TCAPP AND CTIP BUSINESS PLANS

Draft

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Summary of TCAPP Business Plans

Introduction

This document contains business plans for the TCAPP work in Brazil, China, Egypt, Korea, Mexico and the Philippines and the CITP work in Southern Africa. These business plans delineate strategic activities for expanding implementation of clean energy technologies in each of these countries that will achieve key development goals, reduce GHG emissions, and facilitate increased private investment and expanded markets. These activities will also continue to demonstrate U.S. commitment and leadership with implementation of technology transfer under the UNFCCC.

The plans are designed to achieve the TCAPP goal and performance objectives presented below:

Goal*: To accelerate the adoption of clean energy technologies and practices to promote economic and social development, mitigate climate change, expand clean energy markets and trade, and support technology cooperation under the UNFCCC*

Performance Objectives

- Support major economic, social and environmental developmental programs through implementation of clean energy technologies
- Reduce energy sector GHG emissions in key developing countries through clean energy implementation and market transformation
- Facilitate increased business and donor investment in clean energy technologies in developing countries and increase U.S. exports of energy technologies and services
- Demonstrate continued U.S. commitment and leadership in implementation of technology transfer under the UNFCCC.

Based on the results of the recently completed TCAPP review, the plans reflect several important refinements in TCAPP activities, including:

- Concentrating resources and focus on 2-3 technologies in each country that have the greatest potential for supporting development, GHG emission reduction, and private investment and market expansion goals
- Expanding the suite of cooperators (U.S. and developing country institutions) that will be engaged in supporting project implementation, with emphasis on organizations and experts that have skills in project development and financing.
- More clearly defining the market development strategy and pathways to provide clear and consistent guidance and metrics for all partners.
- Applying similar project development services and approaches across activities that are common to several countries, including ESCO market development and business matchmaking and project financing assistance.

The table on the following page provides a summary of the primary activities and their expected impacts that are proposed in each of the business plans. The complete business plans for each country are contained in the following sections.

Overview of Proposed TCAPP Activities and Impacts

Country	***Priority Area***	***Near-Term Impacts – Impacts of Projects Implemented or Project Commitments Made in FY02[1]***				***Long-Term Impacts***
		Implementation	*CO2 Tons (cumulative)*	*Private Investment*	*Development*	
Brazil	Co-generation.	2 projects	1,300,000 MT	$12 Million	Improved Energy Supply, Economic Performance of Sugar Mills	65 MMT C02, $600 M in Investment, Significant Energy Supply and Economic Benefits
	Proposing to stop work on Transportation and Fuel Cells. May re-initiate work on Rural Renewable Energy					
China	Boilers	1-2 projects	500,000 MT	$1 M	9,000 MT SO2, 5,000 MT dust	10 MMT CO2, $20 M in investment
	Motors	1-2 projects	1,600,000 MT	$67 M		20 MMT CO2, $1 B in investment
	Wind	2 projects	3,000,000 MT (based on 2 100MW projects, 20 year lifetime)	$200 M		15 MMT CO2, $1 B in investment
Egypt	Industrial Eff.	3 projects	1,500,000 MT	$10 M	$50 M in Savings, 2000MT SOx, 700 MT NOx	15 MMT in C02, $100 M in Investment, $500 M in Savings
	Commercial Eff. & Cogen	2-4 projects	35,000 MT	$1 M	$ 5 M in Savings, 200 MT SOx, 70 MT NOx	130,000 MT, $50 M in Investment, $250 M in Savings
	Renewable Energy	2-4 Projects	260 MT	$150,000	Econ Dev of Desert Regions and Tourism	500,000 MT, $100 M in Investment
Korea	ESCO	3 Projects	227,000 MT	$27 M	$50 M in Savings	24 MMT in CO2, $2 B in investment, $4 B in Savings
	Landfill Methane	2 Projects	340,000	$4 M	$8 M in Savings	4 MMT in CO2, $50 M in Investment
	Heat Recovery	1 Project	20,000	$2 M	$5 M in Savings	11.6 MMT in CO2, $880 M in Investment
Mexico	ESCO	1-2 Projects	1,700,000 MT	$24 M	Improved economic performance of industrial plants and hotels; reduced local air pollution and GHG; enhanced in-country finance capacity; improved economic development; increase in employment	$10 billion of investment, 37 million tons CO2 avoided
	Solar Hot Water	1-2 Finance agreements	3,000 MT	$1 M	Reduced local air pollution and GHG; enhanced in-country finance capacity; improved economic development; enhanced development of RE sources	$30 million in projects, 18 million tons CO2 avoided
Philippines	Hybrids	1 project, 14 sites	2,100,000	$59.5 M	Reduced dependence on fossil fuels; More reliable, cheaper electricity; Foreign exchange savings.	19 MMT CO2-eq. reduction; $350 M investment
	Rural Renewables	5-10 projects	47,000	$600,000	Energy for rural economic development	7 MMT CO2-eq. reduction; $6 B investment
	Hdyropower	2 projects	239,000	$1 M	Reduced dependence on fossil fuels; More reliable, cheaper electricity; Foreign exchange savings.	2.7 MMT CO2-eq. reduction; $10 M investment
Southern Africa	Cogeneration	3-5 Projects	450,000 - 1,350,000	$5-15 M	Economic benefits reduced SO_2 Emissions for farmers and sugar mills	Not yet defined
	Solar Hot Water	Installation of 3000 SWH Units	15,000	$150,000	Job creation, air quality improvements	Not yet defined

[1] Project impacts will be realized over the lifetime of the projects.

BRAZIL

Executive Summary

This business plan was developed in response to the changing emphasis of the TCAPP program based on the August 2001 USAID review, and in response to lessons learned from the TCAPP work in Brazil since October, 1997. The most important changes of emphasis and direction implied by this plan are:

- It focuses on just two priority technology areas, rather than the four original chosen priorities;
- It proposes to shift responsibility and resources to cooperators with greater in-country presence. More activities will be carried out by Vibhava, the subcontractor selected to carry out this work , and several activities could be carried by other AID subcontractors, after further discussion.
- The name of the program has changed to SETAP - The Sustainable Energy Technology Assistance Program.

This plan proposes work in two areas:

Sugarmill Cogeneration Project Development. In this technology area, TCAPP focuses on accelerating the adoption and utilization of cost-effective, energy efficient bagasse cogeneration technologies by sugar mills in Northeast Brazil with the goal of developing at least one project that achieves the objective of supplying clean and reliable energy to the grid without producing additional greenhouse gas emissions. The near term target is to assist in advancing 1-2 sugarmill cogeneration projects through this initiative through the end of 2002. Of the small to medium sized sugar mills that need TCAPP assistance in the northeastern region of the country, identified projects to date represent investments of about $12 million. Full market replication greatly exceeds $50 million worth of investment. At total market replication, sugarmill cogeneration projects will potentially reduce CO2 on the order of 1.6 million tons per year over lifetime of projects. Other key development goals include improved economics of sugarmill production, increased energy supply to handle current energy crisis, and enhanced in-country finance capacity.

- **Rural Renewable Energy Technology Development.**
  (Under development)

1. Goal of TCAPP: Accelerate the adoption of clean energy technologies and practices to promote economic and social development, mitigate global climate change and support technology cooperation under the UNFCCC.

2. Main objectives for TCAPP in Brazil, as described in TCAPP planning documents developed by an interagency team led by Brazil's Ministry of Mines and Energy

    2.1. To foster private investment in clean energy technologies and projects that speed economic development, including sugarmill cogeneration, and rural renewable energy technologies;
    2.2. To engage host country and international donor support for actions to build sustainable markets for clean energy and clean energy technologies;
    2.3. To promote cooperative work between local and international technical groups.

3. Specific development objectives for Brazil in support of TCAPP objectives

    3.1. Improved economics of sugarmill production
    3.2. Local air pollution reduction
    3.3. Enhanced in-country finance capacity
    3.4. Enhance development of renewable energy sources that have significant potential in Brazil,
    3.5. Help diversify the products of sugar/alcohol industries
    3.6. Demonstrate the viability of electricity generation as a source of revenue for the sugar industry

Sugarmill Cogeneration Project Development

1. Objectives

The objectives of TCAPP work in the sugarmill cogeneration area include:

1.1. To facilitate establishment of a market for large scale (10-50 MW) sugar mill cogeneration projects for small to medium sized sugar mills in the Northeastern region

1.2. To provide information on financing options and assistance through the finance process to sugar mill owners for the development of at least one project

1.3. To carry out these activities in a manner that will lead to replication

2. Benefits in relation to national objectives

2.1. Support for local and/or national development objectives

- Improved economics of sugarmill production
- Increased energy supply to handle energy crisis
- Enhanced in-country finance capacity

2.2. $MMTCO_2$ avoided

- At total market replication, sugarmill cogeneration projects will potentially reduce greenhouse gas emissions by 1,600,000 $MMTCO_2$ per year over lifetime of projects. Presently, 2 projects have been discussed with the TCAPP team that have estimated GHG reductions of 32,000 $MMTCO_2$ per year.

2.3. Scale of investment

The market is quite large for sugar mill cogeneration projects. There are about 300 sugar mills in Brazil, varying in size and production capacity. Of the small to medium sized sugar mills that need TCAPP assistance, proposed projects represent investments of about $12 million. Full market replication greatly exceeds $50 million worth of investment.

2.4. Barriers to implementation of objectives

2.4.1. Small to medium sized sugar mills lack information on the technical aspects, such as type and size of boilers needed for retrofits for cogeneration projects, as well as not understanding economic and environmental benefits.

2.4.2. Small to medium sized sugar mills lack information on finance options for cogeneration projects and have difficulty in obtaining capital from local banks for cogeneration equipment

2.4.3. Local technical capacity may not meet demands of sugar mills interested in purchasing larger boilers

2.4.4. Incentives are low for the sugar mills to increase energy production to sell to the utility when the energy crisis comes to an end.

2.4.5. May be some difficulties in negotiating Power Purchase Agreements with the utilities

3. Suite of Activities to Overcome Barriers

With over 300 sugar mills actively producing, Brazil is the top world ranking producer in terms of sugar and ethanol. For decades, there has been great encouragement from many parties, both national and international, to convince the sugar mills to diversify further and sell excess power produced from bagasse cogeneration. CPFL, the largest utility in Sao Paulo, where the majority of the sugar mills are located, has purchased excess power from sugar mills since the early 1990s from some of the larger, more advanced sugar mills. However, little emphasis has been placed on the sugarmills in the northeastern part of the country. Now that Brazil is deeply immersed in an energy crisis, the opportunity for even more sugar mills to buy technology, particularly those in the NE, that will allow them to produce additional power and then sell the excess to the utility is even greater. However, due to the various barriers, some of which are listed above, a suite of actions needs to be undertaken in order to push the small to medium sized sugar mills towards implementation of cogeneration projects. These actions include:

3.1 Educate sugar mills of the economic and environmental benefits of cogeneration projects

3.2 Educate sugar mills of the technical options available for carrying out cogeneration projects, such as type and size of boilers and alternate fuel sources during the off-season

3.3 Identify finance options for small to medium sized sugar mills

3.4 Assist sugar mills in accessing financing either through national or international sources

3.5 Overcome legal issues associated with power purchase agreements

4. Proposed TCAPP Activities

TCAPP is working on actions to help Brazil establish a market for large scale (10-50MW) sugar mill cogeneration projects by providing financing assistance to small and medium sized sugar mills in the NE for the development of one or two projects in a manner that will lead to replication. TCAPP has been working closely with the National Institute for Energy Efficiency (INEE), the most visible proponent and convener of cogeneration interests in Brazil over the last several years, Copersucar (a Brazilian sugarmill association), the International Cogeneration Alliance, the Institute for Energy Conservation (IIEC) and Econergy Inernational Corporation (EIC).

It has been determined by the above listed organizations that the TCAPP Brazil team can best provide assistance to move forward cogeneration projects in the sugar mill industry by assisting sugar mill owners to understand that various finance options exist for this type of project. In addition, the TAPP team plans to assist local finance institutions in understanding the benefits of providing financial assistance for clean energy technology projects such as sugarmill cogeneration. The TCAPP team plans to assist small to medium sized sugar mill owners with the process of writing and submitting finance proposals to international and Brazilian financiers, and assist in communications with Brazilian and international financiers to support the projects. The TCAPP team may also assist in identifying alternate fuel sources

available in the off-season. In addition, the TCAPP team may assist in identifying Brazilian companies to support the technical and maintenance portion of the projects either directly or by partnering with a non-Brazilian company. For the first stages all activities are focused on the sugar mills located at the Northeast Region considering the partners proximity and unbalanced conditions regarding the Southeast.

Specific TCAPP activities may include:

4.1 Analysis of the sugar mill industry on the Northeast region of Brazil, (including size of industry, associated greenhouse gas emissions, etc.) identify obstacles to electricity generation at bagasse cogeneration plants, and make recommendations to overcome them

4.2 Selection of 1-2 small to medium sized sugar mills interested in cogeneration projects

4.2.1 List and prioritize potential sugar mill candidates for cogeneration projects and prioritize sugar mills based on selected criteria that narrow candidates to maximize chances for success.

4.2.2 Actively encourage one or more sugar mill owner to pursue a large-scale cogeneration project

4.3 Summary prepared of finance options

4.3.1 Prepare information on the complete project cycle for project development, including project assessment, pre-feasibility (preliminary analysis of project) studies, identifying vendors and international finance mechanisms, working with the utility on power purchase agreements, project implementation and evaluation.

4.3.2 The main portion of the summary will include options for pre-feasibility (preliminary analysis of project) funding as well as debt and equity financing mechanisms in Brazil and through international sources that can be made available to the sugar mill owners and develop summary materials on these various financing mechanisms.

4.4 Summary prepared of benefits and technical options and alternate fuel sources available in the off season.

4.4.1 Report summarizing the benefits of and key technical design issues for cogeneration project retrofits, including information on alternate fuel sources for the off-season

4.5 Finance summary and technical summary distributed to selected sugar mill owners

4.5.1 Present information on pre-feasibility and project financing mechanisms to the interested sugar mill owner(s) to determine which of these mechanisms may be most suitable for them and develop a plan for providing financing assistance tailored to their needs. This shall include assisting sugar mill owners in working on the development of co-generation financing proposals.

4.5.2 Technical summary distributed to sugar mill owners in order to understand benefits and technical options.

4.6 Technical assistance provided for preparing and submitting finance proposals

4.6.1 Provide the sugar mill owner(s) with technical assistance in structuring proposals and financing packages that they can present to financing institutions. This shall start with the development of a financing technical assistance plan for each sugar mill project and culminate in development of a financing plan/proposal.

4.6.2 It is likely that a cooperator such as E&Co. would provide a finance training course to the sugar mill owners and then provide follow-up assistance in the development and submittal of proposals.

4.7 Assist with submittal of proposals to national and international financiers

4.7.1 Assist sugar mill owner(s) in presenting financing proposals to Brazilian and international financing institutions, including international Energy Service Companies (ESCOs), International Utility Efficiency Partnerships, Inc. (IUEP), Trade Development Association (TDA), International Finance Corporation (IFC), Inter-American Development Bank (IDB), Overseas Private Investment Corporation (OPIC), etc.

4.8 Assist sugar mill owner(s) in interacting with the Brazilian and international financial institutions to help ensure finance agreements are made.

4.9 Provide additional assistance to move forward projects

4.9.1 Communicate frequently with sugar mill owner(s) and involve them in reviewing activities and next steps that need to be taken to finalize the deals with finance institutions.

4.9.2 Provide additional forms of technical assistance to sugar mill(s) for development of these cogeneration projects, including facilitating communication with utility, if needed, additional communications with finance institutions, determining monitoring and evaluation program for project, etc.

4.9.3 Assist in identifying Brazilian companies to support the technical and maintenance portion of the projects either directly or by partnering with a non-Brazilian company.

4.10 Monitor and evaluate project implementation

4.11 Publicize the initial projects to promote replication by other sugar mill owner(s).

5. Expected Deliverables and Results

5.1. Deliverables

- 1-2 small to medium sized sugarmills implementing cogeneration projects
- Analysis of the sugar mill industry on the Northeast region of Brazil
- Report on alternative financing mechanisms for sugar mill cogeneration projects and steps for sugar mill owners in securing such financing
- Report summarizing the benefits of and key technical design issues for cogeneration project retrofits, including information on alternate fuel sources for the off-season
- Financing plans and proposals prepared for selected sugar mill cogeneration projects
- Financing proposals presented to potential financing institutions
- Financing agreements between sugar mills and Brazilian and international finance partners

5.2. Benefits

The key benefits of the projects directly resulting from the work during FY02 include:

- Private investment on the order of $600 million on sugarmill cogeneration projects for full market replication.
- Avoidance of 1,600,000 metric tons per year of CO_2 emissions over life of the projects.
- Increase energy supply for Brazil during energy crises
- Enhanced in-country finance capacity
- Demonstrate the viability of electricity generation as a source of revenue for the sugar industry

6. Timeline

Milestone	**Completion Date**
Analysis of sugar mill industry in NE Brazil	October 2001
Selection of sugar mills to receive assistance	October 2001
Summary materials on alternative financing mechanisms for sugar mill cogeneration projects	November 2001
Summary materials on benefits, technical project design, and alternative fuel sources	November 2001
Finance training provided to sugar mills, including finance workshop, and individual assistance in preparing proposals	Dec 2001 – Feb, 2002
Financing plans and proposals prepared for selected sugar mill cogeneration projects	Feb - March 2002
Financing proposals presented to potential financing institutions	February - June, 2002
Financing agreements between sugar mills and Brazilian and international finance partners	July - August, 2002

7. Resource Requirements

Work Area	NREL Budget	Cooperator Budget	Potential Cooperators
Analysis of sugarmill industry in NE Brazil	$2,000	$5,000	In-Country Coordinator
Communication with and selection of sugar mills	$5,000	$10,000	In-Country Coordinator
Technical summary	$5,000	$10,000	In-Country Coordinator
Finance summary	$5,000	$15,000	E&Co In-Country Coordinator
Finance and technical options presented to sugarmills	$10,000	$20,000	E&Co In-Country Coordinator
Finance proposal development and submission to finance institutions	$15,000	$30,000	E&Co. In-Country Coordinator
Project Development assistance	$5,000	$30,000	EIC
Finance agreements	$10,000	$15,000	In-Country Coordinator
TOTALS	**$57,000**	**$135,000**	

8. Cooperators
   8.1. Role of other cooperators
      8.1.1. E&Co.: E&Co.'s extensive experience in training local finance institutions on the importance of supporting clean energy technologies will add great value to and complement the TCAPP effort. It is envisioned that E&Co. would offer workshops on finance mechanisms available for clean energy technology projects using the toolkit they have already developed. E&Co. would offer specific assistance to sugarmills to understand finance options for cogeneration projects. After providing information to sugar mills on local and international finance options, E&Co. and TCAPP would assist 1-2 sugar mills develop and submit finance proposals to local and international finance institutions as a specific action to move forward the sugarmill cogeneration market in Brazil.

   8.2. NREL's Role and Value Added
      8.2.1. NREL plays a key role in coordinating efforts between the Brazilian and U.S. cooperators, the in-country coordinator, key government institutions (MME and MCT) and regulatory agencies (ANEEL). NREL already has a relationship will all of these entities, and provides a stable project coordination aspect that will

keep all parties focused on their individual role, without duplicating efforts. In addition, the role NREL plays as the U.S. facilitator for these projects is key to the success and replication of the projects. The reputation of the U.S. national labs, and NREL in particular in the area of energy efficiency and renewable energy provides a degree of acceptance to the program that is unique. The special status of being a government laboratory allows NREL to participate in all aspects of the program from international climate change meetings to detailed involvement in the technical and operational aspects of projects. NREL also has developed strong relationships with a variety of international finance organizations looking for projects. NREL's facilitating role will help those financiers learn about project opportunities in Brazil, and help all the parties better collaborate to move forward sugarmill cogeneration projects.

9. Next Steps
    - Analysis of sugarmill industry in NE
    - List of sugar mill candidates
    - Selection of 1-2 small to medium sized sugar mills
    - Summary materials on alternative financing mechanisms
    - Summary of technical information for sugar mill cogeneration projects
    - Finance training held for sugar mills
    - Financing plans and proposals prepared for selected sugar mill cogeneration projects
    - Financing proposals presented to potential financing institutions
    - Financing agreements between sugar mills and Brazilian and international finance partners
    - Other project development assistance to be determined after financing is secure.

Rural Renewable Energy Technology Development

- In Progress -

Overall Project Coordination

- NREL's major coordination activities including the following:
  a. Coordinating the work of the country team, including Vibhava, Winrock, USAID Brazil, U.S. experts, participating businesses and finance institutions, and donors so that all parties are working toward common goals
  b. Subcontracting with Vibhava and guiding their work
  c. Maintaining an active and effective country team, with active engagement and participation of key government officials, including energy and climate officials from MME, MCT, ANEEL, CEPEL, PRODEEM, and other key development agencies and any existing interagency processes that have been established
  d. Integrating work with TCAPP activities supported by EPA and DOE and with other USG initiatives in the country
  e. Promoting business and donor awareness and participation
  f. Reporting on results and accomplishments
  g. Developing and updating workplans and tracking financial expenditures across activities to help manage an overall budget
  h. Assisting the country team in presenting the work at key climate and energy forms and events

Work Area	**NREL Budget**	**In-Country Coordinator Budget**
Project Coordination	$15,000	$5,000
TOTAL: $25,000		

USG Technology Cooperation Project Coordination and Reporting for Brazil

This is proposed as a separate activity that could be carried out with a small amount of additional funds. The benefit would be to keep all USG agencies aware and up to date of the ongoing technology cooperation activities being carried out in Brazil, and the resulting impacts of the programs and to promote effective integration and linkage between these activities.

1. Identify all USG technology cooperation programs
2. Create and update a report and web-site that list all programs and update on quarterly basis
3. Develop reports that quantify development benefits and GHG reductions associated with all USG technology cooperation programs
4. Prepare summary fact sheets and briefings that can be used to highlight these programs to key officials in Brazil, senior US officials, to the business community, to donors, and to the international climate change community.

Work Area	**NREL Budget**	**In-Country Coordinator Budget**
Tracking and reporting on all USG technology cooperation programs	$25,000	$5,000
TOTAL: $30,000		

CHINA

Executive Summary

This business plan was developed to map the pathways by which the TCAPP program in China can support implementation of clean energy technologies, both in the short-term through investment projects and in the long-term through market transformation. Based on experience in three technology areas since April 1999, the business plan identifies barriers to technology implementation and the role TCAPP activities can play within a suite of actions being promoted by donors, the Chinese government, NGO's, and private sector investors. As the TCAPP program approaches its third year, more attention is being focused on investment projects.

The plan outlines work in three technology areas:

Wind: TCAPP activities are focused on facilitating the development of wind projects through wind resource assessment and monitoring, wind turbine testing for certification, and building wind business partnership. China has the potential to be the largest market for wind technology in the world yet the market is hindered by inadequate resource assessment, inadequate regulatory framework, and pricing issues. Work in 1999 and 2000 focused on capacity-building for Chinese wind experts. Meanwhile, emphasis on commercial projects is growing. This year, a TCAPP-sponsored workshop for wind developers will address the risks and provide input for the first-ever RFP on a 100 MW wind concession in Guangzhou Province.

Efficient motors: Work in this area has been ongoing since 1999 and has included motors testing, labeling, standards and certification as well as motors financing mechanisms and the development of business partnerships. A successful pilot project at the second largest oil company in China, Shengli Oil, resulted in the mitigation of 41 MTC/yr with a $135,000 investment. Expansion of the pilot project could result in mitigation of 0.06 MMTC/yr with $72 million investment. TCAPP has supported business partnership facilitation for the production of variable frequency drives by Magnadrive. Penetration of 1% of total need by 2010 would result in mitigation of 0.4 MMTC/yr at a cost of $700 million. Development of investment projects will be the primary focus of future motors work.

Industrial boilers: This area began in 2001 and will focus primarily on the development of pilot projects that demonstrate increased efficiency of industrial boilers and lead to the development of commercial projects. Currently, four promising pilot projects have been identified, including the use of sorted coal in boilers. Preliminary results show that a 10% efficiency gain can be achieved with sorted coal. A $1 million investment for a 10 million ton plant is being considered by Heilongjiang Blue Sky Environmental Energy Company.

As the TCAPP China program shifts gears into a more market-oriented, project-based phase, changes have been proposed to support effective clean energy project implementation. Modifications presently under discussion include:

- Focus on 2 technology areas (instead of 6) to minimize dilution of resources
- Minimize the role of SDPC-CC and retain SDPC-Basic Industries Division as main advisor since SDPC-Basic Industries Division has common goals and already coordinates wind and energy efficiency projects

- Rework teams to reflect business focus and devolve responsibility for meeting goals to the teams
- Replace technical capacity building with finance capacity building
- Pursue joint activities with other current EPA and USG programs that can offer expertise, resources, activities, etc. that can help expand these markets
- Make connections with other successful TCAPP programs, such as TCAPP Korea
- Solicit projects through an RFP process, offering financial as well as technical support for the successful bidders

Background and Overall Goals

The main objectives for TCAPP in China have been established through a Letter of Intent signed by the head of EPA and SDPC in 4/99:

- ❖ Further identify priority energy technology areas that support the sustainable development priorities of China and simultaneously reduce greenhouse gas emissions at the project level;
- ❖ Identify environmentally sound energy technologies in energy field that are suitable for China and can be facilitated through Sino/U.S. bilateral cooperation;
- ❖ Analyze and identify barriers of priority technology transfer to China; and
- ❖ Put forward proposals for overcoming barriers of priority technology transfer.

During the scoping meeting that set out the initial 5 priority technologies, the following criteria were used for priority selection:

- ❖ Environmental benefits, including mitigation of GHGs and other pollutants,
- ❖ Economic development, including new economic growth and creation of jobs,
- ❖ Conditions for technology transfer, including local capacity and localization of manufacturing, and
- ❖ Investment, i.e., scale and time period of investment, state versus private corporations.

The selected technologies were thermal power generation (clean coal), high efficiency motors, high efficiency boilers, wind energy and coal bed methane recovery. Coal bed methane was carved out as a separate EPA/China project and is not addressed in TCAPP. In 1/00, two new priorities were added: biomass gasification and natural gas combined cycle power generation.

For this business plan, we focus on wind and motors activities, that were designed and implemented starting in 1999, and also boilers activities, that were designed in 2001. Clean coal is still under negotiation between the US and Chinese sides and if agreement cannot be reached, this priority will be dropped. Natural gas and biomass work was planned to begin in 2002.

Wind Power

China has long been recognized as having the potential to be the largest market for wind technology in the world for both on-grid and off-grid applications, and this potential has captivated the wind industry for a number of years. Despite its possessing the world's largest small wind turbine industry and having more than 345 MW of grid-connected wind capacity installed through the end of 2000, to date Chinese wind development has been disappointing.

There is tremendous international interest in China's wind potential and significant public investment has been earmarked for wind farms in China.

Objectives and Benefits

The main objective for China's development of wind power is to accelerate adoption of indigenous energy sources that have low air pollution emissions and reduced environmental impacts. China has world-class wind energy resources, estimated at 250 GW, and demand for power in the next decade is estimated to grow by 200 GW. In order to reach these goals, China hopes to reduce the local cost of wind power through local manufacturing and servicing capabilities. In addition, China needs to improve resource assessment and identify sites for development with the large international investment resources that have been earmarked.

Specifically, wind power can help in meeting national development objectives, such as the Grand Western Development Initiative, which funnels resources to poorer provinces to help them develop, and the 10th Five Year Plan, which calls for a nearly five-fold increase in China's wind capacity by 2005 to 1.5 GW. CO_2 equivalent emissions avoided start at 62,000 metric tons annually from currently proposed projects and reach about 3 million cumulative metric tons over the next 4 years. Private investment in proposed projects of about $22M rising to $1 billion in 4 years upon replication in the market.

Barriers

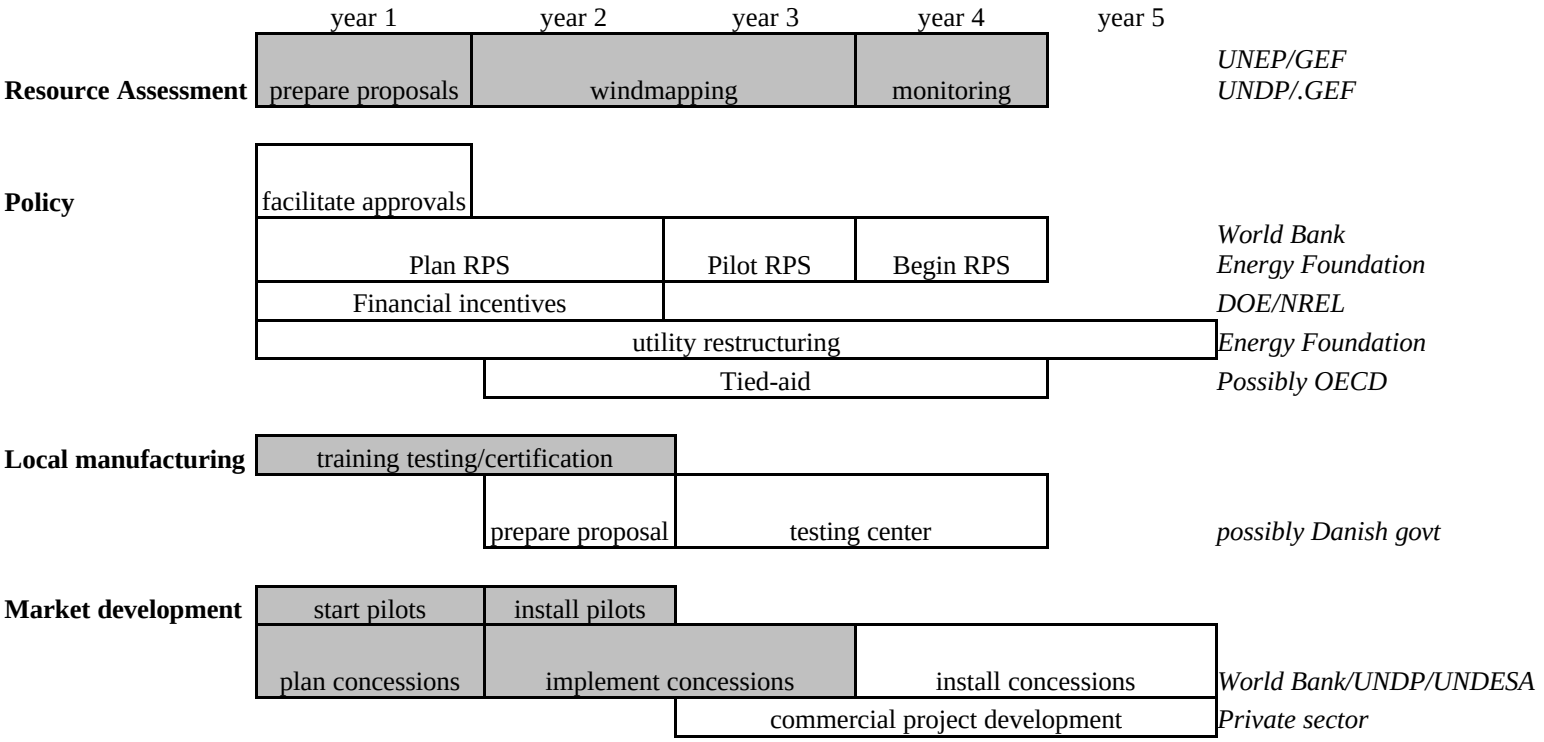
The main barriers to the development of wind power in China are:

1) Inadequate resource assessment – the economic wind potential is still unknown; advanced wind measurement equipment and resource assessment technologies are urgently needed. The lack of identified wind sites is a barrier to the flow of approximately $800M in donor and domestic investment that is earmarked for windpower.

2) Wind power costs more than conventional power sources –
    a. Local manufacturing on a large-scale should help to reduce the cost of wind equipment. The cost of transferring manufacturing know-how is expensive. Local manufacturing is currently done on a very small-scale and the market for local turbines is very small. One problem is that these turbines are not perceived to be proven, reliable and of high quality. There is no mechanism for testing and certifying turbines in China. A second problem is tied-aid: utilities want imported equipment if they are taking on hard currency loans and the loans are tied to a certain percentage of imported equipment.
    b. Lack of financial incentives and policies to promote wind power. Wind power has environmental benefits that are not accounted for in the cost of power. How to spread the incremental costs of wind power over a customer base has been a significant problem, resulting in huge cuts in the recent World Bank wind project.
    c. China is in the midst of utility restructuring. The uncertainties inherent in how the restructuring will play out combined with a power oversupply add to the difficulties in securing PPAs.

3) Inadequate regulatory and legal framework - Standard power purchase agreements between independent power producer and utility have not formulated. An unreliable legal system results in a lack of protection for proprietary technology and intellectual property rights. A transitioning economy and political corruption combine to make securing a reliable and equitable contract difficult.

4) The market is distorted by donor aid - Tied-aid and other public subsidies tend to distort a potentially commercial market. Utilities and the Chinese government want soft loans or GEF grants for wind projects. The market distortion caused by these subsidies makes it difficult for investors, even public investors, to participate in non-subsidized projects.



Five Year Strategy for Wind Development in China – the shaded tasks have been selected by the TCAPP team for implementation under this program.

A Suite of Actions to Overcome these Barriers

5) Inadequate resource assessment – In 1998, US and Chinese members of the wind team collaborated on a wind assessment and monitoring project that resulted in a map of southeast China and multi-year site measurements. There is a lack of funding to continue this work. This work is urgently needed as it forms a basis for all wind development. Wind mapping takes about 1-2 years and wind monitoring prior to wind farm construction is at least a year-long process.
    a. Wind mapping is needed to accurately assess the wind power potential in China. Modern techniques using GIS, new data, and higher hub heights of modern turbines can be taken into account in updating the 1980's wind map of China. There is now a good opportunity to build off of existing international UNEP/GEF efforts to fund this work.
    b. Once specific sites have been identified through wind maps, direct monitoring of the site is necessary for at least one year in order to characterize the economic performance of a potential wind farm. Chinese wind loggers are not suitable for gathering data. US wind loggers are of high quality, but are more expensive. There is a need to purchase high quality wind loggers and ultimately US/China business partnerships could result in cost reductions of wind logging equipment through local manufacturing and increased installations. The UNDP/GEF *Rapid Commercialization of Renewable Energy Project* has funds for this equipment.

6) Wind power costs more than conventional power sources – There are two ways to deal with this issue: reduce the cost of wind power and/or establish financial policy incentives so that wind is cost-competitive. Cost reductions are thought to result from local manufacturing and/or economies of scale of production and installations. Policy incentives can include mandated renewable energy shares of the power portfolio or direct subsidies to renewable energy producers.
    a. Cost reduction through local manufacturing has been a national goal for many years and several European/China joint venture enterprises have been trained to manufacture turbines. There is a need to train Chinese institutions in testing of these turbines and the turbine designs for safety and performance. There is also a need to establish a testing center.
    b. Lack of financial incentives and policies to promote wind power. Worldwide, policy incentives have been the most successful tool in stimulating wind power. In the 10th Five Year Plan, SDPC proposed a 5% renewables portfolio standard. Several organizations are assisting China in this area: the World Bank/GEF *China Renewable Energy Scale-up Project* will establish pilot RPS policies in 3 provinces; the Energy Foundation is building high-level support for RPS and providing information; the US DOE is assisting SDPC in analyzing supporting financial incentives to promote renewable energy.
    c. China is in the midst of utility restructuring. In the next 5 years, generation will be separated out from transmission and distribution. Depending on how this is established and whether supporting policies are put into place for renewables, this could have a large effect on renewable energy development. The Energy Foundation is working with SDPC and ERI to assist in this issue.

7) Inadequate regulatory and legal framework – Standardized power purchase agreements should be formulated with a clear and consistent mechanism for determining power purchase price. This is related to the restructuring issue and how competition can be introduced to wind farm development.

8) Donor subsidies – After a recent ADB/WB dispute over the use of GEF grant subsidies in their wind projects in China, guidelines for GEF grant use were established. There is a need to establish and enforce such consistent guidelines among OECD aid agencies so that donors can coordinate efforts in growing markets in developing countries.

TCAPP Actions

First, it should be noted that SDPC has specifically requested that TCAPP actions directly address technologies and not address policy development. As a result barrier #2b/c and 3 are not addressed in this project. A new policy Annex between US DOE and SDPC was established specifically to fill this gap. It was also recognized that #4 is not necessarily viewed by the Chinese government as a barrier. Moreover, it is a huge task. The team opted to focus on actions that were viable options given the level of resources and overlapping interests of the US and Chinese governments.

1) Wind resource assessment and monitoring – There is a large amount of financing available for wind in China. However, not enough good sites have been identified and assessed for development. Wind resource assessment will help to directly leverage the $800M or so of investment earmarked for wind in China. It will also help to leverage additional private sources of investment, which are likely to be far larger than public sources. This action will likely also provide a better estimate for wind resource potential in China, which is likely to be much greater than original estimates.
    a. Translated NREL's resource assessment and monitoring handbook into Chinese for training. [2/00]
    b. Identified high-priority regions for assessment and prepared part of a proposal that has been packaged into a larger UNEP/GEF Solar and Wind Energy Resource Assessment Project to secure funding to expand earlier assessment activities. The team has already been instrumental in securing endorsement from the Ministry of Finance for this project proposal. [2000]
    c. A proposal for wind measurement equipment has been prepared for the UNDP project. [2000]
    d. A CD-ROM of wind maps and data for Southeast China is being prepared. [fall 2001]
    e. Plan for funding to be in place and wind mapping to begin in 2001-2002.
    f. Good wind sites should be identified by 2002-2003 and can be monitored for development.

2) Wind turbine testing for certification – There are already 3 local manufacturers (joint ventures or licensing) of wind turbines in China. The cost of turbines from these manufacturers is high because production volume is incredibly low. Large production volumes will result in lower costs of turbines which will lower the cost of wind power. One of the reasons Chinese utilities are reluctant to purchase turbines from these manufacturers is

that they do not trust the quality. Establishing a turbine testing and certification program in China will assure utilities that these turbines meet international standards. This action also helps China to adopt standards that are in accordance with US and international standards, thus helping to reduce the possibility of trade barriers.

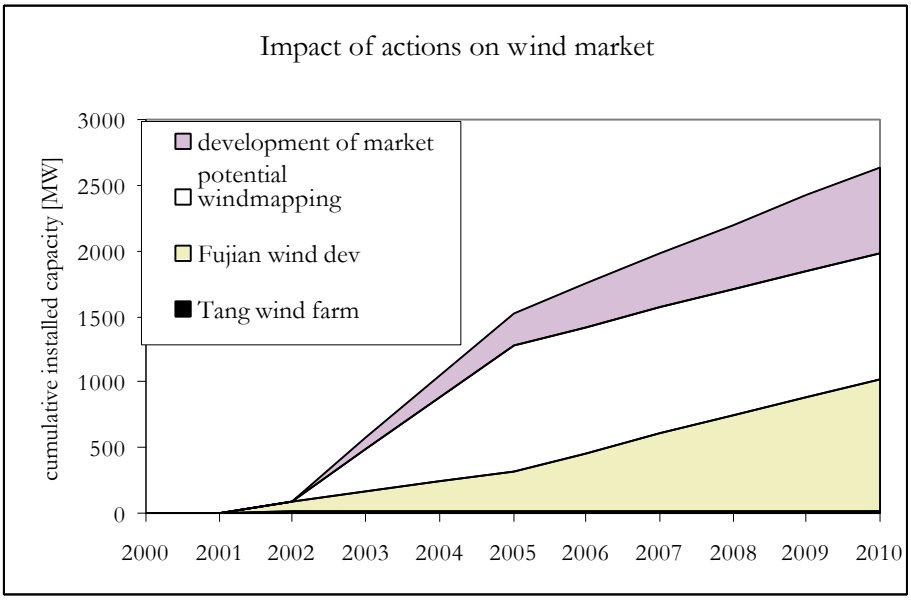
a. NREL provided IEA Recommended Practices and international standards information to the wind team and presented the testing and certification process in the US. [4/00]
b. Forty staff were trained for two days in Beijing on types of testing and certification, testing protocols and testing equipment. [7/00]
c. The China Classification Society (CCS) is preparing the Chinese certification scheme for wind turbines while a Chinese testing organization is being identified. Six CCS staff were trained at NREL on design evaluation certification. [6/01]
d. CCS and U.L. are pursuing a mutual recognition agreement that will allow wind turbine certification by the US or China to be mutually recognized. [6/01]
e. Three Chinese staff will be trained on turbine testing procedures at NREL. [9/01]
f. Training on wind turbine design code software in China. [11/01]
g. Plan to have a Chinese testing and certification capability established by 2002-2003.

3) Wind business partnerships – China's long-term strategy appears to be to cultivate the local manufacture of wind turbines, which few foreign wind firms have been willing to do given the uncertainties of operating in the Chinese market. It seems clear that international companies that want to do wind projects in China will be forced to develop partnerships with local companies. This action helps to develop partnerships between international and domestic companies for not only manufacture of equipment but also development of wind farms, financing of projects and other aspects of wind development. Financing, power purchase agreements, and wind program development are all issues that will be addressed in this action through working with local utilities.

a. The wind team and Guangdong Electric Power Company discussed a wind investment workshop in Guangzhou to present wind development opportunities. [3/00]
b. Members of the wind team, Chinese wind companies, and US wind industry met in to discuss how to 1) further develop business partnerships between international and Chinese companies, 2) help the Chinese to develop wind in a way that will attract more private investment, and 3) help the Chinese to develop wind more competitively to reduce their costs. [4/00]
c. Assistance to the US/Chinese joint venture, Tang Energy Group, in securing equity for their commercially-financed 22 MW wind farm. [>2000]
d. SDPC announces wind farm concession program to allow international bids for 5x100MW wind farms. [end 2000]
e. Guangdong restructuring led to workshop being put on hold. The wind team thus began discussions with Fujian Electric Power Company for a workshop in Fuzhou to strategize large-scale wind farm development that would attract private sector

developers and investors and present potential project sites and wind resource data to developers and investors to attract their interest in Fujian. [3/01]

f. Todd Bartholf working with Tang to identify strategic equity partners for wind farm [7/01]
g. SDPC refuses to approve any projects in Fujian province due to overcommitments and requests wind team to work in Guangdong or Jiangsu. [7/01]
h. Partnership with UNDESA to co-sponsor wind concessions workshop [8/01]
i. Plan for Tang wind farm to be financed by 2001-2002.
j. Plan to identify and help develop additional projects from the workshop in 2001-2002.



Estimated impact of TCAPP actions on wind power development in China.

Expected Deliverables and Results

- The 22 MW Tang wind farm is planned to be financed in 2001 and be commissioned in 2002.
- The wind workshop will be held in late 2001. TCAPP will work with SDPC to help the utility develop a strategy for implementing competitive wind farm concessions.
- Approximately 790 MW of investment is now available for wind power through public sources. Wind mapping will identify good sites for development starting in 2003 and will leverage some of this investment. It is estimated that 790 MW total will be leveraged by 2010.
- Markets will be enhanced by leveraging of private investment through wind mapping, replication of the Tang wind farm, replication of the regional development strategy by other provinces, development of testing and certification for locally manufactured turbines that builds markets for these turbines and reduces turbine cost over time. Assuming that these

actions spur development equivalent to 0.5% of new generating capacity starting in 2003, about 660 MW would be installed and $660M investment leveraged by 2010.

- GHG emissions mitigation - Total practical wind potential in China is 253 GW, corresponding to and mitigation of 196 MMTC/yr[2]. Assuming that some 0.5%[3] of new generating capacity[4] is wind power starting in 2003, about 0.5 MMTC/yr could be mitigated by 2010.
- Donor investment – About $800M has been earmarked by donors for investment in windfarms in China. Windfarm sites have not been identified for much of this investment TCAPP will leverage this investment through wind mapping and identification of good resource sites.
- Air pollution and environmental benefits – Wind will offset other fuel use, which is mainly coal in China. These benefits include fewer SO_x emissions, reduced water use, and reduced rail transport for coal.
- Industry development – Turbine testing and certification activities will help to build these capabilities in China. Locally manufactured turbines can then be tested and certified in China, thus assuring utilities and other purchasers of safety and quality standards. This will help to build a credible and reliable wind industry in China.

Timeline of Activities and Milestones

3/98	**Scoping meeting to select priorities**
10/98	Technology Cooperation framework prepared
4/99	**EPA and SDPC signed letter of intent for this project**
7/99	Initial team meetings for wind, motors, clean coal, boilers
12/99	**Wind and motors technology and market strategy reports prepared**
1/00	**Three wind actions selected by Interagency team**
3/00	Meetings with Guangdong utility on wind workshop
4/00	**Wind team study tour to US; Wind industry roundtable meeting in DC**
12/00	**Assistance to Tang wind farm in identification of equity finance**
7/00	**Wind turbine testing training workshop in Beijing**
1/01	Wind team progress meeting
3/01	Meetings with Fujian utility on wind workshop
6/01	**Wind turbine design certification training at NREL**
6/01	UL and CCS discuss mutual recognition agreement
7/01	Todd Bartholf retained to find strategic partners for Tang wind farm
7/01	Meetings with SDPC on wind concessions – request to focus on Guangdong/Jiangsu
9/01	**Wind turbine testing training at NREL**
10/01	**Wind resource assessment CD ROM prepared**
2001-2002	**Wind farm investment workshop**
2001	**Secure finance for Tang wind farm**
2002	Tang wind farm installed

[2] Assumptions: 30% capacity factor, $1/W investment.

[3] This corresponds to 82 MW of new installations in 2003, which is reasonable given the 345 MW currently installed.

[4] Assumptions: installed capacity grows at 5.5% annually from 299 GW in 1999.

Expected Expenditures through FY02

Activity	EPA	China	UNDESA
Turbine testing training at NREL	$3k	$6k	
Wind resource CDROM	$5k		
Design code software training in Beijing	$2k	$4k	
Wind concessions workshop	$20k	$5k	TBD
Identification of financing for Tang wind farm	$10k		
Total	$40k	$15k	

Additional funding to support development of wind concessions may be needed. In addition to basic education and building local support for the idea of wind concessions, assistance is needed in design of concessions, establishment of model contracts, detailed resource assessment, and design of solicitation.

Cooperators and Funding Mechanisms

Active members of the wind team include

Shi Pengfei – team leader	Hydropower Planning General Institute, SPCC
Qin Haiyan	China Classification Society (CCS)
Zhang Shihui	Badaling Test Center
Li Baoshan	MOST

Cost-sharing for training activities and travel has been borne through MOST, CCS, and Badaling Test Center.

On the US side, NREL provides the lead for wind activities. Dennis Elliott leads the wind resource assessment activities; Hal Link and Sandy Butterfield lead the wind turbine training and certification activities; Debra Lew leads the wind business partnerships activities.

AWEA and BCSE participate in business roundtables and facilitation of partnerships. Tang Energy Group and Xinjiang Wind Energy Company are the main developers of the Xinjiang wind farm investment project that TCAPP facilitates. Todd Bartholf provides support in identification of strategic partners for project developers.

Next Steps

- Continue to push UNEP/GEF funding for wind mapping; work with UNDESA/UNDP on wind monitoring.
- Work with UNDESA/UNDP and others in assisting China to solicit bids for wind concessions.
- Continue to provide technical assistance in testing and certification, dependent on cost-sharing from China, and continue to build US/China relationship in this way.
- Identify additional wind farm projects, especially in conjunction with concessions program, and move forward through development pipeline.

Energy Efficient Motors

Total installed capacity of motors exceeds 400 GW, with consumption of 600 TWh, over 60% of total power generation. In 1997, China produced 30 GW of motors, totaling $800 M. High quality and efficient motors accounted for 30%. Energy efficiency can be improved through use of higher efficiency motors, variable speed drives (VSDs), proper sizing of motors, and soft-start capabilities. The motors team estimates that about 70% of AC motors could benefit from variable speed operation.

Motors in China are generally 3-5 percentage points lower in efficiency than that of foreign motors and system efficiency is 20-30 percentage points lower than foreign systems in operation. Key reasons for this are: high-efficiency motors are not commonly used in China; operation of motors systems are not optimized for energy efficiency; maintenance and repair of motors are inadequate. Available technology options for improving efficiency include: use of high-efficiency motors, use of variable speed drives, and efficient maintenance and repair of motors.

Objectives and Benefits

The main objective is to save energy, thus reducing costs and the environmental impacts of electricity generation. There should be a huge market for improved efficiency of motors and motors systems and China would like to build its capability for manufacturing, installation, operations and maintenance of these technologies.

Current total potential for efficient motors and variable speed drives could mitigate 32 MMTC/yr[5] at a cost of $55 billion.

Barriers

The main barriers for this technology's implementation are:

1) Energy efficient motors are not cost-competitive with standard motors in China
    a. Low power tariffs do not encourage energy efficiency
    b. Insufficient availability of finance. Pilot programs through CECIC for leasing of energy efficient equipment did not achieve sufficient repayment rates.
    c. Energy efficient equipment has higher up-front costs. There are limited local manufacturing capabilities and local products are not as good as foreign products, which are more expensive. The joint ventures in this sector have not typically reached the Chinese goals of product improvements and exports. Local manufacturers do not have enough capital to both expand production capacity and improve efficiency of current products

2) Lack of awareness of energy savings from energy efficiency improvements and lack of information on retrofit opportunities - Difficulty in calculating energy payback of motor/VSD

- Lack of technical capabilities in service institutions, repair institutions, management of motors systems

[5] Assumptions: VSDs are applicable in 70% of all installations; efficient motors save 4% and VSDs save 20% energy.

A Suite of Actions to Overcome these Barriers

In order to coordinate international activities in motors, a working group was formed. Participants include LBNL, ACEEE, ICA, IIEC, NREL, PNNL, DOE, World Bank, and the W. Alton Jones Foundation. In addition, UNDP/UNDESA have very recently begun a energy efficiency strategy project in China with GEF support.

The following activities have been proposed to overcome these barriers:

4) Energy efficient motors are not cost-competitive with standard motors in China
    a. Policies and regulations – Provide incentive policies for manufacturers of energy efficiency motors or systems. Provide incentive policies for use of energy efficiency motor technologies and equipment. The UNDP/UNDESA project may be providing assistance in this area.
    b. Limited local manufacturing capabilities – Encourage and identify partners for joint ventures or licensing. Initiate joint R&D programs to improve quality of local technologies.
    c. Financing – Identify financing mechanisms for energy efficiency investments. Develop and enhance experiences with ESCOs and motors projects. The World Bank ESCO project has established 3 ESCOs which have financing for efficiency projects. ICA/IIEC is trying to develop new financing mechanisms to address motors specifically.
    d. Standards, testing labeling and certification – Establish testing protocols and efficiency standards for China. Label motors according to testing protocols. ICA/IIEC is working to establish standards for motors in China. GTZ has established a testing lab at EPRI.

5) Lack of awareness and information
    a. Information exchange - Exchange information on technical issues and energy efficiency standards.
    b. Establish effective information collection and dissemination system in China for information on both new and retrofit systems. The World Bank ESCO project has established an information dissemination center for energy efficiency that can disseminate information on motors.
    c. Improve awareness of benefits of energy efficient motor driven systems. ICA/IIEC is conducting workshops to build awareness of energy efficient motors.
    d. Conduct pilot project on energy efficiency motor driven system, preferably in one large-scale enterprise, and disseminate results.

6) Lack of technical capabilities
    a. Build expertise in ESCOs and other financiers in energy efficient motors and motors systems.
    b. Introduce advanced motor repair technologies and experiences. Regulate market for motor repair services. Introduce and diffuse energy efficiency motor repair services. Establishing pilot motor repair service center.

c. Training for designers, manufacturers, users, maintainers, finance staff, and managers. LBNL/ACEEE are working to set up a training program for motors.

TCAPP Actions

SDPC requested that policy measures not be the focus of this work. Members of the motors team thought it best to leverage other activities in training, standards, finance and project development. The interagency team selected three actions:

1) Motors Training
    a. Prepared proposal to secure funding for an Efficient Motors Exhibition and Training Center. [6/00]
    b. The motors team co-sponsored and attended conferences in which they presented this proposal. [8/00]
    c. The motors team presented this proposal to a number of funders in the US [9/00]
    d. Provided motors selection and motors systems software [9/00]. Presented team with opportunity to join an international group to get individual country versions of software for $10k, but the motors team doesn't have funding for this.
    e. Prepare proposal to secure funding for a training program - LBNL/ACEEE successfully secured funding from UNF for training. [1/01] Training will be initiated in 2001.

2) Motors testing, labeling, standards and certification
    a. Information on test procedures, certification, and standards provided to the motors team. [2000]
    b. Assist in selection of appropriate protocols, certification and standards [2001]

3) Motors financing and business partnerships
    a. The motors team and IIEC co-sponsored an International Financing Seminar on China High Efficiency Motors in Shanghai to develop pilot projects between end-users, suppliers and financiers. This seminar involved 80 participants from international and local investment communities, motors manufacturers and end-users. [7/00]
    b. IIEC and the Henan First ESCO are following up by identifying projects that can test some of the financing mechanisms presented at the seminar. The Bank of Shanghai is also interested in financing a Shanghai motors project if the team can provide technical assistance. [2000]
    c. The motors team, SDPC and Tsinghua University participated in a study tour of the US. This included visits to Rockwell, Robicon, Magnadrive, and Bechtel and a roundtable discussion hosted by BCSE, which included several companies and financiers. [9/00]
    d. The motors team is arranging for a pilot demonstration and joint venture partners for the Magnadrive technology. [9/00]

e. Follow up meetings with motors team and Magnadrive. Discussions with IFC for financing of JV. [5/01]
f. Technical assistance in implementation of two high-efficiency motors pilot projects with Shengli Oil Company, the second largest oil company in China: 100 units of permanent magnet motors and 10 A/C motors. [6/01]
g. Monitoring of the energy savings and analysis of the results with Shengli Oil Co. Audit and report. [9/01]
h. Further assistance to Magnadrive in business partnership, pilot and financing. [2001]
i. Potential expansion of pilots if initial results show success. [2001]
j. Identification of pilot projects by Henan First ESCO, Bank of Shanghai or other partners [2001]

Expected Deliverables and Results

- The Shengli Oil Company motors pilot projects mitigated 41 MTC/yr through $135k of investment. Expected to be expanded upon verification of successful energy savings and payback. Expansion of this pilot to include all Shengli motors would mitigate 0.06 MMTC/yr[6] by 2010 through $72M investment.
- Magnadrive business partnership facilitation – demonstrate and produce variable frequency drives. Penetration into 1% of the total need by 2010 would result in 0.4 MMTC/yr at cost of $700M.
- High-efficiency motors standards - mandatory minimum standard would mitigate 0.1 MMTC/yr by 2010 at a cost of $387M. The impact of the voluntary high-efficiency standard would provide additional benefits.[7]
- Assuming penetration rates in new motors, replacement motors and potential for variable speed drives of 3%, 0.04%, and 2%, this would correspond to 4 MMTC/yr[8] by 2010 with $6800M investment.
- Other benefits include air pollution benefits and economic benefits for US companies engaged in business ventures

[6] TCAPP is working with Shengli Oil Company, the second largest oil company in China. They consume about 6 TWh/year in motor-driven equipment. Shengli Oil just installed over 100 permanent magnet units and is now retrofitting 10 AC motors. We will provide technical assistance to measure the energy savings and assist in the expansion plans of this pilot. The pilot projects are estimated to save 98 MWh/year and 41 MWh/year, respectively. Replacement includes ten AC motors of sizes 22, 30, 37, 45, and 55 kW at cost of $15k. Loading is 20-80% and run time is 24 hr/day for 324 days/year and efficiency increase is 2-3%. Assuming two of each size and that loading averages 50% and that efficiency increases from 87.5 to 90%, the savings of the AC motors is 41 MWh/yr and the permanent magnet motors is estimated at 98 MWh/yr. Assuming 295gC/kWh, 139 MWh/year corresponds to 41 MTC/yr. Investment is approx. $135k. Replacement of all Shengli's motors with new high-efficiency units will require an estimated $56M of investment and mitigate 44,000 MTC/yr. If this can be done by 2005 and all new motors at an expansion rate of 5% were also high-efficiency, the mitigated emissions by 2010 would be 56,500 MTC/yr at a cost of $72M. Shengli is also trying to promote their internal DSM program to other companies, which would greatly expand these energy savings benefits.

[7] TCAPP is facilitating development and adoption of mandatory minimum and voluntary high-efficiency motors standards which are likely to be approved in 2001. This standard is already being met by about 80% of the current motor market. Adoption and enforcement of the standard would increase efficiency of 20% of the current motor market. The impact of the mandatory minimum standard would roughly mitigate 12,000 MTC/yr upon implementation. Assumptions: motors average 1500 hr/yr; 20% of 6.5 GW motors is improved by 2% each year, corresponding to 12,000 MTC/yr in 2002 and 0.1 MMTC/yr in 2010.

[8] Assumption for motors: 6.5 GW of new motors and 5 GW/yr of replacements for low efficiency installations, 1500 hr/yr, 4% efficiency increase; penetration starts in 2003. Assumption for drives: 70% of Chinese AC motors could benefit from adjustable speed operation; 1500 hr/yr, 20% energy savings.

Timeline of Activities and Milestones

3/98	**Scoping meeting to select priorities**
10/98	Technology Cooperation framework prepared
4/99	**EPA and SDPC signed letter of intent for this project**
7/99	Initial team meetings for wind, motors, clean coal, boilers
12/99	**Wind and motors technology and market strategy reports prepared**
1/00	**Three motors actions selected by Interagency team**
2000	Information exchange on standards, labeling, testing, certification
6/00	Prepared proposal for motors exhibition and training center
7/00	**International Financing Seminar on China High Efficiency Motors**
8/00	Marketed proposal for motors exhibition and training center to funders/donors
9/00	**Study tour to US; meetings with US government, companies, donors**
2000	Follow up with partners for pilot project identification
9/00	Identify pilot demonstration site for Magnadrive and joint venture partners
1/01	Motors team progress meeting
6/01	**Installation of Shengli Oil Company's 2 pilot energy efficient motors projects**
9/01	Analysis of results of 2 pilots at Shengli Oil Co
2001	Further assistance to Magnadrive in developing business partnership in China
2001	Further identification of pilots with partners

Resource Requirements

Funds have been allocated to IIEC to continue pilot project development and technical assistance. Contingency funds should be available to pursue pilot projects on an opportunity basis. It is hoped that through IIEC, Magnadrive, Shengli, Bank of Shanghai, or Henan First ESCO, pilots will be identified.

Cooperators and Funding Mechanisms

The motors team includes:

- Beijing Power Electronics R&D Center – Wang Zhengyuan leads the motors team.
- IIEC leads the motors project development activities; under contract to TCAPP; ICA/IIEC cost-shared the finance seminar.
- Rockwell participates in the standards and testing activities as well as overall guidance to TCAPP

- SDPC – Chen Heping of Basic Industries Div. coordinates this work with other energy efficiency activities including the UNDP/UNDESA/GEF energy efficiency strategy project
- LBNL and ACEEE provide technical assistance and guidance to team and secured funding for training program through UNF
- Bank of Shanghai would like to jointly implement a motors pilot project if one can be identified in Shanghai. They would like technical assistance from the team. They can provide financing for projects.
- Magnadrive is interested in pilot demonstrations of their technology in China as well as a joint venture with a Chinese company; their work is internally funded, as is the Chinese counterpart. IFC is interested in potential funding for JV.
- Henan First ESCO is in the process of identifying pilot projects.

Next Steps

- Follow up with Shengli Oil Co on expansion of pilots.
- Follow up with Magnadrive on development of joint venture.
- Follow up with Henan First ESCO, Bank of Shanghai on pilot identification.

Efficient Industrial Boiler Technology

China produces and uses more coal-fired industrial boilers than any other country in the world. The 500,000 coal-fired industrial boilers represent 40% of total coal consumption in China and ultimately consume almost 400 million tons of raw coal each year. Although it is impractical to promote a large-scale shift to oil or gas-fired industrial boilers due to constraints in fuel cost and resource availability, great potential for greenhouse gas emissions and local air pollution reduction lies in simply increasing the efficiency of existing coal-fired industrial boilers.

Industrial boilers discharge 730 millions tons of CO_2, 7.2 million tons of SO_2, and 4 million tons of dust. Chinese coal-fired boilers are typically 60-65% efficient, while efficiencies of boilers in developed countries are above 80%. Assuming a 20% improvement in boiler efficiencies, this represents a potential 8% reduction in total coal use in China. Low efficiency can be the result of fuel that does not meet boiler design specifications or is untreated, old boiler technology, low quality or mismatched auxiliary equipment, or operation at non-optimal conditions.

Objectives

The main objective is to increase the efficiency of industrial boilers in China, thereby reducing coal use and CO_2 emissions, cutting costs, and improving local air quality. These benefits have significant impacts on national development objectives to encourage economic prosperity, a clean environment, and a healthy population.

Coal-fired boilers in China may eventually be phased out in the long-term but the existing stock of boilers use coal and the majority of boilers manufactured in the next decade will use coal. Therefore, China needs to accelerate manufacture and adoption of coal treating technology and advanced coal-fired boiler technology.

Barriers

The main barriers for the implementation of energy efficient boilers and associated technologies are:

1) <u>Lack of advanced, high efficiency boiler technologies in China</u>

    a. The highly fragmented domestic boilers industry provides few resources and little incentive for new product development (insufficient gains)
    b. International firms have trouble earning a profit: technology is easy to replicate, has a low profit margin (over-supply) and little export potential; few international firms still produce this type of small coal-fired boiler

2) <u>Lack of incentives to for boiler owners to switch from low quality fuel that does not meet boiler design specifications</u>

Even if more efficient boilers are purchased, optimal performance requires knowledgeable operators and coal that meets design specifications. Treated coal and briquettes can be 20-50% more costly than raw coal and outdated efficiency, coal quality, and environmental standards do

not encourage the switch. For instance, many government-affiliated enterprises located in "cold" regions still receive a heating allowance to subsidize fuel, providing further disincentive to pursue energy efficiency measures. Local laws in some areas prohibit the use of raw coal, but the laws are not adequately enforced.

3) Lack of awareness about cost-savings and local air pollution benefits associated with improved technology or quality fuel
    a. Weak product marketing capabilities, customer service, and communication among boiler owners have led to a shortage of consumer information
    b. The lack of systematic ways to finance energy efficiency improvements, through energy service companies or capital markets

A Suite of Actions to Overcome these Barriers

Disseminating efficient industrial boiler technologies has been recognized as the lowest cost pathway to achieving substantial greenhouse gas reductions in China. Therefore, numerous efforts are underway to support this goal. The following activities have been proposed to overcome specific barriers:

1) Lack of advanced, high efficiency boiler technologies in China

- A $101 million GEF/WB project on Efficient Industrial Boilers in China is addressing this fundamental issue by upgrading existing standard boiler designs, acquiring and demonstrating new foreign advanced technologies, and disseminating the results. In addition to adoption of new boiler designs, the program will focus on training for boiler manufacturers, operators, consumers and experts at regional boiler development centers and conservation centers.

2) Lack of incentives to switch from low quality fuel that does not meet boiler design specifications

- Guaranteed efficiency gains from higher quality fuels by supply companies will encourage consumers to buy sorted and washed coal, and briquettes.
- Demonstration of clear and cost-effective technological solutions will motivate local authorities to enforce efficiency and pollution standards.
- Widespread pilot projects to demonstrate cost savings and pollution reduction, and aggressive dissemination among industry groups will accelerate adoption.
- A systemic approach is required to examine fuel supply and the to create markets for quality fuel.
- Introduction of a more detailed coal grading system, similar to developing countries, with encourage the use of appropriate fuels.

3) Lack of awareness about cost-savings and local air pollution benefits associated with improved technology or quality fuel

- Information dissemination, pilot projects, public boiler technology support center, and government-mandated standards can improve information transfer to consumers.

- World Bank energy service company (ESCO) project is working towards pilot projects for financing energy efficiency projects, such as boilers projects. In addition, the GEF project above will study the potential of marketing advanced boilers through ESCOs. As efficient technologies are demonstrated and the results are more widely disseminated, commercial lenders should be more willing to lend money to fund efficiency improvements.

TCAPP Actions

SDPC requested that TCAPP activities focus on hardware technology transfer rather than capacity building. The interagency team selected three actions which would result in the identification of appropriate technologies for Chinese industrial boilers, and the assembly of necessary knowledge and partners to make that technology transfer happen. The actions are:

- Proposal to demonstrate advanced boiler technology transfer on Chinese boilers;
- Study tour for technology transfer of advanced boiler products and concepts; and
- International conference on technical improvements to Chinese industrial boilers to reduce greenhouse gas emissions

1) Proposal to Demonstrate Advanced Boiler Technology Transfer on Chinese Boilers

This action includes the following steps:

a. Identification, evaluation, and selection of suitable pilots sites and test agencies for collaboration on pilot high-efficiency boilers;
b. review of worldwide advanced technology applicable for industrial boilers, (emphasizing high efficiencies, reduced emissions, etc.) and any recent developments;
c. assessment of appropriate advanced technologies for industrial boilers in China; and
d. proposal for transfer of new boiler technology on new boilers with high efficiency and low emissions (possibly higher efficiency or performance than GEF boiler technologies)

The TCAPP industrial boilers team identified four potential pilot projects to pursue. Participating partners include private-sector companies, specialized testing and research centers, government-affiliated companies, and international donors. Each project has good potential for replication and expansion, and will result in reduced carbon dioxide emissions as well as lowered local pollution levels. The TCAPP team will provide technical, information dissemination, capacity-building, and project facilitation assistance.

- *Expansion of Sorted Coal Market and Coal-Sorting Technology*

A profitable, privately-owned company has developed a process to sort coal, and has built a 1 million ton per year plant. The sorted coal provides more efficient fuel for power stations, industrial boilers, and residential boilers. In addition, a local mandate to prohibit the use of raw coal, and the high cost of briquettes guarantee a good market. The TCAPP team will provide verification testing for the sorted coal used in industrial boilers, disseminate the results, and facilitate the building of a 10 million ton per year plant and the replication of this technology.

Initial tests of the sorted coal on a 2 ton/hour steam boiler have shown that the efficiency gain is 7%. With modifications and adjustments in operating parameters, 10% will probably be achieved.

- *Boilers for Biomass Briquettes*

Technology for making briquettes using a combination of coal fines and biomass (straw, rice husk) has been developed. Lab-scale tests, such as pressure and combustion experiments, have already been completed, but the project was discontinued by its foreign sponsors. The next step, which will be facilitated by the TCAPP team, is to complete field tests so that a new boiler can be designed for the biomass briquettes, or an old boiler can be retrofitted. A boiler designed to use this fuel would provide carbon dioxide emissions reductions, an increase in efficiency, and reduction of particulate pollution.

- *Verification of High Efficiency Boilers*

As part of the World Bank/Global Environment Facility project on high efficiency industrial boilers in China, a 20 ton boiler which burns high sulfur coal has been manufactured. The TCAPP team will facilitate testing of emissions and efficiency to verify the benefits of this boiler. Large-volume manufacturing will proceed if the results are positive.

- *Large-scale Briquette Manufacture*

A fuel company in Shanxi has retrofitted a 4 ton boiler to use briquettes. With TCAPP help they plan to retrofit more boilers, and build a 200,000 ton per year briquetting factory. Local environmental law mandates that raw coal can no longer be burned, so the market should be secure.

2) Study Tour for Technology Transfer of Advanced Boiler Products and Concepts

The study tour is aimed at educating Chinese experts on advanced boiler and boiler-related technologies available in the U.S. and internationally. During site visits and conversations with U.S. experts, the Chinese team will begin to identify technologies that are the most suitable for the Chinese situation. The study tour will include manufacturers and designers, most advanced concepts and equipment, and infrastructure and enabling technologies.

3. Integrated Workshop: "International Conference on Technical Improvements to Chinese Industrial Boilers to Reduce Greenhouse Gas Emissions"

The main purpose of this workshop is to widely disseminate knowledge gained in actions 1 and 2 and to pave the way for wide-scale implementation of more efficient industrial boilers in China. The workshop will also provide numerous manufacturing plants and other organizations in the industrial boiler community, including new technology companies (e.g., GEF), the opportunity to present their results. During the conference, all stakeholders in the boiler industry will be invited to exchange information and formulate a future plan of action.

Workshop Objectives:

- Develop exchange of lessons learned, experiences, and new technology
- Collect and disseminate quality data and information to assist technology developers
- Facilitate international technology transfer
- Establish Boiler Owners Association (BOA) to collectively look at key issues that impact boiler performance and technology transfer
- Establish Boiler Original Equipment Manufacturing (OEM) Association to assist manufacturers
- Make site visits and plant tours of boiler houses included in this study

Expected Deliverables and Results

- The 4 pilot projects will be completed by 2002
- The study tour for 6-8 experts to visit US coal treatment and efficient boiler works will take place at the end of 2002 and will support the work in the pilot projects.
- Markets will be enhanced through the dissemination of concrete evidence of efficiency gains and cost savings from use of sorted and washed coal, briquettes, and advanced boiler technologies.
- Heilongjiang Blue Sky Environmental Energy Company is planning to expand operations from 1 million tons per year of sorted coal to 10 million tons. TCAPP will work with them to create markets for their product through information dissemination and certified pilot tests. The $1 million investment for the coal sorting plant could reduce more than 500,000 MTC/year??
- A workshop that may take place in 2002 will kick off the Boiler Owner Association and other industry connections
- The inroads that have been made with the GEF/WB efficient industrial boilers project will be built upon. For instance the follow-up work in developing business plans for taking the efficient boilers to market, in coordinating the formation of a boiler owners association, and promoting ESCOs.
- The systemic fuel network study that is being developed under UN Foundation support will tie in with the fuel quality pilot projects.
- Other benefits include air pollution benefits and economic benefits for US companies engaged in business ventures

Timeline of Activities and Milestones

3/98	**Scoping meeting to select priorities**
10/98	Technology Cooperation framework prepared
4/99	**EPA and SDPC signed letter of intent for this project**
7/99	Initial team meetings for wind, motors, clean coal, boilers
12/00	**Industrial boilers technology and market strategy reports prepared**
1/01	**Three boilers actions selected by Interagency team**
4/01	Identification of 4 potential pilot projects
5/01	**Meetings with companies and experts to select pilot projects**
8/01	Presentation of some initial results at the Clean Energy Technology Forum in Beijing
9/01	Testing of pilot briquettes at NETL
11/01	**Study tour and information exchange in US**
11/01	**Dissemination of pilot tests on coal sorting, briquettes, and advance boiler**
12/01	Proposal to fund widespread implementation of successful pilot projects, including industry workshop
3/02	**Meetings to initiate boilers owners association**
9/01	

Resource requirements

Funds have been allocated to NETL to provide technical support to this project, including the organization of the study tour and providing technical support. Further funding is required for widespread dissemination of pilot test results, additional pilot tests, organizing the workshop, and forming the Boiler Owners Association. A portion of this funding may be leveraged from other ongoing boilers activities in China. Proposals will need to be written to fund the remaining activities.

Cooperators and funding mechanisms

The industrial boilers team includes Chinese experts involved in complimentary boilers-related efforts:

- Yang Qijuan leads the boilers team and is helping to make the link to the WB/GEF project.
- Mao Jianxiong of Tsinghua University is leading work on developing markets for treated fuels. He is making the connection to Jixi coal mine in Heilongjiang province to optimize production for washed coal.
- Lu Zian of the State Key Laboratory on Clean Coal Combustion is developing relationships with private companies. The lab is providing support to the coal sorting pilot project.

- Chen Rumei is developing a boiler pilot project in Shanghai
- Rockwell's Beijing office is actively participating in meetings and is looking at software and controls for boilers.
- Green Capital, based in Beijing, has talked to the developer of one pilot project and is interested in providing funding for promising projects
- Zou Guijin of CECIC would like to develop partnerships with US companies willing to provide ESCO-like leasing. They can make the link to Chinese companies. Long Shenghai, on the steering committee of the WB ESCO pilot project program, is also interested in developing ESCO-type programs sponsored by US manufacturing companies.
- NETL leads technical work on the US side and has a large database of US companies available. Mark Freeman is providing technical support for the boilers project, as well as developing relationships with the boilers and coal cleaning community.
- UNDESA is going to begin a project with UN Foundation to look at coal from a systemic perspective, including policy measures.
- Su Ge, affiliated with the UNDP/UNDESA/GEF energy efficiency project, has worked in Shanxi on biomass briquettes and has extensive contact with Chinese organizations and businesses. She will help form strategic partnerships where possible.

Next Steps

- Help develop strategic partnerships between US companies and CECIC
- Provide technical support for pilot tests
- Plan site visits and meetings for study tour to US
- Continue to identify potential pilot projects and seek funding mechanism to support them.
- Write proposal to fund workshop in 2002.

Supporting Information

- Energy/environment/climate overview of China
- Development and other goals for China
- Technologies and practices needed to support China objectives
- Relevant market information
- Snapshot of existing efforts and organizations active in energy/climate/environment in China

Check List

- ❑ Are our objectives and budget in alignment?

Objectives are high but activities are leveraged with other international programs as much as possible to ensure high rate of success.

- ❑ Who was consulted in preparing the plan (country officials, business partners, AID mission, other cooperators and contractors, others)?

Tsinghua University
Wind team, including State Power, State Economic and Trade Commission
Todd Bartholf
Motors team
IIEC

- ❑ Do we have a strong in-country partner?

Wind – yes, the Hydropower General Planning Institute (Wind consulting arm of State Power) has the leading wind expertise in the country
Motors – The Beijing Power Electronics R&D Center is the lead for the motors team and is not fully on-board with the US market-driven approach, nor are they able to reach suitable agreements with the US side. However, IIEC is able to take a lead in getting on-the-ground results.

- ❑ Are we confident that the chosen technologies are cost-effective and meet development and other objectives?

Wind - Definitely meets development and other objectives. Not cost-effective compared to conventional coal power but environmental costs not accounted for.

- ❑ Are we collaborating with appropriate international and other organizations?

Wind – collaboration with DOE program, UNDP, UNDESA, GEF, Energy Foundation, World Bank
Motors – collaboration with IIEC, ICA, LBNL, ACEEE, DOE

- ❑ How do we plan to bring in the private sector?

Pilot projects are all private-sector-driven: Tang wind farm, Magnadrive joint venture, Shengli Oil pilots.
We also periodically hold business roundtable discussions during US study tours and bring in private sector participation to meetings in China.

- ❑ Other?

EGYPT

Note – This plan contains sensitive information that should not be shared with in-country partners. In particular, see the notes regarding in-country partners in the checklist.

Executive Summary

This business plan was developed in response to the changing emphasis of the TCAPP program as it matures, and in response to lessons learned from the TCAPP work in Egypt since September, 1999. The most important changes of emphasis and direction implied by this plan are:

- It focuses on just three priority technology areas, two of which are very closely related, and
- It proposes to shift responsibility and resources to cooperators with greater in-country presence. The most important of these proposed cooperators will be Nexant, because of their role in closely related work funded by AID/Cairo.

This plan proposes work in three areas:

- Industrial sector energy efficiency. In this technology area, TCAPP focuses on continuing work on investment projects in progress, promoting new high priority investment projects, facilitating partnerships between Egyptian and U.S. firms in energy efficiency projects, and refining an overall strategy for promoting additional investment. Expected results include 3 energy efficiency projects representing on the order of $10 million in investment, which will reduce GHG emissions by 1.5 MMT over their lifetimes.
- Commercial sector energy efficiency and cogeneration. Work in this area also focuses on the development and promotion of high priority investment projects, with some resources devoted to training of Egyptian businesses—partly by using investment projects as "learning by doing" opportunities. Work in this area will also support the development of standards for the ESCO industry, and will develop a market replication strategy in cooperation with the emerging ESCO sector in Egypt. Note that many of the in-country partners, as well as the technical and financial approaches, are the same in both the commercial and industrial sectors, which implies a number of synergies between these two priority areas. Expected results include investments of close to $1 million in projects that will reduce GHG emissions by 35,000 MT over their lifetimes.
- Remote applications of renewable energy. In this area, TCAPP will build on a planned workshop in November 2001 to promote investment and partnerships in this area. Ongoing work includes a path-breaking feasibility study for hybrid renewable electricity systems in desert agricultural applications. Work in 2002 will also include the development of new investment projects and the refinement of a strategy to replicate them in the market place. Expected results include $150,000 of pilot scale investments in projects that will reduce GHG emissions by 260 MT over their lifetimes.

In terms of the prospects for successful projects and potential for broad market replication in the short and medium term, the industrial sector offers the best prospects, followed by the commercial and remote renewable areas in that order. These technology areas all address key

national priorities, as discussed below, and there is no clear consensus on how to rank them according to their development benefits

Goal of TCAPP
Accelerate the adoption of clean energy technologies and practices to promote economic and social development, mitigate global climate change, and support technology cooperation under the UNFCCC.

TCAPP Egypt Objectives
1) Main objectives for TCAPP in Egypt, as described in TCAPP planning documents developed by the Egyptian Environmental Affairs Agency on behalf of the interagency TCAPP working group:

    1.1 Increase the pace of technology transfer in the following technology areas:
    - Industrial energy efficiency retrofits,
    - Lighting efficiency and small cogeneration in the hotel and hospital sectors,
    - Renewable energy applications in the desert agriculture and remote eco-tourism sectors

    These technologies will be promoted through investment strategies developed and implemented in an interagency collaboration, with technical support from NREL

    1.2 Integrate this strategy into Egypt's Climate Change Action Plan and other key policy frameworks.

2) Specific objectives for Egypt in support of TCAPP objectives

    2.1 Increase access to and use of energy efficiency technologies in the industrial sector through pilot projects, facilitation of ESCO partnerships, and technical support.
    2.2 Accelerate the adoption of end use efficiency and small cogeneration technologies in the commercial sector, specifically hotels and hospitals, through project facilitation with emerging Egyptian ESCOs and partnerships with international ESCOs.
    2.3 Promote the cost-effective use of renewable electricity and process heat technologies in remote area, particularly in desert agriculture and remote tourism applications

Industrial Sector Energy Efficiency

1) Objectives

The objectives of TCAPP work in the industrial sector are the following:

    1.1. Advance three high priority projects that demonstrate both industrial energy efficiency technologies and ESCO business practices and lead to broad use of these technologies and business practices.

1.2. Promote business relationships that can result in increased investment in industrial energy efficiency through one major trade mission or reverse trade mission involving U.S. and Egyptian ESCO partners

1.3. Increase the understanding and awareness of the link between industrial energy and GHG mitigation by providing briefings for senior officials and by advancing one or more of the efficiency projects as part of Egypt's exploration of carbon credit trading strategies

2) Benefits in relation to national objectives

2.1 Support for local and/or national development objectives

Industrial energy efficiency addresses three primary national goals:

- Increasing economic efficiency, through the contribution of the direct economic payback to GDP
- Improved balance of trade, through the displacement of petroleum products traded on the international market[9]
- Improved air quality due to reduced fuel use, especially valuable for the many industrial facilities located near population centers.

2.2 $MMTCO_2$ avoided

Industrial energy efficiency projects will reduce greenhouse emissions by 15 million $MTCO_2$ equivalent over their operating life, when fully replicated in the industrial sector

2.3 Scale of Investment

Projects already ongoing in this sector represent investments by private sector partners of about $50,000. The objectives for FY 02 include facilitation of private sector investments of an additional $10 million. It is estimated that full market replication of industrial energy efficiency will entail investments of $100 million.

2.4 Other Benefits

As described by the Egyptian Environmental Affairs Agency (EEAA), industrial energy efficiency represents a major priority for Egypt. Transforming the industrial energy efficiency market—in which TCAPP is seen as having a key role—will have a number of additional benefits, including

- Reduced air emissions of SOx, NOx, and particulates, which will in turn provide health benefits to a large number of people in the areas near industrial facilities. Over twenty years, industrial sector projects could displace 7,000 metric tons (MT) of NOx, 2,200 MT of SOx and 730 MT of particulates.

[9] Egypt is an importer of middle distillate industrial and transportation fuels, so that reduced industrial use of these fuels directly reduces Egypt's import bill.

- Increased GDP, as a result of cost-effective fuel savings. Over the next twenty years, these savings will add between $100 and $200 million in net present value to the Egyptian economy.10
- Improved balance of trade conditions, resulting from decreased petroleum product imports or (equivalently) increased petroleum product exports, equal to the value of the fuel savings.

3) Barriers to implementation of objectives
   3.1 Lack of familiarity with available energy efficiency technologies.
   3.2 High first cost, in particular lack of familiarity with energy service performance contracting and related approaches to the financing of large-scale energy efficiency investments.
   3.3 High cost of capital
   3.4 Regulated fossil fuel and electricity prices that may not reflect true economic costs.
   3.5 Incomplete enforcement mechanisms for existing environmental standards.

4) Suite of Activities to Overcome Barriers

The central feature of TCAPP's approach to this sector is the facilitation of high-visibility, high-payoff investment projects—when carefully designed as part of a market-oriented commercialization strategy—and trade missions can help overcome the familiarity issue.[11] A complete set of actions to address these barriers would include:

- High priority commercial investment projects (see note 3),
- Training and capacity building for Egyptian ESCO partners,
- Facilitation of partnerships between Egyptian and International partners for large or specialized projects, and
- National policy reform to address regulatory, legal, and financial barriers and provide incentives for industrial efficiency initiatives

A viable ESCO industry is a strong response to the first-cost barrier, and, indirectly, to the high capital cost issue. At this point, the ESCO industry in Egypt can be effectively supported by facilitating international partnerships and providing technical support in ESCO-specific tools

[10] The value of the fuel savings represent just the "first round" of contributions to the Egyptian economy from industrial efficiency projects. As firms deploy these additional resources through investments in facilities, increases in employment, and other expenditures, the total contribution will be increased through the multiplier effect. The total increase in Egyptian GDP will be several times the value of the fuel savings.

[11] Egypt has seen an extraordinarily large number of donor-funded demonstration projects, many or most of which became "orphans" in the sense that they resulted in no further transformation of the market place. EEAA tends to have an automatic and strong negative reaction to the phrase "demonstration project." It needs to be made clear that proposed demonstration efforts will be conducted on commercial terms as part of an integrated strategy with good prospects for inducing additional investment in similar projects.

such as performance contracting and monitoring technologies. Efforts to educate local finance providers about ESCO project finance are also critical.

Both the high cost of capital and the subsidies inherent in regulated fossil fuel prices need to be addressed by national policy. The AID Mission provides significant support to GOE agencies in these and related areas, so that in Egypt they are not key elements of a technology transfer program *per se.* AID Mission programs also directly provide capacity building and technical assistance to Egyptian ESCOs. However, we suggest that TCAPP provide strategic, high-value additions to that ongoing work.

5) Proposed TCAPP Actions

5.1 *Facilitate key investment projects.* TCAPP staff will work with private sector partners and other cooperators to identify and facilitate influential demonstration projects that can be replicated in other facilities.

Egypt has seen an extraordinarily large number of donor-funded demonstration projects, many or most of which became "orphans" in the sense that they resulted in no further transformation of the market place. EEAA in particular tends to have an automatic and strong negative reaction to the phrase "demonstration project." In describing these projects, we need to be clear that proposed demonstration efforts will be conducted on commercial terms as part of an integrated strategy with good prospects for inducing additional investment in similar projects.

TCAPP has opened up an important opportunity with the Ministry of Petroleum (MOP), which is interested in upgrading a number of its existing refineries through energy efficiency upgrades. This work will proceed through the following steps:

- Further detailed audit work and feasibility analysis by Honeywell for the boiler subsystem at the Suez Oil Processing Company (SOPC)
- Completion of financing and implementation arrangements for the boiler work at SOPC, including the development of an energy service performance contract[12]
- Development of an RFP for additional energy efficiency services, starting with audits, at SOPC and other refineries

We will build on this opening through intensive work with MOP, providing technical support to the development of an RFP for refinery retrofit work. In partnership with the Energy Efficiency Policy Project (EEPP) and EEAA, TCAPP will involve emerging Egyptian ESCOs and international partners in responding to this RFP and in using the resulting projects in marketing ESCO services to other energy intensive industrial facilities. In terms

[12] The boiler system at SOPC is part of an aging facility with many opportunities for high-paying efficiency retrofits. We are assured by experienced staff both at Honeywell and EEAA that it is essentially assured that the feasibility study of SOPC will identify extremely cost-effective retrofit opportunities.

of greenhouse gas emission reductions, these investments are among the most highly leveraged that can be made in the Egyptian economy.

The retrofit work at SOPC has already led to initial discussions at the Ministry of Petroleum about upgrading their other refineries. During FY 2002, it is expected that at least one other refinery upgrade will be initiated, perhaps through an RFP from MOP. In addition, TCAPP will develop one other high-priority industrial efficiency investment project. [13]

5.2 *Distribute information about project opportunities to potential energy efficiency service providers and organize trade missions.* TCAPP will partner with *ECEE and NAESCO* in this effort. This process will begin by identifying 3 to 6 investment projects, expected to represent investments of about $500,000 in total. At this point, TCAPP will help organize a trade mission or reverse trade mission to provide opportunities for key efficiency equipment suppliers and energy service companies to contact Egyptian industrial customers. The needs of the emerging Egyptian ESCO partners will determine whether a trade mission or reverse trade mission would be more beneficial.

5.3 *Facilitate ESCO partnerships.* The trade mission activity will provide a foundation for TCAPP to facilitate additional partnerships between international and Egyptian ESCOs to advance projects, increase the capacity of the Egyptian partners, and transfer ESCO techniques. TCAPP will provide technical support for the development of project briefs for international partners, based on larger and more complex projects than can be taken on by emerging Egyptian ESCOs. The briefs will describe key ESCO opportunities in the industrial sector—as has been done in TCAPP Mexico, for example. The process of developing these project briefs in collaboration with Egyptian partners will help build their capacity to develop additional project proposals; the briefs themselves are the first step in securing partners and financing for the projects themselves. Additional facilitation activities will include meetings between ESCOs and between ESCOs and the industrial end-users, helping facility managers understand performance contracting, financing assistance, etc. at what step will the project briefs be prepared) Expected Deliverables and Results

5.4 *Strategy for Replicating SOPC projects in other energy-intensive facilities.* Based on the results of the SOPC refinery retrofit, TCAPP will work with EEAA, MOP, and other agencies to develop a strategy for replication of the technology and ESCO finance methods of the SOPC project. This effort will be closely coordinated with the EEPP, particularly in the area of policy reforms. NREL can provide a link to successful U.S. government industrial energy efficiency efforts as well as technical assistance and capacity building for key partners in this effort. One strategy would involve the training of emerging Egyptian ESCO partners in the technical aspects of ESCO

[13] TCAPP working group members include private consultants with close ties to metallurgy and other energy-intensive industries. TCAPP may also work with the Energy Efficiency Policy Project to identify industrial facilities that are converting from oil to gas fuel. A small investment in technical support of these projects, and matchmaking with TCAPP's business partners in the industrial control and automation areas, could add a significant energy efficiency component to these burnertip conversion projects.

operations, such as energy service performance contracting, monitoring and verification, and other tools of the ESCO trade.[14]

6) Deliverables

- Completed re-audit of Suez Oil Processing Company (SOPC) boiler subsystem
- Feasibility study for SOPC boiler retrofit project
- Project design for SOPC retrofit
- Project agreement for retrofit of SOPC boiler system
- Initiation of work on the SOPC boiler retrofit
- Request for Proposals from Ministry of Petroleum for energy efficiency retrofits in other refineries
- Trade mission or reverse trade mission on ESCO industrial applications
- Agreements between ESCOs and facility owners to undertake at least three additional industrial efficiency projects
- Strategy for replicating the SOPC project in other energy intensive industrial facilities (report)

7) Benefits

The key benefits of the projects directly resulting from the work during FY 2002 include the following:

- Private investment on the order of $10 million in industrial energy efficiency technology,
- Direct contribution to the Egyptian economy of $50 million in economic return on these investments,[15]
- Avoidance of 1.5 million metric MT of CO_2 emissions over the life of the projects (75,000 MTs/year),
- Reductions of about 2,000 MT of SOx, 700 MT of NOx and 75 MT of particulates, leading to health benefits for the urban populations near the facilities.
- Initiation of up to 3 additional projects that will generate similar benefits in FY03 and beyond, and promote broader market replication.

[14] As part of its support to the Federal Energy Management Program, NREL staff pioneered many aspects of performance contracting. NREL also has long-established credentials in the monitoring and verification of energy efficiency projects, and played a key role in the development of the standard reference work in this area, the *International Performance Monitoring and Verification Protocol.*

[15] Present value, first round contribution only. See note 2.

8) Timeline

Milestone –	**Completion Date**
Project design for SOPC retrofit	September 2001
Project Agreement for SOPC retrofit project	December 2001
Work begins on SOPC retrofit	January 2002
RFP for work at other refineries	February 2002
Project briefs compete	January 2002
Trade Mission or Reverse Trade Mission	April 2002
Replication Strategy for Industrial Sector	July 2002
Project partnerships for two additional projects	October 2002

9) Resource Requirements

Work Area	**NREL Budget**	**Cooperator Budget**	**Potential Cooperators**
Direct project facilitation (e.g. audits, project briefs, RFP)	$35,000	$50,000	Nexant
Trade mission	$5,000	$25,000	NAESCO, Nexant
ESCO partnership facilitation	$10,000	-[16]	Nexant
In country coordinator		$5,000	TBD
Total	$50,000	$80,000	

10) Cooperators

10.1 *Role of other cooperators.* Nexant, LLC (formerly Bechtel Consulting) is the strongest candidate for collaboration in this area. They are a primary contractor in the Energy Efficiency Policy Project (EEPP) funded by AID/Cairo. TCAPP has already established good working relationships with Nexant's Cairo office, and have been working jointly with them to develop projects for implementation by emerging ESCOs in Egypt. We propose that TCAPP provide additional funding to Nexant to coordinate more closely with TCAPP activities and make the link from their ongoing energy efficiency areas to greenhouse gas emissions reductions.[17]

[16] AID Cairo already funds Nexant to work in this area.

[17] The and complex large scope of Nexant's work for AID/Cairo under EEPP makes it somewhat difficult to engage them actively in the TCAPP work, even where there are clear "win-win" benefits. Accordingly, we propose total funding to Nexant in industrial and commercial sector efficiency areas that

As they have in other TCAPP countries, NAESCO could be very useful in publicizing a trade mission and other ESCO opportunities in Egypt. The Export Council for Energy Efficiency and World Business Council for Sustainable Development could also add value in this way through their network of businesses and their related activities.

10.2 *NREL's Role and Value Added.* From the beginning, NREL has played a key coordination and catalytic role in the SOPC refinery retrofit work, developing the initial concept and establishing ongoing relationships with both Honeywell (Cairo and Phoenix) and senior officials at the MOP. The best way to move this significant project forward is to maintain the continuity of these relationships and to bring in Egyptian and international partners at the appropriate time as it proceeds to implementation.. Technical assistance in performance contracting, monitoring and verification (M&V), and carbon accounting are natural roles for NREL, both because of its established technical capabilities in these areas through its lead role for the FEMP program and because of its standing as a neutral third party without a financial stake in the project itself. Training in ESCO technical and financial methods is also a natural role for NREL. The Laboratory can also work with E&Co and other finance organizations to connect this project with international commercial finance if necessary and to recruit international technical partners where required—roles suggested in previous discussions with Nexant. Do you also want to say anything about our ability to coordinate the work of EEAA in this area?.

In developing and refining a strategy to implement similar techniques at other facilities, it will be natural for the responsibility to shift to Egypt-based cooperators such as Nexant. NREL's role will then shift to focus more exclusively on performance contracting, M&V, and carbon accounting. The longer-term goal of NREL's contribution in those areas should be to establish capabilities and credible Egyptian institutions to carry out these technical functions.18

As demonstrated by its success in other TCAPP countries such as Mexico, NREL is well positioned to organize trade missions in the energy efficiency area in collaboration with NAESCO and ECEE. NREL also has strong capabilities to support reverse trade missions, which could be used to develop the capacity of Egyptian ESCOs in performance contracting and M&V. NREL is uniquely well qualified o add a GHG accounting component to this curriculum, helping to establish the link between energy efficiency and GHG issues at a grass roots level in Egypt. In the emerging industrial energy efficiency and ESCO market in Egypt, a small continuing role for NREL in these areas could add significant value to the ongoing efforts of EEPP in this area.

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will allow staff to be added to their project with a significant amount of their time devoted to TCAPP-related issues.

[18] The TCAPP team in Egypt has proposed to develop an "Energy Efficiency and Environmental Technology Center, (E3TC)" which could assume many or all of these functions, including training technical personnel.

11) Next Steps

The most important next step is to coordinate with AID/Cairo, so that they understand how TCAPP can support their ongoing work in this area and how they can benefit from TCAPP's technical support in linking those efforts more directly to climate change issues and other environmental benefits. Further discussions with Nexant could be useful in setting up that discussion.

Commercial Sector End Use Efficiency and Cogeneration

1) Objectives

1.1. Contribute to the establishment of an ESCCO industry in Egypt through facilitation of three to five new lighting and other energy efficiency projects in the hotel sector. One of these projects may also be a cogeneration application.

1.2. Provide additional opportunities for emerging ESCOS and help facilitate a market transformation in the hospital sector through one to two new investment projects, at least one of which is a cogeneration facility.

2) Benefits of this Objective

2.1 Support for local and/or national development objectives

Commercial cogeneration addresses two key national priorities:[19]

- Increased GDP, through both cost-effective energy savings and increases in employment in the energy service consulting sector, and
- Improved local air quality through the reduction in electricity generation and combustion for process heat.

2.2 MMTCO_2 avoided

Projects in the commercial sector are expected to reduce GHG emissions by 130,000 MTs of CO_2 equivalent per year when full market replication is achieved.

2.3 Scale of Investment

At full market replication, investment in the hotel and hospital sectors end use efficiency and cogeneration will reach $50 million total.

2.4 Other benefits

- Enhanced economic growth and GDP. These investments will contribute to economic growth and GDP through their payback in fuel savings. At full market implementation these savings will be between $50 and $100 million in net present value over the next twenty years.
- Increased employment. Energy efficiency services represent a significant opportunity to create new small and medium sized enterprises (SMEs), and to expand existing SMEs into new business lines in the ESCO area. Full market replication in the commercial sector could create on the order of 10,000 new professional-level jobs.

[19] Here we assume that the contribution to balance of payments from end-use conservation projects will be negligible. This follows from the assumption that displaced electric generation comes entirely from new, gas-fired generating capacity. Natural gas exports will be constrained by the capacity of pipelines, so that gas conserved in electricity generation will not increase the amount available for export. These assumptions are conservative; in reality there could be a small balance of payments benefit from these investments.

- Reduced air emissions. Over their lifetimes, these projects will avoid 50,000 MT of NO_x, 150 MT of SO_x, and 430 MT of particulate emissions.

3) Barriers to Implementation of Objectives

These technologies suffer first of all from the same barriers that they face in the U.S. and other developed countries, although some of these may apply to a greater degree in Egypt. These factors include:

- Lack of familiarity with applicable technologies, both among end-users and among local finance providers,
- End user reluctance to invest in relatively high first costs,[20]
- Institutional issues—the agent who would purchase the energy efficiency equipment is not the agent responsible for paying the energy bill,

Additional issues that are specific to the Egyptian market include

- A current "liquidity crisis," driven by a shortage of hard currency,[21]
- Lack of a viable ESCO industry with established business techniques, relationships and creditworthiness
- Lack of familiarity with performance contracting and other techniques of energy efficiency project finance, both among entrepreneurs and commercial banks.

4) Suite of Activities to Overcome Barriers

Like the industrial sector, the commercial sector focuses on enhancing the capacity of in-country partners to capitalize on cost-effective energy efficiency opportunities, largely through an ESCO business approach. There is overlap between the ESCO partners and applicable business practices between the industrial and commercial sectors, so there are many synergies between the actions in these two sectors. A full suite of activities to address the barriers to efficiency technologies includes:

- High priority commercial investment projects (see note 3),
- Training and capacity building for Egyptian ESCO partners,
- Facilitation of partnerships between Egyptian and International partners for large or specialized projects, and
- National policy reform to address regulatory, legal, and financial barriers and provide incentives for industrial efficiency initiatives

[20] This is sometimes written about in terms of end users acting as if they had high discount rates. In Egypt and other developing countries, this problem is exacerbated by high market interest rates—often prohibitively high for investments to be repaid in dollars.

[21] The shortage of hard currency is driven largely by the Egyptian governments large purchases of its own currency (paid for using its hard currency reserves) in order to maintain a more favorable exchange rate than would be determined in an open marketplace.

The investment projects, and possibly the ESCOs involved, in this sector may be smaller than those in the industrial sector. At this smaller scale, the emphasis should be more on enterprise development and technical assistance, and less—potentially not at all—on the facilitation of international partnerships.

AID Cairo funds related work in this area that is well established and successful, including both the EEPP and the Red Sea Sustainable Tourism Initiative. EEPP's efforts are particularly comprehensive in the area of national policy development. Accordingly, the appropriate role for TCAPP would be to add a small, highly leveraged set of technical assistance activities. NREL is particularly well positioned to offer enterprise-level training in ESCO business practices. It could also be useful for NREL to play an advisory role in setting up national standards and institutions for third party monitoring and verification of energy savings (and GHG reductions

4) Proposed TCAPP Actions

TCAPP Egypt has progressed to the point where an approach like the one taken in Mexico would be applicable—combining the identification and promotion of high-priority investment projects with capacity building for Egyptian ESCO partners organized around those projects on the ground.

5.1 *Identify and promote high-priority project opportunities.* The first requirement for the plan envisioned here is to identify investment opportunities that can serve simultaneously as a learning-by-doing exercise for emerging ESCO partners, an opportunity for international partnerships, and the basis for a financially and environmentally successful project. TCAPP has identified initial leads in both the hotel and hospital sectors. Further detailed, high quality energy audits will probably be necessary to identify the best prospects for this key activity.[22] TCAPP will identify target sectors and sites in cooperation with EEPP. TCAPP will develop briefs for approximately 6 high quality projects, screened on financial and risk criteria. TCAPP will work closely with EEPP in presenting these briefs to potential ESCO partners, and will provide technical support to these project partners in developing project agreements and performance contracts with end-users.

5.2 *Augment the learning-by doing through further training and business matchmaking with key Egyptian ESCO Partners.* TCAPP will organize a reverse trade mission for key Egyptian ESCO partners in close cooperation with EEPP work with those companies. This mission will include both a set of meetings with energy efficiency product suppliers and a short course at NREL with a curriculum covering monitoring and verification, performance contracting, and GHG accounting.

[22] Nexant staff has mentioned the short-run need for "AAA quality" energy audit capabilities to provide projects to use in the first phases of the ESCO industry development process. At the moment, this capability is not readily available in Egypt. While in the longer term developing this capability is part of the capacity building strategy, the best short-run strategy is probably to bring in auditors from outside. NREL has both internal capability in this area and task ordering agreements with capable private sector auditing firms that could be mobilized quickly.

5.3 *Building on the project experience with training materials and outreach.* Other TCAPP countries have found it useful to develop a "Guide to Performance Contracting" as an outreach tool for both ESCO enterprises and for end users who are potential ESCO customers. (These materials can be closely based on translations of existing materials into Arabic.)

5.4 *Institutional capacity building.*[23] Beyond the "Guide to Performance Contracting," ESCO transactions are also enhanced by the development of standards and possibly by independent institutions that perform monitoring and verification functions. TCAPP can play a supporting role to the ongoing efforts in this area currently support by the Mission, by providing technical assistance based on the U.S. experience and by helping ensure that the resulting institutions are consistent with the monitoring and verification requirements of carbon trading regimes.

5.5 *Market Replication.* TCAPP can also play a role in the replication of the initial projects throughout the commercial market place. During FY 2002, TCAPP will develop a strategy for commercial sector replication in collaboration with existing partners both in the government sector and in the private sector and with AID/Cairo and its cooperators. TCAPP can bring to bear its experience in the design and analysis of U.S. market replication strategies, especially focusing on its suite of successful voluntary programs.[24]

6) Expected Deliverables and Results

6.1 *Deliverables*

- Reverse trade mission for approximately 5 Egyptian ESCO partners
- Project briefs for 4 projects opportunities identified by TCAPP
- Project partnerships established to pursue at least 2 of these projects
- Project designs completed)
- Up to two small ($50,000 or less) and two larger ($250,000 or larger) commercial sector energy efficiency projects completed
- Strategy for promoting replication through case study reports, and other means.

6.2 *Benefits*

The projects directly resulting from this work will result in the following:

- Private investment on the order of $1 million in industrial energy efficiency technology,
- Direct contribution to the Egyptian economy of $5 million in economic return on these investments,[25]

[23] This action applies to both the industrial and commercial sectors, since one set of standards and institutions for M&V can apply to both. The functions envisioned here could also be coordinated through the E3TC described in Note 10.

[24] For example, see a recently completed analysis of EPA's Green Lights program developed by David Kline in collaboration with Skip Laitner at EPA. Draft paper available on request.

[25] Present value, first round contribution only. See note 2.

- Avoidance of 35,000 MT of CO_2 emissions over the life of the projects (1,750 MT/year),
- Reductions of about 2,000 MT of SOx, 700 MT of NOx and 75 MT of particulates, leading to health benefits for the urban populations near the facilities.
- Reductions of about 3 MT of NOx, 10 MT of particulates, and 1,000 MT of SOx emissions.

7) Timeline

Milestone	**Completion Date**
Identify and screen 10-15 candidate projects	January 2002
Project briefs for 3-5 high priority projects	February 2002
Project agreements	May 2002
Project designs	July 2002
Replication strategy report	May 2002
Reverse trade mission	April 2002
Four commercial sector efficiency projects	September, 2002
Guide to performance contracting complete	March 2002
Technical support on ESCO industry standards and institutions	September 2002`

8) Resource Requirements

Activity	**NREL Budget**	**Cooperator Budget**	**Potential Cooperators**
Reverse trade mission	$2,000	$20,000	Nexant, NAESCO, PA Consulting
Pilot project development	$25,000	$30,000	Nexant, PA Consulting
Reverse trade mission	$ 5,000	$20,000	Egyptian Energy Service Business Association
Materials and outreach	$1,000	$5,000	Translator TBD
Institutional technical support	$2,000	$5,000	Nexant or TBD
Market replication	$2,000	$5,000	Country coordinator, Nexant
In-country coordination	-	$5,000	TBD
Total	$37,000	$90,000	

9) Cooperators

a. *Role of other Cooperators.* Nexant has the lead, under EEPP, in developing the capacity of emerging ESCOs in Egypt. Nexant staff is actively engaged in developing example projects to use as vehicles for capacity building and enterprise development. PA Consulting has conducted audits of a number of hotels in the Red Sea area that offer particularly good economics for ESCO projects and high visibility. It is proposed that these groups retain the overall lead and coordination role in this area, with

b. *NREL Role and Value Added.* NREL will play a supporting role by supplying the additional technical support, capacity building, and facilitation services, primarily through the organization of the reverse trade mission. NREL will also assist in identifying and promoting an initial set of projects through its initial leads or by supplying auditing or other technical services as agreed with the other cooperators. NREL also has materials and expertise on hand that can be used in educating end-users about the benefits and mechanics of performance contracting. NREL's longstanding involvement in basic ESCO methodologies, including M&V and performance contracting, as well as GHG accounting, uniquely qualifies the laboratory to provide those services. TCAPP work to date with both Nexant and PA Consulting has established working relationships that will enable the necessary coordination with their ongoing work in commercial energy efficiency.

10) Next Steps

The most important next step is to get agreement from AID/Cairo to cooperate along these lines. Again, working with their contractors Nexant and PA Consulting could be a good way to gain intelligence before talking to the Mission.

Remote Renewable Energy Applications

TCAPP will address two related markets under this priority area: desert agriculture and remote tourism/eco-tourism projects.

1) Objectives
   1.1. Identify and promote renewable technologies that can be economically deployed in remote tourism applications
   1.2. Identify, assess and facilitate implementation of the best renewable and hybrid technologies for desert agriculture in the Southwest Egypt area of East Oweinat.
   1.3. Advance the capacity of Egyptian partners to exploit renewable energy technologies in the pursuit of market and development priorities.

2) Benefits of each Objective
   2.1 *Support for local and/or national development objectives.* Remote renewable energy applications address the following key development objectives:

- Sustainable development for rural areas. Areas outside the Nile Delta and Cairo, such as upper Egypt and the desert oases, are the most economically disadvantaged in Egypt. Increasing economic activity and opportunity in those areas is a key national priority.
- Improved agricultural productivity. Cost-effective remote power systems can contribute to the productivity of the agricultural sector by reducing total cost.
- Improved balance of payments. Renewable applications in desert agriculture improve balance of payments by offsetting the use of diesel fuel. Desert agriculture also improves balance of trade by producing crops for export (or, equivalently, obviating the need to import grains).

   2.2 *MTCO2 avoided.* At full implementation, renewable energy projects could avoid 500,000 MT of CO_2 equivalent over their lifetimes.

   2.3 *Scale of Investment.* The market potential of these technology applications is on the order of $100 million.

3) Barriers to implementation of objectives
   3.1 *Incomplete information about renewable resources and technology designs*
   3.2 *Cost of renewable energy, including the high cost of capital.*
   3.3 *Subsidized prices of competing fuel.*[26]

[26] Diesel fuel is a key competitor to renewable power systems in remote applications. Egyptian law requires diesel prices to be uniform throughout the country, which makes the already large subsidy even larger in the remote areas where renewables are most applicable. In East Oweinat, the current subsidy on diesel is approximately equal to the sales price. That is, the economic value (based on international product prices and transportation costs) is on the order of twice the price paid by consumers.

4) Suite of Activities to Address Barriers

A suite of actions to address these barriers includes the following:

- Development and dissemination of improved renewable resource information for Egypt;
- Development and dissemination of relevant renewable energy technology information, including sharing of relevant experience from other countries;
- Feasibility and technical design studies to identify the most cost-effective and valuable renewable technologies for remote applications; and
- Policy reforms to address the large subsidies to competing fossil fuels, especially diesel fuel.

Egypt has been working with a number of donor countries, notably Denmark and Germany, to develop wind and other renewable resources. These studies have included resource assessments, but more remains to be done in that area, particularly for wind.

Egypt and the U.S. recently signed a cooperative agreement in this area for work including a large solar thermal electric research/demonstration project. GOE agencies, including NREA and EEAA, plan to develop a comprehensive plan to promote the use of renewable energy to help achieve environmental and sustainable development priorities. At the same time, the large subsidy on diesel fuel does not appear to be on the table for discussion.

5) Proposed TCAPP Actions

5.1 *Assess Feasibility of Hybrid Renewable for Agriculture.* TCAPP is undertaking a feasibility assessment of hybrid renewable power systems for agricultural applications, based on potential applications in the East Oweinat development area. Egyptian agribusiness firms developing this area have expressed interest in applying—and promoting—hybrid systems that pass the feasibility screening. NREL has created partnerships in Egypt to develop the detailed, local data necessary to carry out this assessment, and has developed an analytical framework which will support the analysis. This analysis will result in a design and feasibility assessment of alternative hybrid renewable power systems for development of the East Oweinat agricultural area, one of the key new areas under development.

5.2 *Development of 2-4 Investment Projects.* TCAPP will provide design and technical assistance to developers of remote renewable applications, such as those that emerge from the feasibility assessment. These projects will be identified through TCAPP's network of Egyptian businesses and screened using the same modeling tools (might be helpful to say a word about these tools under the feasibility study) applied to the feasibility study. Technical assistance will be provided based on these and more detailed modeling tools (such as?) and NREL's extensive experience in remote renewable project design, finance, and implementation. TCAPP will provide similar technical assistance to eco-tourism renewable applications, concentrating on the design of new tourism development areas. Could clarify a bit further what assistance we will provide (e.g. improving cost-effectiveness of project design, evaluation of technology

applications and possible hybrids, identification of project partners, preparation of financing plans, etc.)

5.3 *Organize Workshop on Remote Renewable Applications.* In collaboration with the U.S.-Egypt Joint Committee on Science and Technology, TCAPP is organizing a workshop on renewable energy for remote applications for Fall, 2001. The workshop has the following goals:

- Present an assessment of the prospects for renewable technologies to a broad audience of potential users and policy makers to identify those projects that warrant further development.
- Provide opportunities for renewable energy suppliers and users to meet informally and develop projects and partnerships
- Identify needs and develop plans for technical assistance to high priority projects
- Consider the barriers to renewable energy applications that can be addressed by policy and advance a plan of action to address these barriers through discussion among key stakeholders.
- Prepare a present a plan of action for advancing selected projects.

5.4 *Replication of Initial Projects.* The workshop will help compile what has been learned about a strategy for promoting renewable energy. After the workshop, this information will be compiled into a well-defined plan for promoting renewable energy in remote applications, with particular emphasis on agriculture and tourism.

6) Expected Deliverables and Results

6.1 Deliverables

- Feasibility assessment of hybrid renewable systems for agriculture in East Oweinat (report)
- Project briefs for 2-4 potential investment projects in agriculture and tourism
- Detailed project proposals for the 2-4 projects developed with TCAPP technical assistance
- Project agreements for at least one renewable energy project in agriculture and one in eco-tourism
- Renewable energy applications workshop
- Plan for replicating initial projects

6.2 Benefits

The benefits directly derived from the FY 2002 activities include the following:

- Highly visible contributions to key agriculture objectives, including the development of new desert agricultural areas
- Contribution to sustainable tourism, also a key priority
- Investment of $150,000 in pilot-scale projects

- GHG reductions of 260 tons of CO2 over the lifetimes of the pilot projects
- Increased capacity of Egyptian partners to deploy renewables in pursuing sustainable development in remote areas.
- Establish foundation for increased renewable energy activity in agriculture, tourism, and other areas in future years.

7) Timeline

Milestone	**Completion Date**
Workshop on remote renewable applications	November 2001
Hybrid energy system feasibility study	January 2002
Project briefs for renewable projects	February 2002
Project design work completed	April 2002
Project agreements for renewable projects	May 2002
Two completed renewable projects	January 2003
Plan for market replication	January 2003

8) Resource Requirements

Activity	**NREL Budget**	**Cooperator Budget**	**Potential Cooperators**
Workshop[27]	$5,000		
Hybrid feasibility study	$15,000	$15,000	Arab Academy of Science and Technology
Pilot project development	$40,000	$20,000	SEIA or SEIA member companies
In-country coordination	-	$5,000	TBD
	$60,000	$35,000	

9) Cooperators

9.1 *Role of other Cooperators.* The Arab Academy can contribute detailed knowledge of PV markets and suppliers in Egypt, as well as technical expertise in the design and implementation of remote renewable applications. Dr. Fuad Abolfotouh at the Academy has an internationally established reputation in these areas and has already worked with Egypt TCAPP on related issues. SEIA can help publicize opportunities among its members and identify renewable suppliers active or interested in the Egyptian market. Renewable energy suppliers already active in Egypt, such as

[27] $25,000 co-funding in place from U.S.-Egypt joint committee on science and technology has been allocated for this workshop.

American Solar Energy, can provide advice on strategy and policy considerations that will be key to a successful market strategy.

9.2 *NREL Role and Value Added.* NREL has secured co-funding to pursue the renewable energy workshop. A small amount of additional resources can be used to capitalize on the opportunities presented by the workshop. In addition, NREL has established close working relationships with an important agribusiness firm that is interested both in implementing pilot projects in its agricultural operations and—perhaps more importantly—entering the renewable energy supply market to promote renewable energy to other agricultural firms. Among all the business relationships established by Egypt TCAPP, this one is judged most likely to be disrupted if the NREL staff involved were not able to continue their participation. Could play up more that this is our bread and butter to help screen and develop renewable energy projects and we have extensive tech expertise to offer, as well as good business contacts.

10) Next Steps

Immediate next steps include the completion of the feasibility study and the refinement of the program and recruiting of speakers for the renewable energy workshop, in collaboration with NREA and EEAA. Consultations with the agribusiness firm mentioned in the previous paragraph will also be ongoing.

Project Coordination and Managing the Transition

The question of management of the next phase is somewhat complex. In addition to work on investment projects, TCAPP relies on an essential core element of coordination, communication, and outreach. These functions are necessary to accomplish the market transformation goal that is essential to technology transfer. Considering each of several coordination functions in turn:

- Overall planning and management, including workplans and financial tracking. This role includes ongoing discussions with the USG sponsors, which are particularly important during this transition period. It will be difficult to transfer NREL's ongoing role in this area to another institution, particularly an in-country organization that is not regularly in touch with USG sponsors offices.
- Coordination of in-country team and maintaining engagement of key climate and other officials. NREL has a clear relative advantage in its established relationship with climate officials in Egypt. A change in overall management would require these relationships to be re-established. NREL also has a relative advantage in the coordination of the in-country team because of its history in helping establish and expand that in-country team over time. While a stronger role for in-country partners, particularly the country coordinator, would strengthen the functioning of TCAPP, the cohesion of the overall team would suffer under a transition to new overall management.
- Supporting presentation of project results at UNFCCC and other forums. For many of the same reasons mentioned just above, NREL is particularly well positioned to provide this support, in a way that requires very little incremental effort beyond the other functions of TCAPP.

- Subcontracting with in-country coordinator and others. See the notes in the checklist about the choice of in-country coordinator. NREL could use the support of in-country cooperators in this area. However, the management of these subcontracts so that they meet the evolving needs of USG sponsors requires a high degree of coordination with the sponsors. It will be difficult for a new managing partner to achieve the desired level of coordination in the short run.
- Integration of TCAPP with other USG sponsored work in the country. The stronger role suggested in this plan for in-country cooperators will support the overall manager in achieving a better integration of TCAPP with other USG programs.
- Business and donor outreach. A new overall manager could eventually assume this function, but considerable costs would be incurred in passing NREL's detailed knowledge of current and potential business and donor partners to a new entity. This is another area where personal relationships are what determine success, and these personal relationships cannot be fully transferred to a new coordinator.

These functions could in theory be managed through the Cairo Mission, but this will depend strongly on demonstrating to the Mission how TCAPP advances their existing objectives and securing an individual champion for the work. The relatively modest resources potentially available for Egypt TCAPP will make this demonstration difficult. A Mission Contractor—most appropriately Nexant—could take on these challenges, but for the same reasons it could be difficult to acquire their effective commitment to the work at the budget level that has been available. We continue to believe that a strong NREL role in program coordination—while simultaneously refocusing the efforts as described above—will be the most viable alternative to achieving the program goals.

Appendix: Supporting Information

Contact Information for Potential Cooperators

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Energy Attaché (Has changed since last visit. Need to get contact information from Hany)

Check List

- Are our objectives and budget in alignment?

Yes, the budgets have been estimated according to the activities described for NREL and other cooperators.

- Do we have a strong in-country partner

The in-country partner arrangements for Egypt TCAPP can be improved. EEAA is the lead agency for climate change, and has been cooperative and supportive in their work on TCAPP. However, because of its junior status in the government, EEAA is not completely capable of securing the support of other "implementing" agencies such as the Ministry of Electricity or the Ministry of Agriculture. In order to create a working interagency effort, relationships to other key agencies need to be established and managed by an in-country partner outside of EEAA. EEAA and the in-country coordinators suggested by EEAA have not been as effective as necessary in forging interagency linkages. Cooperators outside EEAA could also increase TCAPP's ability to engage Egyptian businesses in the effort.

- Are we confident that the chosen technologies are cost-effective and meet development and other objectives?

Based on experience in many other countries, we can be sure that there are significant opportunities for cost-effective industrial and commercial energy efficiency technologies. In these areas, it is a matter of identifying and financing specific opportunities as the initial step in catalyzing this market. The expertise required for these tasks is shared between NREL and its proposed cooperators as described above.

The cost effectiveness of renewable technologies in remote applications depends on how the environmental externalities and—more importantly—the large subsidies associated with competing fossil fuels are treated in the analysis. NREL possesses particularly strong credentials in the design and economic evaluation of renewable energy systems, including the impacts of subsidies and environmental externalities.

The technologies squarely address the development goals as defined by the interagency working group that established these priorities in the beginning of the TCAPP process.

- Are we collaborating with appropriate international and other organizations?

The business plan suggests additional international organizations, particular trade associations that would be valuable additional cooperators.

- How do we plan to bring in the private sector?

We plan to increase our connections to the private sector through a stronger connection to Nexant.

- Other?

KOREA

Executive Summary

Korea began the TCAPP process in 1998 and has established technology priorities and initiated implementation of actions to attract investment for these priorities. Priority areas include energy management, methane gas capture and reuse, and the use of heat pumps to reuse waste heat. The TCAPP work is lead by the Ministry of Commerce, Industry, and Energy (MOCIE) with active participation of the Korean Energy Management Corporation (KEMCO) The greatest progress to date has occurred in the energy management and methane sectors.

In the area of energy management it is estimated that with the $200 million in potential investment emission reductions on the order of 27,000,000 tons of carbon dioxide/year can be achieved. Methane projects have potential full market investment of $100 million in investment and 10,800,000 tons of carbon dioxide/year of emissions reductions. Heat pumps can conceivably reduce emissions by 29,700,000tons of carbon dioxide/year for a total investment of $50 million.

Goal of TCAPP

"Accelerate the adoption of **clean energy** technologies and practices to promote economic and social development, mitigate global climate change **and support technology cooperation under the UNFCCC."**

Main objectives for TCAPP in Korea

1. Expand the use of energy saving performance contracts in key industrial and commercial sectors through pilot projects in partnership with international businesses and increased Korean energy auditing and performance contracting capacity.

2. Expand the use of technologies that recover and use methane gas from liquid and solid waste streams through pilot projects in partnership with international businesses and increased Korean expertise in these projects.

3. Expand the use of heat pumps to recover heat from low temperature waste streams through pilot projects and better quality equipment in partnership with international businesses and increased Korean expertise in these projects as well as the manufacture of heat pumps.

Energy Management and Auditing Concepts

Energy management was selected as the top priority for TCAPP during scoping meetings held in Korea. The technology is viewed as being on the cusp of acceptance by industry. Korea is the fourth largest importer of oil in the world. The gains possible through this technology area will be immediate and very substantial. Work in this area has demonstrated interest by both international and Korean companies to jointly pursue projects under TCAPP.

Specific objectives for Energy Management and Auditing Concepts in support of TCAPP objectives

1. Encourage and support the use of energy saving performance contracts (ESPC) in industrial and commercial enterprises to improve energy efficiency.

2. Provide energy auditing techniques and considerations training for Korean industry, energy service companies (ESCO)s, and government agencies involved with ESPCs.

3. Develop a certification program to provide a measure of expertise to the energy service industry.

Benefits of Energy Management and Auditing Concepts

The use of ESPCs, and company funded projects resulting from better audits to improve energy efficiency is expected to increase the adoption of these technologies by using the funds currently wasted due to the use of inefficient technologies, to purchase newer more efficient equipment. TCAPP is expected to improve the performance and subsequent wide spread adoption of ESPCs by more qualified ESCOs. This will result in energy improvements of nearly $1 billion in the commercial and industrial sectors over the next ten to fifteen years.

Three areas of the Korean industrial sector provide the most graphic examples of the potential for savings from energy efficiency projects. It is estimated that in the paper industry $159 million can be saved. This equates to 560,000 toe of energy and 1.26 million tons of carbon dioxide release that can be reduced annually. In the chemical industry $320 million in savings are possible, equating to reductions of 2.26 million toe of energy and 5.9 million tons of carbon dioxide. The steel industry has the greatest potential for savings amounting to $714 million, 2.5 million toe, and 10.4 million tons of carbon dioxide.

TCAPP will also improve the quality of energy audits. This will enhance the ability of ESCOs to find projects. The improvement in audit capability will also improve KEMCO's ability to provide oversight to the ESPC project. Quality audits are also an essential part of ensuring that projects pursued by the ESCOs are successful. The fine points of being able to estimate future energy use and savings flows are critical to the success of ESPCs which can last more than 10 years. Understanding how to structure proposals to address the many areas of risk associated with long term energy efficiency projects, while keeping those costs low enough that the savings can pay for them is an art critical to successful ESPC projects.

TCAPP proposes training and testing for energy engineers that will set a standard to be used for comparison among energy professionals. The professionals and firms involved in Korea's ESCO industry have a large difference in capabilities and expertise. A system of training and testing to certify the abilities of these individuals and firms will have a significant impact on consumer's ability to find qualified professionals to take part in their projects. This is viewed as important to widespread acceptance of the process by the industrial and commercial sectors. There are nearly 100 firms registered as ESCOs. The quality of service provided and amount of expertise of these firms varies greatly. Establishing some type of standard and licensing process is an important step in quality control of this industry. Instituting a quality control tool for firms considering ESPCs will help guarantee a higher percentage of successful projects.

The energy savings being forecast will bring with them the benefit of related improvements in air quality and decreased impacts on the environment.

Barriers to implementation of Energy Management and Auditing Concepts

The shortage of skilled and experienced energy auditors in the field of industrial processes is a key barrier. While there are many engineers who currently claim to be "energy auditors" in Korea, most of them while highly qualified engineers, do not have the experience and skills needed for successful energy audits.

Difficulty in accessing national and international sources of financing due to reduced private sector interest in cost-saving energy conservation and energy efficiency measures makes it very difficult to finance ESPC projects. The lack of interest and trust in the ability of ESPCs to generate the savings needed to support front end investment continues to plague widespread acceptance of this tool. The government has started and continues to operate a revolving fund for ESPC projects. However, this system has problems. Interested Korean ESCOs must qualify the technical aspects of the project through KEMCO and then qualify for the financing through commercial banks which is based on company assets. This barrier has been a significant deterrent to small ESCOs. KEMCO and the MOCIE are continuing to modify this system to make it more accessible to the ESCO industry. The Korean ESCOs have not been able to attract international financiers and hope that TCAPP will help in breaking that barrier as well, due to the participation of foreign ESCOs.

Artificially low utility costs for industry makes it difficult for proposed projects to cost flow. The Korean government currently subsidizes utility prices for large industries. These artificially low utility prices make it more difficult to fund energy efficiency improvements from savings. A proposed project may save a lot of energy, but the low cost per kilowatt makes it difficult for the project to save enough to pay for the improvements.

Short paybacks required of industrial projects further complicate pursuing projects. Industry in general is not favorably disposed to make investments in infrastructure that have more than a couple year's payback. This significantly limits the scope of projects that can be done in these facilities.

Brief Summary of Activities Necessary to Overcome Barriers

To improve the confidence of businesses in performance contracting the Korean government is keenly interested in activities to create partnerships with international ESCOs. It is felt that these relationships will teach the Korean ESCOs the finer points of how conduct successful projects. The Korean government also feels that having international partners, who already have a solid reputation for successful ESPCs, working with Korean ESCOs will help alleviate concerns by Korean businesses about pursuing these projects.

To overcome the shortage of qualified energy auditors the Korean government is pursuing training courses for the auditors. Korea is looking for best practices from overseas to improve deficiencies in this arena. The government has also encouraged formation of a professional association of ESCOs the Korea Association of Energy Service Companies. The ESCO industry and government are also working to learn best practices through joint projects with foreign ESCOs.

KEMCO and MOCIE are actively looking for ways to make funding for these long range projects more accessible to the ESCO community. They have done this by trying to assist small ESCOs not aligned with the large industrial conglomerates. The government is also looking for legislative and regulatory changes that will make these funds easier to get. Periodic meetings with ESCO community are held to discuss the barriers in this area and how to overcome them. These organizations are also working to encourage foreign investment in energy efficiency projects.

Korea has embarked on a structured program to raise the utility prices paid by Korean industry. The program will raise utility prices by 100% over a five-year period. While the prices will continue to be controlled by the government, is it felt these efforts will bring utility prices closer to the actual market value.

Proposed TCAPP Actions

Development of ESCO Projects

TCAPP is actively seeking ESPC projects that will demonstrate the technology transfer process through projects pursued by joint foreign and Korean ESCO teams. Some foreign firms have demonstrated interest in some type of joint project development with Korean ESCOs. Five projects are currently being considered. One project is past the initial proposal stage, with an ESCO working to finalize a proposal. The second project is in the initial scoping and partner identification stage. The third project has been identified, but is waiting until the second project moves along. The forth project has been identified, but the industrial customer is moving slowly. The fifth project has recently been identified and a search is underway to find a suitable U.S. partner.

1. An initial project with the Hyundai Motors' Ulsan complex will save approximately $31 million in electricity over the next 16 years. This project was identified through a joint effort between KEMCO, Hyundai, EPS Korea, and Sempra Energy. Sempra conducted an initial

proposal, with participation by KEMCO and EPS Korea auditors, as well as Hyundai facility personnel. The initial proposal suggested various options that could be implemented to improve the energy efficiency of one of the plants processes.

While corporate level decisions at Sempra forced the company to cease operations in Asia they followed through with the initial proposal. Sempra went as far as to host discussions at their Houston offices with the other partners in this project. Hyundai has since decided to pursue one of the options suggested by Sempra. They are now working with Honeywell, Korea to follow through on the project. This project will be used to develop an initial model for use in other similar TCAPP projects in Korea.

The high level of anticipated investment in this project and the relatively long payback being accepted by Hyundai is being driven by environmental regulatory considerations as much as by energy efficiency concerns. Anticipated changes in emissions standards are pushing Hyundai to consider alternatives requiring more investment and a slower payback. The result is a larger and significantly different project than the one originally considered.

The next steps planned for this project are to assist with evaluation of the initial proposal by Honeywell, Korea. After the initial proposal is approved assistance will be provided during the detailed survey as needed. In the meantime, we are now analyzing the activities of the project to date to develop a model/lessons learned for future projects. During installation of the initial project, the ESCO will also be discussing follow on projects with Hyundai and KEMCO.

2. A project being developed by an LG refinery is expected to save millions of dollars in energy use using traditional energy efficient technologies. This project will in the process of saving energy prevent thousands of tons of CO2 from being released into the atmosphere. It is estimated that the project could save $10 million, equating to cumulative reductions of 86,000 toe of energy and 225,000 tons of carbon dioxide.

   Initial meetings have taken place between the Korean and a U.S. ESCO. The Korean ESCO that will take on this project is Techwin. The U.S. participant will probably be Trane, which not only manufactures equipment, but also has a successful ESCO. A representative from Trane traveled to Korea to meet with KEMCO, LG and Techwin officials. The two companies are trading investment information and are determining the best corporate relationship to form in pursuit of the project.

   We will assist in conduct of the initial survey, and communications between the partners through the initial survey. NREL will assist in evaluation of the initial survey. We will again assist in communications during the final survey and assessment of the final proposal, as needed.

3. Another project being considered by LG will make process improvements at a second refinery to again save millions of dollars in energy. The results of this project are also forecast to prevent thousands of tons of carbon from being released into the atmosphere.

This second project is anticipated to be much more complex than the first project. Trane will certainly be considered as the U.S. partner for this project, but a search is currently underway to find other ESCOs with more refinery specific experience. This project is outside the realm of most ESPC projects. Most of these projects revolve around tried and proven technologies related to general building savings. The movement from these housekeeping type projects to process centered projects introduces significantly more complexity and risk to ESPCs. These are the areas that Korea is most interested in pursuing as part of TCAPP. They are also the areas that are less appealing to foreign ESCOs who will have to bear a great of risk.

The goal is to have this project well underway within a year. The progress will depend on availability of firms with the expertise needed and their willingness to pursue such a project in Korea.

NREL will assist in this project as with the others. We anticipate an initial role in communication facilitation to get the partners working together. There is also a role for NREL to assist in introductions to the AEP Korea office, which is anticipated to be a major source of assistance to companies unfamiliar with doing business in Korea. Once the project is better scoped, NREL will assist as needed during the initial and final proposal development, as well as providing comments for both of these proposals to KEMCO and LG.

4. Pohong Steel has expressed interest in a very large project at one of their sites. The project has significant environmental impacts as well as energy saving associated with it.

   NREL will assist in the scoping of the project and identifying the international partners for this project. The NREL role will then be the same as in the others listed above. While assisting on an as needed basis, we will be analyzing the project and lessons learned from it that can be incorporated into our model for transferring technology using this program.

5. SK Corporation has recently begun forming a project at the Ulsan University Hospital. This type of project lends itself to the ESPC model. NREL drafted a solicitation, which was sent to NAESCO for distribution to their members. The 739-bed hospital has two buildings, one six and one eight story, totaling 52,414 square meters. It is possible it could save $160,000/year, equating to 1380 toe and 3600 tons of CO2.

   The next step for this project is to compile any responses received from U.S. ESCOs interested in taking part in this project and assisting SK Corporation and KEMCO in selecting the U.S. partner. We will then assist as needed during the initial survey phase, assist with evaluation of the survey, assist during the detailed survey phase and evaluation of the proposal. We will also assist as needed in helping the U.S. ESCO make contact with AEP Korea to learn about doing business in Korea, as well as providing samples of agreements used during past projects.

6. Other similar projects are being actively sought by KEMCO. They have received a great deal of interest from the ESCO community for pursuing ESPC projects with foreign partners. The TCAPP goal is to pursue two or three major projects in this area each year. Personnel to support the projects and the number of foreign participants that can be found limit the

number of projects. The goal of these projects is to determine models for successful implementation of ESPC projects. It is also hoped that the initial projects will lead to some solid working relationships between U.S. and Korean companies, which will be a source of continuing transfer of technologies. We will continually look for additional projects to support, though our priority for the next year will be to support those mentioned above.

Training for Improved Auditing

Other classes are expected to help increase the audit skills of the various ESCOs. The current plan is to determine where the major weaknesses are in these skills by observing the auditors during these initial projects. It is felt that the training can be focused to the needs better, after following at least the first project through.

Future intermediate and advanced trainings are being considered to meet the needs of individuals, firms, and government auditors. These workshops will focus on efforts to audit industrial and commercial facilities. The workshops will also attempt to ensure that the energy data compiled can then be successfully combined into projects that will ensure successful ESPC projects. The success of these training programs is considered vital to implementation of ESPCs in Korea. While current auditors have a great deal of engineering knowledge and have experience with audits related to simple technologies, the demand in the market is for more comprehensive projects. These classes will provide the tools needed to ensure better proposals, which will lead to more successful projects. More successful projects in Korea will lead to more universal acceptance of this method of installing projects by customers and financiers.

Qualification of ESCOs

Efforts to establish some type of qualification system for auditors and companies involved in this industry are continuing in Korea. Initial information sharing was coordinated between the Association of Energy Engineers (AEE) and KEMCO. AEE has established testing and registration procedures in the U.S. for energy auditors. It was decided after this initial exchange of information that TCAPP Korea will focus on growing this capability from within Korea, rather than depending on a foreign model.

NREL will provide assistance in this area during the next year if asked to, but no actions are planned at this time to support this goal.

TCAPP Korea Accomplishments to Date

TCAPP has already made significant strides in the Energy Management area. These accomplishments have made it possible to pursue our current goals. Examples of efforts already accomplished as part of TCAPP in this area include:

- A basic energy-auditing course was conducted directly through AEP in November 1999. The course was attended by a variety of government, commercial, and educational

representatives. The course was designed to give attendees an introduction into the techniques employed to determine energy use at a facility. This should increase the skills of new auditors and companies beginning to conduct audits, which should lead to better projects and more savings.

- An advanced course was conducted during January 2000. The goal of this course was to introduce attendees to some of the advanced concepts beyond simple investigation of energy use. Concepts related to advanced data manipulation required to forecast future energy use and develop financeable proposals were discussed. The session was attended by a variety of commercial and governmental energy auditors. This training will help ensure that the data collected from audits will be used in a manner that will lead to more successful energy efficiency projects.

- Information was gathered from AEE regarding trainings and qualification programs they developed elsewhere in the world. These programs were useful in determining the focus of a future Korean program for qualifying ESCOs.

- An industrial visit to Korea by two U.S. ESCOs was coordinated in conjunction with the advanced audit training. The U.S. ESCOs visited the Hyundai site, and discussed both the Hyundai project and other possible ESPC projects in Korea. The result of the exchange was the initial participation of Sempra in the Hyundai site. The exchange provided valuable information on modeling future teaming for projects. The visit also provided invaluable information to the U.S. ESCOs about the current potential of Korean ESCOs as well as of the state of energy efficiency in some major industrial companies.

Expected Deliverables and Results

Deliverables

- Facilitate approval of ESPC contract documents for Hyundai project.
- Review of final energy conservation measures proposed for Hyundai project.
- Provide advice and support of post installation Measurement and Verification (M&V) of savings on Hyundai project.
- Review of initial proposal for first LG project.
- Facilitate approval of ESPC contract documents for LG project.
- Review of final proposal for first LG project
- Provide advice and support of post installation M&V of savings on LG project
- Advice and assistance on U.S. ESCO selection for Ulsan University Hospital Project.
- Review of initial proposal for first Ulsan University Hospital Project.
- Facilitate approval of ESPC contract documents for Ulsan University Hospital Project.
- Review of final proposal for first Ulsan University Hospital Project.
- Provide advice and support of post installation M&V of savings on Ulsan University Hospital Project.

- Advice and assistance on U.S. ESCO selection for second LG project.
- Initial proposal for second LG project.
- Model solicitation for ESCO projects, updated after each project.
- Model for executing ESPC projects under TCAPP, updated after each project.

Benefits –

Estimated Annual Savings/Reductions from Planned Projects

PROJECT		**DOLLAR SAVINGS** (DOLLARS)	**CO2 REDUCTION** (TONS)	**ENERGY SAVINGS** (TOE)	**PRIVATE INVESTMENT** (DOLLARS)
Hyundai initial		1,900,000	16,500	43,000	16,000,000
LG initial refinery		1,000,000	22,500	86,000	10,000,000
Ulsan University Hospital		160,000	3,600	1,400	1,000,000

Full Market Replication Benefits in the Most Promising Sectors

Item	**Estimated Market Size (million US $)**	**energy reduction potential (thousand toe)**	**GHG reduction potential (thousand TCO_2)**
(by industrial sub-sector)			
Energy management in the paper industry	159	560	1,258
Energy management in the chemical industry	320	2,258	5,931
Energy management in the steel industry	714	2,520	6,590
(by technology)			
Low temperature (bellow 140 ?) waste heat recovery from boiler fueled with bunker-C oil	680	3,202	10,367

The investment of hundreds of millions of dollars in energy efficient improvements is expected to give local economies a boost in the arm. Most construction work in the U.S. model is subcontracted out to local contractors for implementation. This usually provides a good deal of investment in community where the projects take place. This investment not only helps the local economy, but also develops support for these kinds of initiatives in the areas around the projects.

Timeline of Activities, including important milestones

Hyundai initial project

- Review of contract documents for the Hyundai project - Nov 2001
- Develop model ESCO solicitation for future projects - Oct 2002
- Post installation M&V report - Mar 2002
- Develop and publish Hyundai case study - May 2002
- Assist in development of follow-on Hyundai project - August 2002

First LG Project

- Assist in partnership development for LG project - Oct 2002
- Review initial proposal for LG project -February 2002
- Review detailed energy survey and final proposal - Jun 2002
- Review of contract documents for first LG project - Sep 2002

Ulsan University Hospital Project

- Assist in partnership development of hospital project - Oct 2002
- Review initial proposal for hospital project - Feb 2002
- Review detailed energy survey and final proposal - Jun 2002
- Review of contract documents for second LG project - Sep 2003

Second LG Project

- Assist in partnership development of second LG project - April 2002
- Review initial proposal for LG project - August 2002
- Review detailed energy survey and final proposal - Nov 2002
- Review of contract documents for second LG project - Mar 2003

Resource Requirements for Energy Management and Auditing

	Current Funding	Full Funding Scenario
Support for Three ESPC Projects	$30,000	$60,000
Develop Model Solicitation and Business Model	$5,000	$10,000
Training for Auditors		$30,000
General Coordination	$5,000	$15,000
Funding to Assist Initial ESCO Visits *		$5,000
Total	$40,000	$120,000

* It's been found in past ESCO visits that offering one or two thousand dollars to the ESCO to help offset travel expenses during an initial visit to a Korean ESCO has been enough to overcome initial cost objections by the ESCO.

Cooperators

KEMCO – is the in country coordinator of all TCAPP activities. They interface with Korean governments and companies to find projects. KEMCO also works to inform the Korean populace of the potential of energy efficiency. MOCIE has also given them responsibility for managing the revolving fund used to finance ESPC projects. KEMCO representatives help develop policy and represent Korea in international climate change meetings.

AEP Korea – provided support for setting up the TCAPP program in Korea. They were instrumental in establishing contacts with MOCIE and their subordinate organizations. AEP provided the majority of the funding for TCAPP activities in Korea initially. AEP provided some travel reimbursement for commercial exchange visits related to TCAPP. AEP can be a tremendous asset to U.S. companies that want to learn about the requirements for doing business in Korea.

EPA – started the TCAPP Korea effort with trips to Korea to meet with Korean government officials. EPA has taken up more and more of the funding for all TCAPP activities in Korea as AEP funds have decreased.

Methane Capture and Reuse

Methane capture and reuse was selected as the second priority for TCAPP during scooping meetings held in Korea. The technology is viewed as being ready for market and having a great deal of potential in Korea. Currently there are only two landfill methane projects in Korea outside those being pursued under TCAPP. The potential for this technology is tremendous both in the traditional landfill type projects and in other projects using waste streams such as hog or chicken waste to produce power and mitigate other environmental damage being caused by this waste. The gains possible through this technology area will be immediate and very substantial. Work in this area has demonstrated interest by both international and Korean companies to jointly pursue projects under TCAPP.

Specific objectives for Methane Capture and Reuse in support of TCAPP objectives

Encourage and support the capture and reuse of methane gas being emitted from municipal, commercial, and industrial liquid and solid waste streams through pilot projects and training activities.

Benefits of Methane Capture and Reuse

As of 1997, annual GHG emissions from waste are about 40.7 million TCO_2. It accounts for 8% of the total GHG emissions in Korea. Most of this is in the form of methane from landfills.

South Korea produces 17 million tons of municipal waste annually. Of the waste, 64% goes to landfills, 7% to incinerators, and 29% to recycling.

As of September 1999 there are 301 landfill sites currently in operation. The total capacity is 408 million cubic meters. The landfills are at 26% capacity. 26 of these sites have a capacity of more than 1 million cubic meter and are filled to 92 percent.

There are significant health benefits that accrue from the capture and reuse of methane. The direct effects of inhaling methane gas are serious if not fatal, however the many indirect effects of large amounts of this gas are also significant. Capturing and reusing this gas productively therefore has multiple benefits.

The explosive nature of concentrated methane alone has prompted many countries to regulate the manner that solids wastes are disposed of. Korea has already begun ringing their landfills with capture systems to prevent the lethal migration of the landfill gas away from the landfills.

Due to the chemical nature of methane gas, it is 27 times as damaging to the atmosphere as carbon dioxide. Since many methane generators are in fairly concentrated areas, like landfills and farms, harvesting this gas has a more reasonable cost than many climate change measures.

The methane gas harvested under this concept will be used as a source of chemical reactions or burned as a source of heat. In this way not only are the ill effects of the methane significantly reduced, the heat generated is offsetting the burning of other hydrocarbons.

The potential for methane gas production in Korea is:

- Food waste: 14,000 tons/day (250,000 toe or 350 million m^3 of bio gas/year)
- Animal manure: 21,000 tons/day (210,000 toe of bio gas/year)
- Sewage sludge: 11,760 tons/day (approx. 120,000 toe of bio gas/year)
- Industrial waste: (approx. 120,000 toe of bio gas/year)

- Total: 700,000 toe of bio gas/year

This leads to an annual reduction of 296,000 TCO_2 due to the energy saved by burning the methane, in addition to the benefits of not releasing the methane gas into the atmosphere. The current estimated potential investment of $50 million should help reduce carbon dioxide emissions by 4 million tons over the next 20 years.

Barriers to implementation of Methane Capture and Reuse

Shortage of skilled and experienced engineers and technicians in the area of landfill gas and other forms of methane capture hamper efforts to implement projects.

The concept is still new to Korea and is not widely accepted and the benefits are not widely understood. To date only four sites are known to be actively pursuing projects in this area.

There is a lack of funding for commercial projects at farms. The funding at landfill sites is better, but still marginal.

The regulations and government agencies involved in making methane capture projects work are split between two ministries. The Ministry of Commerce, Industry, and Energy (MOCIE) and the Ministry of the Environment (MOE) both have responsibilities related to these projects. Coordination of the activities of the two ministries and conflicting regulations makes implementation of these projects more problematic. KEMCO is closely tied with MOCIE and is very adept at pursuing changes to MOCIE controlled regulations when needed. They are not in the same position to improve regulations under the purview of MOE.

Brief Summary of Activities Necessary to Overcome Barriers.

1. To overcome the shortage of qualified engineers in the methane recovery field, KEMCO is working to find qualified international partners for Korean firms.

2. KEMCO is working to publicize the benefits of methane recovery, particularly related to landfill gas recovery at municipal landfills.

3. KEMCO and MOCIE are working with MOE to overcome regulatory barriers to project implementation.

Proposed TCAPP Actions

TCAPP is actively seeking landfill methane projects that will demonstrate the technology. Two projects have been identified and other municipalities have expressed interest in pursuing projects under TCAPP. The program is also considering further training/outreach in Korea, as well as actively pursuing new international partners for future projects.

1. The municipal landfill in Ulsan is the first project where a design-build contract has been awarded as a result of TCAPP work. The project is in the design phase and will require oversight by the MOE, KEMCO/MOCIE, and NREL team. The project team is composed of the environmental team from the SK Refinery, which adjoins the landfill. A Danish environmental consultant is providing the design for the project. The U.S.'s Duke Engineering is providing design oversight for SK. TCAPP's role in this project will be to monitor the partnership of the project team. It is anticipated that advice and assistance in forming the contractual basis for the partnership will be required, as will some third party oversight. This project is also very important from the prospective of determining barriers posed by either MOE or MOCIE regulations. The governmental partnership, which includes local and national level organizations, will work to overcome any regulatory barriers uncovered.

   The next steps for this project are to review the initial proposal submitted by the SK team. NREL will provide advice and assistance during the final design phase, and provide comments on the final design to KEMCO and Ulsan. A model for putting landfill methane projects in place will be developed as this project progresses.

2. A second landfill project is being brought into the program. The project is south of Seoul in the city of Daegu. Daegu's landfill is one of the largest in Korea and the City has been considering the possibility of some kind of project for some time. This project is currently in the feasibility study phase. The Korean Solid Waste Engineering Association, in conjunction with a small Korean consultant, a small U.S. consultant, and SK Corporation are conducting the study. TCAPP's role in this project will be very similar to the role played in the Ulsan project. Duke Engineering is being considered for a larger role in this project.

   NREL will assist in identifying the partners for this project. The feasibility study will be evaluated when it is finished. We will provide input on the results of the initial design and final design documents. We will also provide assistance as needed for the international partner to learn about doing business in Korea, through AEP Korea. The landfill methane model will be modified based on the experiences gained during this project.

3. EPA's LMOP has offered to help fund and coordinate a feasibility study at a third landfill site. KEMCO and MOE are working together to find an appropriate site to study. This site is expected to be the next pilot site. TCAPP is searching for other Korean landfill contractors to take part in this and other such projects. At the same time, other international companies are being sought out to take part in these projects. There has been a significant amount of interest expressed both in Korea and abroad for involvement in these projects. The EPA

LMOP partners list appears to be an excellent means of communicating future projects and interest.

4. There is a tremendous potential to harness the methane released from hog and chicken waste in Korea. This refuse is a serious environmental threat to the water sources in Korea, as well as to the atmosphere. Two U.S. companies that build anaerobic digesters have expressed interest in building some of these facilities in Korea. A pilot site and Korean partner need to be identified for this technology.

   NREL will continue to encourage and assist KEMCO in the identification of one or more pilot sites for this kind of technology. These are expected to be even more difficult for KEMCO to pursue due to the many MOE connections to this kind of project. Once these barriers have been overcome, and a project has been identified, NREL will provide the same kind of assistance as has been provided in the landfill methane projects. These services will be in the areas of partner selection and review of submitted project technical documentation.

TCAPP Accomplishments

The accomplishments of TCAPP in the area of methane capture and reuse are the actions that are shaping our future actions. These past successes include:

1. The U.S. Environmental Protection Agency's (EPA)'s Landfill Methane Outreach Program (LMOP) conducted a two day workshop for national and local government officials, contractors, and academicians. Over 100 people attended the workshop from these various sectors. The Ulsan project and Deagu projects both were positively affected because they sent key participants to the workshop.

   While in Korea, LMOP offered assistance in publicizing the LFG projects and in funding one feasibility study, during meetings between LMOP, MOE, and KEMCO. This meeting and the offered support have been instrumental in developing a stronger interest in MOE for these projects. It has also been important in strengthening the partnership between MOE and MOCIE in working to install methane projects.

2. TCAPP using AEP funds sponsored a business investigation trip to Korea in January 2000. The trip was conducted in conjunction with the Advanced ESCO training conducted under the program. Two U.S. ESCOs participated in this visit. Sempra Energy's participation resulted in an initial audit and proposal of the Hyundai plant under the Energy Management part of TCAPP. Duke Engineering also participated in this visit. As a direct result of the visit and follow on actions by the TCAPP team, Duke expressed interest in pursuing the Ulsan landfill project under TCAPP.

3. In September 2000, SK and KEMCO sent a delegation to the U.S. to explore technology options for the Ulsan project and to meet prospective U.S. partners. The team visited several U.S. experts at national laboratories, and commercial representatives. They also toured a several operational landfill methane projects. One of those sites was a project that had been

installed and is being operated by Duke Engineering. The Duke and SK members discussed possible mutual interests and roles for the Ulsan project.

4. Duke followed up the U.S. visit with trips to Korea to work the potential relationships with SK. The two companies signed agreements during the spring of 2001 regarding sharing of proprietary information. Duke also reviewed the Ulsan landfill feasibility study performed by the Danish firm for SK. These actions have been instrumental in forming the relationship between SK and Duke for working on future projects, including the Daegu project.

5. Representatives from the Korean participants in the Daegu feasibility study traveled to the U.S. and Canada in August 2001 to explore various technologies, which may be applicable to the Daegu project. The trip was based on the SK trip of September of 2000. TCAPP involvement in that trip was basically passing on point of contact and comments regarding the itinerary. The trip should provide valuable information to the city and study task force.

Expected Deliverables and Results

Deliverables

- Facilitate approval of contract documents for Ulsan project.
- Provide technical assistance in review of the Ulsan initial proposal.
- Provide technical assistance in review of the Ulsan final proposal.
- Assist in pairing of partners for Daegu team
- Facilitate approval of contract documents for Daegu project
- Provide technical assistance in review of the Daegu initial proposal.
- Provide technical assistance in review of the Daegu final proposal.
- Facilitate selection of site for EPA funded feasibility survey.
- Provide technical assistance in review of the feasibility survey.
- Facilitate partner selection for the follow on project
- Provide technical support for project.
- Develop model based on lessons learned for implementation of LFG projects.
- Develop aerobic digester projects
- Develop model based on lessons learned for implementation of Aerobic digester projects.

Timeline of Activities, including important milestones

Ulsan project

- Review initial design documents – Mar 2002
- Review final design documents – Jul 2002

Daegu project

- Review results of feasibility study – Nov 2001
- Review of contract documents for the project - Feb 2002
- Review of initial design documents - Jun 2002
- Review of final design documents - Oct 2002

Next feasibility study and project

- Provide input on feasibility study - Oct 2002
- Facilitate partner selection for project - Nov 2002
- Review of contract documents for the project - Apr 2002
- Review of initial design documents - Jul 2002
- Review of final design documents - Dec 2002

Consolidate data from initial projects into model for LFG - Jan 2003

Aerobic digester for animal waste

- Identify candidate sites for pilot project - Feb 2002
- Identify partners for project - April 2002
- Assist in conduct of feasibility study - Jul 2002
    - Review of contract documents for the project - Nov 2002
    - Review of initial design documents - Mar 2003
    - Review of final design documents - Jul 2003

Pursue other aerobic digester projects 2003-2005

Develop and publish model for aerobic digester projects 2004

Resource requirements

	Current Funding	Full Funding Scenario
Support for Three Methane Projects	$20,000	$60,000*
***Includes $15,000 for LMOP for tech review**		
Develop Model Solicitation and Business Model	$5,000	$10,000
Training for LFG Teams - LMOP		$30,000
General Coordination	$5,000	$12,000
Funding to Assist Initial Contractor Visits **		$5,000
Total	$30,000	$117,000

** Providing one or two thousand dollars to international contractors to make initial visits to project sites, with Korean contractors has proven very helpful in the ESPC program to overcoming initial hesitancy to committing resources overseas.

Cooperators

KEMCO – is the in country coordinator of all TCAPP activities. They interface with Korean governments and companies to find projects. KEMCO also works to inform the Korean populace of the potential of energy efficiency. MOCIE has also given them responsibility for managing the revolving fund used to finance ESPC projects. KEMCO representatives help develop policy and represent Korea in international climate change meetings. KEMCO provides the critical link between MOCIE and MOE for all methane projects.

AEP Korea – provided support for setting up the TCAPP program in Korea. They were instrumental in establishing contacts with MOCIE and their subordinate organizations. AEP provided the majority of the funding for TCAPP activities in Korea initially. AEP provided some travel reimbursement for commercial exchange visits related to TCAPP. AEP can be a tremendous asset to U.S. companies that want to learn about the requirements for doing business in Korea.

EPA – started the TCAPP Korea effort with trips to Korea to meet with Korean government officials. EPA has taken up more and more of the funding for all TCAPP activities in Korea as AEP funds have decreased. EPA has remained active in engaging the Korean MOE to keep their interest in TCAPP.

EPA LMOP – Has provided in country training regarding installation of LFG projects. They have briefed Korean groups visiting the U.S. trying to find out more about pursuing LFG projects. LMOP has offered funding for a feasibility study of a Korean landfill site and technical assistance in review of the findings. The LMOP network of engineers and contractors is also expected to play a significant role in finding interested partners for future LFG projects.

Heat Recovery Using Heat Pumps

The general use of heat pumps to capture and reuse heat from low temperature waste streams was selected as the third priority for TCAPP during scoping meetings held in Korea. The technology is viewed as being ready for market and having a great deal of potential in Korea. This technology has not caught on in Korea as much as it has in other parts of the world, and Asia in particular. Part of the problem is widely publicized failures of the technology when it first started being used in the 1980s and 1990s. The proprietary and patented nature of this technology further complicates wide use of the equipment. Korean heat pumps are not competitive with foreign made equipment, and foreign equipment manufacturers are not excited about sharing their technology with Korean manufacturers. Work in this area has uncovered interest by both international and Korean companies to jointly pursue projects under TCAPP, however the barriers associated with this technology have relegated it to a much lower priority than the other two technologies.

Specific objectives for capture and reuse of low temperature heat from waste streams using heat pumps in support of TCAPP objectives

1. Encourage and support the capture and reuse of waste heat from municipal, commercial, and industrial liquid and gaseous waste streams through pilot projects and training activities.

2. Improve the quality of heat pumps manufactured in Korea to take advantage of improved materials and design through partnerships with international heat pump manufacturers.

Benefits of using Heat Pumps to capture and reuse heat from industrial and commercial waste streams

The use of heat pumps in pilot projects to improve energy efficiency is expected to increase the adoption of this technology by Korean commercial and industrial companies.
Boilers burning bunker-C fuel oil supply a large percentage of Korean process heat. Many of these systems have a waste stream with temperatures below 140 degrees centigrade. It is estimated that the market in this area is about $680 million. Installation of heat pumps in these circumstances has the potential of saving 3.2 million toe and reducing carbon emissions by 10,400,000 tons CO_2.

Air compressors and turbo chillers also present a large possible market for capturing waste heat from their exhaust with heat pumps. The potential savings in this area are $63 million, 66,000 toe of energy, and 129,000 tons of carbon dioxide.

The use of high quality heat pumps for more extreme applications is also an area under consideration in the TCAPP program. High temperature waste heat recovery presents opportunities for significant savings. While not as vast as the low temperature market these savings would still be worth pursuing. It is estimated the market is about $140 million. The energy savings could be about 329,000 toe. There is also the potential of reducing carbon dioxide emissions by 1,065,000 tons.

The high temperature environment is an area that requires higher quality materials and manufacturing techniques not currently available in Korea. The increase of these processes and subsequent manufacture of better quality heat pumps is also viewed as a means of creating jobs in the Korean economy.

The improvements mentioned above also bring with them improvements in local air quality as well as lessened impacts resulting from carbon emissions and other green house gases.

Barriers to implementation of Energy Management and Auditing Concepts

The shortage of skilled and experienced engineers in the field of heat pump implementation is a barrier to successful projects. This shortage results in less than optimal projects, over or under sized systems, and customer dissatisfaction. The unsuccessful projects negatively impact other companies considering implementation of the technology.

The poor reputation of heat pumps in Korea is a serious barrier to future projects. The technology is viewed with great distrust by most facility staffs and therefore is not often installed.

Korean manufactured heat pumps are not of the highest quality. This leads to operations and maintenance problems and premature failure of equipment. The local equipment cannot compete performance wise with good foreign made equipment. While the foreign made equipment is of a much higher quality, it is very expensive which further deters companies from installing it.

Brief Summary of Activities Necessary to Overcome Barriers.

The government is looking to joint projects with international companies as a technique for overcoming the shortage of qualified heat pump engineers. They are also looking at opportunities to send Korean engineers to work in international companies to gain the expertise needed for these projects.

Korea is also looking for opportunities to have engineers and scientists work in international laboratories to learn the state of the art in heat pump design and materials.

Successful projects must be installed in Korea and publicized to help offset the bad reputation of heat pumps.

Proposed TCAPP Actions

TCAPP is actively seeking heat pump projects that will demonstrate the technology. Three possible projects are being considered for inclusion in this phase of TCAPP.

1. Pohong Steel is interested in pursuing this technology under TCAPP. They have entered into discussions with KEMCO and are considering various applications for the project. The size of the Pohong plant offers the opportunity to install multiple large projects to significantly improve energy efficiency and the corresponding reductions in pollutants.

We are currently working with KEMCO to attempt to scope this project. This project has also been considered as a pilot to determine and quantify other air quality benefits derived from these kinds of projects. We will continue to attempt to determine means of quantifying the various benefits related to this project. We will also continue to look for international partners interested in taking part in this project. While we will attempt to pursue this under and ESPC type project, we will also determine if other funding is available for a stand alone heat pump project funded by Pohong Steel. We will also continue to research whether or no government or utility grants, rebates, or low interest loans are available to the steel plant.

A part of this project will be to document the actions taken to put the project in place. These actions will be analyzed to determine what works well and is transferable to other projects. These "lessons learned" will be shaped into a model for use in future heat pump projects.

2. Hyundai has a significant possible heat pump project in a large compressor building. The building contains a number of large compressors, which generate a great deal of waste heat, which has to be discharged. Capture and reuse of this heat in other processes in the facility can cut energy use elsewhere in the plant. At the same time the project will help alleviate the problems of dealing with the waste heat from the building. This project may be completed as an ESPC, which will support two of TCAPP Korea's technologies.

   Our actions on this project are on hold pending the results of the initial ESPC project at Hyundai. If that project appears to be successful and the car manufacturer is interested in pursuing work on this project, we will determine if the Honeywell Korea team they are working with will be the ESCO for this project. If that is the case, we will assist in the review of the initial and final proposals. The model for pursuing heat pump projects, as well as the ESPC model will be revised based on the results of this project.

3. The third possible project involves high-rise housing complexes serviced by the Korea District Heating Corporation (KDHC). The KDHC is interested in pursing very large-scale heat pump projects using the Han River as the heat source/sink. The scale of the project and technology that they are interested in using makes this project a more long-term prospect. The technology is probably at least five years from being market ready. There are also environmental impacts that would need to be researched before installing a project of this size using water from the Han River.

   We are continuing a dialog with KDHC during this period. The objective of the dialog is to follow technological advances in the technology area and assess when the time is right to begin a pilot project.

TCAPP Korea Accomplishments to Date

TCAPP has already made some progress in the heat pump area though it is the last priority in Korea. These accomplishments have made it possible to pursue our current goals. Examples of efforts already accomplished as part of TCAPP in this area include:

Visit by KDHC representative from KDHC in October 2000 was the initial action. KDHC sent a representative to the U.S., in conjunction with a conference in Canada, to explore technologies for use in a project in Korea. TCAPP coordinated visits with researchers from Lawrence Berkley Laboratory, Oak Ridge Laboratory, and the University of Maryland during the visit.

Meetings with KDHC representatives were held in Korea to determine the scope and technologies they want to pursue in their project. Both long-term project goals and other currently available renewable technologies were explored for use in projects anticipated by KDHC.

TCAPP facilitated meetings between Trane and KEMCO during June of 2001. Trane has expressed interest in working on projects in Korea with Korean partners. Trane has an experienced ESCO in the area of ground source heat pumps as well as other typical energy efficient technologies. Trane also manufactures and installs heat pumps in a wide variety of applications. They are being considered for future ESCO work, as well as a role in the heat pump technology area.

TCAPP held scoping and project discussions with KEMCO related to possible projects. This technology area is the least defined and most difficult area to pursue under TCAPP. The KEMCO/NREL team continues to work with possible sites and manufacturers/installers to better define the goals of this technology and projects to be pursued under it.

TCAPP discussed opportunities with U.S. laboratories regarding the possibility and roles for visiting Korean researchers. Much of the research being conducted at laboratories in the U.S. is work being paid for by various equipment manufacturers. As a result, most of the work is proprietary and does not lend itself to participation by Korean researchers. There are some opportunities though and we continue to explore possible arrangements that will satisfy both the Korean need for information to improve their technologies as well as the U.S. companies' intellectual property rights.

Expected Deliverables and Results

Deliverables

- Identify initial project for heat pumps in conjunction with KEMCO.
- Facilitate identification of U.S. partner for project team.
- Review project initial proposal/design
- Facilitate approval of contract documents for project
- Review final proposal/design
- Assist with project identification and evaluation
- Facilitate identification of U.S. partner for project team.
- Review project initial proposal/design
- Facilitate approval of contract documents for project
- Review final proposal/design
- Develop model for pursuing heat pump projects.

Timeline of Activities, including important milestones

Initial project

- Identify initial project – Jan 2002
- Identify project team – Apr 2002
- Facilitate contract documents – Jul 2002
- Review initial design – October 2002
- Review final design – February 2003

Follow-on project

- Identify second project – Jun 2002
- Identify project team – Sep 2002
- Facilitate contract documents – Dec 2002
- Review initial design – Mar 2003
- Review final design – Jul 2003

Identify research opportunities for Korean researcher at a U.S. facility studying heat pumps.

- Find research opportunity – Jun 2002

Develop model for implementation of heat pump TCAPP projects

- Draft report in conjunction with KEMCO – March 2003

Resource Requirements

	Current Funding	Full Funding Scenario
Support for Two Heat Pump Projects*	$8,000	$40,000
Develop Model Solicitation and Business Model	$1,000	$10,000
Develop International Production Agreement		$30,000
General Coordination	$1,000	$8,000
Funding to Assist Initial ESCO Visits **		$3,000
Total	$10,000	$120,000

* We are attempting to include heat pumps in an ESPC project. If successful this will minimize and separate project support for the heat pump area.

** Offsetting some travel expenses for an initial meeting and site visit has been enough in ESPC projects to overcome initial hesitation by some international companies considering work under TCAPP.

Cooperators

KEMCO – In country coordinator of all TCAPP activities. They interface with Korean governments and companies to find projects. KEMCO also works to inform the Korean populace of the potential of energy efficiency. MOCIE has also given them responsibility for managing the revolving fund used to finance ESPC projects. KEMCO representatives help develop policy and represent Korea in international climate change meetings.

AEP Korea – provided support for setting up the TCAPP program in Korea. They were instrumental in establishing contacts with MOCIE and their subordinate organizations. AEP provided the majority of the funding for TCAPP activities in Korea initially. AEP provided some travel reimbursement for commercial exchange visits related to TCAPP. AEP can be a tremendous asset to U.S. companies that want to learn about the requirements for doing business in Korea.

EPA – started the TCAPP Korea effort with trips to Korea to meet with Korean government officials. EPA has taken up more and more of the funding for all TCAPP activities in Korea as AEP funds have decreased.

Overall Project Coordination

This section describes the general project coordination activities that NREL will undertake across all three areas.

- Coordinating the work of the country teams, U.S. experts, participating businesses and finance institutions, and donors so that all parties are working toward common goals
- Maintaining an active and effective country team, in coordination with KEMCO, with active engagement and participation of key government officials (including energy and climate officials and other key development agencies and any existing interagency processes that have been established
- Integrating work with TCAPP activities supported by AEP, DOE, AID and with other USG initiatives in the country
- Promoting business and donor awareness and participation
- Reporting on results and accomplishments
- Developing and updating work plans and tracking financial expenditures across activities to help manage an overall budget
- Assisting the country team in presenting the work at key climate and energy forms and events

The cost for each of these requirements is included in the requirements listed under the three technology categories described above.

Alternatives and Justification for NREL Proposed Role

The role NREL plays, as the U.S. facilitator for these projects has been essential to the success of the program in Korea. The reputation of the U.S. national labs, and NREL in particular in the area of energy efficiency and renewable energy provides a degree of acceptance to the program that is unique. The special status of being a government laboratory allows NREL to participate in all aspects of the program from international climate change meetings to detailed involvement in the technical and contracting aspects of projects. NREL's key role in the U.S. Federal Energy Management Program also provides valuable insights into national energy efficiency and renewable energy programs like those we are helping develop in Korea.

Alternative Approaches

1. AEP in Korea could take over the role played by NREL in facilitation of the program. They routinely work to find opportunities for U.S. companies in the Korean market through company exchanges and trade shows. AEP does not have the technical capability in house to provide assistance and oversight to projects. A major perception problem may arise by using AEP as the main facilitator of TCAPP since they are tasked with finding U.S. opportunities and TCAPP is working to be viewed as a more multilateral than unilateral program. AEP also don't provide the broad expertise and involvement in climate change negotiations that NREL can provide. NREL deals with the same government representatives in their work in climate negotiations as they do in project oversight related to TCAPP.

   NREL also brings a significant amount of knowledge of and a working relationship with U.S. ESCOs and energy efficiency companies from their work together on domestic programs in the U.S. AEP Korea can provide invaluable assistance to U.S. companies who desire to work on the program by assisting the companies in learning about how to do business in Korea, but the program will suffer a significant loss of prestige in the eyes of the Korean participants if overall responsibility is transferred to AEP Korea.

2. A private company could be contracted with to take over coordination of the overall program. This arrangement could be made to avoid the government lab markups on work performed. The disadvantages of this approach are that it then sends the message that the work has been downgraded in importance. It now has government organizations in Korea dealing with contractors as the agents for U.S. policy and program direction rather than the special position of a Federally Funded Research and Development Center (FFRDC). NREL's ability to interact with and coordinate the activities of U.S. government agencies and laboratories, as well as other international participants is unique and cannot be duplicated by a private contractor.

Check List – Appendix 1

- Are our objectives and budget in alignment? The objectives are significantly higher than the current budget allowed for this program. As a result they have been prioritized and we will accomplish as many of them as possible.
- Who was consulted in preparing the plan (country officials, business partners, AID mission, other cooperators and contractors, others)? KEMCO and through them MOCIE has been consulted in all iterations of the TCAPP planning, which is a continual process. Business partners are consulted in those aspects of the program that may affect them. Their opinions are also solicited from time to time on more broad aspects of their technology portion of TCAPP. AEP is kept in the information flow for work being pursued under the program. They are invited to participate in the overall planning for TCAPP.
- Do we have a strong in-country partner? Yes. KEMCO is an incredibly influential and active partner.
- Are we confident that the chosen technologies are cost-effective and meet development and other objectives? Yes.
- Are we collaborating with appropriate international and other organizations? Yes, but we could do more to find appropriate international partners.
- How do we plan to bring in the private sector? The private sector is being courted through national organizations like AEE, NAESCO, KAESCO and others. They are also being sought out through EPA's international LMOP network. The most successful means to date has been through NREL contacts established with companies working in these areas in the U.S. federal market.

Supporting Information – Appendix 2

- Energy/environment/climate overview of Korea
- Development and other goals for Korea
- Relevant market information
- Snapshot of existing efforts and organizations active in energy/climate/environment in Korea

MEXICO

Executive Summary

This business plan was developed in response to the changing emphasis of the TCAPP program based on the AID review, and in response to lessons learned from the TCAPP work in Mexico since October, 1997. The most important changes of emphasis and direction implied by this plan are:

- It builds on current successes;
- It focuses on just two priority technology areas, rather than the three original chosen priorities;
- It proposes to shift responsibility and resources to cooperators with greater in-country presence. More activities will be carried out by one or two in-country coordinators, and many activities will be carried out by AID subcontractors such as EIC, Winrock and E&Co.

This plan proposes work in two areas:

- **ESCO projects in the hotel and industrial sectors.** In this technology area, TCAPP focuses on developing model Energy Service Company (ESCO) performance contracts and applying these contracts to help develop ESCO projects in the hotel and the industrial sectors in collaboration with international and Mexican business partners. The near term target is to assist in advancing 4-8 pilot ESCO projects through this initiative through the end of 2002. Several potential projects in the industrial and hotel sectors have been identified. Expected results include 1-2 projects initiated by the end of 2001, representing around $24 million in investment, which will reduce CO2 emissions by 1.7 million tons over their lifetimes. Full market replication of the ESCO market in just the industrial sector could amount to $10 billion of investment and 37 million tons CO2 avoided. Other key development benefits include improved economic performance of industrial plants and hotels, reduced local air pollution and greenhouse gases, enhanced in-country finance capacity, improved economic development and increased employment opportunities.

- **Solar Water Heater business matchmaking and finance assistance**. Work in this area focuses on identifying potential joint ventures or partnerships between Mexican and international solar companies and to support other efforts to establish SWH financing programs. 1-2 financing agreements are targeted for this year, with anticipated results of $1million in investment and about 3000 tons of CO2 reductions. Full market replication estimates include investments of up to $30 million in projects that will reduce CO2 emissions by about 18 million tons over their lifetimes. Projects to date have resulted in $150,000 of investment, and estimated CO2 reductions of 300 tons per year over the lifetime of the projects. Other key development benefits include reduced local air pollution and greenhouse gases, enhanced in-country finance capacity, improved economic development, increased employment opportunities, and enhanced development of renewable energy sources that have significant potential in Mexico.

In terms of the prospects for successful projects and potential for broad market replication in the short and medium term, both these activities have high potential for accelerating technology

implementation and market replication in the short and long term. These technology areas also address key national priorities and development benefit goals as discussed below.

Goal of TCAPP

Accelerate the adoption of clean energy technologies and practices to promote economic and social development, mitigate global climate change and support technology cooperation under the UNFCCC.

Priority Areas

The priority areas were chosen through a series of discussions with a variety of stakeholders, including government agencies, universities and businesses, and mainly driven by the priorities of CONAE. They were chosen because they are linked to CONAE's programs, and are based on their economical and technical feasibility as well as their attractiveness for near-term investment. The U.S. - Mexico Bi-National Committee has also identified these technologies as having important benefits for both countries. The resulting "Framework for Climate Change Technology Cooperation in Mexico" details the process and the priority areas.

Revised Technology Priorities

- ESCO Market Development
- Solar Hot Water Heater Financing and Business Partnerships
- Investment Partnerships for Steam Generation and Distribution

The priority areas have changed somewhat to reflect a larger focus on the ESCO and solar water heating activities and a more detailed approach to business matchmaking and project development. The steam generation and distribution activities have now been linked into the ESCO activities. This business plan reflects these revised priority areas.

Objectives

1. Main objectives for TCAPP in Mexico, as described in TCAPP planning documents developed by an interagency team led by Mexico's National Commission for Energy Savings (CONAE)
   a. To foster private investment in clean energy technologies and projects that speed economic development, including solar water heaters and energy service company (ESCO) project and market development
   b. To engage host country and international donor support for actions to build sustainable markets for clean energy and clean energy technologies;
   c. To promote cooperative work between local and international technical groups.

2. Specific development objectives for Mexico in support of TCAPP objectives
   a. Local air pollution reduction
   b. Enhanced in-country finance capacity
   c. Improved economic performance of industrial plants and hotels
   d. Enhance development of renewable energy sources that have significant potential in Mexico such as solar water heaters

ESCO Market Development

ESCO market development is a priority for Mexico as it was identified by the Government of Mexico as one of the most effective mechanisms for reducing energy use, air pollution, and GHG emissions by the industrial, commercial, and government sectors. The TCAPP Mexico team, together with CONAE, EIC Consultores de Mexico, the Trust Fund for Efficient Use of Energy (FIDE), the National Ecology Institute (INE), National Bank for Public Works and Services (BANOBRAS), and several private companies worked together to develop the CONAE/TCAPP ESCO Pilot Project Development Strategy. The CONAE/TCAPP team has worked with several energy end-users in both the hotel sector and the industrial sector to identify and develop several prospective ESCO projects. The team has been promoting the development of energy savings projects under the ESCO scheme at meetings with representative chambers of the main industry sectors and with hotel representatives and the Hotel Association of Quintana Roo (Cancun). In addition the team has been promoting the ESCO scheme at meetings with various industrial plant managers in Monterrey. The follow-up has consisted ofdiscussing the feasibility of the scheme with energy end users, by means of organization of meetings and visits to the sites together with international and Mexican ESCOs.

Through this process of organizing site visits at hotels and industrial plants interested in the ESCO scheme, there are currently 3 hotels (Krystal, OMNI and Presidente) and 2-3 industrial plants in Monterrey (AHMSA, Trinity and possibly Inmaguza) that have expressed interest in participating in this pilot program. Several Mexican ESCOs and international ESCOs, including Southern Company and Sempra have expressed interest in forming a partnership to carry out these projects. Additional energy information was recently gathered and put into the form of project briefs for two of the industrial plants in Monterrey, and one hotel in Cancun. These project briefs were shared with both Mexican and international ESCOs in July 2001 to be used for the development of proposals to the hotel and plant managers. A site visit to the industrial plants in Monterrey is planned for mid-September, 2001. Both Mexican and international ESCOs will be invited to participate. ESCO partnerships are expected to be developed as well as written commitments from the industrial plant managers by October or November, 2001.

In order to demonstrate the benefits and viability of the ESCO strategy, the Government of Mexico is focusing first on the industrial and commercial (hotel) sectors, and will likely focus on the Federal sector after 2002.

Objectives and Benefits

1. Objectives

The objectives of TCAPP work in the ESCO area include:

1.1. To assist in advancing 4-8 public and private sector pilot ESCO projects in collaboration with international and Mexican business partners.
1.2. To broaden awareness of the benefits of performance contracting in Mexico and capacity of Mexican ESCOs and end-users to participate in performance contracting so

that it becomes a widespread tool for reducing energy use, operating costs, and GHG emissions.

1.3. To develop the necessary elements to facilitate the application of the ESCO strategy

1.4. Build capacity in the private sector for implementing energy savings projects

1.5. To promote the widespread use of performance contracting in the industrial and commercial sectors to reduce local air pollution and greenhouse gases, and reduce energy consumption in all sectors.

1.6. Educate energy end-users of the benefits of the ESCO strategy is an important part of the strategy.

2. Benefits in relation to national objectives

2.1. Support for local and/or national development objectives

- Improved economic performance of industrial plants and hotels
- Reduced local air pollution and greenhouse gases
- Enhanced in-country finance capacity
- Improved economic development and increase in employment
- By attracting international ESCOs to the market, as well as third party financiers, the opportunity to increase foreign direct investment greatly improves.

2.2. $MMTCO_2$ avoided

For the projects already identified, there is an estimated greenhouse gas reduction of over 1.7 million tons of cumulative CO2 reductions over the project lifetime, and up to 37million tons/yr. through full market replication in just the industrial and hotel sectors.

2.3. Scale of investment

The market is quite large for ESCO projects in both the hotel and industrial sectors, varying in size and production capacity. Of the projects identified to date, investments would likely exceed $24 million. Full market replication greatly exceeds $10 billion worth of investment.

2.4. Barriers to implementation of objectives

2.4.1. Lack of experience by Mexican ESCOs: There are very few Mexican ESCOs with experience in comprehensive project implementation, performance contracting, monitoring and verification, the legal procedures in developing a contract, and developing and submitting proposals to energy end-users.

2.4.2. Lack of financial resources: Many Mexican ESCOs lack financing to pay the upfront costs of an ESCO project, and lack experience in seeking a business partner or in seeking financing from an international or local bank. In addition, credit guarantees are important in order to protect the ESCO in the case the industrial plant or hotel fails to make payments.

2.4.3. Lack of information: Most energy end-users do not understand or are not aware of the benefits of energy savings through performance contracting.

A Suite of Actions to Overcome those Barriers

1. Lack of experience: There are very few Mexican ESCOs that actually have carried out energy savings projects through performance contracting. More experience built and then shared with the Mexican ESCO community will help address this barrier. Some strategies for addressing this barrier include:
   a. Development of performance contract guidelines for Mexican ESCOs
   b. Training programs to educate Mexican ESCOs on performance contracting
   c. Interaction with international ESCOs to learn about experiences in other parts of the world and partnering to achieve capacity building and address energy end user needs
   d. Training programs to educate Mexican ESCOs on monitoring and verification
   e. Assistance to Mexican ESCOs in carrying out energy audits in order to put together a package proposal of energy retrofits, rather than focusing on one technology such as lighting.
   f. Assistance to Mexican ESCOs in developing and submitting proposals to energy end-users.
   g. Assistance to Mexican ESCOs and end users in understanding opportunities for carbon offset markets and project-based activities.
   h. Assistance to the Mexican ESCO community in developing an ESCO association or become part of the National Association of Energy Service Companies. An accredited association allows ESCOs to increase capacity, learn about project opportunities, partner on larger projects, and become a credible and reliable segment of the energy sector.

2. Lack of financial resources: Most Mexican ESCOs are very small engineering firms that lack capital to invest in projects. Several ideas to overcome this financial barrier include:
   a. Interaction with international ESCOs to seek possible business partnerships.
   b. Securing third party financing from international finance organizations such as the IFC, World Bank, Fodelec, EEAF, the REEF, and others.
   c. Assistance in developing proposals to submit to international finance organizations. This could include identifying several projects to 'package' together in order to increase the total dollar amount and estimated carbon reduction.
   d. Assistance in identifying credit guarantees or revolving credit loans from entities such as the Development Credit Authority or the World Bank.

3. Lack of information: Most energy end-users are not aware of the potential energy savings benefits from carrying out a package of energy retrofits. In addition, the idea of performance contracting is relatively new to the industrial and commercial sectors in Mexico. Several ideas to overcome this barrier include:
   a. Government lead efforts to encourage end-users to pursue performance contracting and give them confidence in this process
   b. Performance contracting educational guide developed for energy end-users
   c. Training programs to educate energy end-users on performance contracting and energy savings projects
   d. Conducting pilot projects with major energy users that can be models for others

TCAPP Actions (Please note additional activity at end of this section)
TCAPP's near-term target is to advance 4-8 pilot ESCO projects and promote broader use of performance contracting in Mexico. Specific TCAPP activities include:

1. Increase knowledge and capacity of performance contracting for Mexican ESCOs: The TCAPP team hired EIC Consultores de Mexico to develop a model performance contract and guidelines to performance contracting to educate Mexican ESCOs on the legal issues and structure of the contract process. This education tool has been used at various training seminars and continues to serve as a critical segment of the strategy, however it has been noted that improvements and adjustments to the guidelines would be useful. Other activities to build on this effort include:
   1.1 Ongoing and future activities in this area include:
      - Identify Mexican company to revise EIC's submission on performance contracts guidelines with the end users in mind
      - Provide guidance to the Mexican company selected to finalize the Guidelines to Performance Contracting in Mexico
      - Assist CONAE in distributing final guidelines to Mexican Engineering firms and ESCOs
      - In collaboration with NAESCO, explore formation of Mexican ESCO Association
      - Design and organize a monitoring and verification workshop, including training on estimating carbon reduction from ESCO projects *(may require additional funding)*

2. Identify project opportunities by educating energy end-users of the benefits of performance contracting and CONAE's ESCO strategy: The CONAE/TCAPP team has worked with several energy end-users in both the hotel sector and the industrial sector to identify and develop several prospective ESCO projects. The team has been promoting the development of energy savings projects under the ESCO scheme at meetings with representative chambers of the main industry sectors and with hotel representatives and the Hotel Association of Quintana Roo (Cancun). The follow-up has consisted of discussing the viability of the scheme with energy end users, by means of organization of meetings and visits to the sites together with international and Mexican ESCOs. Energy information was gathered and presented in project briefs for two of the industrial plants in Coahuila, and one hotel in Cancun. These project briefs were shared with both Mexican and international ESCOs in July 2001 to be used for the development of proposals to the hotel and plant managers. These projects represent potential investment opportunity of over $24 million for the two industrial plants and the one hotel, with an estimated CO2 reduction of over 24,000 tons equivalent per year.
   2.1 Future planned activities, include:
      - Site visit to the industrial plants in Monterrey, and a follow-up visit to Cancun with hotel managers is planned for September 2001. Both Mexican and international ESCOs will be invited to participate as well as international and local financiers.
      - Project briefs for 12 other industrial plants and hotels are under development.
      - Project briefs will be distributed to NAESCO and other international ESCO networks as they are developed.
      - Additional site visits when the other briefs are complete

3. Promotion of project opportunities to Mexican and international ESCOs: As described in activity 2, project briefs are developed and shared with Mexican and international ESCOs as soon as they are developed. (Information in these briefs include: Current electricity consumption, Project needs (thermal, AC, lighting, etc.,), Type of operation, Size of operation.)
   3.1 This is an ongoing process that includes the following activities.
      - Collect energy information from interested industrial plants and hotels
      - Develop project briefs based on the collected information
      - Distribute project briefs to international and Mexican ESCOs through existing promotion channels such as NAESCO, the CONAE database, etc.
      - Arrange site visits for interested ESCOs and end users

4. Assist in facilitating business partnerships between Mexican and international ESCOs: One of TCAPP's main focus is facilitating business partnerships between Mexican and international ESCOs. After the initial site visits and meetings between ESCOs, the TCAPP team will provide the following assistance:
   4.1 Identify interested parties
   4.2 Provide follow-up to companies who have expressed interest in partnering
   4.3 Collect curricular information, case studies from Mexican and International ESCOs and Engineering firms
   4.4 Disseminates this information through organizations such as NAESCO, CAESCO, and international ESCOs in order to promote partnerships
   4.5 Organize and set appointments or conference calls for parties in order to continue with negotiations.

5. Technical assistance for project agreements and project development
   5.1 Assist with negotiation of contracts between energy end-users and ESCOs. (A representative of the NREL FEMP team has great experience in this area, and can offer this type of expertise)
   5.2 Assist with energy audits, and walk-through visits to identify specific technologies for retrofits
   5.3 Assist with identification of monitoring and verification program and tools
   5.4 Explore Federal sector ESCO projects, in collaboration with FEMP team.

6. Assist in identifying other sources of financing for ESCO projects:
   6.1 Offer direct technical assistance to ESCOs on financing
      6.1.1 Invite finance representatives to attend individual meetings with ESCOs, participate in site visits, discuss opportunities over the phone, and provide written materials on the various finance mechanisms available for ESCO projects in Mexico.
      6.1.2 Organize a finance workshop to educate Mexican ESCOs of finance options
      6.1.3 Develop handbook of international finance opportunities for ESCO projects.

6.1.4 Assist ESCOs in the development of finance proposals and submission to international and Mexican finance institutions.

7. Dissemination of results
   7.1 Gather information resulting from these ESCO projects and evaluate the projects and disseminate results and findings through reports and fact sheets
   7.2 Organization of workshops to promote the ESCO scheme and results of pilot projects
   7.3 Presentation of pilot projects and results at other planned workshops and meetings
   7.4 Provide information on projects and activities on the CONAE web-site

8. Explore collaboration with NAESCO in formation of Mexican ESCO Association in mid 2002.
   8.1 Organize a meeting in Mexico City with NAESCO and Mexican ESCOs to discuss benefits of forming ESCO association
   8.2 Develop plan and next steps for organizing ESCO association

Additional Proposed Activity:
In recent discussion, an observation that there is a need for an overall market study for the potential for ESCO projects. If this activity is funded, NREL is proposing the following steps and would focus the next 3 months to complete it:

- Compile and describe all the current and ongoing ESCO-related activities in Mexico being carried out by CONAE, FIDE, financing institutions such as IFC, Fondelec and IDB, as well as Mexican ESCOs, and consulting firms such as EIC;
- Develop verview of market potential by sector
- Define of barriers to move forward the ESCO market in Mexico
- Evaluate of how well the current activities are addressing these barriers and identification of gaps in activities and opportunities for beter integration
- Identify of the various roles of government and non-government insitutions, particularly those institutions being funded by AID, in order to reduce duplication of activities, and encourage collaboration.
- Identify and develop process for engaging key stakeholders in the development of the implementation plan
- Develop implementation plan with recommendations of how these entities can best work together to achieve their common goal of assisting in the development of the ESCO market in Mexico.

Expected Deliverables and Results

Deliverables

- 1-2 project agreements established in late 2001 between partners
- Assistance with identification of finance sources, and development of finance proposals - early 2002
- Financing secured and implementation commences in 2002.
- A finance workshop will be held in late 2001. TCAPP will work with local and international finance institutions to present finance options to the Mexican ESCO community
- ESCO financing handbook developed and distributed in early 2002
- Revised CONAE strategy for performance contracting distributed to ESCOs and energy end-users in late 2001.
- Second set of project briefs (6-12 in both hotel and industrial sectors) distributed in early 2002 to continue process
- Second trade mission in early 2002.
- Report on pilot project results disseminated in mid- 2002
- Assistance with finance proposals, ESCO partnering, etc. - late 2002
- Project agreements for second set of projects -- end of 2002
- Web information on pilot projects and performance contracting on CONAE website in mid-2002
- Design and organize a monitoring and verification workshop, including training on estimating carbon reduction from ESCO projects *(may require additional funding)*
- If funding is available, market study carried out that describes market potential, and implementation plan developed *(will require additional funding)*

Impacts

- For the projects already identified, there is an estimated greenhouse gas reduction of over 1.7 million tons of CO2 per year (480,000 tons of cumulative reductions over the project lifetime), and up to 37 million tons/yr. through full market replication.
- Of the projects identified to date, investments would likely exceed $24 million. Full market replication greatly exceeds $10 billion worth of investment.
- Development impacts include:
    - Improved economic performance of industrial plants and hotels
    - Reduced local air pollution and greenhouse gases
    - Enhanced in-country finance capacity
    - Improved economic development and increase in employment
    - Increased foreign direct investment

Timeline of Activities and Milestones

Date	Milestone
Feb, 2000	Participated in NAESCO Workshop in Mexico City
Feb-May, 2000	Developed CONAE/TCAPP ESCO Pilot Project Development Program
August, 2000	EIC Consultores de Mexico completed draft model performance contract and guidelines for performance contracting
Sep - Dec, 2000	Meetings held with end-users and Mexican ESCOs to discuss project potential. Presentation of the ESCO scheme in several forums (industry). Visits to plants.
January, 2001	Site visit to hotels in Cancun with Mexican and international ESCOs
Feb-June, 2001	Development of 3 project briefs to distribute to international ESCO community
June - Dec, 2001	Support communication between Mexican and international ESCOs to facilitate business partnerships
July, 2001	Distribute 3 project briefs of industrial plants to international and Mexican ESCO community
September, 2001	Organize site visits to industrial plants with international and Mexican ESCOs
December, 2001	Final version of Guidelines to Performance Contracting in Mexico, including model of performance contract
December, 2001	Finance workshop for Mexican ESCOs
Nov - Dec, 2001	Secure commitments from Mexican and international ESCOs to participate in the ESCO Pilot Program and assist them in submitting proposals to hotel and industrial plant managers
Jan - Feb 2002	*Depending on funding, market study carried out that describes market potential, and implementation plan developed*
Jan 2002	Finance handbook developed
Jan – April 2002	Project agreements established between ESCOs, energy end-users
Jan – May 2002	Assistance in development and submission of finance proposals
Jan - May, 2002	Provide additional technical assistance as needed for hotel and industrial ESCO projects (including M&V, financing, etc.)
Jan – June, 2002	Additional 6-12 project briefs developed and distributed and trade missions carried out
April, 2002	In collaboration with NAESCO, explore possibility of forming Mexican ESCO association - carry out workshop
June 2002	Disseminate information and results on pilot project status
July - Dec 2002	Project agreements for second set of projects established between international and Mexican ESCOs and energy end-users
July - Dec 2002	Assistance in development and submission of finance proposals for second set of projects
July - Dec 2002	Provide additional technical assistance for second set of projects as needed for hotel and industrial ESCO projects (including M&V, financing, etc.)
July - Dec 2002	Explore ESCO opportunities in Federal sector

Resource Requirements out to FY02 for ESCO activities

Work Area	NREL Budget	Cooperator Budget	Potential Cooperators
Identify project opportunities (both first and second sets of projects)	$10,000	$15,000	In-Country Coordinator
Final Guidelines to PC developed and distributed	$5,000	$10,000	In-Country Coordinator **Identify Mexican company**
Organize and carry out trade missions	$10,000	$10,000	In-Country Coordinator NAESCO
Facilitate partnerships between Intl and Mexican ESCOs	$5,000	$5,000	In-Country Coordinator
Secure agreements between end-users and ESCOs	$5,000	$5,000	In-Country Coordinator
Finance workshop	$5,000	$15,000	E&Co (?) In-Country Coordinator
Finance handbook	$2,000	$10,000	E&Co (?) In-Country Coordinator
Finance proposal development and submission to finance institutions	$10,000	$30,000	E&Co (?) In-Country Coordinator
Project Development assistance	$10,000	$10,000	In-Country Coordinator
Development of Mexican ESCO association	$2,000	$5,000	In-Country Coordinator NAESCO
TOTALS	**$64,000**	**$115,000**	

Additional Proposed Work:

Work Area	NREL Budget	Cooperator Budget	Potential Cooperators
Carry out market study and develop implementation plan based on results	$50,000	$10,000	Schiller & Associates In-Country Coordinator
TOTAL: $60,000			

Next Steps

1. Organize and carry out site visit tour to Monterrey and follow-up visit to Cancun, together with Mexican and International ESCOs, as well as local and international financiers.
2. Facilitate business partnerships between Mexican and international ESCOs
3. Secure commitments from Mexican and international ESCOs to participate in the ESCO Pilot Program and assist them in submitting proposals to hotel and industrial plant managers
4. Technical assistance needs identified for implementation stage of project development
5. Organize finance workshop for Mexican ESCOs.
6. Develop finance handbook
7. Assist in development of finance proposals and submission to finance organizations
8. Final version of Guidelines to Performance Contracting in Mexico, including model of performance contract
9. Explore formation of ESCO Association in Mexico
10. Continued development and distribution of project briefs to Mexican and international ESCO communities
11. Design and organize a monitoring and verification workshop, including training on estimating carbon reduction from ESCO projects *(may require additional funding)*
12. Carry out market study and develop implementation plan based on results *(will require additional funding)*

Solar Water Heater Business Partnering and Finance Assistance

Objectives and Benefits

Officials of the Government of Mexico have recommended that replacing or substituting liquid petroleum (LP) gas tanks with solar water heaters (SWHs) to heat water in the residential and commercial sector will have positive impacts on air quality, health, and the economy. INE, CONAE, the National Autonomous University of Mexico (UNAM), and others, through World Bank funding, developed a feasibility study to prove that this recommendation is viable. Due to notable gaps in the study, such as lack of demand information and cost feasibility information, TCAPP, together with the USAID Mission decided to put more funding towards an improved market transformation study. TCAPP is providing a portion of the funding and will continue to work towards meeting objectives that were defined in the original workplan for this technology area.

The TCAPP role is in this activity is to identify potential joint ventures or partnerships between Mexican and international solar companies and to support other efforts to establish SWH financing programs. The goal is to work closely with CONAE, INE, the USAID Mexico Mission and other organizations in expanding the SWH market in Mexico based on the results of the new market transformation study.

TCAPP activities to date have included:

- Assisted in facilitating the sale of 356 solar water heaters from American Energy Technologies of the U.S. to Optima Energia of Mexico for a hotel project in Cancun. Each collector will save 350 kg. of LP gas or the equivalent of 80 metric tons of carbon per year for the 356 solar water heaters combined. Additional sales of SWHs are underway between the two companies.
- Organized a two-part meeting with a representative of the International Finance Corporation -- one with 12 SWH companies, and then with 6 ESCOs. The result of the meeting was the identification of several sources of international financing that the companies may explore for large projects. Two of the SWH companies were extremely interested and will work with TCAPP to explore the best options, and then assist with proposal writing and submittal.
- Promoted business matchmaking at the Millennium Solar Forum 2000 and organizing a successful press conference in which several Mexican solar companies, together with the National Association for Solar Energy (ANES) had the opportunity to discuss their goals for increasing the use of solar energy nation-wide, and expressed the interest in international collaboration. Also during the forum, several project ideas were discussed with both U.S. and Mexican solar companies including the need from a Mexican solar company for a finance mechanism to install solar water heaters for over 500 homes in several affordable housing projects in early 2001.
- The TCAPP Mexico team has also created an on-line information exchange forum on the CONAE website for Mexican and international solar companies to find out about project opportunities, and interest in partnering on projects. So far over 30 companies have joined this forum from Mexico, the United States and Germany.

Objectives and Benefits

1. Objectives

   The objectives of TCAPP work in the SWH area include:

   1.1. To assist in the development of a market transformation study

   1.2. 1-2 business partnerships and business and financing plans developed

   1.3. A finance workshop will be held in late 2001. TCAPP will work with local and international finance institutions to present finance options to the Mexican SWH community.

   1.4. Submission of 1-2 finance proposals to international finance organizations for large SWH projects.

   1.5. Continued assistance in facilitating business partnerships between US and Mexican SWH companies.

2. Benefits in relation to national objectives

   2.1 Support for local and/or national development objectives

   - Reduced local air pollution and greenhouse gases
   - Enhanced in-country finance capacity
   - Improved economic development and increase in employment
   - Enhance development of renewable energy sources that have significant potential in Mexico such as solar water heaters

   2.2 $MMTCO_2$ avoided

   There is an estimated reduction of over 18 million tons CO2 per year through full market replication. GHG reductions for projects already implemented are estimated at 300 tons per year over the lifetime of the projects. If financing proposals are approved this year, there is an approximate CO2 reduction of 3000 tons.

   2.3 Scale of investment

   Markets will be enhanced by increased participation from the international SWH community. The market potential for SWH projects is over $30 million. $150,000 has been invested through TCAPP-related activities so far, and investments of up to $1 million are estimated for this year if financing proposals are approved.

3. Barriers to implementation of objectives

   3.1 Lack of information on the market: Although many studies have been carried out on the market potential for the SWH market in Mexico, there still lacks significant information that would lead to the development of a large-scale program, such as not enough cost or financial analysis, and not enough info on demand. Information should be gathered from both Mexican and international SWH companies, as well as potential customers in order to understand the demand for SWHs.

   3.2 Lack of financial resources and business planning capacity by Mexican SWH businesses Many Mexican SWH companies are interested in exploring the possibility

of carrying out large-scale projects, however they lack sufficient financial resources to do so. The identification of finance options as well as identifying opportunities to partner with international SWH companies would help address this barrier. These companies also tend to very small and don't have much sophistication in business planning.

3.3 High up-front capital costs of SWHs.

A Suite of Actions to Overcome those Barriers

A group of stakeholders has been meeting regularly to identify next steps in the development of a large-scale program to promote SWHs. That working group has been comprised of representatives from CONAE, GDF, INE, CANACINTRA, ANES, WB, GTZ, TCAPP, and USAID. Through these meetings, the broad outlines of a plan to foster the sale, installation, and maintenance of SWHs throughout the Metropolitan Area of Mexico City (MCMA) have been developed. The working group agreed on the following activities as necessary to overcome barriers to developing a large-scale SWH program:

- Determining gaps and/or inconsistencies in the data currently available regarding the cost-effectiveness and environmental impact of SWHs, including demand and financing availability and addressing these limitations;

- Gathering and evaluating data from both potential users and manufacturers/distributors of SWHs to determine key elements of a program to promote SWHs (e.g., willingness-to-pay on the part of residential users, preferred financing mechanisms) as part of the market study;

- Identifying and developing options for financing a program that would foster the large scale sale and installation of SWHs;

- Developing an integrated approach for transforming the SWHs market in the long run;

- Designing a pilot program that would, through the sale and installation of a certain number of SWHs, test the assumptions regarding how best to transform the market in the long run;

- Facilitating partnerships (e.g., joint ventures) between U.S. manufacturers and their Mexican counterparts; and

- Prepare documentation to present a program that would foster the sale and installation of SWHs throughout the MCMA to relevant financing agencies.

TCAPP Actions

The specific TCAPP role is in this activity is to conduct the market transformation study, identify and develop potential joint ventures or partnerships between Mexican and international solar companies and to support other efforts to establish SWH financing programs. The goal is to work closely with AID in the development of the market transformation study, and with CONAE, INE

and other organizations in expanding the World Bank SWH pilot program and identify possible finance mechanisms to increase the SWH market in Mexico.

The TCAPP activities will include:

1. Assistance to the Market Transformation study
   1.1. Develop Terms of Reference (together with the AID Mission) for a request for proposals (RFP) from consulting firms to develop a market transformation strategy for SWHs in Mexico City
   1.2. Assist in carrying out market transformation study
      1.2.1. Provide guidance and technical support This could include assistance with technology assessment, gathering feedback from U.S. and Mexican businesses, identifying opportunities to link with international financing programs –e.g. IFC, integration with Mexican government programs.
      1.2.2. Coordinate participation of Mexican businesses, technical institutions, government agencies, U.S. businesses, etc.
      1.2.3. Coordinate international technical review
      1.2.4. Present the study results to Mexican and U.S. businesses and Mexican government agencies and donors and U.S. agencies, etc through workshop to decide on the implementation of the market transformation plan.

2. Develop joint ventures and partnerships
   2.1. Continue to facilitate partnerships between Mexican and international SWH companies
      2.1.1. Continue to identify sectors for project opportunities
      2.1.2. In collaboration with ANES and SEIA, organize and carry out matchmaking workshop
      2.1.3. Assist with development of joint financing proposals
   2.2. Organize one or more reverse trade missions to promote these partnerships.
   2.3. Continue to develop CONAE website for business partnerships and project opportunities

3. Establish financing programs and provide financing assistance
   3.1. Identify the specific market applications or market niches that are most promising based on the market study, then for these market sectors identify business partners in Mexico and the U.S. that have the capabilities and interest to develop projects
   3.2. Identify finance options based on input market transformation study for SWH companies for large projects in Mexico and consultations with financing experts (e.g. EIC, E&Co, etc.) and international financing organizations (e.g. IFC, etc.)
   3.3. Identify SWH companies that have the capability and experience to participate in the market and assist them in preparing financing proposals writing for financing for large projects and in preparing business plans.
   3.4. Educate Mexican SWH companies and potential international partners of finance options

3.5. Provide SHW companies assistance with financing proposals

3.6. Together with selected subcontractor for the market transformation study, assist World Bank with proposal to GEF to expand SWH market in Mexico by providing market information and specific customer information to focus the SWH work on sector-specific end-users, based on market transformation study

Expected Deliverables and Results

Deliverables

- Market transformation study
- 1-2 business partnerships developed or business deals carried out
- A finance workshop will be held in late 2001. TCAPP will work with local and international finance institutions to present finance options to the Mexican SWH community.
- Assist in developing 1-2 finance plans
- Submission of 1-2 finance proposals to international finance organizations for large SWH projects.
- 1-2 reverse trade missions carried out to build technical capacity in Mexican SWH companies
- Assistance to World Bank for development of proposal to GEF to expand SWH market in Mexico based on results of market transformation study
- Continued assistance in facilitating business partnerships between US and Mexican SWH companies.

Impacts:

- Estimated reduction of over 18 million tons CO2 per year through full market replication. GHG reductions for projects already implemented are estimated at 300 tons per year over the lifetime of the projects. If financing proposals are approved, an estimated 3000 tons of CO2 reduction is estimated over the lifetime of the projects.
- The market potential for SWH projects is over $30 million. $150,000 has been invested through TCAPP-related activities so far, and investments of up to $1 million are estimated for this year if financing proposals are approved.
- Other development benefits include:
  - Reduced local air pollution and greenhouse gases
  - Enhanced in-country finance capacity
  - Improved economic development and increase in employment
  - Enhance development of renewable energy sources that have significant potential in Mexico such as solar water heaters

Timeline of Activities and Milestones

Date	Milestone
May, 2000	Organized successful Solar Trade Mission with U.S. and Mexican Companies
August, 2000	Facilitated sale of 400 SWHs from U.S to Mexican company for Cancun Hotel project
September, 2000	Organization of solar business side event at the Solar Forum 2000
September, 2000	Organization of climate change technical session at the Solar Forum 2000, with participation by NREL climate change expert
September, 2000	Solicitation released through BCSE network for solar water heater business opportunities in Mexico on Virtual Business Matchmaking website: www.conae.gob.mx/tcapp/tcapp.html
Oct - Feb, 2001	Follow-up with Mexican and international SWH companies to identify needs for business partnering or finance assistance
May - Aug, 2001	Develop Terms of Reference (together with the AID Mission) for a request for proposals (RFP) from consulting firms to develop a market transformation strategy for SWHs in Mexico City.
Aug - Dec, 2001	Assist in carrying out the AID-funded market transformation study
Dec - Jan, 2002	Educate SWH companies on possible finance options, based on results of market transformation study
Jan – Feb 2002	Finance workshop
Jan - March, 2002	.Assist SWH companies in proposal writing for financing for large projects through IFC and other finance mechanisms
Jan - March, 2002	Assist World Bank with proposal to GEF to expand SWH market in Mexico based on results of market transformation study
Jan – March, 2002	Continue to facilitate partnerships between Mexican and international SWH companies (through matchmaking, workshops, joint financing proposal development, and related activities)
February 2002	First reverse trade mission
April 2002	Second reverse trade mission
March - June 2002	Finance proposals prepared and submitted to finance organizations
July 2002	Financing secured for large-scale SWH projects

Resource Requirements out to FY02 for SWH Activities

NOTE: Because of the great number of activities associated with both the ESCO and SWH work, it is recommended that an additional subcontractor be hired to work specifically on the SWH activities.

Work Area	NREL Budget	Cooperator Budget	Potential Cooperators
Provide technical support for and coordination of market transformation study	$5,000	$75,000 ($20K from TCAPP / $50K from AID Mission to fund EIC)	In-Country Coordinator EIC
Facilitate partnerships between US and Mexican SWH companies	$10,000	$10,000	In-Country Coordinator SEIA EIC
Organize and carry out trade missions	$10,000	$10,000	In-Country Coordinator SEIA
Finance workshop	$5,000	$15,000	E&Co (?) EIC In-Country Coordinator AID Mission
Finance proposal development and submission to finance institutions	$10,000	$30,000	E&Co (?) EIC In-Country Coordinator
TOTALS	**$40,000**	**$135,000 ($50 is provided by AID Mission)**	

Next Steps

- Develop Terms of Reference (together with the AID Mission) for a request for proposals (RFP) from consulting firms to develop a market transformation strategy for SWHs in Mexico City
- Assist in carrying out market transformation study
- Identify finance options based on input market transformation study for SWH companies for large projects in Mexico
- Educate Mexican SWH companies and potential international partners of finance options
- Finance workshop
- Assist SWH companies in proposal writing for financing for large projects
- Continue to facilitate partnerships between Mexican and international SWH companies (through matchmaking, workshops, joint financing proposal development, and related activities.
- Carry out 1-2 reverse trade missions
- Assist World Bank with proposal to GEF to expand SWH market in Mexico by providing market information and specific customer information to focus the SWH work on sector-specific end-users.

Overall Project Coordination

1. NREL's major coordination activities for this work include the following:
   1.1. Coordinating the work of the country teams, including CONAE and INE, U.S. experts and trade associations such as NAESCO and SEIA, participating businesses including U.S. and Mexican SWH companies and ESCOs, finance institutions, including the World Bank, IFC, and donors, such as USAID, DOE and EPA so that all parties are working toward common goals.
   1.2. Subcontracting with CONAE and guiding their work, and identifying and managing additional in-country support and subcontractors
   1.3. Maintaining an active and effective country team, with active engagement and participation of key government officials, including energy and climate officials from CONAE, SE, INE and SEMARNAT, and other key development agencies and any existing interagency processes that have been established
   1.4. Integrating work with TCAPP activities supported by EPA and DOE and with other USG initiatives in the country
   1.5. Promoting business and donor awareness and participation
   1.6. Reporting on results and accomplishments
   1.7. Developing and updating workplans and tracking financial expenditures across activities to help manage an overall budget
   1.8. Assisting the country team in presenting the work at key climate and energy forms and events

Work Area	NREL Budget	In-Country Coordinator Budget
Project Coordination	$15,000	$10,000
TOTAL: $25,000		

USG Technology Cooperation Project Coordination and Reporting for Mexico

This is proposed as a separate activity, that could be carried out with a small amount of additional funds. The benefit would be to keep all USG agencies aware and up to date of the ongoing technology cooperation activities being carried out in Mexico, and the resulting impacts of the programs and to promote effective integration and linkage between these activities.

1. Identify all USG technology cooperation programs
2. Create and update a report and web-site that that list all programs and update on quarterly basis
3. Develop reports that quantify development benefits and GHG reductions associated with all USG technology cooperation programs
4. Prepare summary fact sheets and briefings that can be used to highlight these programs to key officials in Mexico, senior US officials, to the business community, to donors, and to the international climate change community.

Work Area	NREL Budget	In-Country Coordinator Budget
Tracking and reporting on all USG technology cooperation programs	$25,000	$5,000
TOTAL: $30,000		

PHILIPPINES

The goal of TCAPP overall is to accelerate the adoption of clean energy technologies and practices to promote economic and social development, mitigate global climate change and support technology cooperation under the UNFCCC.

The main objectives for the Philippines' participation in TCAPP were explained in a presentation by Mr. Reuben Quejas of the Philippines Department of Energy (PDOE) in October, 1998:

- Enhance socioeconomic development by identifying better energy sources and technologies
- Promote environmentally benign energy development pursuant to the Philippine government's Agenda 21
- Use the geographic advantages that make the Philippines suitable for new and renewable energy systems

Taken together, these objectives guided TCAPP to focus on renewable energy technology applications that could support economic development. Both off-grid, rural applications and applications on existing main grids or isolated grids were explored, with the following objectives for these two different renewable energy applications:

- Enhance rural economic development through productive use of renewable energy in off-grid, rural applications, including rural electrification and agricultural water pumping;
- Reduce energy-related foreign exchange expenditures, improve reliability of energy supply through greater diversity, reduce electrical subsidies, and reduce greenhouse gas emissions by increasing the use of renewable electricity for the main grid or existing isolated grids.

Based on the interests of the PDOE and renewable energy businesses, TCAPP Philippines selected three technology application areas, the first and third for main grid or isolated grid applications, and the second for off-grid, rural applications:

- Wind / Diesel Hybrid Generation for Isolated Electrical Grids
- Off-Grid Rural Renewable Energy Use
- Hydropower Retrofits for Electric cooperatives.

In response to the review of TCAPP, and in preparation for the start of TCAPP Phase 2, this business plan describes each of these technology applications, including objectives and benefits, barriers, actions to address the barriers, and details of proposed TCAPP actions. We recommend alternative approaches to narrow the focus of the technology applications, and identify opportunities for greater cooperation with a variety of groups. We also document the benefits of TCAPP, including:

- For Wind / Diesel Hybrids, reduced foreign exchange payments, improved reliability, lower costs, and environmental benefits compared to diesel generation; mitigation of 19 million metric tons of CO_2 in the long term; $350 million investment at full market replication.

- For off-grid rural renewables, more cost-effective rural electrification and greater agricultural productivity; mitigation of 7 million cumulative metric tons of CO_2 with full market growth; $6 billion in investment.
- For hydropower retrofits, diversification of electricity supply; mitigation of 2.7 million metric tons CO_2; investment of $10 million upon full replication in the market.

Wind / Diesel Hybrid Generation for Isolated Electrical Grids

The Philippines enjoys a much better wind resource than was formerly believed, thanks to its island geography and mountainous terrain, which overcome the general trend of tropical locations to have poor wind resources. The completion of the Wind Atlas of the Philippines documented this resource and kindled interest of the PDOE, PNOC, National Power Corporation, and private industry in using wind turbine generation of electricity. One particularly promising application of wind energy technology occurs on isolated island electrical grids, away from the main Luzon grid. Diesel generation is now the primary source for these isolated grids. The economic, performance, and environmental advantages of adding wind generation to these grids have been analyzed to identify the most promising sites, and the opportunity has attracted the interest of commercial developers, including BreezElectric which has developed the Philippines Hybrid Energy Systems, Inc. (PHESI) Island Wind Power Project. This pioneering project is well on the path towards implementation, although technical, financial, and policy barriers remain. Completion of this project, and expansion to additional sites are the next steps for market development of wind / diesel hybrid generation.

Objectives and Benefits

The major objective for wind / diesel hybrid generation for isolated electrical grids is to increase in-country abilities to use of wind / diesel hybrid generation on isolated electrical grids where there are good wind resources to provide locally-available, economically competitive electricity in rural areas.

Benefits of wind / diesel hybrid generation for isolated electrical grids include economic development, greenhouse gas mitigation, and investment. The development benefits are increased use of local energy resources for electricity supply, which helps achieve national electric sector objectives because of foreign exchange, reliability, cost, and environmental benefits.

The greenhouse gas mitigation benefits average about 70 thousand metric tons of CO_2 equivalent emissions avoided annually from current commitments by BreezElectric / PHESI, and reach about 19 million cumulative metric tons over the next 30 years with full market development of wind / diesel hybrid projects.

Benefits from planned private investment start at about $59.5 million from the proposed BreezElectric / PHESI project, and rise to about $500 million upon full replication in the market; Proposed public investment is estimated at $35 million in proposed projects, and rises to about $350 million at full market replication.

Barriers

Technical, financial, and policy barriers remain that impede both the implementation of currently planned BreezElectric/PHESI project and potential future wind / diesel hybrid generation projects for isolated electrical grids. A partial list of these barriers includes:

1) Insufficient local technical expertise: Site selection and system design at specific prospective wind sites require technical expertise that is insufficiently developed in-country, and is expensive to obtain from international sources.
2) Financially troubled customers: Many electric cooperatives, the prospective purchasers of the electricity, are credit risks. This seriously complicates financing of the project by raising uncertainties about project revenues.
3) Limited project development resources: Resources for project development are few because of the high risks of using an unfamiliar technology with higher initial capital costs in geographically remote areas of the Philippines.
4) Insufficient local financial institutional expertise: Local financial institutions are particularly important for expansion of the wind / diesel hybrid market to smaller, locally-financed projects. These institutions lack experience with evaluating new and renewable energy technology projects and are therefore likely to overestimate financing risks.
5) Uncertain diesel ownership: Future ownership of existing NPC-owned diesel generation on isolated electrical grids is uncertain. This is a barrier because coordination between wind and diesel is necessary to ensure a functional hybrid system
6) Uncertain or unfavorable policies: Policy uncertainty, and some unfavorable policies, continue to impede wind / diesel hybrid generation projects, despite significant improvements. Additional policy clarifications and reforms are needed to resolve these issues.

Actions to Overcome Barriers

1) Insufficient local technical expertise:

A small group of people in the Philippines has developed initial technical expertise on system design and site selection for wind / diesel hybrid projects. So far, however, no one in-country has had the opportunity to put this expertise to the test by designing a complete project for implementation. The BreezElectric / PHESI team and the National Power Corporation's Strategic Power Utilities Group have worked closely with NREL on site screening and system design issues at BreezElectric / PHESI project sites, but they or others will require further experience with project completion before they could independently provide these technical services. If additional market growth is to include implementation of smaller wind / diesel hybrid projects, it is particularly important that in-country expertise be readily available because of the cost of tapping international expertise for these smaller cases. Actions to build local technical expertise include:

a. Local BreezElectric / PHESI and NPC-SPUG personnel can gain expertise through continued interaction with international experts on the selection and design of specific sites for the BreezElectric / PHESI project.

b. BreezElectric / PHESI project or other project sites can be used teaching tools for additional potential in-country technical experts.
c. Development of other, smaller projects can create consulting opportunities for in-country technical experts.

2) Financially troubled customers:

Electric cooperatives are the target customer for the electricity that the currently planned BreezElectric / PHESI wind / diesel hybrid projects would generate, and the likely customer for many other projects. However, many of them have such bad credit ratings that their power purchase agreements are insufficient payment guarantee for the projects to obtain financing. Addressing this issue is essential if wind / diesel hybrid projects are to serve the isolated grids operated by electric cooperatives. National policy initiatives, such as the Electric Power Industry Reform Act of 2001 (R.A. 9136) (hereafter, "Power Act" or "Act"), and international development efforts, such as those of the Asian Development Bank and the World Bank, seek to address management and policy issues of electric cooperatives to improve their financial standing. In addition to these general, fundamental reforms, one action that could reduce the non-payment risk for a power purchase agreement with an electric cooperatives is to develop a payment guarantee systems to ensure payments for renewable energy projects.

3) Limited project development resources:

Private sources of project development funding seek expected financial returns that are commensurate with the risks. Thus a wide variety of actions that increase expected returns or decrease risks can help bring more project development funds to the wind / diesel hybrid market. Among these actions are the following:

a. Complete the BreezElectric / PHESI project. The success of this pioneering project is crucial to demonstrate to other project developers that this type of project can succeed. The BreezElectric / PHESI project itself may need further project development resources.
b. Collect, analyze, and communicate initial technical and business information about project opportunities to likely project developers. This type of information helps potential project developers to focus their resources on the most likely projects, which reduces their risks and improves the chance that they will spend money for project development.
c. Fund initial project scoping activities. If project development risks are too high to attract private sources, public funding could be used to pay for the development of a pre-feasibility project proposals.

4) Insufficient local financial institutional expertise

International development efforts, notably the UNDP's FINESSE project with the Development Bank of the Philippines, have worked to educate Philippines development financial organizations about renewable energy, but these efforts have not reached the private financial institutions that are important if wind / diesel hybrids are to enter the technological mainstream. Actions to

address this barrier include:

a. Communicate with financial institutions in advance of the presentation of a project proposal for financing, and prepare the project proposal to anticipate and address their concerns
b. Inform financial institutions about international experiences with wind /diesel hybrid technologies.
c. Public and development financial institutions can assist in disseminating their renewable energy project evaluation expertise throughout the financial sector in the Philippines.

5) Uncertain diesel ownership:

Hybrid systems require coordination for effective operation, and so the simplest arrangement is to have a single owner for both diesel and wind technologies. NPC-SPUG's diesels on isolated grids may be sold when NPC is privatized, as provided in the Act. If the different technologies have different owners, then it becomes essential for the electrical grid operator (the electric cooperative or its delegate) to understand and require technical and operational measures for successful hybridization to ensure grid function. When there will be multiple owners, the following actions can be taken to ensure performance no matter what the outcome on diesel ownership:

a. Inform all parties of hybrid operational issues that need to be addressed.
b. Establish agreements that will ensure coordination of diesel operation with wind project no matter who owns the diesel.

7) Uncertain or unfavorable policies:

The remarkable progress recently on policy issues that affect new and renewable energy has included the Departmental Circular, Executive Order, Power Act, and work towards a New and Renewable Energy Bill. Despite these achievements, some policy issues remain unresolved, or are unfavorable to wind / diesel hybrid generation. During project development, the BreezElectric/PHESI team has experienced policy limitations first hand, and has prepared recommendations to address these policy issues. Actions to resolve these issues could include:

a. Departmental review of recommended policy changes by the PDOE
b. Development of draft implementing policy documents (Departmental Circulars, Executive Orders, Legislation, etc.)
c. Adoption of these policy documents through the appropriate public process

TCAPP Actions

Past TCAPP activities have emphasized support of commercial development at fourteen technically favorable sites, which are now targets of the BreezElectric/PHESI project. TCAPP has primarily addressed technical and financial issues, although TCAPP policy activities aimed to advance renewable energy in general were also very valuable for this specific project. The wind / diesel hybrid area of TCAPP is now at an important transition, with opportunities to

support resolution of remaining issues for the BreezElectric/PHESI project; to support expansion to other projects; and to focus on policy issues.

If the next phase of TCAPP actions includes expanding the market to additional projects, then it may be better to describe this technology application area as "renewable energy hybrids for isolated grids," not "wind / diesel hybrids." This is because the next set of existing diesel generators may be retrofit most effectively through combinations of several technologies. Even so, the preceding summary of barriers would still apply in this more general renewable energy technology case.

This section proposes actions that TCAPP can undertake to address the barriers. To address the first barrier, insufficient local technical expertise:

1) Guide technical design of wind / diesel hybrid sites. TCAPP is now establishing a site design process for the BreezElectric / PHESI project with PDOE and the project team. This current-phase TCAPP action includes planning the steps and implementing them for one of the fourteen target sites. In the new phase of TCAPP, we will assist the site design team by reviewing and providing technical comments on their work at additional sites. Local technical staff will develop their capabilities through participation in the site design team and through TCAPP review of their work. The site design work includes site-specific resource data acquisition and data review and design of equipment installations and equipment control systems tailored to the sites.

TCAPP will address the second barrier, financially troubled customers, as follows:

2) Support development of payment guarantee systems to ensure payments for renewable energy projects. TCAPP will support the development of a payment guarantee system that is underway through BreezElectric work with PDOE and financial institutions. TCAPP support will include meeting facilitation and logistical assistance, development of draft program documents, and expert review and comment on the proposed system.

The third barrier is limited project development resources, to be mitigated through the following TCAPP actions:

3) Identify project development resources for the BreezElectric / PHESI project. TCAPP will continue its current activities to assist BreezElectric/PHESI in securing project development resources to complete feasibility work. Current TCAPP actions have generated several specific leads for potential project development resources.

4) Analyze and disseminate hybridization opportunities. TCAPP will screen additional existing diesel sites for opportunities for renewable energy hybrids, and provide results to potential project developers. This information will help potential project developers to evaluate the opportunities and make decisions to commit project development funds. In addition to BreezElectric / PHESI, Smith-Bell and PNOC are among the potential in-country project developers.

5) Support preparation of project proposals by project proponents. TCAPP will fund project proposal development through a competitive, matched funding process, and provide expert review of the project proposals. Financial institutions are one possible audience for these proposals, because they have lending programs that target rural economic development, renewable energy development, and high-risk or advanced technology projects. If the project proposals are to be submitted to a financial institution, TCAPP will link this to Action #6, below.

Insufficient local financial institutional expertise is the fourth barrier, to be addressed through the following action:

6) Analyze projects with local financial institutions. TCAPP will analyze actual hybrid project proposals from Activity #5 with up to 10 trainees from local financial institutions. Participants will be selected who are or will be in charge of evaluations of hybrid projects. The training will feature international experiences with evaluation of renewable energy technology financing risks, and international financial experts who have financed hybrid projects will lead the training.

TCAPP action to address the fifth barrier, uncertain diesel ownership, is as follows:

7) Address technical and operational issues for hybrids under multiple owners. TCAPP will hold up to three workshops for electrical grid operators (electric cooperatives), owners of diesels, and owners of wind generation on the technical and operation issues that need to be addressed to ensure grid function. The outcome of these workshops will be draft agreements to resolve these issues.

Action to address the sixth barrier of uncertain or unfavorable policies will be:

8) Develop draft policy language and issue papers to support policy reforms. Apart from initial policy reform activities, TCAPP has supported work on few policy issues. There is now an opportunity to address remaining policy concerns of wind / diesel hybrid project developers within the context of the new Power Act, and possibly in a NRE bill. TCAPP will work with the PDOE and other stakeholders to develop draft language and issue papers to address 3 selected policy issues. These documents would then be used by PDOE in implementation of policy changes.

Deliverables and Results

The primary TCAPP deliverables corresponding to each of these actions are:

1) Technical reports to review site designs. For each of the BreezElectric/PHESI sites, TCAPP will review a draft site design, provide comments, and recommend how site design skills could be improved. Results are technically feasible site designs and development of in-country technical skills.

2) Payment guarantee system meetings facilitation. TCAPP will provide coordination, logistical assistance, and draft program documents for up to 5 meetings to reach agreement on a payment guarantee system.

   2a) Payment guarantee system review report. TCAPP will provide expert review of up to five specific issues related to the development of the proposed payment guarantee system.

3) Two additional project development leads for BreezElectric/PHESI project. TCAPP will contact and assess two organizations that have an interest in funding further project development of the BreezElectric/PHESI project. TCAPP will provide BreezElectric/PHESI with the results of this assessment and facilitate initial contact.

4) Site screening report on additional existing diesel sites. TCAPP will screen existing SPUG or other large diesels that are not yet slated for hybridization and identify those best suited for project development.

5) Three hybrid project proposals. TCAPP will provide matching funds and review for three hybrid project proposals.

6) Hybrid project analysis and training for financial institutions. TCAPP will analyze 1-3 hybrid project proposals and train up to 10 staff of local financial institutions on this analysis.

7) Workshop series and draft agreement on hybridization with multiple owners. TCAPP will hold up to three workshops, leading to a draft agreement to resolve technical and operational issues for hybrids with multiple owners.

8) Draft policy documents and issue papers. For each of three selected policy issues, TCAPP will develop a draft policy document and issue paper.

The major benefits of the TCAPP actions for development, greenhouse gas emissions reduction, and investment are:

- Development Benefits: TCAPP will facilitate market development of wind/diesel hybrid generation, which will reduce the use of diesel fuel for electricity generation, thereby reducing government subsidy payments by over 1.5 billion Philippine pesos, and saving 35 billion pesos worth of foreign exchange during the first 10 years of operation.
- GHG Emissions Benefits: 2,100,000 metric tons CO_2 equivalent over 30 years from current commitments made by BreezElectric / PHESI
- Investment Benefits: $59.5 million committed or planned investment in the BreezElectric / PHESI project

Timeline

TASKS and DELIVERABLES	DATE
1. Guide technical design of wind / diesel hybrid sites	Oct 2001– Apr 2002
DELIV. #1. Technical reports to review site designs	Apr 2002
2. Support development of payment guarantee system	Nov 2001 – May 2002
DELIV. #2a. Payment guarantee system meetings facilitation	Nov 2001 – May 2002
DELIV. #2b. Payment guarantee system review report	Mar 2002
3. Identify project development resources	Sept 2001 – Jan 2002
DELIV. #3. Two additional project development leads for BreezElectric/PHESI project	Jan 2002
4. Analyze and disseminate hybridization opportunities	Jan – Mar 2002
DELIV. #4. Site screening report on additional existing diesel sites	Mar 2002
5. Support preparation of project proposals	Mar – Jul 2002
DELIV. #5. Three hybrid project proposals	Jul 2002
6. Analyze projects with local financial institutions	May – Aug 2002
DELIV. #6. Hybrid project analysis and training for financial institutions	Aug 2002
7. Address technical and operational issues for hybrids under multiple owners	Jan – Apr 2002
DELIV. #7. Workshop series and draft agreement on hybridization with multiple owners	Apr 2002
8. Develop draft policy language and issue papers	Nov 2001 – Feb 2002
DELIV. #8. Draft policy documents and issue papers	Feb 2002

Resource Requirements

The following preferred level of resources is prepared without imposing an overall budget constraint. Alternatives for constrained budgets are presented in the Management Decisions section. (Values are in thousands of dollars)

Activity	**Priority**	**Activity Budget**	**NREL**	**Cooperators**
Total		**$200**	**$100**	**$100**
1. Guide technical design of wind / diesel hybrid sites	*1*	$30	$20	$10
2. Support development of payment guarantee system	*2*	$15		$15
3. Identify project development resources	*1*	$5		$5
4. Analyze and disseminate hybridization opportunities.	*3*	$25	$10	$15
5. Support preparation of project proposals	*3*	$40	$10	$30
6. Analyze projects with local financial institutions	*3*	$30	$25	$5
7. Address technical and operational issues for hybrids under multiple owners	*1*	$15	$10	$5
8. Develop draft policy language and issue papers	*1*	$30	$15	$15
Technical Coordination	*1*	$10	$10	

Cooperators

In-Country Technical Expert will provide local expertise on hybrid technologies, and the cooperation will enhance these local capabilities to develop hybrid projects. This role will include primary responsibility for Deliverable 4 (Site screening report on additional existing diesel sites), with participation in preparation of Deliverables 1 and 5 - 8. Possible cooperators include NPC-SPUG technical staff and Silver Navarro.

International Technical Expert will have extensive prior experience in planning and design of a variety of hybrid projects. This role will include primary responsibility for Deliverables 1 (Technical reports to review site designs) and 7 (Workshop series and draft agreement on hybridization with multiple owners), with contributions to Deliverables 4 – 6 and 8. NREL is the most likely candidate to fulfill this role because of its unparalleled experience with a wide range of hybrid projects.

Project Proponents are businesses targeting renewable energy hybrids as a business line, or should represent such businesses. They will be responsible for Deliverable 5 (Three hybrid project proposals), with possible involvement as stakeholders in Actions 2,4, and 6-8. Possible business cooperators include BreezElectric/PHESI, PNOC, Smith-Bell, and WorldWater Philippines.

In-Country Renewable Energy Finance Expert will be familiar with the capabilities and concerns of local financial institutions. This role will include primary responsibility for Deliverables 2a (Payment guarantee system meetings facilitation) and 2b (Payment guarantee system review report), and active participation in preparation of Deliverable 6. Possible cooperators include AED because of their previous leadership on the UNDP/FINESSE project, or other financial consultants.

International Renewable Energy Finance Expert will provide international perspectives and experiences on the evaluations of renewable energy projects that financial institutions perform. This role will include primary responsibility for Deliverable 6 (Hybrid project analysis and training for financial institutions) and active participation in preparation of Deliverables 2a and 2b.

International Project Development Expert will identify possible sources of project development funding for the BreezElectric/PHESI project, explore their interest, and initiate contact between the funding source and project proponent. This will include completion of Deliverable 3 (Two additional project development leads). Todd Bartholf is the likely cooperator for this activity because he has already successfully initiated contact with several project development leads.

In-Country Renewable Energy Policy Expert will identify and engage local stakeholders, assess and summarize their needs, and work together with the international renewable energy policy expert to prepare draft policy documents and issue papers. This cooperator will be an essential participant for completion of Deliverable 8 (Draft policy documents and issue papers). Possible cooperators include PEI.

International Renewable Energy Policy Expert will recommend factors to consider in selecting priority policy issues, identify relevant international experiences with the selected priority policy issues, review and guide refinement of the assessment of stakeholder needs, and work together with the in-country expert to prepare draft policy documents and issue papers. This cooperator will be an essential participant for completion of Deliverable 8 (Draft policy documents and issue papers). Possible cooperators include NREL, AED, international trade associations, Winrock International, and others.

Technical Coordination will emphasize coordinating technical, financial, and policy actions so that together they provide coherent advances to hybrid market opportunities. It is recommended that NREL fill this technical coordination roles because it has experience with the inter-relationships of technical, financial, and policy aspects of renewable energy technology implementation.

Next Steps

- Complete work planning with PDOE, BreezElectric/PHESI, and other cooperators.
- Finalize funding for all cooperators.

Off-Grid Rural Renewable Energy Use

The PDOE seeks to provide access to modern energy services, both electricity and fuels, for the rural population of the country to assist with economic development efforts. About 80 percent of the barangays[28] in the Philippines are now officially considered to have access to electricity, and the PDOE seeks to electrify all barangays by 2006. Some of these areas will be served through extension of existing electrical grids; others will be off-grid, requiring individual systems or isolated mini-grids. In these off-grid areas, renewable energy technologies are one part of a least-cost solution that the PDOE and its international development partners are planning to use.

Objectives and Benefits

The primary objective for renewable technology applications for off-grid, rural renewable energy use is to facilitate widespread use of these technologies by:

- Improving GOP and private sector decision-making capability to evaluate least-cost rural energy services, especially renewable energy technologies;
- Facilitating partnerships with international firms; and
- Encouraging businesses to provide rural renewable energy services.

Off-grid rural renewable energy use benefits development, mitigates greenhouse gases, and encourages private investment. Development benefits of this technology application area are more cost-effective rural electrification and greater agricultural productivity. These are primary national development objectives because rural electrification supports community services, business development, and achievement of individual goals. Agricultural productivity is a core development issue because of high agricultural employment and dramatic opportunities for agricultural improvement.

Greenhouse gas mitigation averages about 3,000 metric tons CO_2 equivalent annually from currently proposed WorldWater agricultural water pumping project and reaches about 7 million cumulative metric tons with full market replication of both agricultural water pumping and rural electrification over a 15 – year project life.

Benefits from private investment start at about $800,000 from rural electrification and agricultural water pumping projects, and rise to about $1 billion upon full replication in the market; Public investment in proposed projects is estimated at $36 million, and rise to $5 billion.

Barriers

Barriers to renewable energy commercialization and to rural energy modernization have been evaluated through a variety of PDOE projects with international development institutions, and a complete summary of these findings is not attempted here. A short list of substantial barriers to off-grid, rural renewable energy use include:

[28] The smallest Philippines political division, below provinces and municipalities.

1. Inadequate economic decision-making: Up-front capital costs for modern energy may be high relative to available funds. Decision-makers may also lack analytic experience in comparing costs among technologies with different capital costs as compared to operations and maintenance costs. Separation of responsibility for capital investment from responsibility for operations and maintenance may also eliminate incentives to minimize economic costs. Together, these factors result in selection of non-renewable technologies with lower up-front capital costs but higher operations, maintenance, and environmental costs.
2. Local capacity is underdeveloped: This includes capacity to manufacturer and/or distribute and/or maintain renewable technologies for rural applications. Local capacity to distribute, operate, and maintain technologies is crucial, and manufacturing capability would strengthen the supply chain in the longer term.
3. Decision-makers lack information: Decision-makers in the market have greater information, experience, and access to competitor non-renewable technologies, leading to preference for those non-renewable technologies.

Actions to Overcome these Barriers

1) Inadequate economic decision-making:

The PDOE has embarked on an ambitious agenda with its international development partners to provide rural energy services, and has taken initial steps to ensure that technology selection is based on economic criteria, by starting to use economic evaluations in World Bank and Asian Development Bank projects. However, a decision to select technologies based on lowest costs over the whole life cycle is more complicated than a decision to select the technology with the lowest initial capital cost, and the adoption of economic decision-making is far from complete. It is crucial to incorporate these approaches fully and immediately into technology selection decisions because otherwise costly commitments to inappropriate technologies may be made. In-country capability to select among non-renewable and renewable technologies based on economic comparisons is crucial to the success of rural development efforts, and also to the effective use of renewable energy technology. Full incorporation of economic decision-making into Philippines government institutions at all levels will likely take another 3 years, because energy technology selection decisions are made in so many different agencies. Specific actions include:

a. Decision-makers can gain access to economic evaluation techniques that adequately compare life-cycle costs of renewable energy and competitor technologies through the further development of in-country expertise.
b. PDOE can lead the way to establish economic evaluation standards for energy technology selection, and disseminate these approaches throughout government agencies and financial institutions.
c. Financial institutions can provide financing that will encourage the selection of economically optimal technologies, rather than only those technologies with the lowest up-front capital cost.

2) Local capacity is under-developed

Distribution, operations, and maintenance capacities for renewable energy technologies are at a very early stage of development in the Philippines, and need continued development so that these technologies will be available, reliably and continually. Capacity development actions include:

a. Establish the economic basis for distribution, operations and maintenance by designing rural renewable energy markets so that these services will be funded in the long term, and so that payments for these services, taken together for all the systems in an area, are sufficient to create permanent jobs for the necessary personnel.

b. Facilitate distribution of renewable energy technologies by accessing non-traditional distribution networks, such as agricultural supply company networks; by streamlining procurement processes; by focussing distribution of equipment and supplies on areas where there is a solid economic base; and by using advanced logistics and communications systems.

3) Decision-makers lack information:

PDOE, the Climate Change Information Center, the Philippines renewable energy industry, and a variety of other groups are reaching out to all levels of decision-makers to inform them about the opportunities to use renewable energy in rural areas. Despite these ongoing efforts, many decision-makers, from the local level to the national level, have greater experience and comfort with conventional options such as diesel generation and grid extension. Continued outreach and improved, targeted information is needed to achieve the potential of renewable energy to assist economic development in rural areas.

TCAPP Actions

Because rural electrification is such a high priority of the Government of the Philippines, nearly all of the major international development institutions have a rural electrification project or are planning to undertake one. It is therefore a challenge to identify a small incremental activity where TCAPP can have a distinct contribution to this high priority area. However, we have identified a set of actions that complement activities of other groups and could be crucial to the long-term success of rural renewable energy use. We envision that TCAPP's contribution will be coordinated with USAID's other rural energy use activities as well as rural renewable energy use projects sponsored by others. With these major rural energy projects underway, we believe it does not make sense for TCAPP to generate a separate pipeline of projects, but rather to enhance existing efforts. These existing, external projects could include:

- Rural Power (Renewable Energy Component) in preparation for a proposed World Bank APL
- Asian Development Bank Projects, such as the Project Preparatory Technical Assistance Rural Electrification Project, and the Advisory Technical Assistance Rural Electrification Institutional Strengthening Project
- UNDP Renewable Energy Project (now under development)

TCAPP will select which of these rural energy project development efforts to target most directly. TCAPP has discussed possible collaboration with the AED team for the World Bank project, which would welcome this set of complementary actions. However, the in-country capacity that this activity will develop could support any or all of them once it is fully established.

TCAPP will pursue a set of actions that address the first two barriers, above, because these are most directly related to immediate project development. For the first barrier, inadequate economic decision-making,, TCAPP actions will begin to implement actions 1a and 1b, above: the access to economic evaluation techniques and the establishment of these techniques for the Government of the Philippines. Our economic decision-making actions are:

1) Economic analysis. TCAPP will provide in-depth, hands-on, project-focussed consultation with in-country analysts to enhance the development and use of analytic techniques that take life-cycle technology costs into account. TCAPP will provide two to three in-country analytic organizations with coaching on a monthly or more frequent basis to support their development of economic analyses of renewable energy technologies for rural applications. This support will result in 5-10 economic analyses of rural electrification projects and a comparative economic analysis for agricultural water pumping, which will contribute to pre-investment planning for these projects. The analyses could support decisions about World Bank, Asian Development Bank, United Nations Development Programme, or other rural electrification projects of international development institutions. For rural electrification, in-country organizations may receive funding through related efforts, such as the PDOE – World Bank pre-investment study led by AED to develop rural electrification market packages. For agricultural water pumping, funding for an in-country analytic team is needed.

2) Decisions using economic analysis. TCAPP will provide recommendations on institutional processes and organize discussions with decision-makers to promote the effective use of economic analyses. PDOE leads the adoption of economic evaluation approaches to technology selection for rural energy use, and Philippines Department of Agriculture makes decisions about agricultural water pumping technologies that it will support. Other government decision-makers about rural energy projects reside in the PDOE, the Philippines Department of Agriculture, the Department of Agrarian Reform, the Department of Interior and Local Governments, and other government institutions. TCAPP will organize a decision-makers' workshop to assist the PDOE rural electrification program in using the 5-10 economic analyses in its program design decisions. The workshop materials will be provided to in-country analytic organizations for future use with additional decision-makers. TCAPP will prepare an agricultural water pumping program design for the Philippines Department of Agriculture to use as the basis for its decisions on technology selection.

TCAPP will address under-developed local capacity for distribution, operations, and maintenance by encouraging the underlying market and program conditions that allow local capacity to flourish. TCAPP will not directly create distribution, operations, or maintenance infrastructure, because we believe these roles are best fulfilled by the private sector. Our actions

to develop local capacity for distribution, operations, and maintenance are:

3) Dialogue on rural renewable energy use with the private sector. TCAPP will organize meetings and electronic communications to encourage international business participation in the design of rural electrification programs of PDOE, especially discussion of how this design affects distribution, operations and maintenance. These businesses and supporting organizations can offer their experience in matching products, payment schemes, and customers to ensure a sound business and economic basis for rural electrification. This input will increase the likelihood that businesses will want to be involved in rural electrification programs, which are often unattractive to private investors. TCAPP will obtain cooperation from international business groups and NGOs to assist in business outreach.

Deliverables and results

Major TCAPP deliverables that support each these actions will include:

1) Economic analysis.
   1a. Analysis of 5-10 rural electrification projects.
   1b. Comparative economic analysis for agricultural water pumping.

2) Decisions using economic analysis.
   2a. Rural electrification decision-makers' workshop using project economic analyses.
   2b. Agricultural water pumping program design.

3) Dialogue on rural renewable energy use with the private sector. TCAPP will organize two to three business outreach sessions in the U.S. and one electronic outreach process (website or email messages). TCAPP will summarize the results to document international business feedback on rural electrification program design.

The primary benefits of the TCAPP actions include development, greenhouse gas emissions, and investment benefits:

- Development Benefits: TCAPP will assist PDOE to develop selected elements of their approach for rural electrification, providing a clearer understanding of least-cost rural electrification systems. TCAPP will assist with evaluation of PV-powered agricultural water pumping. The number of places where PV-powered water pumping would be useful will be determined in this evaluation.
- GHG Emissions Benefits: 47,000 metric tons CO_2 equivalent cumulative reduction over 15 years from the proposed WorldWater agricultural water pumping project
- Investment Benefits: $600,000 committed or planned investment in TCAPP-facilitated projects,

Timeline

TASKS and DELIVERABLES	DATE
1. Economic analysis	Nov 2001 – Mar 2002
Designate in-country analytic organizations and select economic analyses to perform	Nov 2001
DELIV. #1.a. Analysis of 5-10 rural electrification projects	Mar 2002
DELIV. #1.b. Comparative economic analysis for agricultural water pumping	Mar 2002
2. Decisions using economic analysis	
Workshop preparations (schedule, draft workshop materials)	Nov 2001 - Feb 2002
DELIV. #2.a. Rural electrification decision-makers' workshop using project economic analyses	Apr 2002
DELIV. #2.b. Agricultural water pumping program design	May 2002
3. Dialogue on rural renewable energy use with the private sector	Nov 2001 – Jun 2002
DELIV. #3. Industry outreach meetings in the U.S. on rural electrification, with documentation of recommendations	Nov 2001 Feb/Mar 2002 May/Jun 2002

Resource Requirements

The following preferred level of resources is prepared without imposing an overall budget constraint. Alternatives for constrained budgets are presented in the Management Decisions section. (Values are in thousands of dollars)

Activity	Priority	Activity Budget	NREL	Cooperators
Total		**$150**	**$70**	**$80**
1. Economic analysis	*1*	$70	$40	$30
2. Decisions using economic analysis	*2*	$35	$15	$20
3. Dialogue on rural renewable energy use with the private sector	*3*	$40	$10	$30
Technical Coordination	*1*	$5	$5	

Cooperators

Solar agricultural team. This in-country team for the solar agricultural water pumping activity will be responsible for data collection and analysis, with substantial responsibilities for Deliverables 1b (Comparative economic analysis for agricultural water pumping), and 2b (Agricultural water pumping program design). Although they are seeking funds for full project development, the small budget included here would serve to initiate analytic efforts. Potential cooperators include Department of Agriculture, WorldWater, and a University technical support group such as Central Luzon State University.

In-country rural electrification analysts will be responsible for day-to-day contact with decision-makers and will undertake analyses, with substantial responsibilities related to Deliverables 1a (Analysis of 5-10 rural electrification projects) and 2a (Rural electrification decision-makers' workshop using project economic analyses). Because they may be funded through the PDOE – WB effort, they have been included in the budget only to provide additional support to the TCAPP decision-makers' workshop, but if no other funding source were available, then this would be a high-priority use of an additional $20K in TCAPP funds. Cooperators could include University of the Philippines at Los Banos, University of the Philippines at Diliman, Affiliated Non-Conventional Energy Centers at technical universities, or others.

International renewable energy economic analysis experts will provide assist the solar agricultural team and the rural electrification analysts to complete the economic analyses and design and implement the decision-maker's workshops. They will have substantial responsibilities for Deliverables 1 and 2. NREL is the suggested cooperator for this activity because of its unique capabilities and computer modeling tools for economic analysis of rural renewable energy use.

Winrock and Trade Organizations will facilitate outreach to international businesses to encourage business-friendly designs for rural electrification programs. They will have primary responsibility for Deliverable 3 (Industry outreach meetings with documentation of recommendations).

Technical Coordination will emphasize linking the economic analyses to influential decisions and integrating the input on program design from international business with the design decisions. It is recommended that NREL fill these technical coordination roles because of its experience with the use of renewable energy economic analyses in rural energy decisions.

Next steps

- Complete work planning with PDOE, Philippines Department of Agriculture, AED / World Bank, WorldWater, and other cooperators
- Finalize funding for all cooperators
- Identify funding source for agricultural water pumping in-country team

Hydropower Retrofits for Electric Cooperatives

The Philippines has tapped its rich hydropower resource to provide electricity through the construction of about 55 mini-hydropower facilities, with a total installed capacity of about 90 MW. Most of these facilities serve rural electric cooperatives on separate island grids and were commissioned from the 1950s to the 1980s. The domestically-available hydropower resource is and will remain important in Philippines energy planning because of its foreign exchange benefits and potentially competitive cost. However, existing mini-hydropower facilities are generally in disrepair, and operating far below their potential. Retrofit of mini-hydro facilities represents a cost-effective opportunity to increase their electricity production by 10 to 20 percent without the use of conventional fuels and without construction of new dams. Retrofits would help the PDOE to meet its ambitious goals for hydropower's contribution to the national energy mix, and would improve electricity supply on isolated island grids. Despite this promise, the historical rate of development of retrofit projects is extremely slow, and for electric cooperatives, virtually nil.

Objectives and Benefits

The main objective for retrofit of mini-hydropower facilities owned by electric cooperatives is to establish and trouble-shoot a legal and financing approach in a model commercial project, and disseminate information about how to replicate this model so that further projects can proceed on a commercial basis.

Hydropower retrofits advance economic development, reduce greenhouse gas emissions, and promote private investment. The economic benefits of using a domestic resource for electricity generation include reducing the foreign exchange requirements associated with imported fossil fuels, electricity production at lower cost, and diversification of risks of electricity price variability and supply disruption. These economic benefits support development because they help electric cooperatives to improve service and contain costs. Greater commercial activity on mini-hydropower retrofits could also spur related business investments, some of which, such as micro-hydro projects by Philippines businesses, could have substantial development impacts.

Reductions of greenhouse gas emissions from the model commercial projects would average about 8,000 metric tons CO_2 equivalent per year over the 30 – year project life, with 2.7 million cumulative metric tons CO_2 equivalent emissions avoided if full market replication is achieved after the initial TCAPP model commercial retrofit projects.

Benefits from private investment start at about $1 million from proposed projects, and rise to $10 million upon full replication in the market. The primary public investment related to these retrofits is likely to occur in the form of transfer of existing project debt to the Philippines treasury, and the magnitude of this loan write-off is now being determined.

Barriers

Barriers to implementation of mini-hydropower retrofits for electric cooperatives have been assessed by the PDOE Mini-Hydro Division and local groups involved in hydropower

development, such as the Philippines Association for Small Scale Hydropower (PASSHYDRO) and Preferred Energy Inc. High priority barriers that were identified through discussions with these players include:

1. Existing debt has legal priority, precluding further investment: Many projects' loans are in default, because of historical financial management problems or project performance problems. Existing project debt has higher legal priority, and effectively prevents financing of additional work on the projects because investors would not get money back until prior debt was repaid. (Electric cooperatives owe National Electrification Administration for hydropower facility loans.)
2. Lack of knowledge of features of retrofit technologies and benefits of retrofit projects: Some Electric cooperative managers view the projects as financial liabilities, sunk costs assumed to be unworthy of further investment until proven otherwise. Local stakeholders lack knowledge of the potential for retrofit technologies to improve performance.

Actions to Overcome these Barriers

1) Existing debt has legal priority, precluding further investment:

The Power Act transfers stranded debts of electric cooperatives. Because hydropower project debt prevents good performance by stifling further investment in retrofits, it is essential to demonstrate how the framework of the Act and its implementing rules and regulations can address existing project debt. Full resolution would immediately address the current impasse, in which private investment is not made because of concerns that pre-existing project debt would prevent payment for new investors in retrofits. Actions to achieve this include:

a. Establish an agreement, consistent with the new legal framework, between electric cooperatives, creditors (primarily the National Electrification Administration), and regulators on resolution of legal and financing issues to attract new investment and restore the value of the hydropower facilities.
b. Implement this agreement in a real project so that it can become a proven, standard mechanism.
c. Inform investors that the issue of prior debt has been resolved so that they can consider the improved opportunity for investment in retrofits.

2) Lack of knowledge on features of retrofit technologies and benefits of retrofit projects:

Retrofit opportunities at Philippines mini-hydro facilities range from simple mechanical upgrades to advanced electromechanical technologies, with a range of local knowledge of these technologies and appreciation of their potential benefits. Lack of knowledge of the technologies means that decision-makers routinely underestimate the potential performance improvement achievable through retrofits, in addition to the owners' understandable skepticism about further investment in financially troubled hydropower facilities. Owners and managers need to evaluate solid information on financial and operational benefits of hydropower retrofits. Actions include:

a. Develop and refine a real example that demonstrates financial and energy benefits of hydropower retrofits.

b. Inform hydropower-owning electric cooperatives of these financial and energy benefits, provide opportunities for them to evaluate the information, and encourage them to review their own opportunities.

c. Show electric cooperative decision-makers and hydropower businesses in the Philippines examples of retrofit technologies that have been implemented.

d. Develop local trade association capabilities to represent ranges of retrofit technology alternatives to potential customers and government decision-makers.

TCAPP Actions

The centerpiece of TCAPP action is the development of model commercial retrofit projects for two hydropower facilities on the island of Mindoro. These projects were selected in consultation with PDOE because their technical attractiveness, relatively small size, and well-run electric cooperative (Oriental Mindoro Electric Cooperative, ORMECO) owner make them a good proving ground for the removal of the legal and regulatory barriers that impede hydropower retrofits. TCAPP work on these projects has already assembled business and technical information, obtained agreement from the owner (ORMECO) and a possible investor to review a business plan, and established a schedule for presentation of that business plan.

TCAPP will use these model commercial projects to address the first barrier, the legal priority of existing debt, through the following actions:

1) Debt Resolution and Investor Commitment.

1a. Propose a legal / financial agreement on existing debt. The TCAPP team (including U.S. Hydropower, PASSHYDRO, and PEI) will propose an agreement that electric cooperatives and creditors can use to establish the legal and financing framework for retrofits. This agreement will build from the provisions of the Power Act and its implementing rules and regulations, but will develop the specific, detailed legal and financial approach needed for actual implementation of a hydropower retrofit project – something that the Act and its regulations will not accomplish.

1b. Pursue implementation of debt agreement. The TCAPP team will work with PDOE, ORMECO, NEA, regulators, and potential retrofit investors toward implementation of this agreement for the model commercial hydropower retrofit projects on Mindoro. Implementation requires decisions from these parties so that a potential investor no longer views prior debt as an impediment to retrofit investment. TCAPP will prepare information, facilitate discussion, and troubleshoot issues to encourage these decisions.

1c. Obtain investor commitment. Identify an investor interested in pursuing the model commercial projects, or determine reasons (other than pre-existing debt) why likely investors are not interested.

To address the second barrier, the lack of lack of knowledge of retrofit technologies and of the potential benefits, TCAPP will use the model commercial projects in actions to:

2) Disseminate information on retrofit technology and benefits

2a. Disseminate information on retrofit technology. TCAPP will sponsor a workshop that features the model commercial projects and creates opportunities to disseminate retrofit technology information and encourage business partnerships for additional retrofit projects. The TCAPP team, including U.S Hydropower and PASSHYDRO, will work with PDOE to select high-priority retrofit technologies for this information dissemination and industry exchange opportunity. This activity will develop the capabilities of PDOE and PASSHYDRO to represent ranges of retrofit technology alternatives to businesses, hydro facility managers, and government decision-makers, so that they can further promote retrofit market development independently.

2b. Disseminate information on benefits of model projects to electric cooperatives. TCAPP will inform additional electric cooperatives of the financial and energy benefits of hydropower retrofits to raise their interest in these projects. TCAPP will develop information materials, identify outreach opportunities and arrange for presentations and discussions to ensure that electric cooperatives that own hydropower facilities become aware of retrofit opportunities. PDOE, PASSHYDRO, National Electrification Administration, and Philippines Rural Electric Cooperative Association will be important collaborators for outreach to electric cooperatives because these organizations are well-positioned for outreach because of their regular communications with electric cooperatives.

Deliverables and Results

The major deliverables from these actions are:

1a. Proposed debt resolution documents. A proposed resolution to legal and financing barriers from existing debt in the form of a document or set of documents that NEA and electric cooperatives could use.

1b. Debt resolution meetings and issue papers. A series of 3 - 5 meetings that facilitate a decision process to seek implementation of the proposed resolution, including meeting logistics and facilitation as well as 3 – 5 issue papers that identify, analyze, and propose solutions to any issues with resolution.

1c. Investor commitment memorandum. A memorandum that shows the commitment of an investor to pursue pre-feasibility work on the model commercial projects, or that identifies why these projects are not attractive.

Information dissemination with the goal of creating interest in pursuing retrofits from at least two additional electric cooperatives or businesses, and including

2a. Retrofit technology report. A retrofit technology report and presentation that explain the technologies most important for electric cooperative facilities, for use with an audience of businesses, hydro facility managers, and government decision-makers.

2b. Retrofit benefits report. A retrofit benefits report and presentation that explain the benefits to electric cooperatives, with specific benefits estimates where sufficient data is readily available.

Benefits of the TCAPP actions will support development, mitigate greenhouse gas emissions, and support investment:

- Development Benefits: TCAPP will facilitate market development of hydropower retrofits, which will reduce the use of diesel fuel for electricity generation and could improve the financial position of electric cooperatives and of the National Electrification Administration. Default on payments on non-functioning hydropower facilities is common problem with electric cooperatives' credit history
- GHG Emissions Benefits: 290,000 metric tons CO_2 equivalent cumulative reductions from the proposed model commercial hydropower retrofit projects over a 30 – year life
- Investment Benefits: $1 million proposed investment in TCAPP-facilitated projects

Timeline

TASKS and DELIVERABLES	DATE
1. *Debt Resolution and Investor Commitment*	
Explore additional Hydropower Retrofit opportunities at industry and electric cooperative outreach meetings in Manila	Sep 2001
Consultations with PDOE, NEA, and ORMECO to plan debt resolution approach	Sep – Nov 2001
DELIV. #1a. Proposed debt resolution documents	Dec 2001
DELIV. #1b. Debt resolution meetings and issue papers. (3-5 each)	Feb 2002
Presentations and consultations with potential investors to encourage their interest	Sep 2001– Feb 2002
DELIVERABLE #1c. Investor commitment memorandum.	Mar 2002
2. *Disseminate information on retrofit technology and benefits*	Nov 2001 – Jul 2002
Review of readily available data on hydropower facilities to identify high priority retrofit technologies	Nov 2001 – Jun 2002
DELIVERABLE #2a. Retrofit technology report.	Jul 2002
Business planning work with investor and ORMECO to estimate retrofit benefits	Sep 2001 – Apr 2002
DELIVERABLE #2b. Retrofit benefits report.	May 2002

Resource Requirements

The following preferred level of resources is prepared without imposing an overall budget constraint. Alternatives for constrained budgets are presented in the Management Decisions section. (Values are in thousands of dollars)

Activity	Priority	Activity Budget	NREL	Cooperators
Total		**$75**	**$15**	**$60**
1. Debt Resolution and Investor Commitment	*1*	$50	$10	$40
2. Disseminate information on retrofit technology and benefits	*3*	$20		$20
Technical Coordination	*1*	$5	$5	

Cooperators

Preferred Energy, Inc. will be the primary liaison with ORMECO, NEA, regulators, and investors. They will have primary responsibility for Deliverable 1a (Proposed debt resolution documents) and Deliverable 1b (Debt resolution meetings and issue papers), as well as a substantial role in Deliverables 1c and 2b. PEI could be funded through Winrock.

East Indies Consulting will serve as the main hydropower retrofit technology and project development consultant. They will attract investors to the projects, assess retrofit benefits, and explain retrofit technologies, with primary responsibility for Deliverables 1c, 2a, and 2b. East Indies Consulting serves U.S. Hydropower, and could be funded through them.

U.S. Hydropower Council for International Development will work on the TCAPP team to provide expert regulatory review and analysis to support the development of the debt resolution, based on U.S. Hydropower's extensive international engagement on hydropower regulatory issues. U.S. Hydropower will identify and prioritize retrofit technologies to feature in information outreach, develop presentation and outreach strategies to communicate the benefits of retrofit projects, and assist PASSHYDRO in developing its capabilities to follow up on these actions. It will play a strong role in all of the deliverables.

Philippines Association for Small-Scale Hydro, as the major in-country trade association for small-scale hydropower, will develop its capabilities to advance hydropower retrofit developments by working closely with U.S. Hydropower on its activities (see above).

Technical Coordination will ensure that the debt resolution is used as effectively as possible to attract investors, and will coordinate the transfer of the experience of model hydropower retrofit projects to the outreach and information dissemination effort.

Next Steps

- Obtain confirmation of ORMECO interest in draft business plan
- Complete work planning with PDOE, NEA, U.S. Hydropower, PASSHYDRO, PEI, and East Indies Consulting
- Finalize funding for all cooperators

Management Decisions and Overall Project Coordination

This section describes major questions about funding and scope, recommends approaches to those decisions, and outlines overall project coordination needs to implement the recommended approach.

What overall budget shall be spent on TCAPP – Philippines for the next 1, 2, and 5 – year periods?

Clearly TCAPP sponsors may choose to sponsor TCAPP – Philippines at any level. We suggest the following approaches to this decision:

1. Establish a minimum target funding level and minimum time period, such as $200,000 per year for 2 years. Below a certain level of funding and duration of project, the transaction costs for USAID, USDOE, and USEPA, USAID/Manila, the PDOE, and the project coordination team become large relative to the value of TCAPP as a distinct program. The suggested minimum $200,000 per year for 2 years would be sufficient to hold these transaction costs under approximately 20 percent of project funding. A 2-year time period is also closer to the duration of major project development steps.
2. Establish a preferred target funding level and preferred program timeframe, such as $300,000 per year for 5 years. A longer-term, higher level of funding as a goal is important to attract quality cooperators. Even if actual funding falls between the preferred target and the minimum target, having a longer-term, higher level target will encourage cooperators and collaborators to view the project as an important one. This could also be used to provide performance incentives by explicitly linking future funding level to performance. Longer-term planning such as 5 years is also closer to typical time frames for actual project implementation.

What technology application areas shall be selected for TCAPP activities?

1. Determine how many technology application areas to select based on expected funding level and desired balance of breadth vs. depth in each area. For example, at the minimum target funding level of $200,000 per year, three technology application areas represents a broad reach with minimal depth, two technology application areas allows moderate depth in each, and one technology application area represents substantial depth/minimal breadth. Concrete illustration of these alternatives appears below where we present constrained budgets.
2. Identify priorities among, and synergies between, different technology application areas to select a good combination. The theoretically possible combinations that build on past work in the Philippines are:
    a. All three technology application areas: Hybrids, Rural Renewables, AND Hydro Retrofits
    b. Hybrids + Rural Renewables
    c. Hybrids + Hydro Retrofits
    d. Rural Renewables + Hydro Retrofit
    e. A single technology application area: Hybrids, Rural Renewables, OR Hydro Retrofits

Considerations and recommendations related to these combinations of technology application areas are discussed below:

a. The advantage of continuing to address all three technology application areas through TCAPP is that a greater variety of actions would be undertaken, thereby spreading the risks and increasing the probability that the program would be involved in a successful activity. Further, none of the connections or plans that have been made in the different areas would be lost to the program. The disadvantage, of course, is that involvement in too many areas might reduce program resources in each area to a level that is too small to achieve positive contribution. Approximately $50,000 per year might be an appropriate minimum funding level below which it may be ineffective to undertake actions in a technology application area.

If two technology application areas are to be selected, the following synergies should be considered:

b. Hybrids + Rural Renewables:
   These technology applications areas both promote optimal selection of appropriate renewable energy technologies, and therefore share analytic approaches and some technology alternatives. They differ in that Rural Renewables targets renewable energy for areas away from existing grids and includes water pumping applications, while the Hybrids area targets existing isolated grids with substantial existing diesel generation. Together, they cover the spectrum of renewable electricity applications, and include an important productive use: agricultural water pumping.
c. Hybrids + Hydro Retrofits:
   Both of these technology applications address renewable energy supply for existing isolated electrical grids, and therefore face similar issues such as creditworthiness of rural electric cooperatives and policies affecting ownership, subsidies, and operation of existing diesels on isolated grids.
d. Rural Renewables + Hydro Retrofit:
   Hydro Retrofit builds the in-country hydro industry, which could develop more micro-hydro projects for rural energy. The water pumping aspect of Rural Renewables also relates to the role of some hydro facilities in management of water for agriculture.

We suggest that synergies are the greatest between Hybrids + Rural Renewables, second for Hybrids + Hydro Retrofits, and the least for Rural Renewables + Hydro Retrofits. Therefore, we recommend that either of the first two combinations of technology application areas should be selected in preference to the third.

We further recommend that the first combination, Rural Renewables + Hybrids is slightly preferable because of concerns that USAID has expressed about dam-based hydropower, though if these concerns are fully resolved we might recommend otherwise. Another consideration is that Hybrids activity could easily include environmentally sound hydropower options where appropriate, so Hybrids + Rural Renewables could represent the least reduction in program options.

e. Selection of a single technology application area presents advantages and disadvantages inverse to the continuation of all three areas: The benefits of focused resources contributing more substantially to single area, must be weighed against the dangers that circumstances beyond the control of the program would impede success in a single area, as well as the loss of connections and options to pursue plans in the areas that were dropped.

Selection of a single area is most likely at low levels of funding. Under such funding conditions, we suggest that TCAPP's potential to contribute is the greatest for Hybrids, because the BreezElectric/PHESI project has very strong project proponents and PDOE support, but greatly benefits from a targeted set of TCAPP activities.

Based on these recommendations, we offer three alternative constrained budgets that target the $200K funding level based on the choice of one, two, or three technology application areas:

One Area: Hybrids

This budget is constrained to $200K by reducing priority level 3 activities to allow for overall project coordination. Rural Renewables and Hydro Retrofits eliminated.

Technology Application	Activity	**Priority**	**Activity Budget**	**NREL**	**Cooperators**
Grand Total			**$200**	**$100**	**$100**
Hybrid Generation for Isolated Electrical Grids	Total		**$185**	**$85**	**$100**
	1. Guide technical design of wind / diesel hybrid sites	*1*	$30	$20	$10
	2. Support development of payment guarantee system	*2*	$15		$15
	3. Identify project development resources	*1*	$5		$5
	4. Analyze and disseminate hybridization opportunities.	*3*	$25	$10	$15
	5. Support preparation of project proposals	*3*	$35	$5	$30
	6. Analyze projects with local financial institutions	*3*	$20	$15	$5
	7. Address technical and operational issues for hybrids under multiple owners	*1*	$15	$10	$5
	8. Develop draft policy language and issue papers	*1*	$30	$15	$15
	Technical Coordination	*1*	$10	$10	
Off-Grid Rural Renewable Energy Use	**Total**		**$0**		
Hydropower Retrofits for Electric cooperatives	**Total**		**$0**		
Overall Project Coordination	**Total**		**$15**	**$15**	

Two Areas: Hybrids + Rural Renewables

This budget is constrained to $200K by eliminating all priority level 3 activities, reducing priority level 2 amounts, and reducing some priority level 1 amounts for Rural Renewables. Hydro Retrofits eliminated.

Technology Application	Activity	**Priority**	**Activity Budget**	**NREL**	**Cooperators**
Grand Total			**$200**	**$115**	**$85**
Wind / Diesel Hybrid Generation for Isolated Electrical Grids	Total		**$100**	**$55**	**$45**
	1. Guide technical design of wind / diesel hybrid sites	*1*	$30	$20	$10
	2. Support development of payment guarantee system	*2*	$10		$10
	3. Identify project development resources	*1*	$5		$5
	7. Address technical and operational issues for hybrids under multiple owners	*1*	$15	$10	$5
	8. Develop draft policy language and issue papers	*1*	$30	$15	$15
	Technical Coordination	*1*	$10	$10	
Off-Grid Rural Renewable Energy Use	**Total**		**$80**	**$40**	**$40**
	1. Economic analysis	*1*	$60	$30	$30
	2. Decisions using economic analysis	*2*	$15	$5	$10
	Technical Coordination	*1*	$5	$5	
Hydropower Retrofits for Electric cooperatives	**Total**		**$0**		
Overall Project Coordination			**$20**	**$20**	

Three Areas: Rural Renewables + Hydro Retrofits + Hybrids

This budget is constrained to $200K by eliminating all priority level 2 and 3 activities, eliminating some priority level 1 activities, and reducing priority level 1 amounts.

Technology Application	Activity	Priority	Activity Budget	NREL	Cooperators
Grand Total			**$200**	**$110**	**$90**
Wind / Diesel Hybrid Generation for Isolated Electrical Grids	Total		**$70**	**$45**	**$25**
	1. Guide technical design of wind / diesel hybrid sites	*1*	$25	$15	$10
	7. Address technical and operational issues for hybrids under multiple owners	*1*	$10	$5	$5
	8. Develop draft policy language and issue papers	*1*	$25	$15	$10
	Technical Coordination	*1*	$10	$10	
Off-Grid Rural Renewable Energy Use	**Total**		**$60**	**$30**	**$30**
	1. Economic analysis	*1*	$55	$25	$30
	Technical Coordination	*1*	$5	$5	
Hydropower Retrofits for Electric cooperatives	**Total**		**$50**	**$15**	**$35**
	1. Debt Resolution and Investor Commitment	*1*	$45	$10	$35
	Technical Coordination	*1*	$5	$5	
Overall Project Coordination	**Total**		**$20**	**$20**	

Overall Project Coordination

TCAPP-Philippines requires substantial overall project coordination under any of the scenarios described above. Teams for each technology application area consist of several cooperators and collaborators whose actions must be orchestrated by a single coordinator. In-country teams, international experts, participating businesses, financial institutions, international development organizations, and others must all understand and fulfill their roles in TCAPP activities. For cooperators, who receive payment for their services, the TCAPP coordinator must establish contractual agreements and monitor deliverables. In the Philippines case, the Hybrids area alone could involve eight different cooperators, many working together to produce deliverables.

One of TCAPP's founding principles is to ensure full engagement of government officials in participating countries. Communication and engagement of government officials requires a significant time commitment and is best accomplished by a single person who can explain the status of the entire set of activities. In the Philippines, the Department of Energy and the

Department of Environment and Natural Resources are the primary government agencies interested in overall TCAPP developments, while the Department of Agriculture has a strong interest in the Agricultural Water Pumping activity of the Rural Renewables area. The connections to the Interagency Committee on Climate Change has consisted of information briefings for its staff, and a higher profile interaction with this group could also be developed, with concerted communication and engagement efforts.

Reporting on results and accomplishments is an overall project coordination task that requires ongoing commitment. The review process and the transition to Phase 2 should provide a strong reporting framework that the project coordinator can use to show accomplishments and facilitate communication between USAID/Washington and USAID/Manila. This reporting framework should also be helpful in communicating results and accomplishments to TCAPP partners, such as the PDOE.

Work planning and budgeting requires ongoing attention from an overall project coordinator. Budgets must be tracked to ensure that each activity receives its planned funding, and that funding is well spent.

The National Renewable Energy Lab has served as overall project coordinator of TCAPP – Philippines during the first phase of the project. Alternative approaches to overall project coordination for Phase 2 include:

- Continued coordination by NREL
- Coordination by USAID/Manila's primary in-country contractor for environmental work
- Coordination by a USAID/Washington contractor
- Separate coordinators for each technology application area, with overall project coordination retained by USAID

We can only address NREL's capabilities for this role, because we are not sufficiently familiar with, or sufficiently neutral, to address the capabilities of other potential project coordinators. Our reasons for suggesting that NREL continue to serve as overall coordinator for TCAPP-Philippines are:

- NREL has detailed familiarity with the TCAPP Phase I activities, with each of the technology application areas, and with all of the players who have been involved in the program
- Quasi-governmental status reduces potential for conflicts of interest and enhances NREL's ability to represent a program of the U.S. government
- NREL's institutional commitment to advancing renewable energy and energy efficiency market development means that our motives align closely with the goals of TCAPP
- NREL has management systems and connections in place to accomplish complex communications tasks to link TCAPP-Philippines with U.S. government agencies and international negotiators.

Check List – Appendix 1

- Are our objectives and budget in alignment?

The objectives and budget are described above, and intended to be in alignment. We welcome further discussion of budget priorities.

- Who was consulted in preparing the plan (country officials, business partners, AID mission, other cooperators and contractors, others)?

The following will be consulted as soon as clearance is received from USAID/Washington
-Philippines Department of Energy
-BreezElectric / Philippines Hybrid Energy Systems Inc., Associates for Economic Development, WorldWater Corporation, WorldWater Philippines, US Hydropower Council for International Development
-USAID/Manila
-Todd Bartholf, Winrock/Preferred Energy Inc., World Bank, Asian Development Bank, UN Development Programme, trade associations (wind, solar)

- Do we have a strong in-country partner?

-Philippines Department of Energy

- Are we confident that the chosen technologies are cost-effective and meet development and other objectives?

-Cost effectiveness is an explicit criteria for further project development for rural renewables and wind
-Need to establish cost effectiveness for hydro

- Are we collaborating with appropriate international and other organizations?

- Associates for Economic Development, Winrock/Preferred Energy Inc., World Bank, Asian Development Bank, UN Development Programme, trade associations (wind, solar)

- How do we plan to bring in the private sector?

This is specific to each technology application area & is addressed within those sections of the plan.

- Other?

Supporting Information – Appendix 2

A partial list of information that is available upon request follows:

1. Philippines Energy Plan
2. Rural Electrification Chronicle
3. Philippines Department of Energy website, with Power Act
4. Philippines Department of Energy presentations on rural electrification
5. Philippines Department of Energy summaries of international development projects for renewable energy and rural energy use
6. Wind / Diesel Hybrid Generation site data and analysis
7. BreezElectric/PHESI project descriptions
8. NREL presentations on computer models that assist rural energy system design decisions
9. Technical and business analysis of model commercial retrofit projects on Mindoro

COOPERATIVE TECHNOLOGY IMPLEMENTATION PLAN FOR SOUTHERN AFRICA (SA CTIP)

Executive Summary

This business plan for the Cooperative Technology Implementation Plan for Southern Africa (CTIP SA) outlines strategic opportunities for implementing actions to increase private investment in clean energy technologies in the Southern African region. The plan builds on previous CTIP SA work that has successfully identified regional technology priorities and established project support among key stakeholders.

The plan outlines specific goals with regard to each technology and describes market barriers, proposed steps, collaborators, resource requirements, and other relevant information. In addition to detailing proposed next steps for priority technologies, the plan discusses the need for overall CTIP SA project coordination.

Since its launch in March 1999, CTIP SA has evolved in the following ways:

- CTIP SA's focus has narrowed to two clean energy technologies from the six originally identified as regional priorities. Actions to promote private investment in biomass power generation and solar water heaters are currently being developed. At the request of CTI members, the possibility of developing a third area of activity, on industrial energy efficiency, is being explored.
- The base of support for CTIP SA has expanded to include other funders, including other CTI members. NEDO (Japan) has committed $500,000 in support of a CTIP SA action to promote investment in biomass power generation. UNIDO has also expressed interest in the biomass power generation project, and the USAID Mission has indicated preliminary interest in supporting work to promote solar water heaters.
- In order to move from priority setting to project implementation, CTIP SA now works independently of the Southern African Development Community, or SADC. Key officials from SADC are regularly briefed on the project and are supportive of the effort.
- Roles have been identified for a diverse group of collaborators and cooperators, including Winrock, E&Co., IIEC, and Econergy.

Recognizing that decisions about funding are currently being made, this plan seeks to provide useful information on the benefits and advantages of the proposed approach, which includes these activities:

- Facilitate investment in more efficient boilers and turbines by sugar mills in Tanzania and Mauritius. These technologies would enable sugar mills to increase the efficiency of their current cogeneration processes and produce more surplus power to sell to national grids or to third party users. CTIP SA proposes to work with multiple stakeholders to complete feasibility studies, expand power purchase agreements, educate plant managers about available technologies, and build financial institutions' support for sugar mill cogeneration

projects. The benefits of this effort are projected to include 4-12 MW of additional power generated from sugar mill cogeneration at 3-5 mills, private investment of $5-15 million in clean energy technologies, and GHG reductions between 6,000-18,000 TCE annually. There would also be reductions in SO2 and increased profits for the small scale farmers that supply sugar mills.

- Promote solar water heater (SWH) technology as an alternative to electric water heaters in Durban, South Africa. CTIP SA proposes to assist solar water heater (SWH) manufacturers and installers in Durban, South Africa in meeting the projected increase in demand for SWHs created by impending tariff restructuring. It is expected that the restructuring will increase the cost of electricity and make SWHs cost competitive, but consumer education and marketing are necessary to realize this market potential. CTIP SA proposes to develop and implement a marketing campaign and to provide business development assistance to SWH businesses. Benefits of this effort are projected to include: installation of 3000 SWH units, private investment of $150K in SWHs, enhanced capacity among SWH manufacturers and installers, job creation, reduction in GHG emissions by 200 TCE annually, and improvements in local air quality due to reduced use of coal and kerosene for hot water.
- Coordinate CTIP SA overall by communicating progress to CTI members, government officials, businesses, and other stakeholders.

GOALS OF CTIP SOUTHERN AFRICA

The Cooperative Technology Implementation Plan for Southern Africa works to accelerate the adoption of clean energy technologies and practices to promote economic and social development, mitigate global climate change and support technology cooperation under the UNFCCC.

In March 1999, Environment Ministers from around the Southern African region formally requested the assistance of the Climate Technology Initiative (CTI) in identifying and promoting investment in clean energy technologies with the greatest potential across the region for meeting sustainable development needs while reducing greenhouse gas emissions. The Ministers requested a regional program that would address market barriers common to countries and that would create investment opportunities involving smaller countries in the region. In response to this request, CTI launched the Cooperative Technology Implementation Plan for Southern Africa (CTIP SA). The US National Renewable Energy Lab (NREL) and Zimbabwe-based Southern Centre for Energy and Environment (SCEE) have to date coordinated CTIP SA and provided technical assistance.

The fourteen countries of the region (South Africa, Botswana, Zambia, Zimbabwe, Tanzania, Mauritius, Namibia, Swaziland, Lesotho, Seychelles, Malawi, Mozambique, Angola, and Democratic Republic of Congo) have selected criteria for identifying priority technologies. The criteria included:

- Potential development benefits, including environmental impacts and job creation;
- Potential for greenhouse gas reduction;
- Potential for generating increased private sector investment in the near term.

Each country nominated priority technologies and included an analysis of the technology's potential benefits. Country officials, technical experts, businesses, NGOs, and other stakeholders commented on the technologies nominated and project stakeholders discussed priority technologies at regional workshops. In September 2000, SCEE compiled the results of these extensive consultations and produced a report identifying six technologies as priorities for the region: biomass power generation, energy efficient and solar powered home systems, industrial motors and boilers (industrial energy efficiency), solar crop dryers, natural gas development, at green housing design.

At present, CTIP SA is finalizing workplans for actions to promote investment in two technologies: biomass power generation (bagasse from sugar mills) and solar water heaters. This business plan will detail proposed CTIP action on these two technologies. In addition, there is significant interest among CTIP stakeholders and CTI donor countries in developing a CTIP action to promote investment in industrial energy efficiency.

Building on a history of extensive stakeholder consultations, main objectives for CTIP SA in the near future include:

- Facilitate increased power production from sugar cane processing mills in Mauritius and Tanzania and assist facilities in selling surplus power to national grids in order to reduce GHG emissions and increase private investment in clean energy technologies.
- Developing the market for solar water heaters (SWH) in Durban, South Africa to increase adoption of this technology and thereby reduce GHG emissions, reduce local air pollution, increase private investment, and create jobs.
- Develop project on industrial energy efficiency, based on CTI donor countries' and country officials' expressed interest in supporting work in this technology area.
- Updating all Southern African countries on current projects with a view to identifying additional opportunities in other countries in the future.

BIOMASS POWER GENERATION (TANZANIA AND MAURITIUS)

Objectives and Benefits

In Southern Africa, there are many sugar estates that, in the process of producing cane and other sugar products, also produce large volumes of crop waste. Sugar processing is unique in that the extraction of the sugar from the cane requires the use of steam for operating plant and drying the sugar solution. Sugar mills typically use excess bagasse as the fuel for a cogeneration plant that produces electricity for in-plant use as well as for export to the grid.

However, the technology used is of low efficiency, with low pressure boilers being the norm. In most cases, plant maintenance is limited and the optimum efficiency of the power plant is not achieved. Bagasse is also sometimes incinerated as opposed to being burned for steam production, as it becomes a nuisance when large volumes accumulate in the plant grounds. Incineration is normally done by reducing boiler efficiency and burning more bagasse for the volume of steam produced. Mauritius is the regional leader in sugar mill cogeneration and is always working to identify additional opportunities to increase surplus power from sugar mills.

CTIP Southern Africa stakeholders have identified biomass power generation from sugar cane waste (bagasse) as a priority clean energy technology. CTIP SA proposes to work with sugar producers in Tanzania and Mauritius that currently sell surplus power generated by sugar cane manufacturing to other companies or to the electricity boards of their respective countries. The electricity boards have expressed an initial interest in an effort to increasing their purchase of surplus power from sugar estates or to facilitate the sale of power from sugar estates to other users. CTIP will help companies negotiate expanded Power Purchase Agreements (PPAs) with national electricity boards. CTIP will also introduce businesses to technologies that would increase power output and will provide information to businesses on financing options to enable expanded operations.

Recognizing the opportunity created by electricity boards' interest in increasing their purchase of surplus power from sugar estates (as is the case with Mauritius) or in selling power to other users (Tanzania), CTIP will work with the boards, sugar estates, and other companies to expand existing PPAs. CTIP will also work with facility managers to complete facility-level assessments of technology options and will introduce managers to better power plant technology that can achieve optimum electricity production. Recognizing that finance for facility upgrade is often an obstacle, CTIP will work with facility managers to explore financing options.

Specific objectives for Tanzania/Mauritius with regard to biomass power generation are as follows:

- Use efficient boilers and other technologies to increase the amount of power generated at sugar cane processing facilities that already use excess bagasse to produce power.
- Address institutional barriers to expanded power purchase agreements (PPAs).
- Displace national grid's use of diesel with clean power from bagasse power generation (Mauritius).

- Displace concrete manufacturing facilities and other companies' use of coal with clean power from bagasse power generation (Tanzania).

CTIP anticipates that there will be two primary benefits from these activities: increasing private investment in energy efficient technologies and reducing greenhouse gas emissions by displacing use of diesel for power generation (Mauritius) and displacing the use of coal by industry (Tanzania). Specific goals will be established with information provided by pre-feasibility studies.

Barriers

There are numerous barriers to increased efficiency of cogeneration in sugar mills in the region:

- Low cost of electricity and power plant overcapacity. Mauritius imports diesel to generate power. Because of the high cost of importing diesel, the country has aggressively pursued purchasing power from sugar mills as a way of reducing its reliance on diesel. Other countries in the region, lacking Mauritius' incentive to develop alternative sources of energy, have not historically expressed much interest sugar mill cogeneration. However, increases in demand for power, the seasonal fluctuations of hydropower-based power, privatization of utilities, and recent interruptions in service have had the effect of stimulating interest in alternative sources of power. Tanzania has expressed interest in learning more about this source of power.
- Need to expand PPAs. Unless they have a willing consumer for the excess power produced, companies have little incentive to invest in technologies to increase their power output. Establishing a market for excess power, either by selling to the national grid or in selling to other companies, is a critical market barrier.
- Lack of facility-level information. Most facilities that are good candidates for more efficient cogeneration have not completed basic feasibility assessments to determine the cost-effectiveness of increasing production of power and selling surplus power. Without pre-feasibility studies, it is difficult to identify facilities where more efficient cogeneration would be economically viable.
- Companies' lack of information on technologies that can increase power output. Because sugar mill facilities typically produce power only for their own needs or for a modest surplus market, there has not been adequate reason for facility managers to gain knowledge of more efficient technologies that would increase power output.
- Financing for cogeneration projects. Because high-efficiency cogeneration technology is a relatively new technology for the region, financial institutions might be hesitant to lend to facilities to enable them to upgrade technologies.

Activities to Overcome Market Barriers

There are numerous activities necessary to fully develop the market for sugar cogeneration. Following are a few critical activities:

- A detailed survey of sugar cogeneration opportunities in the region should be completed to fully assess the full market potential for this technology.

- A comprehensive outreach effort to sugar mills would assist in identifying specific opportunities.
- A needs assessment for the region for sugar mill cogeneration would help identify appropriate technology vendors.
- Educating utilities, governments, and financial bodies on the benefits of this technology is necessary to develop institutional support for market development.

Proposed CTIP Activities

By working with multiple stakeholders, including utility boards, government agencies, sugar mills, and financial institutions, CTIP SA proposes to address a few critical barriers that are currently preventing expansion of sugar mill cogeneration for power generation.

CTIP SA proposes to undertake the following activities:

- Work with stakeholders to expand or establish PPAs. Meet with national utilities to reassess existing PPAs and develop new ones where appropriate. Identify other businesses interested in purchasing power. Without a market for an increased supply of power, sugar cane mills have little incentive to invest in efficient technologies to increase power output. CTIP SA proposes to work with national utilities in both Tanzania and Mauritius, and with concrete companies and other high power users (in Tanzania) to identify markets for surplus power. CTIP SA proposes to consult utilities to learn of their concerns regarding PPAs and to then develop a model PPA that reflects utilities' concerns and businesses' interests. CTIP SA will then hold a seminar with utility officials and businesses and use the model PPA as a basis for reassessing existing PPAs.
- Complete facility-level studies. As a first step, CTIP SA proposes to carry out pre-feasibility studies to identify plants where cogeneration and surplus power generation would make economic sense because of interested buyers of power and because of technical factors, such as amount of bagasse available, efficiency of existing boilers, and capacity for increases in surplus power production. There are three sugar plants in Tanzania and six in Mauritius that will be targeted in the pre-feasibility studies. It is expected that the studies will identify 3-5 plants that are viable candidates for will be targeted in the project's next phase.
- Provide companies with information on technologies that can increase power output. CTIP SA proposes to identify businesses that sell technology appropriate to the facilities that are the focus of the project, and to hold information seminars for facility managers from 2-3 plants on benefits of more efficient technologies. CTIP will also organize study tours for plant managers to see efficient facilities that produce power from bagasse.
- Facilitate financing for cogeneration projects. By organizing seminars for potential funding institutions and explaining the benefits and viability of this technology, CTIP SA proposes to address these institutions' hesitancy in lending to sugar mills to enable increased cogeneration. CTIP SA will also work directly with businesses to provide assistance as necessary in developing loan applications for these more efficient technologies.

Expected Deliverables and Benefits

Deliverables

- Develop model PPA based on consultations with utilities and companies.
- Use model PPA to renegotiate existing PPAs and facilitate agreements between sugar mills and other companies regarding purchase of power.
- Hold seminar on energy efficient technologies for improved cogeneration and organize study tours to encourage awareness of these technologies.
- Hold seminar on new technologies for financial institutions.
- Assist businesses in securing financial support for new technologies.
- Facilitate the adoption of efficient technologies in 3-5 sugar cane facilities in Tanzania and Mauritius.

Benefits

- Increase by 4-12 MW the amount of electricity generated by more efficient cogeneration at sugar plants.
- Facilitate private investment in energy efficient technologies. The exact dollar amount to be determined in pre-feasibility study, but is expected to be in the range of $5-15 million, depending on the number of plants that invest in new technology and the type of cogeneration process that is of interest to plant managers. Studies done by the Stockholm Environment Institute on similar plants in Tanzania found that the pay-back periods for these investments was approximately 6 years.
- Reduce GHG emissions by 6,000 – 18,000 tons of CO2 equivalent by displacing coal used by companies (Tanzania) and diesel used by the national grid (Mauritius) to generate power.
- Reduce SO2 emissions, as biomass has a lower sulphur content than oil or coal.
- Increase target financial institutions' awareness of viability of efficient technology.
- Increase worth of bagasse, thereby increasing profits for the small scale farmers that supply sugar plants.

Timeline of Activities, including Important Milestones

Refine project plans in consultation with NEDO and UNIDO	September 2001
Conduct pre-feasibility study to determine target facilities and project goals	October 2001
Identify businesses that provide the appropriate efficient technologies	December 2001
Conduct feasibility studies at the facility-level to determine detailed technical assessment	February 2002
Consult with national utilities to determine obstacles in expanding PPAs.	March 2002
Develop model PPA.	May 2002
Hold seminar with businesses and utilities to reassess existing PPAs.	June 2002
Hold seminars for sugar mill plant managers to provide information on more efficient technologies.	July 2002
Organize study tours to demonstrate efficient technologies.	July 2002
Hold workshops for financial institutions to build awareness of feasibility of efficient technologies.	August 2002
Assist businesses in securing financial support for upgrading technology.	September 2002

Resource Requirements

ITEM	AMOUNT	USG	OTHER FUNDERS
Project coordination (Proposed to be NREL)	$30K	$30K	
In-region project contact (SCEE)	$20K		Other CTI - $20K
Consultant (to be identified) for pre-feasibility study	$30K		NEDO - $30K
Plant-level feasibility studies	$500K		NEDO - $470K UNIDO - $30K
Consultant (to be identified) for work on PPAs	$40K	$40K	
Study tour/seminar on efficient technologies	$30K		Other CTI - $30K
Seminar for financial institutions	$5K	$5K	
Travel	$25K	$25K	
TOTAL	**$680K**	**$100K**	**$580K**

NEDO has expressed interest in providing $500,000 to support feasibility studies for this project in both Tanzania and Mauritius. They may also be interested in providing support for further project activities. UNIDO is interested in supporting pre-feasibility and feasibility work for the project in Tanzania. This support is not yet confirmed. If a state or municipal entity is interested in taking out a loan for efficient technologies or to upgrade power transmission infrastructure as part of this project (as will likely be the case in Mauritius, where the government oversees the sugar estates), the Development Bank of Southern Africa is interested in supporting technical assessments in preparation for a possible loan. In addition, other CTI donors (notably GTZ) work in the field of biomass power and will be approached for additional support.

Cooperators

The Southern Centre for Energy and Environment will coordinate the work and will identify consultants with extensive experience in bagasse power technologies and negotiating PPAs.

Econergy International is currently working with sugar mill cogeneration in Latin America and is currently working on sugar mill market assessments in South Africa. Econergy is a potential partner, particularly for facility-level work on appropriate technologies.

Given the technical complexity and number of stakeholders involved in this project, there is a need for a project coordinator. NREL is well positioned to play this role for two reasons. First, NREL's Biomass Center has significant technical expertise on the use of biomass for power generation. NREL has worked on sugar cogeneration specifically as part of the TCAPP Brazil program. Second, as a result of the many CTIP workshops that have been held in the region, NREL has established a strong rapport with key government officials in Tanzania and Mauritius and with actual and potential donors (NEDO, UNIDO, etc.). The CTIP SA market development approach is closely associated with NREL, and NREL is well positioned to secure the support of donors, government officials, and others for this work.

Next Steps

- Conduct pre-feasibility study.
- Based on results of pre-feasibility study, develop a detailed project plan.
- Consult with NEDO, UNIDO, DBSA, and possibly other CTI donors to determine project roles and to finalize donor support for various project activities.

Overall Project Coordination

Project coordination tasks will include:

- Develop project goals and workplan in close consultation with NEDO, UNIDO, and other actual and potential donors.
- Present project to government officials, including energy and climate officials, and seek their feedback in finalizing workplan.
- Work with in-region subcontractor to conduct immediate next steps and to finalize workplan.
- Meet with national utilities, sugar mills, technology purveyors, and other stakeholders to solicit feedback in finalizing workplan.
- As implementation of workplan begins, communicate progress to all stakeholders and seek feedback to refine project steps.
- Coordinate with subcontractor to organize seminars and workshops.
- Promote linkages between project and other related efforts where appropriate.
- Build awareness of project goals among businesses, government officials, and others.
- Coordinate the presentation of project results to national officials and at regional and international fora.

As outlined in a previous section, this project as currently envisioned builds on relationships that NREL has developed with relevant donors and government officials. Maintaining these relationships is critical to the successful completion of this project.

SOLAR WATER HEATERS (South Africa)

Objectives and Benefits

Solar water heating (SWH) is a well-established technology in Southern Africa, but there are significant market barriers to the full development of the SWH market. CTIP SA has identified a market opportunity in Durban, South Africa that has the potential, if developed, to yield significant private investment as well as environmental and development benefits. CTIP SA proposes to carry out a project to increase investment in SWH in Durban with a view to extending the project to other cities and countries if it is successful.

According to South Africa's Department of Minerals and Energy, some 484,000 square meters of Solar Water Heaters (SWH) collectors are installed in the country. This means that less than 1% of dwellings in South Africa are outfitted with SWHs. This lack of market interest is due to many factors, chief among them the fact that the low cost of electricity in South Africa makes all solar powered home devices too expensive to compete with electric devices.

Recently, the South African government guaranteed 50 free kWh of electricity to low income households. In order to meet this obligation, municipal electricity providers are being forced to reconsider existing tariff structures. In Durban, the Electricity Board has announced that tariffs will change in the next six months. It is estimated that the tariff restructuring will increase the price of electricity by 25% for middle-income residential users in Durban.

This increase in cost is expected to make SWHs cost-competitive with electric water heaters. CTIP SA proposes to take advantage of this market opportunity to build consumer interest in SWH technology and to build business capacity to meet the increase in demand.

Additionally, initial market analysis done by IIEC-Africa[29] suggests that smaller capacity, free standing, low cost SWH units may be an attractive and affordable technology in lower income communities. The adoption of SWH technology in these communities would have significant development benefits, as SWHs would displace the coal and paraffin (kerosene) currently used to heat water.[30] Use of coal and paraffin causes significant indoor pollution problems.

CTIP SA proposes to meet the following objectives in this effort:

- In the middle income sector, encourage power conservation by having SWH displace electric water heaters.
- In the low-income sector, encourage adoption of SWHs as a way of displacing the polluting use of coal and paraffin for heating water.
- Encourage builders of new, low-cost homes to adopt SWH technology as part of strategy to create energy-efficient, environmentally sustainable new homes.
- Facilitate installation of SWH units in middle-income and low-income homes in target communities

[29] *Consumer Response Survey on Mobile Solar Water Heaters*, IIEC-Africa, April 2000

[30] The IIEC/Winrock study found that even low income households that have electric geysers use coal and paraffin to heat water as electricity is too expensive for them.

By meeting these objectives, CTIP SA expects to achieve the following benefits: reduction of GHG emissions (by reducing use of coal-generated electricity in middle-income households and by displacing coal/paraffin in low-income households); improved indoor air quality in low-income communities; enhanced ability of SWH firms to meet market demand; new jobs created; and increased private investment.

Barriers

There are numerous barriers to the full development of the SWH market in South Africa:

- Low cost of electricity. Due to South Africa's plentiful indigenous coal reserves, the country enjoys very low electricity prices. This low cost has dampened the market for renewable energy technologies by making them too expensive in comparison to electric devices. However, recent political commitments to provide free electricity to low-income households have created pressure for tariff restructuring. The Durban Electricity Board has already announced price increases; it is expected that many other cities in South Africa will soon follow suit. These price increases will create new opportunities for RE industries that have long been dormant in the country.
- Lack of consumer awareness of SWH technology. Because the market for solar water heaters has been so flat in recent years, consumers are not aware of the benefits of this technology, which may include cost advantages over electricity and savings of time and energy to those using coal/paraffin to heat water.
- Need for standards for SWH products and professional standards for installation/maintenance. For many years, the South African Bureau of Standards (SABS) had established overly precise standards for SWHs that few manufacturers could meet because of the lack of affordable testing facilities. At present, efforts are underway to revise and set more reasonable standards. A related problem is the lack of certification for SWH installation and maintenance technicians. Poorly trained technicians install units improperly, leading to unit failure and consumer lack of confidence in the technology. If the market share for SWHs is to increase, professional standards for technicians must be developed to protect consumers, prevent unit failures, and build consumer confidence.
- Lack of understanding of consumer interest in technology. There is conflicting information about consumer interest in solar water heaters, especially in low-income communities. A few studies, such as that done by IIEC, suggest that hot water is a valued commodity and that consumers are willing to pay for SWHs or even to take out loans to purchase them. However, there is a lack of concrete, detailed data on how much consumers in low-income communities are willing to pay for SWHs, the kinds of units that are most suitable, and how best to market these products. Without understanding the factors that make SWH attractive to particular consumers, and the price points that make them competitive in low-income communities, it is difficult to dramatically increase the market for this technology.
- Lack of awareness among municipal officials and developers on benefits of technology. South African government officials have publicly announced and embarked on a plan to builds hundreds of thousands of units of low cost housing to meet the housing demand in the country. This massive effort in house building is a remarkable opportunity for renewable energy and energy efficient technologies to be installed by the builders or selected by new tenants. Since these home are for low income residents, most of whom cannot afford

electricity, there are cost as well as environmental benefits. However, municipal officials and developers are largely unaware of RE/EE technologies, including solar water heaters. Educating this constituency so that they incorporate clean energy technologies such as SWH where appropriate is a key barrier.

- SWH businesses' need for assistance in meeting new demand created by increase in electricity tariffs. While there are SWH manufacturers and installers in Durban and across South Africa, they are small businesses that have not enjoyed large market shares in the past fifteen years. Many of these firms will not be able to meet increased demand because of a lack of labor and a lack of experience in developing and implementing business plans.

Activities to Overcome Market Barriers

A range of activities are necessary to fully realize the market potential for this technology. It is quite likely that the biggest barrier – the high cost of SWHs in comparison to the use of electricity for water heating – will change soon because of changes in South Africa's power sector.

Productive barrier-removal activities would include:

- Developing a full market assessment for residential use of SWHs across a range of income levels. Consumer preferences and concerns are not well understood and hamper marketing efforts.
- The use of SWHs by the commercial sector has not been systematically explored because of cost issues; tariff restructuring may make this sector promising for adoption of SWH technology.
- Completing work to create an effective system of testing and certification for SWH units. Such a system would increase consumer confidence in the technology.
- Certification of installation and maintenance technicians. Poor installation and maintenance, because of lack of proper training and certification, create product failure and undermine consumer confidence. Addressing this problem would increase the professionalism of SWH technicians and would be a critical step toward widespread consumer acceptance of the technology.

CTIP SA proposes to work with businesses, community leaders, and municipal officials to increase market penetration of SWHs across a range of income levels. CTIP SA proposes three categories of action: marketing of SWH, assistance to SWH businesses, and engagement with municipal officials.

CTIP SA will market SWHs to consumers based on consumer preference surveys, will assist SWH businesses in securing loans and expanding operations, and will demonstrate to municipal officials and developers the advantages of incorporating SWH technology into home building efforts.

Proposed CTIP SA Actions

CTIP SA proposes these activities to address critical market barriers:

- Determine consumer preferences on SWH technology. Without being able to characterize consumer preferences, especially in the low-income market, it is very difficult to design an effective marketing campaign. CTIP SA proposes to conduct a consumer preference survey in target communities.
- Install subsidized demonstration SWH units. Based on the results of that survey, CTIP SA will install 100 demonstration units in households in target low-income communities. The units will be provided at 50% cost to raise initial interest. These demonstration units are expected to raise awareness of SWH products in target communities and to provide additional information about consumer preferences.
- Create marketing campaign to build consumer awareness of benefits of SWH technology. With the anticipated tariff restructuring in Durban, solar water heaters will be cost-competitive with electric water heaters, making SWHs more attractive to middle-income consumers who use electric heaters for hot water. However, because of the very flat market for SWHs in recent years, consumers are simply unaware of the technology. Similarly, low-income consumers who might be interested in the advantages of SWHs over use of coal and kerosene (saves time and labor, reduces smoke inside house) are unaware of the technology. By developing a marketing campaign (brochures, TV/radio promos, expos, technology fairs) that is tailor-made for different markets and is based on consumer preference surveys (for the lower-income market), CTIP SA will build consumer interest in SWH products.
- Engage municipal officials and developers on benefits of SWH technology. The Development Bank of Southern Africa is working with First Metro Housing in Durban to explore the feasibility of installing SWH in new low-cost housing that is being constructed in the city. DBSA and First Metro Housing are working closely with city officials to gain their support for the technology. CTIP SA will collaborate with DBSA on activities of mutual interest, such as technology demonstrations for municipal officials and developers.
- Assist SWH businesses in meeting new demand created by increase in electricity tariffs. CTIP SA proposes to work with E&Co. to provide business development assistance for SWH firms that, because of the flat market of the past few years, lack experience in developing and implementing business plans and securing capital for business expansion.
- Facilitate the creation of new jobs in the industry. To meet projected demand, SWH firms will have to expand their staff. This can be a challenge, especially for firms that are operating in the Durban area for the first time and lack local contacts. CTIP SA, as part of its consumer survey work, will identify individuals from target communities that businesses can train as SWH installation/maintenance technicians. This will facilitate trained individuals being hired for new jobs created by market opportunities.

Expected Deliverables and Benefits

Deliverables

- Complete consumer preference surveys.
- Install 100 demonstration units in low-income communities.
- With E&Co., hold workshop on enterprise training development to 10-15 SWH businesses. Provide one-on-one consultation with E&Co. for 2 businesses.
- Identify individuals for businesses to train as installation technicians, leading to jobs being created (specific metrics still need to be determined).
- Workshop for government officials, especially at DEAT, to build support for project replication and additional activities on clean energy technologies.

Benefits

- Increase number of SWH units installed. Facilitate the installation of 2000 units in middle-income sector of the market and install 100 units as part of demonstration of technology in low-income community. It is expected that these demonstrations will result in 1000 units installed in following year.
- Have facilitated $150,000 in private investment within one year of project completion. Private investment from market replication within 2 years of project initiation are likely to be much higher but are still being determined.
- Have reduced GHG emissions by 200 tons CO2 equivalent annually.
- Improve local air quality (metrics still need to be determined) by displacing the use of coal and paraffin in low-income communities. Reduced pollution from particulate matter will be particularly important in terms of human health impacts.
- Create jobs for installation technicians and identify individuals from target communities for businesses to train (specific metrics to be determined).
- Reduce consumers' expenditure on energy by displacing need for grid power, kerosene, and coal.

Timeline of activities, including important milestones

Project planning meeting with SWH businesses, local community leaders, and municipal officials	October 2001
Conduct survey to determine user preferences in target communities	December 2001
Develop marketing/education campaign based on user preference survey	January 2002
Work with Durban metro government/DBSA to decide on sites for SWH demos in low-income communities	February 2002
Identify individuals from target communities who businesses may train as installation technicians	March 2002
Launch marketing/education campaign for middle-income communities	May 2002
Businesses train installation technicians	June 2002
Hold enterprise development seminar with E&Co. for SWH businesses	July 2002
Launch marketing/education campaign for low-income communities	August 2002
Brief local and national officials, including those at the Dept of Environmental Affairs and Tourism (DEAT) of progress	September 2002

Resource requirements

ITEM	**AMOUNT**	**USG**	**OTHER FUNDERS**
Project coordination (proposed to be NREL)	$20K	$20K	
Solar Engineering Services for project implementation	$25K	$25K USAID Mission	
Consultant and labor for Consumer Preference Survey	$5K	$5K	
SWH Marketing/Education Campaign *Brochures and radio/TV promotions – $26K *Installation of 100 demonstration units – $4K	$30K	$10K – USAID Mission. $10K – other USG	DBSA - $10K
Business training workshop	$5K	$5K	
Travel	$10K	$10K	
Government briefing workshop	$5K	$5K – USAID Mission	
TOTAL	**$100K**	**$40K – USAID Mission. $50K other USG**	**$10K**

The USAID Mission in South Africa is planning to launch a program to support demonstration and public education campaigns on RE/EE technologies. Initial meetings indicate that aspects of the CTIP SA proposal on SWHs (for example, the marketing campaign) may be good candidates for USAID Mission support under this new program.

The Development Bank of South Africa is working with First Metro Housing in Durban on a project to explore the feasibility of installing SWHs in new low-cost homes. DBSA has expressed initial interest in collaborating with CTIP SA on activities of mutual interest, such as demonstration projects for municipal officials and aspects of the education campaign.

Cooperators

It is envisioned that Solar Engineering Services, a Durban-based NGO that has worked closely with Winrock International and IIEC on promoting SWH technology, will be the in-country coordinator for this project. The NGO brings extensive contacts with community groups and with SWH businesses to this project.

E&Co., the international NGO that specializes in providing business development assistance, will work with SWH businesses.

Winrock International has expressed interest in this project and may be a key cooperator for the consumer preference survey.

NREL is well-positioned to coordinate this project for several reasons. NREL has close working relationships with key collaborators and has presented this project to the USAID Mission, to key country officials and to SWH businesses. NREL would also bring its considerable technical expertise in SWH technology. NREL's extensive contacts with key officials in other Southern African countries could be tapped to promote replication of this effort as appropriate.

NREL has already approached Winrock and IIEC about this project in order to build on existing efforts.

Next steps

- Hold project planning meeting with SWH businesses, Durban municipal and national officials, and other partners.
- Finalize project plans with feedback received at meeting.
- Initiative consumer preference survey.

Overall Project Coordination

Project coordination tasks will include:

- Work with subcontractor to develop workplan and solicit feedback on workplan from key stakeholders.
- Present project to government officials, including energy and climate officials, and seek their feedback in finalizing workplan.
- Work with in-region subcontractor to conduct immediate next steps and to finalize workplan.
- Meet with municipal officials, developers, businesses, community leaders, and other stakeholders to solicit feedback on project aims.
- As implementation of workplan begins, communicate progress to all stakeholders and seek feedback to refine project steps.
- Coordinate with subcontractor to organize seminars and workshops.
- Promote linkages between project and other related efforts where appropriate, especially with DBSA.
- Build awareness of project goals among businesses, government officials, and others.
- Coordinate the presentation of project results to national officials and at regional and international fora.

As outlined in a previous section, Winrock is an alternative for the role of project coordinator. However, NREL has already begun the process of presenting the proposal to various stakeholders, including potential funders such as the USAID Mission. Momentum may be lost if NREL is no longer in the coordinating role.

INDUSTRIAL ENERGY EFFICIENCY

CTIP SA is currently working with local partners to identify opportunities for effective investment actions. Business plan details will be provided as the project develops.

CTIP SA PROJECT COORDINATION

CTIP SA was designed to be a multi-lateral effort undertaken at a regional scale. This presents many opportunities as well as management challenges. Identifying and refining actions to promote investment, securing donor support, coordinating in-country partners, and communicating progress to the numerous regional stakeholders are critical to CTIP SA's success. NREL's leadership in engaging all partners and maintaining a functional regional framework has been important in identifying and developing specific projects and may be a critical factor to the success of efforts to reduce market barriers to each of the technologies.

Specific project coordination activities include:

- Coordinating with key officials in target countries, especially climate officials, to engage them in CTIP SA work and to build support for technology transfer activities.
- Engaging country officials and key institutions (development banks, regional governmental bodies) to build support for expanding activities to additional countries in time.
- Building business awareness of CTIP SA efforts and engage greater number of businesses in market development activities.
- Broadening support for CTIP SA by engaging other CTI members.
- Reporting progress to USG and CTI.

The budget to support these activities is as follows:

ITEM	**AMOUNT**
Project Coordination	$20K
Travel	$10K
TOTAL	**$30K**

APPENDIX 1: CHECK LIST

- Are our objectives and budget in alignment?

  Biomass – There is significant support from NEDO, UNIDO, and DBSA. While there is a need to work out project roles and increase support for specific project activities, the level of support expressed is encouraging.

  Solar water heaters – No, there is still a need to identify donors to support project activities.

- Who was consulted in preparing the plan (country officials, business partners, AID Mission, other cooperators and contractors, others)?

  CTIP SA has consulted with numerous stakeholders, including national governments, technical experts, businesses, and NGOs. The USAID Mission in South Africa has been periodically briefed on the project and is supportive. The USAID Regional Centre in Botswana has also been briefed, though their involvement is limited because energy is not among their strategic objectives.

- Do we have a strong in-country partner?

  Biomass – Yes, the Southern Centre for Energy Environment (SCEE) has been contracted by other international organizations, including DANIDA, to assess the market for sugar cane biomass power generation. SCEE's previous work in this field and their contacts with specific facilities and businesses will contribute to the success of the project.

  Solar water heaters – Yes, Solar Engineering Services (SES), the lead partner for the SWH project, has worked extensively on this technology. SES has worked with Winrock, IIEC, and others to assess the market for this technology and has good contacts with SWH businesses and target communities.

- Are we confident that the chosen technologies are cost-effective and meet development and other objectives?

  Yes. CTIP SA has consulted extensively with government officials, technical experts, and others to establish technology priorities for the region. Cost-effectiveness and the furtherance of development objectives were key criteria used to select priority technologies.

- Are we collaborating with appropriate international and other organizations?

  Biomass – Yes, working with UNIDO on the biomass power project will allow CTIP SA to leverage resources.

  Solar water heaters – Yes, collaborating with DBSA on the SWH project will contribute to the success of that project, as will collaborating with E&Co. for business development assistance.

- How do we plan to bring in the private sector?

  In both the solar water heater and biomass power generation projects, the interest of the private sector has already been established. Project activities such as technology information seminars (biomass power) and business development assistance (SWH) are being developed in response to stated private sector needs and will deepen the private sector's involvement in CTIP SA.

- Other: CTIP SA in the context of Climate Technology Interest

  Successfully starting the implementing these two projects will demonstrate the strength of the CTIP SA program and will encourage other CTI donors to support these projects or others in the future.

APPENDIX 2: SUPPORTING INFORMATION

- Energy/environment/climate overview
  The fourteen countries of the Southern African region (South Africa, Zambia, Zimbabwe, Botswana, Tanzania, Namibia, Malawi, Mauritius, Seychelles, Lesotho, Swaziland, Democratic Republic of Congo, Angola, Mozambique) have abundant energy resources (renewable as well as fossil fuel) and are net exporters of energy. In 1999, according to a February 2001 report by the US Energy Information Administration[31], the Southern African region consumed 5.14 quadrillion Btu of commercial energy, accounting for 1.3% of world consumption. In that same year, the region produced 7.62 quadrillion Btu. Coal, hydropower, and natural gas are all used to generate electricity; South Africa also has one nuclear power plant.

  Despite abundant energy resources, delivering energy services has been a challenge for national governments in the region. According to an April 1999 report completed by the African Energy Policy Resources Network, only 48% of people in South Africa have access to electricity, while only 17% of the people in Zimbabwe and 13% in Botswana have access. Turning to poorer parts of the region, only 4% of the population in Malawi and 3% in Lesotho have access to electricity. Significant transmission losses, power theft, and the cost of reaching remote areas contribute to challenges in providing grid electricity. Wood and other biofuels continue to be the primary source of energy for 75% of the region's population.

  Environmental challenges in the region include desertification, lack of adequate potable water, deforestation, pollution from oil and gas development, and decline in biodiversity. Deteriorating conditions in urban centers, including decrease in air quality and significant solid waste management problems, constitute another set of environmental challenges in this urbanizing region.

  According to the US Energy Information Administration, Southern Africa's GHG emissions constitute 1.8% of world's total. South Africa, the region's largest economic engine, uses

[31] Please see http://www.eia.doe.gov/cabs.sadc.html

coal both for power generation and for the production of synthetic fuels. South Africa's emissions account for 88.1% of the region's carbon emissions.

- Development and other goals
  Facilitating economic development, increasing private investment, and creating jobs are major development objectives in the region.

  Providing basic services, such as electricity, housing, clean water, education, and health care to rural or previously disadvantaged populations is another important goal. Preventing the spread of HIV/AIDS is a major development goal in a region where it is estimated that 25% of the population is infected.

- Technologies and practices needed to support objectives
  The government officials who participated in CTIP SA's extensive consultations identified technology transfer, capacity building, and public education as critical components in a sustainable development programs.

  The CTIP SA consultation process identified these technologies as priorities for the region: biomass power generation, solar crop drying, energy efficient and solar powered home systems, natural gas development, green housing design, and efficient motors and boilers.

- Relevant market information
  Because of on-going efforts in non-grid rural electrification, Southern Africa is one of the top market for photovoltaics in the world. According to the Development Bank of Southern Africa's November 1999 *Renewable Technology in Southern Africa: A Guide for Investors*, significant markets for wind farms, biomass, small hydro, and small appliances such as solar water heaters also exist.

- Snapshot of existing efforts and organizations active in energy/climate/environment
  There are a number of efforts in the region. Here are a few highlights:
  - Eskom, South Africa' utility, has granted six concessions in the country to provide off-grid electrification to remote areas. To date, only one concessionaire, Shell Solar, has made significant progress. Shell has installed 5000 units and is committed to completing its 60,000 units in its concession area of Eastern Cape.
  - Botswana and Zambia have extensive off-grid rural electrification programs in place. Botswana recently received a PDF/B grant from the Global Environment Facility to identify and address barriers to rural electrification. UNDP also has projects to support rural off-grid electrification.
  - Mauritius is the region's leader in power production from sugar cane waste (bagasse); Tanzania, Swaziland, and other countries are in dialogue with Mauritius to explore similar efforts in their countries.
  - IIEC and the Minerals and Energy Policy Centre, both based in Johannesburg, South Africa, and the Cape Town-based Energy Research Institute all have projects underway on industrial energy efficiency. All three projects draw on Eskom's new emphasis on industrial demand side management.

APPENDIX 3: KEY CONTACTS

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