the installation problems with the encased well and the lack of civil work for a completed pumping system, Tsitsos declined to approve an official project inauguration ceremony turning the site over to the Moroccan government until the problems cited had been resolved. "I did not believe AID would want to be in the position of turning over a completed project which pumped water for which there was no use." The project's inauguration was tentatively re-scheduled for July 10, 1985 and Tsitsos asserted that SES would not be allowed to return to complete the installation until the well had been cased and the reservoir for water storage completed.

Tsitsos also raises a number of serious concerns in her memo regarding the pilot project's institutional framework and the responsibilities assigned to various parties. Regarding CDER's cooperative arrangements with other institutions she concludes that, "the price paid is that there is no one truly in charge. There is no way for CDER to enforce its agreements on others." She adds, "Neither CDER nor ORMVA provided the amount of assistance either in tools or equipment that the RFP indicated and the equipment supplier (SES) expected." She states, "more CDER people were needed ... CDER (was) ... hampered by the coincidence of installation of another PV pilot project (by the French)."

In her opinion, "ORMVA was not nearly as expert as we had been told" and she mentions deficiencies in equipment handling and work with steel pipes and pumps. She also mentions that she had, "assumed much greater RTI involvement in this project than was actually the case in reality. Apart from one visit each to the site during actual work, neither resident participated in the installation." "I had been relying heavily on the assumption of the participation of RTI's engineering expertise in all stages of the project", she adds. "Their contract calls for their providing technical assistance to pilot projects, even though AID is purchasing equipment directly."

At the time of the evaluation team's visit to the pilot project site nearly four months after the initial installation on September 17, 1985, the installation had still not been completed. We also learned that ORMVA was installing electric power at the site in order to run an additional set of electric pumps, unrelated to the well pumping aspect of the PV project, because the total head involved on pumping water from the on-site storage tank to the irrigated plots some ¼ - ½ mile away exceeded the original design's pumping capacity. It is also partly due to the fact that the PV array has not been installed adjacent to the drip irrigation project as originally planned. The two wells at the irrigation site are being presently serviced by diesel pumps installed by ORMVA presumably after it concluded that the PV pilot project would be delayed and unable to pump water at the originally scheduled project completion date.

The net result of this project to date appears to be a relatively mismatched demonstration system where the PV system has been installed at such great distance from the point of use that any possible efficiencies or economies in its installation and operation have been voided. Although the project was scaled back by RTI, the original objectives to the project raised in the PP still stand. The pilot project as presently installed is

not a good model PV system and is unlikely to ever be replicated in Morocco due to its high capital costs and limited applicability.

Tabant (Tabant-n'Ait Imi) Micro-Hydro Pilot Project

In 1977, 45 million kilowatt hours of electricity or 3% of the total electric production from hydro-electric plants, came from small hydro installations in Morocco (page 33 Project Paper). In a study conducted by an AID specialist in 1978, 700 sites were identified in Morocco for small hydro potential of at least 9 months per year operation. A subsequent study in 1979, conducted by ONE, identified twenty sites in the high mountains, where no electric grid is envisioned in the near future, as having potential for small decentralized hydro installations. A C.T. Main team visited ten of the sites in July of 1980, and based upon preliminary engineering analysis, selected three for development in the provinces of Tabant, Msenrir, and Arhbalou. C.T. Main also made some preliminary recommendations for civil engineering and sized the hydro electric turbines.

In a letter dated September 8, 1980, by USAID project officer, Mark Ward to Alan Jacobs of S&T/EY, Mr. Ward expressed concern about the economic viability of the recommendations made by C.T. Main. As a result, a small hydro specialist from the U.S. National Rural Electric Cooperative Association (NRECA) made a field visit to Morocco to evaluate the C.T. Main study in conjunction with ONE The report, published in December 1980 concludes that, the units recommended by C.T. Main were unnecessarily large and extravagant and the recommended smaller units to be used were to be off the shelf power modules with civil engineering installations in lower costs. This reduced the price to approximately one fifth of the projected cost by C.T. Main (p. 40). Although the economics is still not favorable, the pilot units are intended to be a demonstration for a system that could potentially provide 3,300 people with up to 330 kilowatts of power. It is interesting to note that the World Bank's 1983 report on the Moroccan Energy Sector says, "Many small hydro sites exist but even cumulatively they are a minor resource (approximately 50 megawatts).

Following the re-design of the three pilot projects a series of delays ensued. In February 1983, RTI's micro-hydro consultant traveled to Morocco to visit the proposed sites and work with ONE who had primary responsibility for preparation of bid documents for detailed design studies and equipment. During the visit, the advisor recommended that the equipment solicitations be held back until more site data, particularly on flow and topography, were available. Flow observed during one site visit was considerably lower than earlier estimates. It was agreed at that point that ONE would, using its own resources, initiate flow and topographic studies and also proceed with the letting of bids for the detailed design studies. Concurrently, RTI would develop a model RFP package into which detailed site information would be inserted when it became available. ONE, AID, and RTI agreed that the RFP should simply state site characteristics and design performance specifications in order to allow manufacturers flexibility in their responses. This is necessary because of the restricted number of manufacturers in the U.S. and the need to encourage several responses. ONE's independent flow studies later

confirmed that flows at two of the sites (Arhbalou N'kerdouss and Tinkhar Ifni) were considerably lower than the average originally estimated.

In November 1984 the Mission's Associate Director Harvey Petroquin wrote to Mr. Tazi at ONE threatening to cancel all three projects because of a lack of compliance and unexplained delays. Based on the evaluation team's discussions with Mission staff it seems that most of the delays hinged on ONE's lack of funds and thus its inability to complete site engineering and construction of civil works for the three micro-hydro projects as called for in the agreement between USAID and ONE

In a letter to USAID on February 21, 1985 Mr. Sandi of ONE informed the Mission that GOM budget cuts forced the cancellation of two of the three micro-hydro pilot projects. The project that remained, the Tabant project, had the most favorable economics and best flow regime of the three. It was also retained because of its role in providing power to a Ministry of the Interior development project in the area (see CDER/RTI report R-60). The total budget for the project, designed to yield 200 kw. of power, is approximately $500,000 of which $200,000 was to be paid by USAID for two 100 kw. turbines imported from the U.S.

In July of 1985 Mission Director Robert Chase wrote to Mr. Tazi of ONE indicating that ONE had finally met the pre-conditions for USAID funding of its portion of the project and recommending that Mr. Tazi request an extension of the project completion date beyond the PACD in order to allow sufficient time to complete the project installation. ONE later requested an extension to December 30, 1986 which has now been granted by USAID.

At the time of the evaluation team's visit to Morocco in September we learned that ONE has issued an RFP for completion of the civil works (earth-moving and concrete foundation installation) and that USAID has prepared an RFP for the two turbines to be purchased, shipped to Morocco and installed on-site by a U.S. firm. Assuming that there are no major additional delays, it is reasonable to expect the project to be installed and completed in eight months to a year.

One of the key sources of delay and problems associated with this project was the fact that funds for the micro-hydro project were channeled by USAID to ONE through CDER and its budget. CDER has no particular expertise in micro-hydro projects while ONE has considerable experience in this area. The control of the micro-hydro funds by CDER seems to have engendered conflicts with ONE which were detrimental to the completion of the project. It is the recommendation of this evaluation team that CDER take no further responsibility for small hydro activities and rely on ONE for national small hydro activities. It is unclear why the Mission placed ultimate control or authority for small hydro activities in this project with CDER. As late as April of 1985, RTI's short-term small hydro expert John Topile was preparing for CDER a description of a proposed micro-hydro section in CDER assuming that CDER was to take complete responsibility for assessment, installation and management of micro-hydro sites (RTI Task Order #114, April 19, 1985). This project thus appears to have fed unrealistic expectations to CDER about its possible future role in a national micro-hydro program while only incompletely serving to bolster

ONE's existing technical capabilities through providing selective technical assistance in bid document preparation, site studies and system engineering.

Naima-Oujda Pilot Projects

In the originally selected pilot projects prepared by C.T. Main there were to be two projects in the Oujda area in northern Morocco. One was to be a combined wind electric generator/PV hybrid system for water pumping at PK-8 well serving a dispersed human population and sheep. The other was a stand-alone PV water pumping system at Rat Tatani which was subsequently dropped as a pilot project upon re-evaluation by RTI and USAID. In April 1983, RTI's short-term wind energy expert visited the sites to evaluate the Main proposed project at PK-8. Based on this field visit and supplementary wind data received by CDER in July 1983, RTI concluded that the PK-8 project was not viable. The information revealed a severe mismatch between the availability of the wind resource and local demand which would have required a far larger system to satisfy. In view of the high power requirements at the site due to well depth and water flow, other renewable energy systems would be extremely costly. Thus RTI recommended to CDER in September of 1983 that the Oujda PK-8 site no longer be considered for a wind generator pilot project. CDER Director General Fawhaw agreed to the negative findings and asked that a replacement project be found in Oujda province.

In September and October of 1983, RTI wind energy specialist Alan Wyatt recommended a replacement wind energy water pumping project at Naima commune in Oujda province. The project would entail installation of two wind generators to service a regional water distribution system. Water would be pumped from a spring at Ain Tolba to the settlement of Dar Hamra where it would be distributed to the settlements of Hachleff by gravity and Rmilat by pump. The project proposes to equip Ain Tolba with a 5 kw wind generator and Dar Hamra with a 4.5 kw machine. The latter system would also supply a small amount of electricity to a nearby school for lighting, using battery storage.

Economic analyses of the project's life cycle costs indicated that the wind generator at Ain Tolba will cost approximately the same as a diesel while the Dar Hamra system will be slightly more than the diesel alternative. A local operator is available to assure daily maintenance and local staff from the Provincial Agricultural Development Delegation (DPA) who are completely familiar with mechanical wind pumping machines will be trained to operate and maintain the installed systems.

The CDER proposal for the Naima pilot project was submitted to USAID in January 1984 and the Mission did not formally approve it for six months. At that time it was decided that pilot project equipment procurement and installation would occur on an incremental basis with the CRAFA and Sidi Boulanovar (another wind electric generating system pilot project originally selected by C.T. Main and not reviewed here) being completed first, followed by Naima and the School of Mines PV pumping project.

In December of 1984 following issuance of USAID's new renewable energy policies stressing cost-effective projects, the Mission re-evaluated the

Naima project. This led to a decision to drop the battery storage component of the Dar Hamra system. USAID subsequently re-approved the project in mid-June 1985. The evaluation team did not visit this site or obtain any further information on its current status.

APPENDIX D
MINOR POINTS WORTH NOTING

1. The list of task orders provided to the evaluation team by RTI does not cross-reference the work products produced under these task orders. It is thus impossible to verify whether the stated product has indeed been completed satisfactorily.

2. On some tasks, the work effort seem excessive. Some examples:

Task #	Description of Work	Level of Effort
38	Prepare a speech for Mr. Fakihani	3 days
66	Participate in planning for observational visit by Mr. M'Zabi	20 days
100	Prepare a 2-3 page description of major climate forces in Morocco	5 days
105	Prepare promotional newspaper article	5 days

3. On some tasks, work days and calendar days are in conflict. Some examples:

Task # 117	26 workdays in 3 1/2 weeks
Task # 1	124 workdays in 3 months

4. We have carefully reviewed the French language version of the law creating CDER (Decret No. 2.80.504 and Dahir No. 1-81-346). We cannot interpret these as giving CDER authority to raise funds on its own and invest in joint ventures. We have also discussed this question with several individuals knowledgeable about the legal status of Moroccan parastatals. The question seems at least unclear and should be resolved.

5. In our discussion with representatives of the Ministry of Finance and the Ministry of Energy and Mines, we gained the definite impression that these individuals saw only a limited scope for use of renewable energy, in areas away from the national grid. If our impressions are correct, and if the people we contacted indeed represent official GOM positions, they would constitute a not insignificant shift. USAID/Morocco should follow-up on this and such classification if necessary.

Budget Summary
(from Cost Proposal)

Analysis of Estimated Costs -- Reimbursement of Costs
Research Triangle Institute

	Details in Appendix	Months of Work	Cost in Local Currency	Cost in U.S. Dollars	Total Costs (U.S.$)
Salaries of Field Staff	1	108	71,421	149,334	220,755
Off-site Overhead (19%)					41,943
Salaries of Home Office	2	114			288,995
Onsite Overhead (90%)					260,096
Administrative Costs* (OMASE) (10%) on salaries and expenses					368,001
Fixed Fee					237,708
SUBTOTAL					1,417,498
Costs of Subcontract	6	73.5		881,905	881,905
Cost of Consultants	7	15		78,600	78,600
Travel and allowances					
(a) per diem	3			225,128	225,128
(b) travel and allowance in U.S.	3			18,554	18,554
(c) local travel and per diem in Morocco	3		29,254		29,254
Transportation of:					
Baggage	8			8,060	8,060
Personal effects	8			27,313	27,313
Equipment	8			48,300	48,300
Equipment	4			1,949,722	1,949,722
Other Direct Costs					
insurance	5			66,174	66,174
miscellaneous	5		114,969	227,098	342,067
SUBTOTAL			144,223	3,530,904	3,675,127
TOTAL EXPENSES					5,092,625

* The administrative costs for all subcontracts will not exceed $2500 per year.

Analyse des Coûts Encourus
Première année contractuelle
RTI/CDER

Pour la période du 2 octobre 1982
au 1 octobre 1983

Rubriques dans le budget		Année 1	
Postes	Numéro	Coûts totaux encourus ($E.U.)	Budget ($E.U.)
Salaires de Base-Personnel sur le terrain	1	71,195	70,875
Frais Generaux-Personnel sur le terrain	3	13,775	13,466
Salaires de Base-Personnel au siége	4	103,923	101,813
Frais Generaux-Personnel au siége	5a	95,197	91,632
Frais Administratifs	5b	62,727	61,295
Honoraires Fixes	6	48,206	51,902
Coûts de soustraitance ATKearney, Inc.	8	336,692	337,919
Coûts des Consultants	9	48,000	43,200
Voyages et Indemnités journalieres	10	99,690	107,848
Transport	11,12,13	34,141	21,230
Equipement, Matériel	14	11,793	0
Autres Coûts Directs	15	82,370	75,736
Formation	16	6,543	37,150
TOTAL DES COUTS	18	1,012,152	,013,066

Summary of Costs
Year 2
RTI/CDER Contract

For the period 2 October 1983 to
1 October 1984

Budget Categories					
Item	Number	Total Costs Incurred ($)	Budget Year 2 $	Percent-age of Budget	Total Costs YR 1-2
Salaries - field staff	1	68895	72118	96%	140090
Overhead - field staff	3	12805	13702	94%	26580
Salaries - home office	4	131218	144968	91%	235141
Overhead - home office	5a	116104	133371	87%	·211301
Administrative costs (OMASE)	5b	80775	113373	71%	143502
Fixed Fee	6	62239	98284	63%	110445
Subcontractor A.T. Kearney, Inc.	8	325782	359278	91%	662474
Consultants	9	79618	98300	81%	127618
Travel/per diem	10	76330	128697	60%	176020
Transport	11	4869	8400	56%	39010
Equipment	12	99115	200000	50%	110908
Other Direct Costs	13	85316	83167	103%	167686
Training	14	13674	122945	11%	20217
TOTAL COSTS	16	1156740	1576603	73%	2168892

SUMMARY OF PROJECTED COSTS
YEAR 3
RTI/CDER Contract

For the period 2 October 1984 to
1 October 1985

Category	FY1985 Projected Costs	FY1985 Year III Budget	% of Budget Expended
Salaries - field staff	78,348	87,205	90%
Overhead - field staff	14,833	16,569	90%
Salaries - home office	149,274	150,909	99%
Overhead - home office	134,674	138,839	97%
Administrative cost (OMASE)	89,091	125,379	71%
Fixed Fee	95,549	85,537	112%
Subcontract A.T. Kearney, Inc.	389,392	352,922	110%
Consultants	81,173	184,180	44%
Travel	84,189	142,310	59%
Transport, Material	8,830	16,000	55%
Equipment	57,498	202,600	28%
Other Direct Costs	112,449	97,730	115%
Training	26,394	78,470	34%
TOTAL COSTS	1,321,694	1,678,647	79%

APPENDIX II.7

ANALYSIS OF ESTIMATED COSTS FOR THE FOURTH YEAR OF THE CONTRACT - REIMBURSEMENT OF COSTS

Item	Details on Annex	Months of work	Total costs ($ US)
1. Salaries - Field Staff	1	34	87,393
2. Overhead - Field Staff (19%)	2		16,605
3. Salaries - Home Office		50	159,213
4. (a) Overhead - Home Office (92%)			146,476
(b) Administrative costs 11.5% on all salaries (Items 1,3), overhead (Items 2,4a), and other costs (Items 7-13).			209,013
5. Fixed Fee			103,511
6. SUBTOTAL		84	722,211
Costs of Subcontract	6	20	359,470
8. Costs of Consultants	7	506 days	156,916
9. Travel and Per Diem	3		
(a) International travel and per diem			79,280
(b) Travel and per diem in US			3,360
(c) Local travel and per diem-Morocco			25,608
10. Transport - Material	8		85,325
11. Equipment	9		861,909
12. Other Direct Costs			
(a) Insurance	4		5,855
(b) Miscellaneous	4		81,000
13. Training	5		69,970
14. SUBTOTAL (7 through 13)			1,728,693
15. TOTAL ESTIMATED COSTS (6 plus 14)			2,450,904

Note: Variations in any item cannot exceed 15% without the approval of the Contracting Officer.

APPENDIX F
INSTITUTIONAL MODELS FOR CDER

V.1 Functional Models of Institutional Development for CDER

At this stage in its development a number of institutional models are available to help guide CDER's activities in renewable energy. These models have been developed by both industrialized and developing country experience in the renewable energy field over the last decade. Renewable energy institutions may undertake activities associated with only one or several of these functional models, depending upon their organizational purpose, the financial and staff resources available to them, and the national or regional context in which they will operate. A brief typology of these models follows.

1. Research-oriented Model (i.e. SERI in U.S.)

Such an institution conducts both basic and applied research concerning a range of renewable energy resources and technologies. It may analyze the distribution and abundance of discrete forms of renewable energy in one or several areas leading to new product development, generally in the more sophisticated high technology end of renewable energy technologies (RETs). It may carry out laboratory and field research to compare and contrast the performance of experimental prototypes and commercial products in a variety of representative settings. Its principal outputs are scientific papers for publication in professional journals after extensive peer review and technical papers intended for the use of other research scientists and engineers.

2. Policy-oriented Model (i.e. Renewable Energy Institute or California Energy Commission in U.S.)

This type of institution focuses primarily on the analysis of the general energy and economic context with which renewable energy development must take place. It may conduct policy analysis into the financial, economic and technical aspects of RETs, focusing on those technologies for which there is a realistic prospect for commercialization. The policy analysis may prescribe legislative and regulatory remedies or reforms. Its key output is policy advice, generally options and recommendations. In general such an institution lacks policy autonomy or the ability to carry out its recommendations.

3. Technology Testing and Adaptation Model (i.e. Royal Scientific Society's Solar Energy Research Center in Jordan)

Such an institution reviews available RETs from a variety of sources with reference to their suitability given their country's needs, resources and conditions. It conducts experimental prototype installations of selected RETs to evaluate equipment performance. It may make engineering modifications or simplifications to components of commercially available RET systems to better match local needs or financial resources, it may provide technical support to local manufacturing firms, especially in the areas of

local product standardization, performance measures and certification. Its key output is technical information which can be used by local consumers, manufacturers and imported RET distributors to expand the utilization of improved and properly designed RET systems.

4. Extension Model (Biogas programs in India and China; Peace Corps Energy Program Approach)

This type of institution is principally concerned with the wide-spread dissemination of selected RETs in lower-income, remote, rural areas where traditional energy sources (woodfuels, crop residues and manure) usually predominate over commercial energy. The RETs selected for dissemination are generally ones with well-established market niches for which local investment capital is unavailable. These are usually low capital, fabricated from locally available materials. The extension approach is to provide a series of village-based installations of the selected RETs to promote social understanding and acceptance. Then local people are trained to fabricate, install and operate the RETs. Grants, loans, donated equipment or other subsidies are often used to encourage RET adoption and to promote self-supporting local economic development. The output is a large number of installed devices complete with a network of local extension workers and technicians.

5. Promotional Model

Such an institution organizes a series of outreach activities designed to promote consumer awareness of renewable energy, to boost sales of commercially available RET products, and to encourage the utilization of RETs by other technical implementing agencies. The advertising and promotional approaches adopted are derived from limited study of the technical and economic aspects of RETs. Tools utilized in outreach activities may include T.V., radio, newspaper and other media as well as other promotional materials. Such an institute's outputs will principally be exhibits for trade shows, promotional materials, commercials, films, and other publicity/public relation products.

6. Information Collection/Dissemination Model

Such an institution emphasizes the compilation and catologuing of renewable energy literature from a variety of sources, both in the industrialized and developing countries. The objective of such an institution is to strengthen the information base available to the technical research and engineering community and to promote information exchange among those in the field. A secondary objective is to help promote popularization of renewable energy. The primary function though is to serve as a clearinghouse for books, technical reports, professional journals and other work which documents the progress and current state-of-the-art in renewable energy technology. The outputs are copies of pertinent items of technical literature for distribution, newsletters, catalogues and other listings of available source materials.

7. Consulting Services Model

This type of organization has as its objective to be able to respond quickly to technical inquires from clients concerning the proper utilization of RET systems. The emphasis of the services provided is on resource estimation, site selection and optimal location, system design engineering and installation from commercially available component RETs, and financial or other parameters deemed essential to viable projects. The organization operates on a fee for service basis with its clients drawn from the private sector, public agencies or individuals. A consulting services model promotes a flexible orientation and emphasizes reliance on the technical skills of those outside the organization when appropriate (consultants, subcontractors etc).

8. Joint Venture Promotion Model

This type of organization is principally concerned with identifying viable market opportunities for RETs and securing financial packages for those projects deemed worthy of support. The goal of this group is to prepare sufficiently detailed pre-feasibility analyses for potential projects so that financial commitments can be attracted from private businesses; investment banks; government financing agencies; and multilateral lending agencies. For private investment to take place projects will have to be subjected to rigorous analysis of technical feasibility, financial requirements and projected rate of return, marketing and other non-economic indicators of project viability. Depending upon its own organizational financial resources, such an institution may take a major equity stake in resulting joint ventures for manufacture, importation or distribution/installation of RETs or confine its participation to small amounts of seed capital in order to leverage equity and debt investment by others. The output of such an institution is a portfolio of bankable projects which are soundly documented and which ultimately yield a positive revenue stream to equity investors or debtholders.

9. Educational Services Model (i.e. New Mexico State University's Solar Energy Institute in U.S.)

Such an institution provides a range of educational services oriented to renewable energy. As part of a large university or other educational center it may provide a full range of course and laboratory or field study concerning RETs, usually centered on engineering principles. It may develop curricula and other educational materials for other institutions to utilize and often provides in-service training programs, seminars or short courses for individuals affiliated with other institutions or firms. Its main outputs are course materials, educational services, in-service training programs and vocational education programs designed to familiarize others with the RETs currently available, their design, cost, manufacture, installation, use and maintenance as well as assessment of the resources upon which they depend.