

**Asia-Pacific Economic Cooperation  
Guidebook for Financing New and Renewable Energy Projects**

**ASIA-PACIFIC ECONOMIC COOPERATION  
ENERGY WORKING GROUP  
EXPERT GROUP ON NEW AND RENEWABLE ENERGY TECHNOLOGIES**



Prepared by

**Sustainable Energy Solutions**

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Prepared by:

Sustainable Energy Solutions

Dr. Ellen Morris

Mr. Andrew Price

100 Reade Street, Suite 5D

New York, NY 10013 USA

Tel: 1-212-587-7871

Fax: 1-212-566-5477

Email: [morrise@infohouse.com](mailto:morrise@infohouse.com)

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Japan

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## **EXECUTIVE SUMMARY**

### ***The challenge***

Although great strides have been made in bringing the benefits of electrification to the rural areas of the APEC developing member economies, the job is not nearly complete. This is demonstrated by the fact that an estimated two billion people still have limited access to electricity and over two-thirds of these people live in rural areas. Out of a desire to privatize state-run industries while continuing to promote economic and social development has emerged an interest in encouraging the private sector to take on the challenge of funding the electrification of underserved rural areas. While large, capital intensive grid connected energy projects have continued to attract commercial financing, smaller energy projects have so far failed to bring in private investment dollars to the extent project developers would like to see. This is particularly true with renewable energy projects.

### ***Renewable energy as a solution***

Renewable energy technologies appear poised to play a much larger role in meeting the energy needs of the APEC developing member economies. Falling costs, growing environmental awareness and focusing political attention bring promise that renewable energy technologies may at last live up to their potential, especially in rural areas. Since renewable technologies are ready to help meet rural power needs, the question has become how to pay for their deployment. The answer lies in the liberalization of energy markets and the mobilization of private capital. To believe in this solution, one must assume that the rural population represents a strong market. Deliver on the promise of affordable, reliable power, and over 50% of the rural population is a potential renewable energy customer. The challenge remains how to finance projects, how to access the necessary capital, and how to spur investment in renewable energy markets.

### ***Investments in renewable energy***

Long-term growth in the market for renewable energy technologies is going to be determined by social and economic development that is occurring in both the rural and urban areas of developing member economies as well as by the ability of these technologies to compete with other energy options on a level playing field. From community-based energy service companies to international manufacturers of renewable technologies, and from the local entrepreneur selling appliances to the global investment banker, the private sector is looking at the need for energy in the rural areas and seeing opportunities. Each is at work creating tactics and techniques to access the capital required. And they are making progress. At the local level, entrepreneurs are figuring out ways in which creative financing can put energy within the reach of great numbers of people. At the international level, investors are beginning to see that it may be possible to get acceptable returns from risking money in rural energy ventures.

## ***Purpose of the guidebook***

Recognizing that a large gap exists between the investment community and project developer, a practical guide to financing of renewable energy projects in rural areas was developed. The purpose of this document is to be a guidebook for project developers, manufacturers, entrepreneurs, non-governmental organizations, community-based organizations, local utilities, and others on the various financing mechanisms that are appropriate for renewable energy projects in rural areas, the potential sources of capital for these projects, and how to access these organizations. In addition, policy and regulatory measures to promote the use of renewable energy and innovative measures that will help foster renewable energy development in the APEC region are presented in this guidebook. The hope is that this resource will help in furthering understanding of the financing issues that must be faced in designing or expanding renewable energy businesses in rural areas.

## ***Major findings***

### Chapter 2

Chapter 2 addresses common concerns that investors may have with regard to financing a renewable energy business venture. The ability to attract sufficient capital to develop energy opportunities in rural areas is primarily dependent on the ability to offer investors competitive financial returns on their renewable energy investment. Until renewable energy projects have more of a track record with the investment community, current returns and risks will serve as a barrier.

Beyond traditional financing challenges, renewable energy faces other specific barriers that affect investment decisions. These hurdles include uncertain rates of return, high transaction costs, undeveloped and poorly understood markets and unfamiliarity with renewable energy technologies.

Prospective investors also need to be convinced that the projected sales and number of projects will justify their consideration. With ongoing technological developments, increased modularity and improving economies of scale of renewable energy technologies, markets are expected to expand. Another aspect of rural markets that is very important to an investor is the customers' ability to pay for the renewable energy system, and proper financing mechanisms are paramount to reaching out to the end-user. Sales in rural areas range from cash to financed sales to fee for service, depending on the income of the end-user.

### Chapter 3

Chapter 3 discusses a variety of ways in which financing can be structured for renewable energy projects. To better understand the relationship between the host of potential investors, the various financial institutions that may be involved, and their relationship to the end-user in financing a renewable energy project, a value chain analysis is useful.

Historically, traditional types of financing have been difficult to secure for renewable

energy projects because of their small size, long payback period, and lack of identity in the financial markets. However, as renewable energy projects increase in visibility in capital markets and their risks are better understood, there will be a growing number of financing mechanisms tailored to smaller rural projects. This chapter describes a range of possible financing mechanisms, including debt, equity, risk mitigation, and hybrid structures. They are all near to mid-term possibilities for financing renewable energy projects.

Debt structures that may be appropriate include more traditional techniques such as non-recourse financing and loans from development banks or multilateral institutions, as well as smaller-scale lending through micro-credit, fee for service, revolving funds, and rural cooperatives. Under equity financing, possibilities include joint ventures, specialized investment funds, and venture capital. Loan guarantees and political risk insurance can also be important mechanisms to mitigate investment risk. Four case studies are also included to illustrate a range of financial structures that are being used in rural energy development.

#### Chapter 4

Chapter 4 identifies a range of financial institutions from the public and private sectors that are interested in capitalizing renewable energy businesses and projects. The financing organizations and groups noted in this chapter have made commitments to the increased use of renewable energy systems, and they are making capital available. Generally speaking, their common goal is to infuse capital and assistance into commercial businesses that are attempting to develop the rural market for renewable technologies and energy services. They accomplish this goal not by dispensing aid but rather by allying themselves with local businesses or entrepreneurs in order to leverage the capital and services they can provide.

Twenty different financial institutions and programs are discussed in detail, including their scope, funding allocations, project cycles, and eligibility requirements. Following the detailed descriptions of each program, there are summary tables with current contact information.

#### Chapter 5

Presented in Chapter 5 are important policy measures that will affect rural electrification and by extension adoption of renewable energy technologies. If public policies support an environment conducive to the spread of renewable technologies then entrepreneurs and investors should be attracted to the opportunity offered in rural areas. Fundamentally these policies need to promote the smooth functioning of the general economy. Policies that foster a healthy investment and business environment can lead to the creation of wealth, which is important in building sustainable businesses.

Proactive policies can help to open up and accelerate renewable energy markets and create a level playing field for competition. Subsidies, import duties, and tied-aid can have adverse impacts on markets by creating price distortions and undermining the efforts of the private sector. Through their elimination or reduction, market demand for

renewable energy will be enhanced. In addition, clearly defining the grid expansion plans in a member economy can support the introduction and adoption of renewable energy technologies. Often, such a statement is deemed to expend political capital but is a key to unlocking the entrepreneurial activity needed to expand rural energy production.

### Chapter 6

A variety of measures to promote the use and adoption of renewable energy are discussed in Chapter 6. If the use of renewable energy technologies in rural areas is a priority, then efforts need to be made to create a market-pull for the products.

The Kyoto international climate change treaty may potentially be a driving force in building new markets for renewable energy technologies through joint projects between industrialized and developing countries and emissions trading. Resource concessions and joint ventures are other ways to engage the private sector in renewable energy development at a minimal cost to a host country.

Other means of spurring investments in renewable energy and creating customer satisfaction that are mentioned in Chapter 6 include setting performance and efficiency standards, education, training, and information exchange. Educating prospective buyers in rural areas on the value of the energy service is essential to creating market demand and consequently attracting investors. Equally important is building in-country capacity through training in the policy, technical, and financial sectors. An additional way to broaden the reach of renewable energy in the APEC region is to create an information clearinghouse on rural power, financing, and access to capital, perhaps through an Internet website.

### ***Prospects for the future of financing renewable energy projects***

In preparing this guidebook, a number of general conclusions can be drawn about investment in the renewable energy sector and how that will most likely be done. The general themes that emerge are:

- ❖ **There is a large market potential for renewable energy**
- ❖ **The challenge is to link the investment community with renewable energy projects**
- ❖ **There is a need for stable economic conditions, sound business practices, and risk mitigation measures to spur private sector investment**
- ❖ **It is important to increase the demand for renewable energy services and improve their affordability**
- ❖ **The profit margins from rural energy projects are improving in the long-term**
- ❖ **There is a need for improved education and outreach for project developers and investors, specifically including global access to information, training, and capacity-building**

## **Chapter 1 INTRODUCTION**

The aggressive energy usage of the APEC member economies reflects compelling productivity. In 1996, the APEC member economies consumed over 50% of the world's generated energy supply. This energy appetite fuels 18 economies that have collectively experienced a sustained GDP growth of close to 6% for the last 10 years. The fastest growth is found in the developing member economies whose expanding presence in the global market economy has produced a wide array of opportunities for investment and profit. To maintain the rapid growth of these developing economies, a tremendous investment in the energy sector will be made. Over the next 15 years, roughly half of the world's expansion in energy capacity is projected to be in Asia, with a large part of that slated for the developing economies of the APEC region.

Not all areas of the developing APEC member economies are sharing equally in this impressive growth. Particularly in rural areas, the increase in both economic development and access to energy services has, in many cases, been minimal. Often, modern energy services are simply not available or are unaffordable. Meanwhile, lower load demands and geographic isolation have made it uneconomical to extend conventional grid service. Without a convenient, affordable energy supply, these areas will be unable to match the growth in productivity that other parts of the region enjoy. Over time, they will fall even further behind in their economic development, which could lead to both social and environmental problems.

Practical alternatives to grid extension exist. Among the most important of these are renewable energy technologies. Falling costs, growing environmental concerns and increasing political attention bring promise that renewable technologies can put modern energy services within the reach of underserved people. With this promise comes the hope that rural populations will at last have the access to the power they will need if they are to enjoy the rewards of economic expansion along with the rest of their countrymen.

One critical piece of the puzzle is lacking: capital to grow the rural renewable energy sector. A second key factor is the lack of economic returns typically seen for renewable energy projects, dictating where capital is used. With local and national governments practicing greater austerity, renewable energy projects can no longer rely either on subsidies or grants for funding. Instead, these projects must compete for investment dollars based on their financial performance and future prospects in the marketplace. The challenge for the renewable energy industry is to win this competition.

The gap in understanding between an investor and a rural consumer is vast and the technologies are in general not well understood. The problem is clear: neither party is convinced that buying or selling renewable technology in rural areas makes sound economic sense. Large numbers of the end-users of the energy, whether they are households, villages or businesses, have not yet been able to or chosen to invest their limited resources on the technology. At the same time, the international investment

community has not been convinced that the returns associated with rural renewable energy projects justify risking of capital.

This situation is unlikely to change until the developers of renewable energy projects listen more attentively to their customers, both consumers and investors. Evidence shows that the rural consumer will choose renewable energy if the product is reliable, effective and competitively priced. At the same time, certain investors will invest in a thoughtful business plan with a competitive rate of return. Too often, neither party is offered these basic requirements. Ultimately, it is the rural energy project developer who will be responsible for addressing these issues either by changing the product, the service or the price. They are the ones who must convince the consumer to buy and the investor to risk.

The good news is that throughout the APEC region and the world, progress is being made in addressing these issues. Creative policy initiatives and industrious entrepreneurs are working to turn on the capital spigot and generate economic returns. Significant innovations in micro-financing techniques and a better understanding of the needs of the rural population are unlocking demand for renewable technologies. Meanwhile, increasingly sophisticated business plans and a focus on execution are tempting certain types of investors. The challenge now is to develop bankable projects that are self-sustaining and will result in an increased rural energy supply.

Project developers do not work in a vacuum. APEC governments play a crucial role in promoting the adoption of renewable technologies. Project developers thrive only if they operate in a business environment that supports their efforts. Public policies and public investments foster this environment. By supporting private sector efforts to offer energy services to rural areas, governments can tap private capital to improve rural living conditions. As governments embrace policies that lead to the creation of wealth they will be indirectly supporting the spread of rural electrification by increasing the discretionary income of rural areas. In addition healthier capital markets will make it easier for developers to fund projects.

The target end-users for renewable energy systems in rural areas are defined by their ability to pay, and can range from individuals to the communities to business enterprises. The mixed economic profiles of the rural energy consumers determine the market for renewable energy systems. For the purposes of this study, it is assumed that up to 10% of the rural market is willing and able to pay cash for energy services; an additional 20-30% are potential consumers if access to affordable credit is offered; and up to 55% will use renewable energy systems if there are no upfront costs and they can purchase the energy services at a guaranteed rate (e.g., “fee-for-service”). The remaining portion, the so called “bottom poor,” are probably not buyers of energy services regardless of the financing model used and will require public assistance to meet their needs. In a world where an estimated two billion people still have limited access to electricity and have little hope that the grid will reach them any time soon, renewable energy offers too much promise to not be fully supported by governments and too much potential profit not to be tempting to the private sector.

The purpose of this guidebook is to describe financing mechanisms that are appropriate for renewable energy projects in rural areas and to identify potential sources of capital for these projects and how to access them. In addition, policy and regulatory measures that will promote the use of renewable energy and innovative measures that will help foster renewable energy development in the APEC region are discussed. This guidebook is designed to be a practical tool for project developers, manufacturers, entrepreneurs, non-governmental organizations, community-based organizations, local utilities, and others that are seeking financing for renewable energy projects in rural areas.

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## **Chapter 2 MAKING THE MATCH BETWEEN GOOD IDEAS AND FINANCING**

Private sector financing of rural renewable energy projects, such as those utilizing photovoltaics, wind, and biomass technologies, is fairly new since typically these projects have been funded as stand-alone demonstration projects implemented by international development and bilateral aid programs in coordination with local governments. The exceptions to this are large-scale hydropower and geothermal projects for utility-scale applications which have been financed as typical bulk power projects. Now that many renewable energy technologies have matured and costs have been reduced enough to make them cost-competitive, there are new business opportunities with a unique set of challenges for the investment community.

Attracting sufficient private capital to fully develop energy opportunities in rural areas will require offering investors competitive financial returns. For this to happen, developers must design projects that can withstand the due diligence criteria to which prudent investors will subject them to. Prospective investors need to be convinced that risks have been anticipated, realistic business and marketing strategies have been devised and management possesses the experience to execute its business plan. Providing a high level of comfort is critical with rural renewable energy projects because the perceived risks have historically discouraged investors.

As they design projects, developers need to keep in mind where they will be raising the necessary capital. Until the renewable energy industry has more of a track record, targeting investors having an interest in “green” or “social” investment is going to be the key to obtaining funding since attracting investors who are interested only in commercial financial returns is going to be a challenge. Fortunately, many investors are comfortable with the terms and risks associated with financing renewable energy projects provided their other agendas (e.g. environment, climate change, etc.) are advanced. In some cases they are private investors and in others they are institutional investors. In Chapter 6, there are descriptions of many of the types of investors and sources of capital for renewable energy enterprises. However, before beginning the search for financing, a project developer must produce a well-thought out business strategy that can answer fundamental questions about the proposed project, the market, and profitability.

Numerous discussions with the public and private sector investment communities has yielded a number of common concerns with respect to investments in the renewable energy sector. The following are examples of questions that a renewable energy project developer should be prepared to answer in seeking capital for a business venture.

## *General concerns with rural renewable energy ventures*

### What is the track record for rural renewable energy project investments?

This is a vexing question for both project developers and investors. Investors generally want to see a history of profitable performance in an industry. Because renewable energy is new to the investment community, a track record for this type of investment is just beginning to be built up. The fact is, that even after all the effort that has been focused on bringing renewable energy solutions to rural areas, very few, if any, projects have yielded commercial returns that would justify placing anything other than venture capital at risk. Historically, problems that have inhibited this industry range from ill-conceived projects and bad management to a lack of supporting macro-economic conditions and very limited demand. As these problems have been recognized and addressed, project developers and manufacturers believe that the time is right for rural renewable energy projects to thrive if only the flow of capital can be turned on and there is an economic return on investment. Most of the companies active in the renewable energy sector are ready to seize the expanding markets. However, they suffer capital constraints and difficulties achieving sufficient profit margins.

### What are the business barriers to attracting investment?

In the past, investors have been reluctant to participate in projects because of concerns with the business fundamentals of rural renewable energy. Some of these concerns are common to any new industry and others arise from the nature of the renewable energy business.

- **Uncertain (and typically low) rates of return:** Renewable energy projects are often associated with uncertain or low returns on investment when compared with the usual return on investments in conventional energy projects that they are usually in competition with. Because of the limited track record of the renewable energy industry, developers struggle to accurately forecast sales or expenses, and therefore predicting the rate of return for a renewable energy project can be difficult. The variables over which the project developer has limited control but which can have an impact on a project's bottom line include political instability, changing and/or uncertain government policies and regulations, currency risk, and changing markets. There are a number of other issues that also affect the rate of return, including technology obsolescence, shorter project time frames for financing, and a lack of technical and market information.

In order to satisfy investor criteria for risking capital, the rates of return need to be improved for renewable energy projects. A demonstrated record of performance and cost recovery as well as a risk profile provides the best means of evaluating future returns and helps attract potential investors. Also, if there were incentives for investors to provide long-term financing to renewable energy projects, then returns on renewable energy investments could be improved. It is also important that the investor be aware of technology developments that are underway so that

they are able to capitalize on the current emerging technologies. Finally, accurate technology and market profiles as well as information that shows how well investments have performed should be made available to financial institutions.

- **Foreign exchange risk:** Developers can face exchange rate risk if their revenue streams are in a currency different from the currency of financing. For example, a developer in the Philippines may have the opportunity to borrow Japanese Yen for five years at low rates from a renewable energy manufacturer in Japan. During those five years the project developer will be paying off the debt in Yen while receiving revenues in Philippine Pesos. If during that period the Peso weakens against the Yen, the project developer will be faced with higher payments in Peso terms while having the same Peso revenues. If the weakening is significant enough it could bankrupt the project. This has been the case in several rural energy projects which have been brought to a standstill by the recent upheaval in Asian financial markets and the currency devaluations that followed.

Fortunately, there are risk management tools available to mitigate this problem, and these should be investigated before any debt is incurred. These tools include: foreign exchange forward contracts, foreign exchange options, and currency swaps. These transactions are over-the-counter or customized transactions that can be entered into with an international bank. A forward allows the customer of a bank to guarantee a specific exchange rate on a fixed date in the future on a fixed amount of money, while a currency swap allows the customer to guarantee a specific exchange rate on a series of dates in the future. The project developer may determine that it is necessary to hedge all of the risk if the margins on the revenue stream are small. With larger margins the developer would be less sensitive to currency fluctuations and could afford to absorb some losses. When structuring the financing of a project, these transaction costs should be considered in the overall costs.

- **High project transaction costs:** Projects considered for rural areas are usually very small in terms of capital requirements, making it difficult for large investors to justify the cost of the due diligence process that they normally undertake. The transaction costs incurred in preparing a financing package can easily become very high relative to the amount of financing being sought for a small renewable energy project. For this reason, investment bankers have traditionally sought larger projects and the bigger fees they generate.

To help mitigate transaction costs, it has been suggested that similar smaller projects that meet particular financial criteria could be bundled together and considered as a single larger project. One large package containing many smaller projects could be presented to investors who would then be able to justify the due diligence that such an investment would demand. Because financial institutions need to have experience and familiarity with the technology and the associated financial instrument in order to make ongoing investments, replicability of small projects will also help reduce transaction costs. As financial institutions learn

through experience with smaller, easily duplicated projects, they can potentially improve their returns while reducing their risks. Another way in which smaller projects could be financed includes mortgage type financing for individual systems or financing provided on the basis of the project developer's assets and collateral (Ecotec, 1996). Finally, the due diligence process could be modified for smaller projects so that there are less stringent requirements on smaller individual projects. This would require finding investors who are willing to invest in a number of smaller projects with some additional degree of risk taken on because of the less stringent financial review. No single project would require as much investigation by the investor since the risk would be spread out across the portfolio of projects with the hope that at least some of the investments would lead to profitable returns.

- **Unfamiliarity with rural markets:** Rural markets present a particular challenge to an investor because of their diversity and lack of identity in capital markets. The financial community views itself as responding to the demand for finance rather than creating it, and therefore markets need to be stimulated in order to create an investment framework for rural areas. In the current age of credit reports and standardized mortgage reports, investors often do not feel immediately comfortable with consumer debt that does not rely on conventional collateral or with customers whose cash flow is seasonal, as is common in agricultural areas. This uncertainty is translated into higher levels of risks factored into the investment decisions and correspondingly less favorable terms for financing.

Information that is targeted at the financial sector on the strengths and weaknesses of rural markets is needed. This could include market briefings, profiles of the rural renewable energy sector, and case studies of successful financing models. For example, companies like P.T. Sudimara of Indonesia and financial intermediaries like Grameen Shakti in Bangladesh are showing that with the right financing vehicles, rural customers can support a profitable business. These models should be conveyed to the investor to instill confidence in the financial condition of end-users and in the strength of the market for the product. In addition, project developers must have a strategy for ensuring investors that end-users either reliably make their payments or lose their system. For example, by requiring on-time and regular payments for their energy services, Soluz Dominicana, which is based in the Dominican Republic, has enjoyed almost 100% collection of fees.

- **Unfamiliarity with renewable energy technology:** Renewable energy technologies are often viewed by investors as unproven and therefore renewable energy investments are often considered a high risk. This unfamiliarity with the technologies can greatly deter lenders from making an investment. Therefore it is critical to ensure that renewable energy projects involve technologies that have a proven track record and that the terms and conditions of the contracts are well understood (e.g., product guarantees, warranties, and service). The perception that the technologies are unproven and unreliable is pervasive within the investment community.

Awareness by financiers of up-front capital costs, operating costs, technical performance, and equipment life expectancy are essential in accurately characterizing a project. In the case of biomass, wind and photovoltaic technologies, it is essential that they are field-tested and their performance is well understood. Unless investors are comfortable with the particular technology they are financing, they will be unlikely to risk their capital for renewable energy projects. Therefore, project developers and manufacturers need to demonstrate the reliability of renewable energy systems by further establishing a track record of performance, cost-effectiveness, and applicability to rural areas. These issues should be clearly explained in the project developer's business plan. As an aside, unfamiliarity with technology is of minor importance in comparison to the barriers mentioned previously.

#### How large is the rural market for renewable energy options?

This is a difficult question to answer since over two billion people are without access to modern energy services and yet the number of installed renewable energy systems is still very small. However, sales of renewable technologies are growing and the projections are promising. For example, the world market for small wind turbines was \$23 million in 1995 and growing at 30% a year (M. Bergey, Bergey Windpower, personal communication). For photovoltaics, the sales in 1997 were US\$600 million and sales are expected to grow at an impressive rate. By the year 2010 worldwide sales of photovoltaics are estimated to grow to US\$5 billion (M. Hammonds, BP Solar, personal communication). Despite these impressive growth projections, renewable energy will still make up a relatively small part of the energy supply portfolio, but with ongoing technological developments, increased modularity and improving economies of scale in the manufacturing process, sales are expected to increase. Confidence in the market is also indicated by the increased investment being made by large photovoltaic manufacturers (e.g, BP Solar and Siemens) in rural areas of the APEC region.

### ***Investor Questions About A Specific Project***

#### Is the project well conceived?

A decade ago, when energy projects were designed as demonstration or pilot projects, funding agencies were more concerned with technology deployment than with the management skills of the operator or the profitability of the project. This situation has changed. Investors now require projects to be well formulated, well managed, and have realistic goals. Too often, the renewable energy projects that investors are asked to finance do not offer some or any of these elements. In fact, privately, some members of the renewable energy community are saying that it is a lack of fundable projects that show an economic return rather than a lack of capital that is slowing the spread of the technology. Recognizing this, many business development organizations are attempting to anticipate investor concerns and helping project developers design projects

accordingly. These organizations work with project developers to shape their business plans so that due diligence requirements of investors are met. As an example, the World Bank, International Finance Corporation (IFC), and several U.S. charitable foundations are designing a new fund, the Solar Development Corporation, which has earmarked close to a third of its capital or nearly US\$15 million dollars to business development services. The intent is that these resources will be utilized to shape projects that then will be eligible for Solar Development Corporation funding.

#### Is the business and political environment supportive of the project?

As a World Bank (1997) study on rural finance shows, rural financial markets and rural energy markets require a supportive business environment if they are to thrive. This includes providing the right macroeconomic conditions, removing policy biases against the rural sector and establishing integrated and efficient financial markets that put credit within the reach of the rural population. Investors will be looking to see if these conditions are in place.

In terms of macroeconomic issues, the key is that policymakers pursue prudent fiscal and monetary policies to achieve price stability and to maintain a sound, well-aligned exchange rate policy. As noted earlier, and as the recent events in some Asian member economies have illustrated, the lack of such policies can have a negative impact on rural electrification efforts.

Governments can work to strengthen and regulate financial institutions that serve rural areas. Accomplishing this would increase the transparency, accountability, and risk bearing capacity of these institutions. By encouraging the growth of robust financial markets, the government can increase the rural population's access to capital, which will improve the prospects for economic activity generally, and energy projects specifically.

#### Can the customers afford the technology?

Increasingly the answer to this question has been yes. That is, the rural energy consumer is willing and able to pay for energy services that meet his or her needs. Entrepreneurs are realizing that the rural markets are strong if the proper financing mechanisms are in place. In recent years, three models for successfully selling rural renewable systems have emerged.

➤ **Cash Sales:** Ten percent of the rural population is thought to have the resources to pay in full for an energy system. This is the group that is often described as “the low hanging fruit,” or the customers who are most easily able to pay with cash. Most biomass systems and some of the solar home systems are purchased this way. Given the dispersed nature of the rural population, relying exclusively on cash sales can require targeting a broad market that can create problems in marketing, installation and service over a large geographic area.

➤ **Financed Sales:** An additional 20 to 30% of the population are potential

customers if access to credit is an option. In most cases, an initial cash payment of 20-35% is required and monthly payments are made on the balance. Occasionally a dealer will make loans directly, but this is usually done more effectively and economically by a local lending institution such as an agricultural cooperative or local bank. Until recently, few rural lenders have shown willingness to make loans for energy systems, particularly at the household level. Fortunately, this has begun to change as lenders have become more familiar with the technology and have designed repayment plans that are tailored to the consumer. The three main barriers to these types of loans are:

- (1) **High Initial Costs:** Saving enough money to make an initial cash payment of at least 20% can be extremely difficult for a customer given the high cost of the energy systems. The experience of Sudimara of Indonesia shows that lowering the amount of the down payment has much more of an impact on sales than lowering the monthly payment. Many potential customers just do not have the cash reserves to be able to afford a high down payment even though they have a monthly cash flow that permits them to service the debt.
  - (2) **Non-traditional loan collateral:** Frequently a customer does not have access to the types of assets that lenders typically consider when structuring a loan, such as a title to property. Increasingly, lenders are willing to view the system itself as collateral, since it is easily repossessed. However, in certain cultural-political environments it might prove difficult to remove a home system from a customer who cannot pay.
  - (3) **Transaction costs:** Relatively small loan amounts can be seen to generate a return that does not justify the cost of administering the transaction. Grameen Shakti of Bangladesh has, however, shown that it is possible to make a profit even with very small loans, on the order of \$300.
- **Fee for Service:** Over 50% of rural populations are thought to be potential users of renewable energy if there is no upfront cost and the only charge is a monthly fee for an energy service (e.g., electricity). Under this scenario, the system installer acts as an energy service company (see the case study on SOLUZ at the end of Chapter 3) for a detailed description of this model). The dealer is responsible for installation and maintenance. If the customer doesn't pay the monthly fee, then the system is removed. This monthly fee tends to equal the amount that the customer is currently paying for fuel (e.g. diesel), making it a relatively easy expenditure to justify for the consumer. By removing the down payment burden, the fee for service model appears to put renewable energy within reach of most people. This is the model for solar home systems that appears to be most attractive to outside investors, and it is being duplicated in several countries.

#### Who provides end-user financing?

Particularly in the case of solar home systems, financing for end-users can be provided by

a dealer. This poses a challenge for dealers in that it necessitates having large capital reserves and can be a concern for an investor. If a dealer is arranging financing and is also responsible for collecting payment, they may not be as focused on increasing sales. Currently, since local lending institutions often lack experience with making renewable energy system loans, sellers may have to be responsible for extending credit to customers. However, as rural lending institutions become comfortable with renewable technology loans, dealers can stop being lenders. This will lead to benefits both in terms of their focus and the balance sheet.

#### Who provides marketing and after sales service?

Given the embryonic state of renewable energy development in rural areas, entrepreneurs are usually required to do everything from educating the marketplace to handling after-sales service and bill collection. Such a broad range of responsibilities can cause a huge drain of both economic and personnel resources and yet they are essential to the success of a venture. A comprehensive business plan must explain how these services will be provided. Clearly supporting such a range of services is going to demand that a company grow to a rather substantial size before it becomes profitable. Therefore, having sufficient capital reserves to last during this period of growth is critical. Or, the company will have to fund expansion through cash flow, which may constrain growth.

### ***Business Plan Checklist***

A business plan is essentially the road map that tells prospective investors how a project developer intends to reach financial and programmatic goals. It is a statement of purpose that, if successful, convinces investors that they can have reasonable expectations of a return on the capital put to risk. More importantly, the business plan should show that the developer has anticipated risks, has devised strategies for overcoming them, and has the experience to execute the strategy. This is especially critical in renewable energy business plans because the risks associated with these projects have historically been perceived by the investment community as very high and difficult to characterize. Whether investors are concerned about the intended market, the rural population of developing countries or are concerned about renewable technologies, the developer has to provide answers within the business plan. A secondary purpose of the business plan is to outline a company's strategic plan and guide the operations of the company.

#### Initial assessment

Before preparing a business plan, there are a number of issues that the project developer must address in order to enter the renewable energy market. A thorough assessment of the fundamental aspects of the potential market, the end-user, and in-country resources are critical in preparing a well-thought out business plan. Issues to be considered include:

- ✓ Current energy services being provided and prices being paid by end-users
- ✓ Renewable energy resources



- ✓ Appropriate technology given the energy services required by end-users
- ✓ Economic profiles of end-users
- ✓ Previous experience and familiarity in the community with renewable energy
- ✓ Market demand for the product/service
- ✓ Existing mechanisms available to build a maintenance and spare parts infrastructure
- ✓ Existing rural credit, savings, and banking institutions
- ✓ Presence of local organization or partner interested in renewable energy development
- ✓ Existing complementary infrastructure (e.g., transport and communication)

### Business plan framework

After the initial assessment of the project, the pertinent financial, technical, and operational information about the proposed business venture must be determined to develop the business plan. A summary of the elements that could be contained in a business plan are presented to highlight the range of different issues that will need to be considered before approaching potential investors. These include:

#### **PROJECT DEVELOPER IDENTIFICATION**

- ✓ The company and its corporate objectives
- ✓ Management capacity
- ✓ Experience

#### **PROJECT PLAN**

- ✓ Description of the project and technology
- ✓ Schedule of project implementation
- ✓ Products/services being deployed in the market
- ✓ Proposed location
- ✓ Capital equipment and infrastructure requirements
- ✓ Human resources needed and in-country capacity

#### **MARKETING**

- ✓ Market overview
- ✓ Market segments for the product/service (e.g., household, small industrial, and/or public services)
- ✓ Marketing and promotion strategy
- ✓ Estimate of current and projected demand for the product/service
- ✓ Competition for the product/service in terms of quality and price
- ✓ Expected production capacity and market share

#### **FINANCIAL**

- ✓ Total project cost
- ✓ Fixed assets
- ✓ Working capital requirements
- ✓ Projected sales, prices, and revenue stream

- ✓ Costs to manufacture and sell the product/service
- ✓ Projected internal rate of return
- ✓ Assessment of risk exposure (e.g., exchange rate, interest rate, power purchase agreements, and government policies)
- ✓ Financing received from other sources (e.g., multilateral, concessional, and grants)
- ✓ Assessment of cash flow with respect to costs of maintenance, service, end-user payment default, future purchases, staff support, etc.)

#### **TECHNICAL ISSUES**

- ✓ Source of the product components (locally produced or imported)
- ✓ Possibility of doing local assembly
- ✓ Requirements for installation
- ✓ Operational history of the equipment
- ✓ Capability for project monitoring
- ✓ Equipment maintenance requirements

#### **OPERATIONAL ISSUES**

- ✓ End-user financing (e.g., fee for service, credit, or purchase)
- ✓ Transaction costs
- ✓ Method for collection of fees and payment levels
- ✓ Policy to handle defaults on loans and terms of repossession
- ✓ Local financial intermediaries that could be used to manage end-user financing
- ✓ Mechanism for sales, installation, and service
- ✓ Training and capacity-building of local community in operation of system
- ✓ Plan for procurement and assembly of main system components
- ✓ Details of consumer protection measures including warranties, service, and education

## **Chapter 3 FINANCING MECHANISMS**

As APEC member economies have embraced policies that ultimately lead to a shrinking government presence, a stronger private sector, and liberalized capital markets, the method in which infrastructure projects are being financed has changed. The potential funding sources for new energy projects have multiplied. Whereas in the past the state wholly owned most energy developments, now joint ventures between public and private entities are much more common. This latter model provides a more flexible framework for sharing project risks and permits a wide variety of debt/equity structures (Razavi, 1996). Developers of all types of energy projects can begin to utilize these financing mechanisms to access capital that was previously unavailable.

Government need to take action if private investment, including debt and equity finance, is to become an important source of project funding. Critical to encouraging private investment in emerging markets are laws that support transparent legislation and regulations that help promote better macroeconomic fundamentals. In addition, the implementation of regulatory and legal measures that protect investors and developers are necessary. Stronger laws governing contracts, new bankruptcy codes to allow corporate failure and a more open environment for mergers and acquisitions will promote investment. Measures requiring full disclosure, particularly of liabilities, and supporting freer access to credit information will allow investors to more accurately assess risk. Employing standardized accounting and banking procedures will speed up the due diligence process.

To better understand the relationship between possible investors and the renewable energy product cycle, in light of investors role in project development and financing, a value chain analysis is useful (Environmental Advantage, 1995). A value chain analysis illustrates the steps that occur in the project development process, the range of players involved at each step, and the concerns that each of the players may have. This framework (Figure 3-1) illustrates the types of potential investors, the various financial institutions that may be involved, and their relationship to the end-user in developing a renewable energy project. There are several entry points along the chain for potential investors, depending on the scale and focus of their investment. The issues facing the institutional investor are obviously much different than the financial intermediary, and when structuring the financing package it is important to keep in mind who is being approached and how to address their particular concerns. For example, institutional investors are interested in investment-grade products with high rates of return whereas financial intermediaries (e.g., village credit facilities, local banks, and rural cooperatives) may be able to work with smaller margins or leverage their funds with other types of funding. The chain can also be entered by making investments in project developers or manufacturers. The primary linkage with end-users is through financial intermediaries and local retailers, who both require capital in order to provide credit to end-users. Since providing end-users with affordable and reliable energy services is the goal, this linkage is perhaps the most important.

Figure 3-1:

**Financial Services Chain:**

**Concerns:**

- Default rate
- Repayment rate
- Criteria for loan pool
- Method of hedging currency

**Concerns:**

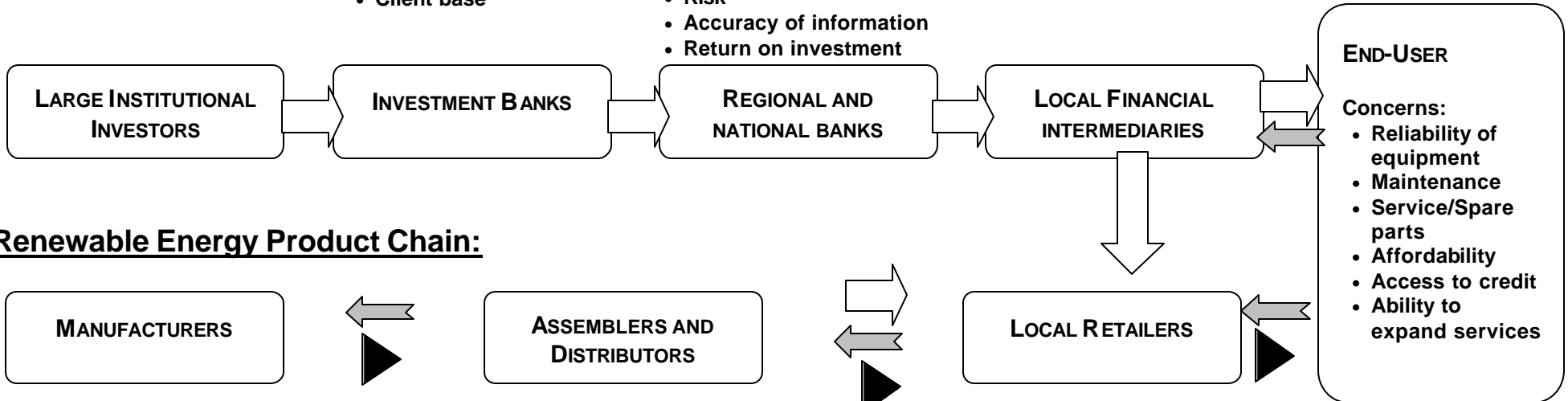
- Credit history
- Size of deal
- Risk
- Repayment history
- Terms of loan
- Collateral
- Existing monopolies on credit
- Client base

**Concerns:**

- Experience of intermediaries
- Collection rates
- Regional and seasonal variance
- Ability to raise capital
- Value and depreciation of equipment
- Risk
- Accuracy of information
- Return on investment

**Concerns:**

- Demand for financing
- Risk
- Repayment history
- Cost of capital or fees
- Necessary terms of financing
- Return on investment



**Renewable Energy Product Chain:**

**Concerns:**

- Ability to gauge size and location of markets
- Education and training of dealers
- Spare parts availability
- Access to markets
- Tariffs/regulations

**Concerns:**

- Education and training of retailers
- Access to local retailers
- Credit terms
- Distribution networks
- Spare parts availability
- Working capital

**Concerns:**

- Accurate information on product performance
- Cost of installation and maintenance
- Financing terms for end-user
- Access to working capital
- Product reliability
- Education of end-user

**LEGEND:**

- ➡ Credit/investment
- ← Cash Flow
- ▶ Product Flow

Source: Adapted from Environmental Advantage (EA Capital), 1995

Renewable energy project developers should benefit from a growing investor willingness to risk money in emerging markets. Historically, debt and equity have been difficult to secure for renewable energy projects because of their small size, long payback period, and lack of identity in the financial markets. However, as renewable energy technologies increase in visibility in the capital markets and their risks are better understood, smaller rural projects should be able to utilize these financing mechanisms.

### ***Debt Finance***

Debt financing is a financial instrument that provides capital for the purpose of earning interest for the lender. Debt financial instruments are classified as medium risk with medium rates of return because lenders are usually repaid before distributions are made to shareholders that hold equity (Mendis, 1997). Commercial bank lending for small-scale renewable energy projects is not readily available because of the small size of the projects. However, different types of debt financing are currently being used for renewable projects and new ones are on the horizon. Debt financing can include non-recourse financing, development bank loans, and micro-credit loans, among others.

#### Non-recourse financing

Investment and commercial banks can lend money on a non-recourse basis, which means that in the event of default on the loan, they have no claims other than on the assets of the project itself. This type of financing, which is based on long-term commercial contracts, is usually underpinned by indirect sovereign government guarantees. Non-recourse lending has been used primarily for large fossil-based and geothermal power plants in Asia. In the case of large renewable energy projects, resource risk is addressed by incorporating additional mechanisms such as reserve accounts or contingent repayment schemes (deLucia and IFREE, 1995).

It is not likely that, in the near-term, non-recourse financing will be available for smaller renewable energy projects, such as those in rural areas. This type of financing has not been used much because of the lack of interest by conventional financial institutions in the smaller, more specialized loans that are required in rural energy projects. In addition, the long-term loan structures (e.g., repayment over 20 to 30 years) used in non-recourse financial instruments are not generally available for renewable energy projects because of the perceived higher risks and the unfamiliarity of the investment community with the technologies. However, this type of financing might be available for renewable energy projects if developers are able to secure similar long-term debt structures, and lending institutions recognize that the equipment is reliable, there are low operating costs, and that the increased use of renewable energy contributes to both the social and economic development goals set forth by the government. Many developers of renewable energy projects have identified the lack of availability of long-term loans as being a significant barrier to industry growth. If a government that is committed to renewable energy development were to provide the kind of underlying guarantees required by investment banks, non-recourse financing could be considered. This would be more viable if smaller

projects were aggregated together so that the overall project size and associated capital requirements were larger to help mitigate the transaction costs and possibly the pool of loans could be securitized.

### Development banks and multilateral institutions

Loans to private companies can be made through regional development banks such as the Asian Development Bank and multilateral institutions such as the International Finance Corporation. An increased awareness by these institutions of the importance of renewable energy when combined with their ongoing support for sustainable energy development could lead to additional financing and help overcome institutional barriers.

As a development finance institution, the Asian Development Bank can serve as a catalyst for private capital flow to developing member countries through co-financing arrangements. Co-financing from the Asian Development Bank can include making loans to cover part of project costs, helping secure external debt financing, providing partial credit and risk guarantees to secure export credit financing on favorable terms and offering concessional official development assistance. This organization has begun to initiate debt guarantee programs to extend the period of debt financing for renewable energy projects, but this has only been done on a limited basis for large-scale power projects such as geothermal and hydropower plants. The Asian Development Bank has not actively pursued the smaller projects that are the focus of this paper.

The International Finance Corporation, the private sector arm of the World Bank, makes investments in private sector projects on a commercial (i.e., non-concessional) basis, sharing full project risks with its partners. Long-term loans at fixed or variable rates, loan guarantees, and standby financing are some of the debt instruments used by the International Finance Corporation. It is important to note that the International Finance Corporation charges international market rates for its products and does not accept government guarantees. In other words, IFC lends in hard currency and charges international market rates, as opposed to lending in local currencies at local rates.

### Micro-credit

A subset of the traditional debt financing model is the issuance of micro-credit, smaller loans that are tailored to borrowers with limited ability to pay. Because cash sales to purchase systems outright are often not an option for rural customers, financing at the local level is critical in making renewable energy systems affordable and available. Micro-credit is an effective mechanism for financial institutions to use in providing households and small businesses with access to capital via loans for small-scale investments under flexible and often non-traditional lending conditions. Loans are usually very small and typically include flexible repayment schemes, fee schedules that match customer income streams, and longer loan repayment terms. In the most successful and profitable models (e.g., Grameen Bank in Bangladesh), loans are provided at non-subsidized rates of interest, which encourages productive economic activity from borrowers and covers the cost of fund mobilization and loan administration.

Typically, micro-credit schemes rely on peer group lending. Borrowers form a group that then applies for a loan. The group as a whole is responsible for repayment of the loan (Gregory, et al., 1997). Due to peer pressure within the group to adhere to the repayment terms, risk to the financial institution of default is minimized. In order for micro-credit schemes to work, there are a number of considerations for the financial institution. A branch of the bank should be located close to the customer base so that it is easy to apply for a loan and convenient to make payments. In addition, the local bank staff must be familiar with the types and purpose of the loans and the customers. The loan application procedure should be kept simple. Loan collateral requirements should be structured so that they don't pose a barrier to households that do not own property or do not have a clear property title. In such cases, the renewable energy system itself can serve as the collateral. It should be noted that banks would be less reluctant to use the system as collateral if a secondary market existed for used energy systems.

### Leasing

Along the lines of a conventional utility, but much smaller, leasing, which is sometimes referred to as “fee for service,” is a means for the end-user to pay for energy services (e.g., electricity) rather than purchasing the hardware to produce the electricity. The “service provider” owns the system and manages the entire operation—leasing, training, service, billing, collection, etc. The end-user rents the energy system (typically a solar home system) for a monthly fee, and in return the service provider agrees to provide guaranteed maintenance and reliable energy services. The monthly fees are usually intended to match what the end user is currently paying for traditional fuels such as kerosene. Fee-for-service arrangements relieve the first-cost burden from the rural customer and put the capital risk onto the energy service provider. Since the service provider has a large amount of capital tied up in inventory, access to working capital is critical. An additional benefit for the end user is that because the energy service provider only can charge the customer if the system is working, there is an incentive to keep the systems in good shape.

The fee for service model is emerging as one of the best opportunities for financing renewable energy systems in rural areas. Several successful “fee for service” businesses are now operating in rural areas. In fact, the companies that have proven this unique concept are now trying to raise capital to expand their businesses and are offering consulting services. For a more detailed discussion of one of the more successful business ventures with a fee for service structure, see the case study on SOLUZ at the end of this chapter.

### Revolving funds

A way in which affordable credit can be extended to rural end-users is through the use of revolving funds. A revolving fund is a loan fund that is replenished by borrowers as they repay their debt. This type of loan fund has been used in rural areas, mainly in the agriculture sector. Revolving funds are designed to be self-sustaining because with the

ongoing replenishment of funds, new loans can continue to be made. Typically the interest on the loans is used to manage the loan pool and help offset some of the risks associated with inflation, loan defaults, and cost of capital (Gregory et al., 1997). The interest rates charged are near commercial rates and the funds are usually successful at preserving their initial seed capital.

The infusion of capital to start a revolving fund is typically a loan or grant from a development organization, and the implementation and management of the lending program is done by a local institution. If a grant is used to start a revolving fund (which does not have to be repaid), this lowers the overall operating costs, whereas debt finance (where a loan must be repaid on certain agreed upon terms) has much higher costs because the revolving fund needs to cover their cost of capital as well as the cost of individual loan disbursements. Factors that have been identified by Gregory et al., (1997) that are important in the success and sustainability of a revolving fund include the ability of the fund to: provide loans at market rates; cover administration costs; ensure that service and installation will be done; expand the number of clients; and maintain lending capital. In addition adequate training on the credit scheme as well as trained technical staff to maintain the systems should be incorporated into a revolving fund program.

Revolving funds have been established to finance the purchase of small photovoltaic systems in developing countries. For example, the Solar Electric Light Fund (SELF) has shown these funds can be very successful given a small amount of start-up funding for purchasing PV home lighting systems. By extending credit over 2 to 5 years and requiring a small initial payment, repayments on the loans have been able to finance additional purchases.

### Rural credit cooperatives

Financial intermediaries in rural areas can be rural credit cooperatives that are part of the semi-formal lending sector. These institutions traditionally have been set up to provide loans to the agriculture and residential sectors. However, they are now expanding their reach to include renewable energy. Cooperatives are usually much smaller than banks and are focussed on the local community in terms of their resources, loan requirements, client base, and repayment schemes. They require clients to first establish a savings account with a good record of savings and then the client can usually apply for a loan. Similar to a revolving fund, the credit institution tries to keep their operating costs low and their repayments current so that they can be self-sustaining financial institutions. Some of the benefits of rural credit cooperatives, outlined by Gregory et al., (1997), include the ability to provide credit to low-income borrowers; an in-depth knowledge of clients since the cooperative is locally-based; a less complicated bureaucracy; and a more flexible lending structure tailored to the income stream of end-users.

A cooperative can either issue debt to consumers to purchase renewable energy systems or they can be directly involved in the implementation of projects. Credit cooperatives can be very appropriate for financing renewable energy purchases by rural borrowers



because they provide households with access to low-cost, short-term credit, which can be used to facilitate loan repayment for the systems. For example, in Bolivia, a solar electrification association was set up to be run by a cooperative. The cooperative owns and maintains the lighting systems in exchange for a monthly fee that is collected from each household (Asian Development Bank, 1996). Availability to technical assistance to maintain and service the equipment and collect fees is essential to a program's success.

### ***Risk Mitigation Measures***

Despite the fact that renewable energy technologies are now proven and cost-effective in many applications in rural areas, the lending community continues to perceive renewable energy projects as a risky place for their money. Until this mindset changes, borrowing for rural energy projects will be challenging. Investors and financiers find it difficult to absorb or manage certain types of risk, particularly those related to the maintenance of stable political, economic and regulatory conditions over the long-term, or the effective performance of contractual obligations by government agencies. Mitigation of risks can make a crucial difference in mobilizing private funding for development projects. Offering to guarantee repayment of loans can help offset private sector exposure to risks and assuage the concerns of lenders.

#### Loan guarantees

Loan guarantees can spur lending to a particular sector or customer-base by spreading risk among the guarantor (e.g., multilateral agency or government), the lender (e.g., a local or regional bank), and the borrower (e.g., the rural customer). Loan guarantee schemes in rural areas have two main objectives. The first is to improve access to financial services for a targeted sector by reducing risks and transaction costs. The second is to encourage lenders to undertake profitable lending to an underserved clientele (Stearns, 1993 and Yaron et al., 1997). The underlying premise is that ultimately the loan guarantee will not be needed because the lenders will be convinced that the risks and transaction costs are reasonable and manageable.

Guarantees can cover commercial risks associated with loans to clients who have insufficient traditional collateral or on a larger scale, political risk associated with the member economy's financial stability. Governments have used loan guarantees to reduce risk for rural financial institutions and to encourage them to lend to customers without sufficient collateral or credit histories. Yaron et al., (1997) suggests that guarantees can allow for greater leverage of capital resources and thus can have a significant impact on rural areas. Loan guarantee programs have often been hindered by such factors as: a lack of incentives for lenders, below-market pricing which makes it difficult for governments to recoup their costs, bureaucracies that limit efficiency of the program, and a relaxed approach to guarantees for public lenders who are not held to commercial terms for repayment (Yaron et al., 1997).

Loan guarantees in rural areas have traditionally been used to finance rural agricultural

operations, farmers, and small-scale industrial plants. Given that there are power demands in these sectors that may not be currently met, it is possible that loan guarantees could be an appropriate financing mechanism for the application of renewable energy technologies. Guarantees could be expanded to include financing for renewable energy development in rural households or other productive uses. They could be useful in easing the financial risks and reducing the high transaction costs that are associated with rural lending.

### Partial loan guarantees

Partial loan guarantees can be provided for a variety of debt vehicles including loans, lines of credit, and debt funds. These types of guarantees allow debt capital to be leveraged with private investment in the project while reducing the perceived risk of the projects. In fact, access to a partial guarantee can be the deciding factor in the financial viability of a project because it can reduce risk to a level where the lender becomes comfortable and willing to accept the terms of the loan. These guarantees are especially important to developing member economies that may have restricted access to international capital markets, but which are considered a good credit risk for obtaining longer maturities of credit needed to improve project viability. Partial guarantees are designed to cover a portion of the financing provided by private financiers for projects that need long-term funds to be financially viable. Partial guarantees on a loan can be used to guarantee principal payments to commercial lenders for a limited time (usually two years). These types of guarantees can be used to limit the risk exposure of the lender or to extend the terms of a loan. A partial guarantee on a line of credit typically extends maturities of loans and covers all events of nonpayment for a designated part of the debt service. It entails providing credit on pre-established terms (usually credit and technical criteria) that are used for project preparation and approval. Guarantees provided for existing debt funds could also be effective in reducing the transaction costs. For example, if projects are already pre-screened by a debt fund then the lender can more quickly evaluate the loan.

### Political risk insurance

Political risk is the possibility of a multinational company being significantly affected by political events in a host country or change in the political relationships between a host country and another country. For example, political change can affect all foreign companies operating in a host country or only impact a particular industry. Because there will always be some degree of political risk, appropriate management involves the assessment of possible risk and the implementation of strategies to minimize that risk.

Political risk can range from government action which has minimal effect on the cash flow and ownership of foreign entity assets, to the extreme case of total expropriation without compensation (Goddard, 1991). Governments are responsible for the development of legal and regulatory frameworks for doing business in their member economies, and the way in which these frameworks are set up and enforced has a direct bearing on a member economy's risk profile. The evaluation of political risk is not an

exact science and investment can take place while the situation is changing in a particular member economy. Factors that are typically considered when evaluating political risk include: stability and form of the government, type of legal system, attitude toward foreign investment, previous problems with foreign investments (e.g., expropriation), degree of civil unrest, and others (Goddard, 1991).

In order to help mitigate political risk for private sector investment, a World Bank entity, the Multilateral Investment Guarantee Agency (MIGA), was established. MIGA provides investment guarantees against certain non-commercial risks (i.e., political risk insurance) to foreign investors in developing member economies. It offers long-term (e.g., 15 years), low-maintenance political risk insurance coverage to eligible investors for qualified investments in developing member economies. Insurance is provided against the following risks: currency transfer, expropriation, breach of contract, and war and civil disturbance. The program is designed to complement national and private investment insurance schemes.

Although MIGA insures investments in a wide range of industries, it is not known if renewable energy projects have taken advantage of this type of insurance. Certainly the renewable energy sector could benefit from political risk insurance such as this in order to help make projects more economically viable and attractive to private sector investors. Since the World Bank group is becoming more aware of the importance of investments in the renewable energy sector to meet development and environmental goals, it is possible that this type of insurance will be offered for small renewable energy projects.

### ***Equity Financing***

Equity (shares of stock) can be used to raise capital for a project or company. As opposed to debt finance, an equity investor has the right to play an active role in making decisions related to a particular project. The investor's stake in a company is represented by shares which give the shareholder residual ownership of the assets and earnings of a company but only after all other obligations to holders of debt and preferred stock are met. This is considered a high-risk financial vehicle and therefore the expected rate of return is very high (usually greater than 20%). Equity in a project could be between 20-40% of the project depending on the specific arrangements. Possible sources of equity financing include joint venture partnerships, equity investment funds, pension funds, and venture capital.

Cross-border investment flows and the growth of capital markets are becoming essential factors in matters of development. Equity markets will serve as an ever-growing source of capital for new businesses. According to Mr. Marshall Carter, the Chairman and Chief Executive Officer of State Street Corporation, which invests nearly US\$458 billion worldwide, a fundamental shift in assets from banks towards capital markets is reshaping corporate finance worldwide. Businesses are moving away from traditional bank borrowing and instead are issuing stocks and bonds as a way to raise capital. Mr. Carter estimates that by the middle of 1998 in the United States, the mutual fund industry will

have more assets than the banking industry. This trend towards collective ownership of assets is accelerating around the globe. The number of stock exchanges worldwide has doubled in the last twenty years to stand at 200 today. By the year 2010 over 1 billion people are predicted to be stockholders. It should be noted that mainstream equity financing will be unlikely for renewable energy projects in the short term because of the typically small size of the projects and the relatively low rates of returns. Currently, however, there are numerous financial institutions that specialize in renewable energy investments and this is expected to grow.

When considering equity financing as potential sources of capital, it should be remembered that the managers of mutual funds and pension funds have fiduciary responsibility to their shareholders and therefore the risks that they are allowed to take are limited. One important restriction is that they must maintain liquidity. This means that they must be able to quickly shift their assets from one investment into another. This requirement prevents them from taking direct ownership in a company that is not public. Instead they need to be able to buy shares for which a market exists. Pension and mutual funds cannot invest directly in development projects but can do so indirectly through stock ownership. As an example, if a bank were to raise capital in order to expand its renewable energy lending program, the pension fund managers would only be able to participate if the bank were to sell shares that could then be traded on an open market. Debt financing and direct ownership in the bank would not be an option.

Many types of equity ownership exist. The one that is most suited for a particular business will be determined by the needs and goals of both the developer and the investor.

### Joint ventures

A type of ownership sharing that is very popular among international companies is the joint venture, in which a company is owned by more than one organization. These types of partnerships involve combining assets, resources, and expertise to improve overall competitiveness in the markets. Joint ventures -- in which each partner provides a portion of the capital or holds a portion of the equity of the company -- can take many forms. Depending on the type of business, the foreign partner may have very little involvement in direct management of the joint venture, or may work side-by-side with the in-country partner. Joint ventures can be structured so that foreign and local partners jointly own a manufacturing plant in the member economy; they may import parts from abroad and assemble finished products locally; or the two partners may jointly provide consulting services. Usually a joint venture is a strategic alliance between two or more companies that have a narrowly defined objective.

The major incentives for an investor to undertake a joint venture are 1) by forming an alliance, the costs of research, marketing, and production are shared, 2) companies can spread technological and financial risk between them so that they engage in higher risk projects, 3) companies can complement each others skills and resources, and 4) by forming a local partnership, companies can gain entry into markets where they are not

well established or launch new products more easily (Sigurdson, 1997).

The most important aspects of successfully setting up a joint venture are selecting the right partner and ensuring that there is a sufficient market to justify the investment. A stable, well-established local partner is invaluable in providing local access and contacts, and in navigating the local bureaucracy. For renewable energy projects, joint ventures are usually formed by manufacturers for the purpose of building in-country manufacturing capacity. These types of agreements can lead to cost reductions since equipment becomes locally produced, which has the additional benefit of spurring local economic development.

Some APEC member economies have incentives in place to promote the development of joint ventures in certain sectors and industries. In China, for example, all joint ventures which have operation agreements over a period of ten years are exempt from state income tax for the first two profitable years. From the third to the fifth year of operation, the joint venture will only have to pay 50% of the required income tax. Joint ventures established in remote and developing areas of China can continue to pay 15 -30% less income tax for an additional ten years after the fifth year of operation.

#### Equity investment funds and individual investors

Hoping to extend the environmental and economic benefits of renewable energy, specialized equity funds have been created to invest in environmentally and commercially sound energy companies. Some are in the private sector (e.g. Triodos bank in the Netherlands) and others are sponsored by the multilateral organizations (e.g. International Finance Corporation and the Global Environment Facility). These funds can provide equity investment capital for renewable energy, energy efficiency, or other environmentally responsible technologies in return for a share of the equity of the project. The expected return on equity is generally much higher than the expected return on debt. As equity investors stand to make the highest return, they also assume the greatest risk because they are paid back after all other financial (e.g. debt investments) and tax obligations are met. Ideally, equity investment funds can leverage bilateral or multilateral financial resources in order to develop an in-country renewable energy fund. Engaging a local entrepreneur or financial institution to be responsible for project identification, development, financing, and monitoring can strengthen the management of the equity fund.

Private equity capital can frequently be obtained from individual investors. These types of investors may finance a business venture either because they know the entrepreneur or because they have a personal interest in the business. Individual investors may be well-suited to participation in equity financing that are too small for venture capital firms to consider (e.g., under US\$500,000). Typically, these types of investors are more flexible on the rates of return they require from their investment due to their personal commitment to the project. Possible drawbacks to this type of investment are that the investor may not possess the time or expertise to advise the entrepreneur on business operations, and the funding may be a one-time event without the possibility of additional

funding in the future.

### Venture capital

Venture capital financing distinguishes itself from most traditional forms of financing by representing a true partnership between capital and management. Venture capital firms invest in and participate in the development of early-stage technology companies that have the potential to grow rapidly into substantial enterprises. It is available to companies when more conventional sources of financing are not, either because of the high level of risk inherent in the investment or because the company is not able to offer the type of collateral traditional institutions normally demand. To maintain a high degree of control over their investments, venture capital firms typically demand a large equity stake. Returns on the order of 50-60% are not uncommon targets in venture capital projects. Venture capital firms may combine their equity investment with debt, convertible debt or convertible preferred in order to leverage their risk and exposure. Access to venture capital is based on the relationship between the investor and the entrepreneur. Usually venture capital firms play an active role in management and strategic decisions. Venture capitalists often are involved in founding new companies.

Typically venture capital investments are made in high-growth enterprises that have large market capitalization (US\$3-4 million) and are involved with new technologies. However, smaller deals on the order of US\$500,000-\$1 million are also considered. Venture capital funds have funded renewable energy businesses, but only on a very limited basis since more profitable shorter-term opportunities abound elsewhere. However, if the rural markets for renewable energy systems expand and start to offer healthy returns to investors, venture capital firms may become interested.

### ***Combining financial instruments***

Creatively using a combination of existing financial instruments can be an effective way of financing renewable energy projects. Such combinations would promote flexibility and could mitigate investment risks because of the different terms and asset coverage associated with each instrument.

Because of high up-front costs and relatively long payback periods for renewable energy systems, longer-term financing (10 to 12 years) is essential to a project's viability. Longer-term financing could be completed by extending the loan repayment period using partial credit guarantees, as described above, or possibly by issuing bonds combined with loans issued by export credit agencies. Securing long-term financing for a power project can be brought about by combining loans received from export credit agencies (such as the US Export Import Bank) and bonds issued by an investment bank. A successful model for combining bond financing and loans has been implemented recently in Indonesia for a large power plant. German and US Export Credit Agencies guaranteed loans with a term of fifteen years and bonds were issued by a US investment bank with payment starting after ten years. This arrangement provided the needed flexibility of

repayment and security for the investors. Although this model has been successful for large conventional power plants, it might be possible to scale down to better match the needs in financing a renewable energy project or several similar projects that are bundled together.

Another approach identified by deLucia and IFREE (1995) is the modification of commercial financial structures that have been developed for other capital investments to fit renewable energy projects. This typically would involve the issuing of long-term debt by an investment bank, with equity issued internally rather than in capital markets. Although deLucia and IFREE (1995) explain that this has not been widely used to date in the APEC region, it is conceivable that as financial markets develop in the APEC member economies, there will be opportunities to utilize both the debt and equity markets in this way.

### *Case studies*

The following are examples of renewable energy projects that illustrate a range of financing models and project concepts.

#### **Bringing affordable energy services to rural areas** **SOLUZ, Inc. and Enersol Associates**

Two models for pursuing a market-driven transition to renewable energy in off-grid applications have been developed in recent years. The first, Enersol Associates, Inc., is a non-governmental organization (NGO) that works within the community to introduce the option of solar electrification by doing catalytic market development work in financing and training. The second, SOLUZ, Inc. is a private-sector energy service company offering sales and maintenance of decentralized electricity services to rural households and small businesses. Enersol and SOLUZ together form part of the Global Transition Group.

The Global Transition Group believes that both NGOs and private commercial firms need to play a role in introducing and promoting renewable energy technologies in rural areas. NGOs are effective as catalysts and can introduce new solutions to rural populations. However, large-scale expansion of the market-driven delivery of renewable energy products and development of supporting financial services will require significant capital and management expertise. Private commercial firms are best suited to tackle that challenge.

Enersol Associates, Inc., the NGO, has had renewable energy development programs in the Dominican Republic since 1984 and in Honduras since 1992. It trains independent technicians and entrepreneurs and encourages the development of credit mechanisms for renewable energy systems. The Enersol model helps to provide early exposure to renewable energy technologies and experience among local participants with credit in

remote rural areas. Its success as an NGO led to the installation of several thousand

small solar systems for homes and businesses by local for-profit entities and entrepreneurs, chiefly rural-based.

SOLUZ is a U.S.-based for-profit company that grew out of commercial activity begun in the Dominican Republic in the mid-1980s. SOLUZ was created to develop a fee-for-service model for providing affordable electric services to rural people. In 1995, SOLUZ established a subsidiary aimed at serving 5,000 customers in the Dominican Republic, and more recently expanded to Honduras. The company markets four different size PV units ranging from 15 to 50 Watts for set monthly fees of up to US\$20. In this scenario, end-users are buying only the energy services provided by solar home systems. There is no down payment nor ownership, so removing the system because of non-payment is less of a struggle. The monthly payments are collected on an individual basis. Following installation, users deposit their payments in cash at designated collection points in the community. The fees can be adjusted to offset any currency devaluations that may occur. This approach has proven to generate demand far beyond what would be possible with cash and credit sales. The SOLUZ model for a renewable energy service company has attracted attention from many groups looking to encourage private sector involvement in the rural markets.

The equipment/component/spare parts infrastructure was set up originally through Enersol's training program in each country. This has resulted in the formation of several dozen independent microenterprises serving rural areas. These microenterprises are run by entrepreneurs and are supplied by various importer/distributors as well as SOLUZ, who sell to them at wholesale prices. There are about four to six importers/distributors in each country and the microenterprises can shop around for the best prices. The local entrepreneur's own target retail markets (usually having limited geographic scope) are self-contained, with their own technical and financial infrastructures. Maintenance and repair of the systems are done by Soluz Dominicana and Soluz Honduras.

SOLUZ buys almost all components directly from manufacturers on behalf of its affiliates, including modules, ballasts, and controllers. Soluz Dominicana and Soluz Honduras buy the batteries locally and assemble lighting fixtures and some controllers. There is no local manufacture or assembly of panels in the Dominican Republic or Honduras for the SOLUZ operation. Customs and duties on the equipment are accounted for as a cost of doing business.

SOLUZ and/or its affiliates was initially financed by the for-profit Dominican PV company, Industria Electrica Bella Vista (IEBV), and support from the Rockefeller Foundation was used to develop the prototype fee-for-service operation. Additional funding has since been obtained from a number of different sources, and in total SOLUZ has attracted US\$2.4 million in financing. Sunlight Power International recently made an equity investment of US\$500,000 each in SOLUZ Dominicana and SOLUZ Honduras. In addition, Sunlight Power International pledged to raise US\$1 million in debt capital to support both companies. Other equity and debt investors have been Environmental



Enterprises Assistance Fund (EEAF), E&Co, Rockefeller Foundation, Calvert Socially Responsible Investment Fund, Winrock International, and self-financing. Enersol's support has come from donations (principally foundations and individuals) and government contracts.

**Solar energy businesses in the rural areas**  
**PT Sudimara Energi Surya**

PT Sudimara Energi Surya sells solar home systems in rural Indonesia where an estimated 25 million families have no access to electricity. To reach its customers, the company has set up a network of service centers that are responsible for sales, on-going maintenance, and financing. Sudimara believes that it is only through this combination of services that the sustainable delivery of solar energy to rural households can be realized.

In order to offer these services reliably, Sudimara has divided its territory into “sub-districts” that contain up to 5,000 households without access to electricity. Each of these subdistricts is home to a “Sudimara Service Center”. Each service center has three to four staff, each of whom has a permanent employment contract and an office provided by the company. From this central office, the staff goes out to neighboring towns and villages.

All of the photovoltaic modules are imported from Intersolar in the United Kingdom, who sells the product to Sudimara with a credit line. All other components are produced and assembled locally by Sudimara. The costs related to customs and duties are reasonable: 7.5% plus value added tax of 10%. However, the import procedures are complicated and cumbersome. Currency exposure has not been hedged for Sudimara's operations.

Initial marketing efforts take place at the village level through presentations and informative meetings. The local government can be very helpful in organizing these. Later, the sales force goes door to door. Within a year, most sales take place through word of mouth or through direct sales at the service center. Systems are installed within one week of purchase and are monitored on a monthly basis.

Some systems are sold by cash, but most are sold through down payments and credit. Generally, the down payment is 30% of the system cost with a 44-month loan term. Since Sudimara is providing the credit, a good portion of the company's working capital is tied up in inventory, which limits the capital available for expansion. The company believes that the down payment amount is the key factor in the buying decision, with little attention paid by customers to the interest rate or the monthly payment amount so long as it fits within the household's cash flow.

The amount of working capital obtained to start Sudimara was approximately US\$500,000. Sudimara got its seed money from its major shareholders: Sudimara BV, Amsterdam (80%) and the President of Sudimara (20%). Sudimara BV is a privately

held company owned solely by the President of Sudimara. Sudimara has not relied on financing from other sources since its initial capitalization.

### **Turning crop residue into electricity** **BG Technologies**

To exploit the opportunity to sell energy services in underserved areas of the developing world, Energy Works (a joint venture between Bechtel Enterprises and Pacificorp) launched a subsidiary, BG Technologies, to sell turn-key installations of small modular biomass gasifier units (100kW-2MW) to small agricultural and forest products businesses and, eventually, villages. As of July 1, 1998, an individual has purchased BG Technologies from EnergyWorks, and the key management is looking for new investors.

By persuading rural business owners that they are underutilizing their biomass residues, BG Technologies looks to turn waste products into an asset, power, that can either be used by the company on-site or sold locally. This power can be produced less expensively than diesel power, which is used frequently, and is often more reliable than grid electricity, which may or may not be available. By partnering with local industrial distributors to market and maintain the systems, the company hopes to avoid the expense of building a sales force. The strategy is to use larger industrial gasifiers as a market entry point and later expand to village power markets with smaller units (20-40kW) which can serve close to 150 households.

BG Technologies has an exclusive license and distribution agreement with Ankur Scientific Energy Technologies of India, and currently all systems are manufactured in India, tested at the factory and shipped to the customer site for installation. Once the local markets are better developed, BG Technologies intends to establish local manufacturing operations. BG Technologies is just getting started and has sold one system, which is operating near Medan in North Sumatra, Indonesia. However, close to 80 systems, ranging in size from 40kW to 500kW are in place in India, suggesting that if a supportive infrastructure of sales and service is available, there is demand for the systems. System cost ranges from \$700/kW to \$1,000/kW. To help with currency exposure, BG Technologies sells all its equipment based on US dollars.

Their business approach is to identify established local distributors who will add BG-Systems to their product line. Local distributors make the sales, carry out system installation under BG Technologies' supervision, and provide warranty/maintenance interface to customers in exchange for a commission on every sale. As part of the installation process, a BG Technologies supervisor trains the customer's operators to operate and maintain the system. In addition, the distributors make two maintenance inspections during the warranty period to make sure operating procedures are being followed. Marketing materials, training for sales and service people, and problems with equipment warranties are the responsibility of BG Technologies.

Relying on cash sales, BG Technologies has been limiting the number of customers because most of the potential market cannot be tapped until access to borrowed money is

made easier. In the meantime, financing sales through traditional financial institutions has proven difficult because, although the customers have cash flow, they lack the capital needed for a down payment. The challenges for this energy business are import duties, lack of familiarity with the technology, and the development of the market. The APEC member economies that BG Technologies is focusing on include Philippines, Malaysia, Thailand and Indonesia.

Energyworks was capitalized by Bechtel Enterprises and PacifiCorp Holdings as a 50-50 joint venture. Societe General provided EnergyWorks with a US\$150 million pool of debt financing for projects developed by EnergyWorks. The seed investment by EnergyWorks in the BG-Systems business was over US\$1 million. Currently BG Technologies is well along in the process of obtaining financing from new investors, and expects to have its initial round of capital closed by September 1998.

### **Using solar energy to create jobs**

#### **ASE Americas, Inc.**

Rather than focus on meeting rural household energy needs, ASE Americas, Inc. chooses to focus on supplying energy solutions to entrepreneurs running small-scale enterprises that generate income. By encouraging the use of photovoltaics for income-earning activities, they believe they will spur demand and market expansion for renewable energy in the rural areas. The rationale for this strategy is that access to credit for purchase of solar home systems is still very difficult but access to capital for productive uses is already possible in most rural areas, either through cooperatives or agricultural banks.

ASE is financially supported by ASE GmbH, who in turn is supported by Nukem GmbH. Nukem GmbH is owned by RWE, Germany's largest electric utility company. The company began over 20 years ago with an investment by Mobil Oil, who sold it in 1993 to ASE Americas, Inc. No additional grants or loans have been used to finance ASE Americas, Inc., although it does participate in programs that may include a cost-share component funded by grants. These programs have been very helpful in allowing ASE to accelerate more aggressive initiatives.

ASE Americas, Inc. plans to hold expositions of numerous PV-powered micro-enterprises that are appropriate for rural areas. These expositions will be small standalone units highlighting a range of applications. The income-earning opportunities demonstrated might include vaccine refrigeration, rice husking, water purification, battery charging, sewing, lighting, entertainment or communication. The hope is that such expositions will encourage local people to start new businesses and thereby promote rural economic development. ASE Americas, Inc. is then prepared to help these entrepreneurs grow their businesses.

ASE Americas, Inc. typically supplies technology, raw materials (photovoltaic cells and module assembly materials), sales and marketing support and a network for company-to-company exchanges and sales. Manufacturing is done in the U.S. and Germany, and products are also sold to manufacturers in Saudi Arabia, South Africa, India, and

Mongolia. Very little of the raw materials are imported. In order to hedge their currency exposure, ASE Americas, Inc. requires payment in U.S. dollars. The equipment/component/spare part infrastructure is designed on a project-by-project basis. The service and maintenance infrastructure is also set up on a project-by-project basis. Clusters, or the concept of having a sufficient number of solar systems in a local region to establish critical mass, where critical mass means that there is enough activity to justify a local service infrastructure (often serving the dual role of service and revenue collection), are being considered as a good alternative.

Although ASE Americas, Inc. can offer extended credit terms, they try to collect payments directly from the customers. These customers in turn set up their own collection systems. The focus on development of business enterprises will help the local entrepreneurs pay back their loans on shorter terms. ASE Americas, Inc. cites the example of a T-shirt company that was able to double its production using a solar-powered sewing machine. The increased production allowed the owner to pay back the loan taken out to pay for the machine in 106 days, even though the interest charged by the local lender was 45%.

The underlying belief in this strategy is that it is not a lack of entrepreneurial initiative that is preventing development in rural areas, but a lack of energy services. Socio-economic development and jobs creation is linked to the provision of energy services, and energy services are what ASE Americas, Inc. hopes to provide.

## **Chapter 4 SOURCES OF CAPITAL**

Renewable energy projects face significant challenges in accessing capital. There has been very little experience to date with commercial financing of renewables, and very few have focussed on the rural areas. There is a gap that exists between the investment community and the project developer because both have different expectations and different ways of evaluating the merits and risks of a particular project. It will be necessary to bridge over this gap if any headway is to be made in attracting capital to the renewable energy sector. For example, the financial community needs to become aware of the business opportunities associated with investments in renewable energy projects and the project developer needs to provide the potential investors with projects that have sound business plans that address the concerns of the investors. Currently, most of the substantial sources of capital for renewable energy projects come from the multilateral development banks and agencies. However, there are a small number of innovative financial institutions and entrepreneurs that are also actively engaged in financing for renewable energy projects on a commercial basis. As barriers begin to break down so that private investors are engaged and willing to invest in projects, the renewable energy sector will be an important emerging market in the APEC region. What follows are detailed descriptions of the various programs and institutions that provide funding and support for renewable energy projects.

### ***Multilateral Institutions***

The main role for the multilateral institutions in the context of access to capital will be in acting as a catalyst for investment. They have been involved in activities that support the development of local capital and financial markets through direct financing, co-financing, and the provision of loan guarantees. Historically, the multilateral financing institutions have financed large power infrastructure projects, but increasingly they have begun to play a role in stimulating the rural energy markets.

### ***World Bank***

The World Bank has been involved in rural energy since as early as the 1970s focussing on rural electrification, biofuels, and pilot projects in renewable energy. The first policy analysis done by the World Bank targeted at rural electrification was in 1975 (World Bank, 1975 and World Bank, 1996). Their conclusions were that:

- Economic investments in rural energy do exist in developing countries
- Alternatives to grid extension can be cost-effective and provide higher rates of return
- Cost recovery should be sought in rural energy projects

Although the findings were fairly general, they served the purpose of bringing rural energy to the fore and setting the stage for future investments and the development of

new program initiatives at the Bank. From 1980-1995 the total amount of loans classified as rural electrification were US\$2.7 billion for 38 projects in 22 countries—with over 75% of the funds targeted for Asia (World Bank, 1996).

**Table 4-1: World Bank/GEF Projects in the APEC region**

<b>Member Economy: Name of Project</b>	<b>Project Scope</b>	<b>Funding (US\$ in millions)</b>	<b>Year project is approved</b>
<b>Indonesia: Second rural electrification loan</b>	Support for policy measures to create a sustainable & efficient small power market. Focus on small geothermal & mini-hydropower.	18.0	1995
<b>Indonesia: Solar home systems</b>	Support for investments in 200,000 solar home systems in areas without the grid.	44.3	1997
<b>Indonesia: Renewable energy for small power</b>	Support for grid-based renewable energy projects. Focus on biomass, mini-hydropower, & small geothermal.	70.4	1997
<b>Indonesia: Eastern Indonesia renewable energy development<sup>1</sup></b>	N/A	25.0	1999
<b>China: Renewable energy promotion<sup>1</sup></b>	Support for the accelerated development of renewable energy resources.	95.0	1999
<b>Philippines: Transmission restructuring<sup>1</sup></b>	Support for wind/PV hybrid systems for remote islands.	10.0	1999
<b>TOTAL</b>		262.7	

<sup>1</sup>Note: Project preparation underway

N/A: information not available

Source: World Bank (1997).

As far as renewable energy technologies are concerned, they started to be recognized as a possible alternative by the World Bank in the 1980s. From 1980-1995, thirty renewable

energy projects for a total investment of US\$1.3 billion were financed in eighteen countries, including eight projects that were co-financed with the Global Environment Facility (GEF) (World Bank, 1996). The largest portion of these loans was directed toward geothermal energy projects and since 1990 there has been a larger emphasis placed on other renewable energy technologies more suited for rural applications (mainly solar, wind, and biomass).

From 1992-1999, the cumulative World Bank lending for the power sector in Asia is estimated to be US\$15 billion (World Bank, 1997a). Of that amount, US\$1.2 billion involved World Bank/Global Environment Facility renewable energy and energy efficiency loans, credit, and/or grants in Asia. This growth in the Asian alternative energy portfolio, up from one approved renewable energy project component in 1992, to 30 alternative energy projects/components today, is due in large part to the work of the Asia Alternative Energy Program (ASTAE). ASTAE was created in 1992 by the World Bank and several donors (U.S. Department of Energy, Government of the Netherlands, and the United Nations Development Programme), with the goal to increase lending for renewable energy and energy efficiency in Bank operations in Asia. Today, ASTAE supports a broad-based alternative energy portfolio in 12 countries with total project costs of \$2-3 billion. In 1998, alternative energy lending accounted for 14.2% of total power sector lending in Asia, up from 0.1% in 1992.

Renewable energy project support in APEC member economies has been limited. Out of the 17 renewable energy projects in Asia, in the period 1995-1999, six are located in APEC Member economies (Table 4-1). These projects have been primarily in Indonesia and projects are planned in China and the Philippines. The projects are summarized below:

In the World Bank (1996) report they discuss another World Bank evaluation that was done in 1994 of rural electrification projects in Asia. They note that although overall the projects were considered a success, only four of the ten projects had rates of return greater than 10% and none of the projects was financially self-sustaining. These statistics lead to the conclusion that these types of projects would at this point not be attractive investments to the private sector. However, it is important to note that the reason for this apparent poor performance was that the institutional and regulatory framework was such that pricing policies provided cross-subsidies for rural power which served to undermine the economic viability of the projects.

A World Bank policy directed at the delivery of energy services to rural areas was agreed to in 1996. This policy broadened the scope of policies that were originally agreed to in 1992 where the World Bank committed to “lending only where there was a demonstrated commitment to power sector reform, and its projects would promote clean technologies and practices”. The revised policy adds the following elements:

- Extend modern energy supplies to unserved populations.
- Promote sustainable supply and use of biofuels.
- Introduce new and renewable energy technologies by:

- Promoting commercial pricing, including in particular oil products and coal
- Involving private sector in distribution
- Providing incentives for extension of service
- Supporting agroforestry and biofuel programs
- Encouraging local initiatives and open markets.

Given the commitment by the World Bank to consider rural energy projects and the increased awareness of the economic and social benefits associated with the provision of energy services, the potential to broaden their investment portfolio is there. It will most likely happen as the developing member economies in the APEC region firmly establish market economies and associated policy and regulatory reforms that will engage the private sector who could then leverage their funds with World Bank financing. To this end, there are now several avenues for World Bank funding specifically focused on renewable energy projects. However, the number of projects is still very small given the overall portfolio of the bank and the projects targeted at rural areas are even less. As the new initiatives are put into place and existing ones expanded hopefully the situation will evolve so that renewable energy is a more prominent part of the Bank's portfolio. Currently there are three programs that are relevant to the APEC region: the Energy Sector Assistance Program (ESMAP), the Global Environment Facility (GEF), and the Asia Alternative Energy Program (ASTAE).

Energy Sector Management Assistance Program (ESMAP, 1997 and D. Lallement, World Bank, personal communication)

The Energy Sector Management Assistance Programme (ESMAP) was established with the support of the United Nations Development Programme (UNDP) and 15 bilateral official donors in 1983 to support the development and introduction of policy and institutional reforms to promote increased private investment related to:

- Energy and the environment
- Rural and household energy
- Renewable energy technologies
- Energy sector reform
- Energy efficiency
- International energy trade.

ESMAP funding in 1997 totaled US\$8.4 million. Projects that are ongoing in the ESMAP include: an examination of the environmental impacts of the expansion of coal-based electricity generation in India, development of a clean coal initiative, design of energy-environmental assessment tools, air quality management, development of new mechanisms for decentralized rural electrification, analyzing factors that determine cost-effective delivery of rural energy services, establishment of a rural electrification concession in Argentina, preparation of a solar thermal project in Egypt, and a pre-investment study for decentralized solar power in Cape Verde.



## Energy Sector Management Assistance Program (ESMAP)

<b>Primary funding Institution</b>	World Bank, United Nations Development Programme and donors
<b>Mission</b>	Support the development and introduction of policy and institutional reforms to promote increased private investment in energy and supply and end-use energy efficiency; natural gas development; and renewable, rural, and household energy; and mainstream renewable energy into the World Bank's lending
<b>Year initiated</b>	1983
<b>Capitalization</b>	In 1997: US\$8.4 million 25.5 committed
<b>Type of financing available</b>	➤ Grants
<b>Average size of financing</b>	Total project costs range from US\$50,000 to US\$2 million
<b>Technology Focus</b>	Renewable energy and energy efficiency technologies
<b>Country Focus</b>	Developing countries and economies in transition
<b>Types of projects</b>	Global technical assistance program related to: energy and the environment, rural and household energy, renewable energy technologies, energy sector reform, energy efficiency, and international energy trade pilot projects
<b>Who is eligible</b>	Governments
<b>Contact information</b>	<p><b>Name:</b> Ms. Dominique Lallement Manager</p> <p><b>Address:</b> The World Bank 1818 H Street, NW Washington, DC 20433 USA</p> <p><b>Phone:</b> 1-202-458-2849</p> <p><b>Fax:</b> 1-202-522-3018</p> <p><b>E-Mail:</b> <a href="mailto:dlallement@worldbank.org">dlallement@worldbank.org</a></p> <p><b>Website:</b> <a href="http://www.worldbank.org/html/fpd/esmap/esmap.html">http://www.worldbank.org/html/fpd/esmap/esmap.html</a></p>

## Global Environment Facility (UNDP, 1997 and World Bank, 1994)

The Global Environment Facility (GEF) was set up in 1991 by the World Bank, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) as an international fund dedicated to providing grants and concessional funds to developing countries to address global environmental problems and promote sustainable growth. It operates in part by helping developing countries bear the extra cost of measures designed to mitigate global environmental effects, by providing concessional funding and by offering other incentives for environmentally favorable projects. In 1994 the GEF was restructured and replenished with over US\$ 2 billion, to be used over a three year period. Their resources are targeted at four themes:

- Climate change
- Biological diversity
- International waters
- Depletion of the ozone layer

And, a fifth, only as it relates to each key area:

- Land degradation desertification and deforestation)

GEF projects and programs are managed through the three implementing agencies: the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank. The World Bank administers the GEF funds and is also responsible for investment projects. They also try to mobilize private sector resources for projects that are compatible with GEF objectives and national sustainable development strategies. The UNDP is responsible for technical assistance activities and capacity-building. Through its worldwide network of country offices, UNDP helps to identify projects and activities consistent with the purpose of the GEF and national sustainable development strategies. It is also charged with running the Small Grants Programme, which provides funding for non-governmental organizations (NGOs) and community groups around the world. UNEP is responsible for catalyzing the development of scientific and technical analysis and advancing environmental management in GEF-financed activities. It also manages the Scientific and Technical Advisory Panel, an independent advisory body that provides scientific and technical guidance to the GEF.

### *Access to Funds*

The GEF covers the incremental costs of a project undertaken with global environmental objectives in mind, and the costs of an alternative project that the country would have implemented in the absence of global environmental concerns.

Governments may apply for GEF funds directly to any of the implementing agencies. NGOs can do the same once the government has endorsed the project in principle. Projects submitted for funding under the Small Grants Programme in the 33 countries where the program is operational should be sent directly to the national committee of the

GEF Small Grants Programme. GEF funds are also available for traditional development assistance.

In order to draw upon other organizations' comparative advantages in efficient and cost-effective project execution in a particular country, projects can also be planned and implemented by organizations other than the government. This could include multilateral development banks, specialized agencies and programs of the United Nations, other international organizations, bilateral development agencies, national institutions, NGOs, private sector entities, and academic institutions.

### *Eligibility*

Currently 160 countries are participants in the GEF. Countries may be eligible for GEF funds in one of two ways: (1) if they are eligible for financial assistance through the financial mechanism of either the Climate Change Convention or the Convention on Biological Diversity; or (2) if they are eligible to borrow from the World Bank (IBRD and/or IDA) or receive technical assistance grants from UNDP through a Country Programme.

Most importantly, GEF projects must be country-driven, incorporate consultation with local communities and, where appropriate, involve non-governmental organizations in project implementation.

There are five general criteria that must be met for accessing GEF funds:

- The project must fit into one of the four GEF focal areas—for energy this would be the climate change theme
- There must be demonstrated benefits to the global environment
- The incremental cost of the proposed project must be presented relative to the national or regional baseline
- The project must be located in an eligible country
- There must be support from the host government for the project

### *Funding Allocations*

In order to ensure that the GEF resources are not absorbed by a few projects, limits were set for each of the implementing agencies. For the World Bank the limit is set at US\$30 million for projects associated with regular World Bank projects and US\$10 million for stand-alone projects. For the UNDP, the ceiling is US\$10 million and for UNEP the limit is US\$5 million. For each of these allocations, there are six categories of GEF funding.

**Operational Programs:** This is funding for major, long-term GEF projects that include all aspects of the design, implementation, and coordination. Projects fall within ten focal areas under the four themes of the GEF. The focal areas that relate to sustainable energy are under the climate change theme and include:

- Removing barriers to energy conservation and energy efficiency
- Promoting the adoption of renewable energy by addressing barriers and reducing implementation costs
- Reducing the costs of low greenhouse gas-emitting energy technologies

**Project Development Facility:** Project Development Facility funds support the development of GEF projects from concept stage into fully approved project documents. There are three different levels of funding available: up to US\$25,000 (Block A ); up to US\$200,000 (Block B); and up to \$1 million (Block C).

**Small Grants Programme:** The Small Grants Programme is available for projects falling within the four focal GEF thematic areas that are proposed by local community organizations and NGOs in developing countries. There is a ceiling of US\$50,000 for national projects and US\$250,000 for regional projects.

**Enabling Activities:** Enabling activities are technical assistance and capacity-building activities to help developing countries meet their Convention (either climate change or biodiversity) obligations. This includes inventories, compilation of information, policy analysis, and the development of strategies and action plans.

**Short-term Response Measures:** Short-term Response Measures are urgent, high-priority activities to meet immediate needs which the GEF will on occasion fund even though they are not part of the overall operational program and are not enabling activities.

**Medium-size Projects:** This is a new category of projects that is being designed to expedite the delivery of GEF funds for projects with budgets of under \$1 million. The funding criteria and project cycle is still under development.

### *Project cycle*

Depending on which implementing agency is undertaking a project, there are different procedures for developing and implementing a project. The basic stages of GEF project processing are:

- Project identification
- Technical review by an independent expert prior to funding approval
- Funding approval
- Project design, appraisal, and agency approval
- Pre-implementation
- Project Implementation
- Project completion and evaluation

## Global Environment Facility (GEF)

<b>Primary funding Institution</b>	World Bank, United Nations Development Programme, and United Nations Environment Programme
<b>Mission</b>	To provide grants and concessional funds to developing countries to address global environmental problems and promote sustainable growth in the focal areas of climate change, biological diversity, international waters, depletion of the ozone layer, and land degradation as it relates to the other four issues
<b>Year initiated</b>	1991
<b>Capitalization</b>	Pilot phase: US\$1.2 billion, Second phase: US\$ 2 billion
<b>Type of financing available</b>	➤ Grants, loans, and credit to finance incremental costs and/or mitigate risks
<b>Average size of financing</b>	World Bank: US\$30 million limit for projects associated with regular World Bank projects and US\$10 million for standalone projects. UNDP: US\$10 million limit UNEP: US\$5 million limit
<b>Technology Focus</b>	All renewable energy and energy efficiency technologies
<b>Country Focus</b>	All countries that are eligible for GEF funds
<b>Types of projects</b>	Projects related to: design, implementation, and coordination of projects in the GEF focal areas; support for project development; technical assistance and capacity-building; and short-term high-priority activities
<b>Who is eligible</b>	Governments can apply to any of the implementing agencies or non-governmental organizations that have the endorsement of the government for the project
<b>Contact information</b>	<p><b>Name:</b> Mr. Charles Feinstein Senior Environmental Specialist</p> <p><b>Address:</b> The World Bank 1818 H Street, NW Washington, DC 20433 USA</p> <p><b>Phone:</b> 1-202-473-2896 <b>Fax:</b> 1-202-522-3256</p> <p><b>E-Mail:</b> <a href="mailto:cfeinstein@worldbank.org">cfeinstein@worldbank.org</a></p> <p><b>Website:</b> <a href="http://www.gefweb.org">http://www.gefweb.org</a></p>

### *Small Grants Programme*

Within the GEF is a program that is dedicated to the development of smaller projects called the GEF Small Grants Programme (GEF/SGP). The purpose of the GEF/SGP is to use small-scale activities and approaches that could help alleviate global environmental problems if they were replicated successfully on a larger-scale. This program focuses on households and communities through initiatives that address local environmental and livelihood needs in an integrated manner within the GEF areas of concern. The program is administered by UNDP.

In the program's pilot phase, which was launched in mid-1992, GEF/SGP country programs were established in 33 countries in Africa, North Africa and the Middle East, Asia and the Pacific, Central Europe, and Latin America and the Caribbean. Over the course of the pilot phase more than 700 projects were supported by the GEF/SGP and over 90 percent of these activities addressed biodiversity conservation and climate change.

The types of activities that are funded include:

- Community-based assessment and planning grants. Usually small grants (up to US\$2,000) are available to support preliminary assessment and planning activities.
- Pilot projects. Funds are allocated to test the viability of innovative community-level approaches, technologies and institutional arrangements in the GEF focal areas.
- Capacity-building. Usually associated with pilot projects or for technical assistance and training activities to support community-level activities in the GEF focal areas.
- Monitoring and analysis. Grants for project monitoring, development of "best practices", and case studies.
- Dissemination, networking and advocacy. Supports efforts that will promote reform of policy and removal of barriers to local activities in the GEF focal areas.

The procedure to access funds under the GEF/SGP is much more straightforward than the regular GEF projects. The grants are awarded at a national level in each country on a competitive basis to local community groups and NGOs.

## Small Grants Programme

<b>Primary funding Institution</b>	Operates within the Global Environment Facility
<b>Mission</b>	Support of small-scale activities and approaches that could help alleviate global environmental problems if they were replicated successfully on a larger-scale
<b>Year initiated</b>	Pilot phase: 1992
<b>Capitalization</b>	Funded as part of the overall GEF Programme
<b>Type of financing available</b>	➤ Grants, loans, and credits
<b>Average size of financing</b>	US\$50,000 limit for national projects and US\$250,000 for regional projects
<b>Technology Focus</b>	Under the climate change focal area: renewable energy and energy efficiency technologies
<b>Country Focus</b>	33 country programs established in Africa, North Africa and the Middle East, Asia and the Pacific, Central Europe, and Latin America and the Caribbean
<b>Types of projects</b>	Community-based assessment and planning grants; pilot projects; capacity-building; monitoring and analysis; grants for project monitoring, development of “best practices” and case studies; and dissemination, networking and advocacy
<b>Who is eligible</b>	Local community groups and non-governmental organizations
<b>Contact information</b>	<p><b>Name:</b> Mr. Alfonso Sanabria Coordinator, Small Grants Programme</p> <p><b>Address:</b> United Nations Development Programme 304 East 45<sup>th</sup> Street, 10<sup>th</sup> Floor New York, 10017 USA</p> <p><b>Phone:</b> 1-202-906-5832</p> <p><b>Fax:</b> 1-202-906-6690 or 6698</p> <p><b>E-Mail:</b> <a href="mailto:alfonso.sanabria@undp.org">alfonso.sanabria@undp.org</a></p> <p><b>Website:</b> <a href="http://www.undp.org/gef/">http://www.undp.org/gef/</a></p>

### Asia Alternative Energy Program (World Bank, 1997a)

The Asia Alternative Energy Program (ASTAE) is a special World Bank program that is charged with mainstreaming renewable energy and energy efficiency options into the World Bank assistance given to its clients in the Asia region. The main objective of the Asia Alternative Energy Unit is to help identify and develop renewable energy and energy efficiency projects for World Bank/GEF financing in Asia. ASTAE also designs and implements training in energy efficiency and renewable energy options, helps formulate alternative energy policies, assists in strengthening institutional capabilities, collaborates with donor agencies, and mobilizes technical assistance funds in support of its program. ASTAE is currently engaged in alternative energy activities in India, Indonesia, Sri Lanka, Thailand, the Philippines, the People's Republic of China, the Lao PDR, Vietnam, and Pakistan. As of March 1998, the loan portfolio in Asia contained 30 projects with US\$1.2 billion of World Bank/ Global Environment Facility commitments.

The primary activities of ASTAE are:

- Mainstreaming sustainable energy options at all levels of decision-making for World Bank staff and borrowers.
- Strengthening institutional capacities of countries through technical assistance and training to help remove regulatory, financial, and institutional barriers to sustainable energy.
- Fostering public-private sector partnerships to help the development of renewable energy markets in Asia.



## Asia Alternative Energy Program (ASTAE)

<b>Primary funding Institution</b>	World Bank and Global Environment Facility
<b>Mission</b>	Mainstream renewable energy and energy efficiency options into the World Bank assistance given to its clients in the Asia region and to help identify and develop renewable energy and energy efficiency projects for World Bank/GEF financing in Asia
<b>Year initiated</b>	1992
<b>Capitalization</b>	For operational support: 1992-1997: Total US\$14.5 million and 1998-2000: Planned total of US\$10.5 million (US\$8.6 million already committed)
<b>Type of financing available</b>	➤ Grants, loans, and credits
<b>Average size of financing</b>	US\$ 18 million to US\$100 million (combined World Bank and GEF funds)
<b>Technology Focus</b>	Renewable energy and energy efficiency technologies
<b>Country Focus</b>	East Asia and Pacific and South Asia regions
<b>Types of projects</b>	Projects that develop lending operations in support of sustainable energy in the Asia region, capacity-building, technical assistance, identification of “best practices” and analysis related to role of renewable energy and energy efficiency in the power sector
<b>Who is eligible</b>	Local community groups and non-governmental organizations
<b>Contact information</b>	<p><b>Name:</b> Mr. Yoshihiko Sumi Sector Manager, Energy</p> <p><b>Address:</b> Asia Alternative Energy Program The World Bank 1818 H Street, N.W. Washington, DC 20433 USA</p> <p><b>Phone:</b> 1-202-458-2880</p> <p><b>Fax:</b> 1-202-522-3573</p> <p><b>E-Mail:</b> <a href="mailto:ysumi@worldbank.org">ysumi@worldbank.org</a></p> <p><b>Website:</b> <a href="http://www.worldbank.org/astae/astae.htm">http://www.worldbank.org/astae/astae.htm</a></p>

## Multilateral Investment Guarantee Agency (MIGA)

<b>Primary funding Institution</b>	World Bank
<b>Mission</b>	Encourage flow of private capital to developing countries by mitigating political risks through the provision of investment guarantees
<b>Year initiated</b>	1988
<b>Capitalization</b>	US\$ 1.08 billion
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Long-term political risk insurance for equity investments, loans, and loan guaranties</li> <li>➤ Funds for technical assistance for means of enhancing the local business environment</li> </ul>
<b>Average duration of guarantee</b>	Standard term of coverage is 15 years
<b>Technology Focus</b>	Not applicable
<b>Country Focus</b>	All member countries of MIGA (currently 140 countries but expanding to 160)
<b>Types of projects</b>	Insurance coverage for political risk associated with foreign exchange; expropriation; breach of contract; war; and civil disturbance
<b>Who is eligible</b>	Investors that are a national of a member country other than the country in which the investment is being made
<b>Contact information</b>	<p><b>Name:</b> Mr. Christophe Bellinger Chief Guarantee Officer</p> <p><b>Address:</b> The World Bank 1800 G Street, NW 12<sup>th</sup> Floor Washington, DC USA</p> <p><b>Phone:</b> 1-202-473-6163</p> <p><b>Fax:</b> 1-202-522-2630</p> <p><b>Website:</b> <a href="http://www.miga.org/miggu/invest.htm">http://www.miga.org/miggu/invest.htm</a></p>

## ***International Finance Corporation***

The International Finance Corporation is a member of the World Bank Group that is responsible for fostering private sector activities in developing countries. IFC is the largest source of loan and equity financing of private sector projects in developing countries (IFC, 1997a). Their investments are geared toward the growth of productive enterprises and the development of efficient capital markets. Their operating principle is that IFC participates in an investment only when it can make a value-added contribution that complements the role of other market players. Although IFC operates within the World Bank Group, it is an independent entity, whose policies and activities are governed by the 172 member countries. The three primary functions of the IFC are:

➤ **Providing financing for private sector projects**

This includes long-term loans, equity investments, quasi-equity investments (e.g., subordinated loans, preferred stock, income notes), guarantees, and risk management services

➤ **Resource mobilization**

Taking advantage of IFC's high visibility and good standing, it can act as a catalyst for other private sector investment. Financing could be mobilized by syndicating loans, underwriting investment funds and corporate securities issues, and doing private placements.

➤ **Technical assistance**

In this capacity IFC provides advice to businesses and governments in developing countries on a range of issues. For example, IFC can provide guidance on formulating business plans, identifying markets, and accessing capital for businesses. For governments, the IFC can help them create conditions that stimulate the flow of both domestic and foreign investment including the development of capital markets and privatization.

The size of the investment portfolio of IFC is understandably quite substantial. In 1997, IFC approved US\$6.7 billion in financing for projects whose costs totaled US\$17.9 billion. In addition their loan and equity portfolio in 1997 was US\$8.4 billion. Power generation was the IFC's largest investment sub-sector in 1997, mainly focused on large power plants (e.g., greater than 100 MW). However, IFC has now made the environment one of its priorities, and IFC's Power Department is consequently focused on making renewable energy and energy efficiency investments. To address this priority, IFC sponsored the Renewable Energy and Energy Efficiency (REEF) targeted at projects less than 50 MW. In addition to REEF, IFC is also involved in several other initiatives which focus on renewable energy, including the IFC/Global Environment Facility Small and Medium Scale Enterprises Program, and the Solar Development Corporation. IFC also has another program, the IFC/Global Environment Facility Photovoltaics Market Transformation Initiative (PVMTI), but it is focused on countries that are not members of APEC and as such will not be discussed in this report.

### Small and Medium Scale Enterprises Program (IFC, 1997c and IFC, 1997d)

The Small and Medium Scale Enterprises Program (SME) is a joint program of the Global Environment Facility and the International Finance Corporation that began operation in 1995. The main goal of the SME Program is to stimulate small- and medium- scale enterprises that address two GEF themes—biodiversity and greenhouse gas reduction. An SME is defined as an entity with assets of less than US\$5 million, however most of the SMEs that are funded by the program have assets of less than US\$1 million. The design of the SME Program centers on funding that is channeled to financial intermediaries that can identify, analyze, finance, and monitor GEF-eligible SME projects. These intermediaries, who can be traditional financial institutions, non-governmental organizations, or specialized financial institutions such as venture capital funds, provide loans or equity to these enterprises, thereby assuming some of the project risk.

The pilot phase of the SME program (1995-1997) was funded through GEF at a level of US\$4.3 million and was managed by the IFC. The second phase of the SME Program has been replenished with US\$16.5 million to expand the program. In the pilot phase there were no projects funded in the APEC region, however in the second phase of the program they are anticipating 15 projects in South East Asia and 15 projects in China.

#### *Eligibility*

Financial intermediaries are selected on the basis of:

- Experience with small- and medium- scale enterprises and they must have a pipeline of GEF-eligible projects;
- Financial viability;
- Technical expertise with analyzing and structuring commercially-viable SME projects; and
- Technical expertise in evaluating environmental components of a potential project.

The financial intermediaries must in turn agree to finance SME projects that have the following characteristics:

- The project must be financially viable. This is defined as having a minimum 4% internal rate of return per year. Also, financing provided by the intermediary cannot be at a rate less than 4% per year;
- Projects must fit within the GEF program areas under biodiversity and climate change;
- Funds must be leveraged as much as possible because the SME program will not fund the entire costs of the project; and
- There must be no negative environmental impact from the project.

### *Access to funds*

Once the financial intermediaries have been selected by the IFC on the basis of the criteria outlined above, they will sign a standard loan agreement with the IFC, which will entitle them to receive a long-term low interest loan. In that agreement, there will be details concerning the use of the funds, the number of SME projects that will be financed, and the amount of funding that will be provided to the SMEs. Typically the intermediary will receive from US\$500,000 to US\$1,000,000 at an interest rate of 2.5% per year. This money will be used to provide some financing for the SME projects, but it is expected that there will also be co-financing from the SME and other sources to leverage the costs. The funding provided by the financial intermediary cannot exceed US\$250,000 per project, and the total project costs are typically less than US\$5,000,000. The financial intermediary will be reimbursed for a portion of the costs involved in project development through fees that are paid by the SME Program upon the closing of each deal. Another source of income for the financial intermediary is the possibility of retaining up to 50% of the funds loaned to or invested in eligible projects, if the loans and investments are repaid.

## Small and Medium Scale Enterprises Program (SME)

<b>Primary funding Institution</b>	International Finance Corporation and Global Environment Facility
<b>Mission</b>	Stimulate small- and medium-scale enterprises that address biodiversity and greenhouse gas reduction
<b>Year initiated</b>	Pilot phase 1995-1997, Second phase 1998
<b>Capitalization</b>	Pilot phase: US\$4.3 million, Second phase: US\$16.5 million
<b>Type of financing available</b>	➤ Long term low interest loans to the financial intermediary who in turn identifies, analyzes and finances projects
<b>Average size of financing</b>	Funding for the intermediary of US\$500,000 to US\$1 million at an interest rate of 2.5% per year. Individual project funding cannot exceed US\$250,000, and total project costs are typically less than US\$5 million
<b>Technology Focus</b>	In the climate change area: renewable energy and energy efficiency technologies
<b>Country Focus</b>	All countries that are eligible for GEF funds
<b>Types of projects</b>	Projects that address: removal of barriers for energy conservation and energy efficiency; promotion of the adoption of renewable energy technologies; and reducing the cost of low greenhouse gas-emitting technologies
<b>Who is eligible</b>	Financial intermediaries, including traditional financial institutions, non-governmental organizations, or specialized financial institutions such as venture capital funds
<b>Contact information</b>	<p><b>Name:</b> Mr. Douglas Salloum Task Manager</p> <p><b>Address:</b> International Finance Corporation, Environmental Projects Unit Environment and Technical Department 2121 Pennsylvania Street, NW Washington, DC 20433 USA</p> <p><b>Phone:</b> 1-416-690-1250</p> <p><b>Fax:</b> 1-416-690-9757</p> <p><b>E-Mail:</b> <a href="mailto:dsalloum@ifc.org">dsalloum@ifc.org</a></p> <p><b>Website:</b> <a href="http://www.ifc.org/depts/html/envIRON.htm">http://www.ifc.org/depts/html/envIRON.htm</a></p>

## Renewable Energy and Energy Efficiency Fund (IFC, 1997b)

The Renewable Energy and Energy Efficiency Fund (REEF) is a specialized fund, expected to be operational in late 1998 or early 1999 to invest in private sector projects in the renewable energy and energy efficiency sectors in emerging markets. The fund is targeted to be capitalized by the Global Environment Facility (US\$30 million), IFC, and a group of large investors (US\$210 million) which will be able to leverage projects with total costs of US\$300-800 million. REEF will consist of an equity fund with capitalization of US\$110 million and a debt facility with a loan portfolio of US\$100 million. The GEF funds are intended to be used for grants to finance incremental costs and/or mitigate risks of investing in projects that may not be acceptable to commercial investment funds because of their inadequate risk-adjusted rate of return. One of the challenges for the REEF is securing a significant amount of external funding from the project sponsor. It is planned that REEF will invest its resources over a five-year time period and will liquidate the portfolio 10-13 years after the first closing date.

The primary objective of the REEF is to generate a competitive rate of return from diversified equity and debt portfolios containing renewable energy and energy efficiency investments. REEF will never serve as the principal investor on a project, and will only invest in projects when the sponsor holds a significant financial stake. The underlying goal of the REEF is that it will catalyze further investment in these types of projects by increasing awareness about the technologies and project structures that have been proven in the market, supporting new types of projects, and developing and accessing new sources of commercial financing.

Because the IFC sees the possibility of rapid expansion of the renewable energy and energy efficiency markets in developing countries, they have targeted the REEF at on-grid and off-grid renewable energy projects and energy efficiency businesses. This will be done by making investments in:

- Grid-connected renewable energy power projects;
- Small-scale off-grid power systems that use renewable energy technologies (e.g., solar home systems, small distributed mini-grids);
- Energy service companies and individual end-users that investment in energy efficiency technologies; and
- Local manufacturing companies and financial intermediaries involved in the renewable energy and energy efficiency sector.

### *Fund allocations*

Both the debt and equity components of the REEF will invest primarily in projects with total costs less than US\$50 million. However, the equity fund will seek to allocate at least 20% of its resources to smaller projects (less than US\$5 million). In order to ensure

a balanced portfolio, the REEF guidelines specify that neither the equity fund nor the debt facility will invest more than 80% of its funds in one of the three target themes (e.g., on-grid renewables, off-grid renewables, and energy efficiency). In terms of geographic focus, the guidelines also specify that not more than 60% of the funds can go to one particular region. The regions are defined as Asia, Latin America and the Caribbean, Africa and the Middle East, and Central and Eastern Europe and the Newly Independent States.

### *Eligibility*

All countries that are eligible for GEF funds will be able to submit proposals to REEF. Detailed eligibility requirements for GEF are outlined in the GEF section, earlier in this chapter. The intended recipients of REEF financing are private sector renewable energy and energy efficiency project developers, energy service companies, independent power producers, energy end-users, and financial intermediaries.



## Renewable Energy and Energy Efficiency Fund (REEF)

<b>Primary funding Institution</b>	International Finance Corporation
<b>Mission</b>	Catalyze investment in renewable energy and energy efficiency projects by increasing awareness about the technologies and project structures that have been proven in the market, supporting new types of projects, and developing and accessing new sources of commercial financing
<b>Year initiated</b>	1998
<b>Capitalization</b>	Total US\$240 million (GEF: US\$30 million, Investors: US\$ 210 million)
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Debt and equity finance</li> <li>➤ Grants to finance incremental costs and/or mitigate risks</li> </ul>
<b>Average size of financing</b>	Generally total project costs of less than US\$50 million and 20% of the equity fund allocated for smaller projects of less than US\$ 5 million
<b>Technology Focus</b>	All renewable energy and efficiency technologies
<b>Country Focus</b>	Asia, Latin America and the Caribbean, Africa and the Middle East, Central and Eastern Europe and the Newly Independent States
<b>Types of projects</b>	On-grid renewables, off-grid renewables, and energy efficiency
<b>Who is eligible</b>	Project developers, energy service companies, independent power producers, end-users, and financial intermediaries
<b>Contact information</b>	<p><b>Name:</b> Mr. K.R. Locklin Managing Director, REEF</p> <p><b>Address:</b> Energy Investors Fund 727 15<sup>th</sup> Street, NW, 11<sup>th</sup> Floor Washington, DC 20005 USA</p> <p><b>Phone:</b> 1-202-783-4419</p> <p><b>Fax:</b> 1-202-371-5116</p> <p><b>E-Mail:</b> <a href="mailto:krlocklin@ifree.org">krlocklin@ifree.org</a></p> <p><b>Website:</b> <a href="http://www.ifc.org/depts/html/environ.htm">http://www.ifc.org/depts/html/environ.htm</a></p>

## Solar Development Corporation (IFC, 1998)

The Solar Development Corporation (SDC), an initiative being launched by the World Bank Group and a number of U.S. charitable foundations, will provide finance and business advisory services with the objective of accelerating the use of photovoltaics (PV) systems in off-grid applications in developing countries. SDC aims to overcome many of the key barriers to accelerated growth of PV in the off-grid market, including lack of medium-term funding to enable customers to repay the high initial costs of PV systems over time, lack of understanding of PV by conventional financial intermediaries, and weak capitalization of many PV companies. These obstacles will be addressed through the provision of both financing and business advisory services.

SDC will conduct two separate activities:

- Provide financing for investee companies through an Investment Fund; and
- Provide technical assistance through business advisory services.

An outside manager (called the SDC Manager) will manage the Investment Fund and administer the business advisory services grant funding. The SDC Manager and the Investment Fund together form what is referred to as the SDC. SDC has a target capitalization of US\$50 million, with up to US\$32 million devoted to the Investment Fund and up to US\$18 million allocated as grant funds for the business advisory services. The Investment Fund will invest in private sector companies involved in rural, commercially sustainable PV projects, including the distribution, sales, fee for service, or finance of solar home systems and other productive use PV systems for electricity generation. The SDC should be operational in 1999, and the pilot phase is expected to be 5 to 8 years. The target countries for the pilot phase of the SDC are China, India, Indonesia, Vietnam, Kenya, Morocco and South Africa, Brazil, Argentina, Bolivia, Mexico, Dominican Republic, and Honduras.

There are two primary functions of the SDC:

- 1) **The Investment Fund:** This part of the SDC will seek to make debt, equity, and quasi-equity investments in a wide array of PV-related businesses, including local assemblers, system integrators, distributors, retailers, energy service companies, and financial intermediaries such as banks, leasing companies, non-government organizations, and other non-bank financial intermediaries. Market information indicates that the largest financing gaps are in two areas: (i) end-users financing mechanism and credit for rural customers; and (ii) working capital for PV distributors, systems integrators, and retailers. Therefore, it is assumed that about 60% of the investment funds will take the form of loans to financial intermediaries for on-lending to end-users, and the remaining 40% will take the form of loans, equity or quasi-equity investments to PV manufacturers, integrators, and retailers. Investment size per project will likely range from US\$50,000 to US\$3 million and cofinancing with local financial intermediaries will be encouraged.

- 2) **Business Advisory Services:** The second component of the SDC will support technical assistance for potential investee companies (about 70% of the Business Advisory Services budget) and also fund more general photovoltaic awareness and capacity-building services (about 30% of the Business Advisory Services budget). Both aspects of the Business Advisory Services are needed in order to build and nurture the existing pipelines of projects while simultaneously increasing awareness of the benefits and applications of photovoltaics to further expand the markets.

## Solar Development Corporation (SDC)

<b>Primary funding Institution</b>	International Finance Corporation
<b>Mission</b>	Facilitate access to pre-commercial and parallel financing to expand channels of distribution and end-user credit for solar technologies; and provide market and business development services for photovoltaics business ventures
<b>Year initiated</b>	End of 1998
<b>Capitalization</b>	US\$50 million
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Debt and equity finance</li> <li>➤ Market and business development services to accelerate the growth of private firms and to expand the market for solar home systems and other photovoltaics applications</li> </ul>
<b>Average size of financing</b>	US\$50,000 to US\$3 million
<b>Technology Focus</b>	Photovoltaics
<b>Country Focus</b>	All World Bank and Global Environment Facility eligible developing countries
<b>Types of projects</b>	Equity investments, working capital, and funds for end-user credit, and Assistance for entrepreneurs and businesses in the preparation of business plans; training and support service to financial intermediaries and businesses; promotion of photovoltaics in target countries
<b>Who is eligible</b>	Financial intermediaries, project developers, photovoltaic businesses (e.g., assemblers, distributors, retailers, etc.)
<b>Contact information</b>	<p><b>Name:</b> Ms. Carolyn Breslin Project Officer</p> <p><b>Address:</b> International Finance Corporation 2121 Pennsylvania Avenue, NW Room Number F-9K-142 Washington, DC 20433 USA</p> <p><b>Phone:</b> 1-202-473-6905</p> <p><b>Fax:</b> 1-202-974-4349</p> <p><b>E-Mail:</b> <a href="mailto:cbreslin@ifc.org">cbreslin@ifc.org</a></p> <p><b>Website:</b> <a href="http://www.ifc.org/depts/html/envIRON.htm">http://www.ifc.org/depts/html/envIRON.htm</a></p>

## ***Regional and National Development Banks***

### Asian Development Bank-Private Sector Group

The Asian Development Bank is a multilateral development finance institution owned by its 56 member countries. Its role is to accelerate economic and social development in the Asia-Pacific Region by providing financial and technical assistance for projects that support economic development. With respect to private sector investments, the ADB helps private enterprises undertake financially viable projects and mobilize domestic and foreign private capital for their projects. To demonstrate their commitment to making this happen, the Asian Development Bank established the Private Sector Group in January 1995 to provide loans, underwriting, investment in equity securities, co-financing, investment advisory services and guarantees for the private sector.

Their assistance is geared toward:

- Establishment and expansion of financial intermediaries involved in leasing, venture capital financing, merchant banking, mutual funds, insurance, securitization, credit enhancement, and credit ratings;
- Direct financing of large infrastructure projects such as in the power, water supply, transport and telecommunications sectors including build-own-operate (BOO)/build-operate-transfer (BOT) arrangements; and
- Support for smaller business ventures in industrial, agri-business and other areas which have significant demonstrational/economic merit

The total amount of Bank assistance to a project, including loan, equity investment, guarantees and underwriting commitment, will not normally exceed 25 per cent of the total cost of the project or US\$50 million, whichever is lower. The Bank supplements financing available from local or external sources and does not wish to compete with these resources. The Bank's equity investment will not exceed 25 per cent of the share capital nor will it be the largest single investor in an enterprise.

Although not explicitly outlined by the Asian Development Bank as a priority, support for renewable energy development is consistent with their overall priorities, outlined above. However, funding in the renewable energy sector has been limited because the Asian Development Bank is more involved in financing large-scale infrastructure projects, and currently there are no dedicated programs or funds for renewable energy projects. In reference to rural energy development and how to attract the private sector, the influence of a regional organization like the Asian Development Bank could be critical in creating an enabling business environment. If the ADB's support can be channeled to financial intermediaries in the rural areas, then major strides can be made in developing the markets and capitalizing emerging enterprises.

## Asian Development Bank-Private Sector Group

<b>Primary funding Institution</b>	Asian Development Bank
<b>Mission</b>	Accelerate socio-economic development in the Asia-Pacific Region by helping private enterprises undertake financially viable projects and to catalyze domestic and foreign private investment capital
<b>Year initiated</b>	1995
<b>Capitalization</b>	Information not available
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Debt and equity</li> <li>➤ Guarantees and underwriting commitments</li> </ul>
<b>AVERAGE SIZE OF FINANCING</b>	Will not normally exceed 25 per cent of the total cost of the project or US\$50 million, whichever is lower
<b>Technology Focus</b>	No specific technology focus
<b>Country Focus</b>	Developing member countries in the Asian Development Bank
<b>Types of projects</b>	<p>Projects that support the establishment and expansion of financial intermediaries involved in leasing, venture capital financing, merchant banking, mutual funds, insurance, securitization, credit enhancement, and credit ratings;</p> <p>Projects that improve the environment for private sector investment in basic services such as power, roads, ports, water, etc.; and</p> <p>Projects that support for smaller business ventures in industrial, agri-business</p>
<b>Who is eligible</b>	Private sector enterprises in developing member countries. An enterprise jointly owned by private interests and the government may also be eligible.
<b>Contact information</b>	<p><b>Name:</b> Manager, Private Sector Group</p> <p><b>Address:</b> Asian Development Bank P.O. Box 789 0980 Manila, PHILIPPINES</p> <p><b>Phone:</b> 632-632-4444</p> <p><b>Fax:</b> 632-636-2346</p> <p><b>Website:</b> <a href="http://www.asiandevbank.org/private/private.html">http:// www.asiandevbank.org/private/private.html</a></p>

## Asian Finance and Investment Corporation Ltd. (AFIC)

<b>Primary funding Institution</b>	Asian Development Bank
<b>Mission</b>	Support for mid-sized projects and transactions that the ADB would find too small
<b>Year initiated</b>	1989
<b>Capitalization</b>	Not applicable
<b>Type of financing available</b>	➤ Underwriting, syndication, and other merchant banking services
<b>Average size of financing</b>	Not applicable
<b>Technology Focus</b>	None, support focuses on industry and manufacturing sectors
<b>Country Focus</b>	All countries eligible for Asian Development Bank funds
<b>Types of projects</b>	Smaller projects focused on support of the industry and manufacturing sectors
<b>Who is eligible</b>	Project sponsors
<b>Contact information</b>	<p><b>Name:</b> Asian Finance and Investment Corporation Ltd.</p> <p><b>Address:</b> 31/F, Citibank Tower Citibank Plaza 8741 Paseo de Roxas 1226 Makati City Metro Manila, Philippines</p> <p><b>Phone:</b> 632-817-3806</p> <p><b>Fax:</b> 632- 816-3209</p> <p><b>Website:</b> <a href="http://www.asiandevbank.org/private/afic.html">http://www.asiandevbank.org/private/afic.html</a></p>

## Development Bank of the Philippines

The Development Bank of the Philippines is a government financing institution responsible for providing medium- to long-term financing for agricultural and industrial enterprises in the Philippines. The source of the funds for development projects is from the bank's profits, and 30% is allocated for this purpose. Although the financing is only available for projects within the Philippines, it is useful to illustrate the financing mechanisms that are suited for renewable energy projects so that they might be replicated in other member economies and it will be possible to learn from their experiences.

There are three “windows” of retail lending: short- and long-term working capital loans and lending for projects that will have a catalytic effect on economic development. The latter window of retail lending, Window III, is the most relevant to renewable energy projects and is considered the centerpiece of their program. The objective of Window III financing is to support projects that will contribute to socio-economic development in the Philippines and create self-sustaining projects. This can be done by providing credit lines for working capital or medium- to long-term loans for infrastructure and capital equipment. The underlying goal is to support economically disadvantaged groups whose projects have distinct social benefits, show management competence, and financial viability. Typically these borrowers would not have access to regular credit facilities.

The Window III program is designed to provide flexible terms of credit with interest rates lower than the commercial rates. For example interest rates range from 6%-12%, depending on the project; loan terms are based on the payback period of the project; there is a grace period on repayment, depending on the project's cash flow; and collateral requirements are flexible.

These funds have been used to finance photovoltaic projects—thus far only solar home systems in the rural areas. The goal of this program is to support the government's rural electrification program in remote areas that remain unelectrified by providing loans for cooperatives, community associations or development organizations. The financing is used to set up lease-purchase arrangements for solar home systems. Terms of the loans depend on the cash payback period of the project, but typically the terms do not exceed five years and the interest rate is 15% with a 3% prompt payment rebate. The Development Bank of the Philippines will only finance the cost of the outdoor components (e.g., the solar panels) and the individual household is responsible for the indoor components (e.g., lighting, wiring, batteries, etc.). This could prove onerous to the average rural household.

The two solar home system projects funded by the Development Bank of the Philippines have had some problems in the field with repayment and sustainability. First, the equipment did not perform as promised. For example, the end-users were not satisfied because the bulbs went bad very quickly due to the low voltage of the power systems and batteries had to be replaced after 2.5 years, which was expensive. A second more fundamental problem was that the end-users stopped paying their loans on the systems



when they learned that nearby areas were able to purchase solar home systems at almost half the price under a different financial arrangement. This created ill will in the community and the opportunity for future sales was greatly diminished if not eliminated. Efforts are currently underway by the Bank to remedy this situation in some way.

### ***Private sector: Debt or Equity***

There are increasingly more and more opportunities for private investment in the APEC rural energy sector. The private sector can bring financing and technical know-how in order to help develop local capital markets and new institutional mechanisms to support the development of the rural areas. As investment and trade policies are reformed, more partnerships between foreign and domestic investors will emerge, and these reforms should lead to more commercial opportunities in the renewable energy sector. The current trend in private investment is that it is used as co-financing with other funds provided by multilateral financing institutions, governments, and others. Pure commercial investment at this point is fairly limited, but there are entrepreneurs who are leading the way in this direction, developing projects with limited or no government support. However, in the near-term the way to accelerate investment by the private sector will be through leveraging of their capital and their risk with the large multilateral funds and bilateral support. By serving as a catalyst rather than a handout, the multilateral and public sector funds will be sustained and maximized due to the profit incentive that will be instilled from the private sector partnership. In the long-term, as the renewable energy markets become well established and their commercial viability is demonstrated, the market will be driven primarily by the private sector. There are numerous financial institutions or financial intermediaries that have been instrumental in catalyzing funding, generating interest by the investment community, and bridging the gap between project developers and the investors.

#### E&Co (E&Co, 1998)

E&Co is a commercially-oriented non profit organization that is involved in supporting businesses, organizations, community groups or other entities that will finance or deliver renewable or energy efficiency technologies to provide energy services. They view the rural, decentralized areas as a viable business opportunity in the renewable energy sector that is not being tapped by the traditional investment community. E&Co seeks to address the gap that exists between access to financing and project developers who are ready to deliver the technologies. E&Co's goal is to support enterprises that create economically self-sustaining energy projects that use modern technologies, and that will produce a more equitable distribution of energy services, with special concern for people living in poverty. Their investments cover a wide range of technologies including solar, biomass, geothermal, hydropower, energy efficiency, and advanced gas turbines and have a significant track record in financing off-grid and small on-grid renewable energy projects.

Their investment in a company ranges from US\$15,000 to \$250,000, with total project costs ranging from US\$130,000 to US\$170,000,000. E&Co typically leverages their

investments with other sources to a high degree so that although their contribution can be fairly small, they can play an integral role in getting a project off the ground. Leveraging on their investment can be as low as 1.5 times (e.g., revolving loan fund) and as high as 1000 times (e.g., large geothermal project). As of 1996, E&Co had invested about 40% of their portfolio in debt finance 40% in equity positions and about 20% in grants. E&Co specifies that they invest in a project once technical and economic feasibility studies have been done, negotiations on resource supply and power purchase agreements have been completed, and the business plan and financials are in preparation. Financing and financial services from E&Co can include:

- **Small loans:** To provide early-stage funding for promising business ventures, small loans can be given to advance a project to the next stage of investment.
- **Risk capital:** E & Co may provide debt or equity financing for an emerging company that needs capital in order to catalyze investment from other sources and attract investors. Usually these funds are provided on flexible terms, however interest rates and terms are negotiated on an individual project basis.
- **Financial intermediary services:** To assist companies in identifying other funding sources, E & Co can play an important role in helping to capitalize and implement a project. They seek to mobilize resources (e.g., grants, loans, or equity) from other sources such as multilateral development banks, bilateral donors, foundations, and private sector investors interested in the renewable energy and energy efficiency sector.
- **Technical assistance:** This support for engineering services, financial analysis, strategic planning, and business plan development can be instrumental in getting the project to a point where it will have better chances of obtaining commercial financing and being implemented.

The only project thus far in the APEC region was equity finance to establish a PV manufacturing facility for solar home systems in China. However, they certainly would consider other projects in the region.

## E & Co

<b>Primary funding Institution</b>	Private foundations and multilateral institutions
<b>Mission</b>	Support enterprises that create economically self-sustaining energy projects that use modern technologies, and that will produce a more equitable distribution of energy services
<b>Year initiated</b>	1995
<b>Capitalization</b>	US\$3.5 million
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Debt and equity</li> <li>➤ Grants</li> <li>➤ Guarantees</li> </ul>
<b>Average size of financing</b>	From US\$15,000 to \$250,000, with total project costs ranging from US\$130,000 to US\$170 million
<b>Technology Focus</b>	Renewable energy and energy efficiency
<b>Country Focus</b>	No pre-determined priority countries. Projects have been done in Latin America and Caribbean region, Asia, and Africa
<b>Types of projects</b>	Early-stage funding for promising business ventures; debt or equity financing for an emerging company that needs capital in order to catalyze investment from other sources and attract investors; rural energy-community development; financial intermediary services to assist companies in identifying other funding sources; technical assistance to support engineering services, financial analysis, strategic planning, and business plan development
<b>Who is eligible</b>	Businesses, non-governmental organizations, and community organizations
<b>Contact information</b>	<p><b>Name:</b> Mr. Philip LaRocco</p> <p><b>Address:</b> Energy House 383 Franklin Street Bloomfield, NJ 07003 USA</p> <p><b>Phone:</b> 1-973-680-9100</p> <p><b>Fax:</b> 1-973-680-8066</p> <p><b>E-Mail:</b> <a href="mailto:eco@energyhouse.com">eco@energyhouse.com</a></p> <p><b>Website:</b> <a href="http://www.energyhouse.com">http://www.energyhouse.com</a></p>

## Environmental Enterprises Assistance Fund (Chaikowsky, 1998, Delphos, 1996)

Environmental Enterprises Assistance Fund (EEAF) provides equity and debt financing for small-scale renewable energy and environmentally responsible projects in developing countries. EEAF is a non-profit corporation that channels all of its earnings into new projects.

EEAF holds minority equity positions in projects, provides both senior and subordinated debt, provides venture capital funds, catalyzes additional financing and investors for projects, and provides management assistance. They can participate in higher risk, later stage investments, with a goal of leveraging funding from other sources. EEAF does not invest in publicly traded companies, but instead in entrepreneurs and smaller, start-up companies. The time horizon for investments is seven to eight years. The rate of return expected for an equity investment is 20% whereas a debt position requires a 9% return. They have invested in 25 small projects, including 10 in the renewable energy/energy efficiency sector, and it currently has US\$15 million under management. Financial packages from EEAF range in size from US\$100,000 to US\$1,000,000, although the fund may co-finance larger projects.

EEAF is interested in investing in environmentally responsible projects and building in-country capital markets through investments in the following industries:

- Renewable energy
- Energy efficiency
- Sustainable agriculture, forestry, and aquaculture
- Ecotourism
- Recycling
- Pollution abatement

In the APEC region, EEAF has been active in the Philippines and Indonesia, but currently their level of activity has been reduced due to the financial turmoil in the region. Projects that they have funded in the region include: assembly and sale of household photovoltaic products, air pollution monitoring, water pollution control, and new uses of crop wastes.

## Environmental Enterprises Assistance Fund (EEAF)

<b>Primary funding Institution</b>	Multilateral institutions, commercial banks, and individual investors
<b>Mission</b>	Reverse and prevent environmental damage by using venture capital financing and entrepreneurial assistance to increase developing countries' capacity to build an environmentally sustainable private sector and to create environmental investment funds
<b>Year initiated</b>	1990
<b>Capitalization</b>	US\$15 million
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Equity</li> <li>➤ Senior and subordinated debt</li> </ul>
<b>Average size of financing</b>	US\$100,000 to US\$1,000,000
<b>Technology Focus</b>	Renewable energy; energy efficiency; sustainable agriculture, forestry, and aquaculture; ecotourism; recycling; and pollution prevention
<b>Country Focus</b>	Developing countries only. Projects in Central America, Indonesia, Philippines, India, Mexico, and Brazil
<b>Types of projects</b>	Provides venture capital financing for emerging sustainable environmental businesses, catalyzes additional financing and investors for projects, and provides training, technical assistance, and management assistance
<b>Who is eligible</b>	Small and medium-sized business enterprises
<b>Contact information</b>	<p><b>Name:</b> Mr. Brooks Browne President</p> <p><b>Address:</b> 1901 North Moore Street Suite 1004 Arlington, VA 22209 USA</p> <p><b>Phone:</b> 1-703-522-5928</p> <p><b>Fax:</b> 1-703-522-6450</p> <p><b>E-Mail:</b> <a href="mailto:eeaf@igc.apc.org">eeaf@igc.apc.org</a></p> <p><b>Website:</b> <a href="http://www.eeaf.org">http://www.eeaf.org</a></p>

## Triodos Bank (Triodos Bank, 1998)

Innovative work has been done at Triodos Bank to demonstrate that investments that are good for the environment and are socially responsible can be both prudent and profitable. The main purpose of the work at Triodos Bank is financing projects and businesses that have social, environmental, and cultural objectives, including renewable energy, organic agriculture, arts and culture, protection of the environment, and conservation of natural resources. They are a full service commercial bank as well as offering fund management and insurance brokerage. In addition to banking services, Triodos Bank provides management for specialized funds that meet their specific objectives. These specialized funds include: green investment funds, North-South funds, poverty alleviation funds, and an ethical equity investment fund.

Of primary importance to the APEC region for the support of renewable energy projects are the following foundations of the Triodos Bank group: Stichting Triodos-Doen, Stichting Hivos-Triodos Fonds, and Stichting Solar Investment Fund.

### *Stichting Triodos-Doen:*

This fund invests in businesses and institutions that are not eligible for traditional financing, but have strong growth potential. The portfolio is comprised of 76 investments in loans, guarantees, and equity. Financing is considered in two priority areas:

- Nature and environment: Projects related to renewable energy, organic agriculture, recycling and waste processing, and conservation.
- Third world cooperation: Projects focusing on promotion of economic independence, financial intermediaries involved in providing credit for small and medium-sized enterprises (e.g., micro-credit), fair trade in products, and manufacturing facilities or cooperatives.

Applying for financing through the Triodos Doen Foundation is relatively simple and straightforward. A two-page application outlining the project and how it meets the goals of the fund must be filled out. After an initial positive assessment, a full due-diligence will be done

## Stichting Triodos-Doen

<b>Primary funding Institution</b>	Triodos Bank and Doen Foundation
<b>Mission</b>	Provide finance to businesses and institutions with social added-value which are not eligible for subsidies and fall outside the criteria for a regular bank loan
<b>Year initiated</b>	1994
<b>Capitalization</b>	US\$14.4 million
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Equity</li> <li>➤ Debt</li> <li>➤ Guarantees</li> </ul>
<b>Average size of financing</b>	US\$100,000 to US\$500,000
<b>Technology Focus</b>	Renewable energy, organic agriculture, recycling and waste processing, conservation,
<b>Country Focus</b>	Developing countries, Eastern Europe, and the Netherlands
<b>Types of projects</b>	Projects related to: protection of nature and environment (e.g., renewable energy, organic agriculture, recycling and waste processing, and conservation); support of developing countries' economic independence, financial intermediaries involved in micro-credit, Fair Trade projects, and manufacturing facilities or cooperatives.
<b>Who is eligible</b>	Small and medium-sized businesses, financial institutions, and non-governmental organizations
<b>Contact information</b>	<p><b>Name:</b> Mrs. Marilou van Golstein Brouwers Manager, Triodos-Doen Foundation</p> <p><b>Address:</b> Triodos Bank NV P.O. Box 55 3700 AB Zeist The Netherlands</p> <p><b>Phone:</b> 31-30-693-6500</p> <p><b>Fax:</b> 31-30-693-6566</p> <p><b>E-Mail:</b> <a href="mailto:marilou@triodos.nl">marilou@triodos.nl</a></p> <p><b>Website:</b> <a href="http://www.triodos.com/">http://www.triodos.com/</a></p>

*Stichting Hivos-Triodos Fonds:*

Founded by a Dutch donor organization (Hivos) and Triodos Bank, Stichting Hivos-Triodos Fonds provides loans, guarantees, and equity for partner organizations in the South, focusing on Africa, Asia and Latin America. The goal in setting up this fund was to match Triodos' banking skills with Hivos' development experience to reach out to organizations and enterprises that have no access locally to credit but which can show that they have reasonable business practices.

The fund's resources take the form of a credit facility made available by Triodos Bank and maintained by deposits and interest on the account. This fund seeks to participate with local financial institutions in order to support and expand local credit institutions, especially micro-credit facilities. Stichting Hivos-Triodos Fonds also tries to lend in local currency in order to help alleviate problems for the local financial institution with currency risk. In 1997 the fund was capitalized at US\$4.8 million to finance over 40 projects in developing countries, focusing on micro-credit (65% of the portfolio), fair trade (33% of the portfolio), and other projects (2% of the portfolio).

Applications for the Fund are prepared and submitted locally and the loan, guarantee, or equity investment will be provided and administered by Triodos Bank. Both Hivos and Triodos play an active role in appraisal of the applications, project monitoring, and providing investment advice.



## Stichting Hivos-Triodos Fonds

<b>Primary funding Institution</b>	Hivos, a development organization and Triodos Bank
<b>Mission</b>	Provide financing to enterprises in the South by participating with local financing institutions in order to support and expand local micro-credit institutions, fair trade businesses and environmental projects.
<b>Year initiated</b>	1995
<b>Capitalization</b>	US\$4.8 million
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Equity</li> <li>➤ Debt</li> <li>➤ Guarantees</li> </ul>
<b>Average size of financing</b>	US\$100,000 to US\$300,000
<b>Technology Focus</b>	No specific technology focus
<b>Country Focus</b>	Developing countries in Africa, Asia, and Latin America
<b>Types of projects</b>	Projects which focus on micro-credit, fair trade, organic agriculture, nature, and renewable energy
<b>Who is eligible</b>	Small businesses, cooperatives, and credit institutions in the South and Dutch and European organizations that support development in the South
<b>Contact information</b>	<p><b>Name:</b> Mrs. Marilou van Golstein Brouwers Manager, Hivos-Triodos Foundation Fund</p> <p><b>Address:</b> Triodos Bank NV P.O. Box 55 3700 AB Zeist The Netherlands</p> <p><b>Phone:</b> 31-30-693-6500</p> <p><b>Fax:</b> 31-30-693-6566</p> <p><b>E-Mail:</b> <a href="mailto:marilou@triodos.nl">marilou@triodos.nl</a></p> <p><b>Website:</b> <a href="http://www.triodos.com/">http://www.triodos.com/</a></p>

*Stichting Solar Investment Fund:*

Focused on solar energy for rural households and small businesses in developing countries, the Stichting Solar Investment Fund was launched in 1997 with support of the Dutch Ministry of Foreign Affairs. The Solar Investment Fund's objective is to provide finance to local financial intermediary organizations (e.g., credit organizations, cooperatives, non-governmental organizations, or entrepreneurs in the photovoltaics business) to enable them to capitalize a solar home system business and then offer the units to consumers for example in a "hire purchase" or "fee for service" scheme. As of 1997 the fund was capitalized with US\$4 million, and had its first investments disbursed in the beginning of 1998.

The hire purchase scheme means that the end-users pay a regular monthly installment that covers rent and interest for a solar home system. At the end of the financing period, the end-user owns the system. Usually the down payment is 20-30% of the system cost and payment schedule is tailored to the end-users' income stream. If there is default on the payment, the system is repossessed by the financial intermediary. The financial intermediary pays back the loan to the Stichting Solar Investment Fund based on rent and interest received from the end-user. The intermediary is responsible for all aspects of the project implementation including transport, installation, service, training, administration, marketing, and monitoring. However it is up to the intermediary to decide if they want to subcontract for that aspect of the project or do it themselves.

Some key criteria for eligible projects by the Stichting Solar Investment Fund are:

- The project should be located in areas where the grid will not be in place for at least 10 years and in areas that are accessible for sales and service;
- The financial intermediary must be directly involved and responsible for the project; and
- End-users have to prove that they have sufficient sources of income and credit worthiness and be able to pay off the system in three years.

## Stichting Solar Investment Fund

<b>Primary funding Institution</b>	Dutch government, Utility, and a private foundation
<b>Mission</b>	Support local financial intermediary organizations (e.g., credit organizations, cooperatives, non-governmental organizations, or entrepreneurs in the solar business) to enable them to capitalize a solar home system business and to provide end-user finance for solar home systems
<b>Year initiated</b>	1997
<b>Capitalization</b>	US\$4 million
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Loans</li> <li>➤ Guarantees</li> <li>➤ Equity</li> </ul>
<b>Average size of financing</b>	US\$100,000 to US\$1 million
<b>Technology Focus</b>	Photovoltaics-solar home systems
<b>Country Focus</b>	Developing countries throughout the world. Investments being arranged in Sri Lanka and Bolivia
<b>Types of projects</b>	Projects involving the development and implementation of end-user credit schemes or fee for service schemes for solar home systems and the initiation of revolving loan funds
<b>Who is eligible</b>	Local financial intermediaries including credit institutions, cooperatives, non-governmental institutions, and solar home system businesses
<b>Contact information</b>	<p><b>Name:</b> Mr. Hans Schut Manager, Solar Investment Fund</p> <p><b>Address:</b> Triodos Bank NV P.O. Box 55 3700 AB Zeist The Netherlands</p> <p><b>Phone:</b> 31-30-6936500</p> <p><b>Fax:</b> 31-30-6936566</p> <p><b>Email:</b> <a href="mailto:hansschut@triodos.nl">hansschut@triodos.nl</a></p> <p><b>Website:</b> <a href="http://www.triodos.com/">http://www.triodos.com/</a></p>

### Solar Bank Project (M. Eckhart, Solar Bank, personal communication)

A new financial instrument that has the potential for attracting large amounts of capital to the photovoltaic markets, the Solar Bank Project, is being developed to bridge the gap between end-user financing and the large market for solar systems. Seeing the need for a mechanism to direct sources of capital (e.g., insurance companies, pension funds, and others) to the smaller end-use financing for photovoltaic projects, the Solar Bank aims to standardize loans for solar projects to facilitate the access to capital in developing countries. The Solar Bank will be a private financial institution that will be a secondary lender to existing in-country financial institutions such as banks, cooperatives, credit unions, electric utilities, energy service companies, micro-credit enterprises, and others that are positioned to finance local photovoltaic markets. The underlying goal is to create a new mechanism that will provide capital to the photovoltaic end-use markets at the lowest possible cost that is consistent with current lending and investment practices. End-user loans could range from US\$500 for a solar home system to US\$100,000 for larger community-based systems.

Two types of lending programs are envisioned for the Solar Bank Project:

- Secondary Lending: Solar Bank will be a secondary lender to existing financial institutions that will then on-lend to end-users for the purchase of solar systems.
- Project Financing: Solar Bank will participate in financing the implementation of photovoltaic projects by energy service companies, electrification programs. Photovoltaic project developers, and utilities.

There will be three components to the Solar Bank Project. A non-profit branch will focus on efforts to define opportunities and develop the appropriate financing mechanism. This will be funded out through grants, donors, and other contributions. The second component will involve in-country affiliates of the Solar Bank (e.g., SolarBank of India and SolarBank of South Africa) that will be in charge of on-lending funds to existing lending institutions (e.g., financial intermediaries) in the country. These SolarBank affiliates will be efficient, small operations that manage the flow of wholesale capital and can tailor loans to retail lenders. These retail lenders, or intermediaries, will provide affordable credit and financing to the end-user. The third part of the Solar Bank is a for-profit capital management firm, SolarBank International. Its main objective will be to raise capital from large institutional investors. Initially, it is envisioned that these investors will be pension funds, insurance companies, and others that are interested in environmentally and socially responsible investing.

At this stage, the concept for the Solar Bank is being refined and they are in the process of raising capital to support the initiative. The amount of capital to be raised is measured in terms of the amount of capital that will be deployed each year, perhaps US\$5 million for the first year, US\$20 million the second year, and US\$50 million the third year. For the initial phase the Solar Bank Project has targeted the countries of India and South Africa, but they have plans to expand to Latin America and possibly the APEC region.

## Solar Bank

<b>Primary funding Institution</b>	Funds being sought from pension funds, insurance companies, investment banks, commercial banks, governments, foundations, bilateral aid agencies, and multilateral institutions
<b>Mission</b>	Create a new mechanism will provide capital to the photovoltaic end-use markets at the lowest possible cost that is consistent with current lending and investment practices and ultimately providing affordable credit and financing to the end-user
<b>Year initiated</b>	1998
<b>Capitalization</b>	Not available
<b>Type of financing available</b>	<ul style="list-style-type: none"> <li>➤ Debt</li> <li>➤ Guarantees</li> </ul>
<b>Average size of financing</b>	End-user financing on the order of US\$10 per month
<b>Technology Focus</b>	Photovoltaics
<b>Country Focus</b>	Initial focus on India and South Africa with goal to expand to Latin America and possibly the APEC region
<b>Types of projects</b>	Secondary lending to existing financial institutions that will then on-lend to end-users for the purchase of solar systems; and project financing for the implementation of photovoltaic projects by energy service companies, electrification programs, photovoltaic project developers, and utilities
<b>Who is eligible</b>	In-country financial institutions such as banks, cooperatives, credit unions, electric utilities, energy service companies, micro-credit enterprises, and others that are positioned to finance local photovoltaic markets
<b>Contact information</b>	<p><b>Name:</b> Mr. Michael T. Eckhart Managing Director</p> <p><b>Address:</b> Solar Bank Development Fund 1828 L Street, NW Suite 1000 Washington, DC 20036 USA</p> <p><b>Phone:</b> 1-202-463-8451</p> <p><b>Fax:</b> 1-202-293-4598</p> <p><b>E-Mail:</b> <a href="mailto:solarbank@ati.org">solarbank@ati.org</a></p>

### Solar Century Initiative (Solar Century, 1998)

The Solar Century Initiative, officially launched in June 1997, aims to attract private capital to invest in renewable energy in industrialized and developing countries. It will work as a broker between solar investment project proposals and investors. Part of this brokerage fee will go to a Solar Century Global Community Fund, a revolving fund for investment assistance for those most in need, especially in the developing world. Their overall goal is to accelerate the growth of the market for solar by promoting the increase in supply of solar products (by building volume prices will come down) and by fostering the demand pull in new markets for solar products. Although still being established, the Solar Century Initiative will focus on three areas:

- **Establish a Solar Century Buyers Club:** This will be a way for a buyer of a solar product to choose a product supplier that has agreed to give a portion of their fee (e.g., a commission) to the Solar Century. The consumer will be recognized as a purchaser of an energy system that is good for the environment and the product supplier will be recognized for their contribution to furthering the use of solar products. The commission goes to pay for administration of the Solar Century and to fund the Solar Century Global Community Fund.
  
- **Develop the Solar Century Global Community Fund:** This will be a non-profit revolving fund that is financed by the fees paid by product suppliers to the Buyers Club (see bullet above). The concept is to provide micro-credit and other investments to provide financing to end-users and product suppliers in developing countries. All interest will be channeled back into the fund except for administration and marketing costs.
  
- **Establish the Solar Century Investors Club:** Designed as an investment forum to facilitate flow of capital into solar companies, the Solar Century Investors Club will build international solar markets by linking the financial community with project developers and manufacturers. The club will serve to introduce promising businesses that are seeking capital to potential investors through an investment forum. At the investment forum the project is presented to the investors for their consideration. After this introduction the investor will do their own due diligence, and if an investment is made, a brokerage fee will be paid to the Solar Century. Since this has begun, they have had one private placement and they hope to broaden their investment scope from venture capital to public offerings.

## Solar Century

<b>Primary funding Institution</b>	Large institutional investors such as insurance companies, reinsurance companies, investment banks, electric utilities, and governments
<b>Mission</b>	Attract private capital to invest in renewable energy in industrialized and developing countries by accelerating the growth of the market for solar by promoting the increase in supply of solar products (by building volume prices will come down) and by fostering the demand-pull in new markets for solar products
<b>Year initiated</b>	1997
<b>Capitalization</b>	Information not available
<b>Type of financing available</b>	➤ Loans through their Solar Century Global Community Fund revolving fund for developing countries
<b>Average size of financing</b>	Information not available
<b>Technology Focus</b>	Photovoltaics
<b>Country Focus</b>	No specific focus.
<b>Types of projects</b>	A consumer alliance or “buyers club” to catalyze the global market for photovoltaics; establishment of a non-profit revolving fund to provide micro-credit and other investments for financing for end-users and product suppliers in developing countries; and hosting of investment forums to bring together potential investors with emerging photovoltaics businesses.
<b>Who is eligible</b>	Photovoltaic business enterprises and businesses, organizations and institutions interested in investing in or installing photovoltaic products
<b>Contact information</b>	<p><b>Name:</b> Dr. Jeremy Leggett</p> <p><b>Address:</b> 32 St. Bernards Road Oxford OX2 6EH UNITED KINGDOM</p> <p><b>Phone:</b> 44-1865-513534</p> <p><b>Fax:</b> 44-1865-316127</p> <p><b>E-Mail:</b> <a href="mailto:jl@solarcentury.co.uk">jl@solarcentury.co.uk</a></p> <p><b>Website:</b> <a href="http://www.solarcentury.co.uk/">http://www.solarcentury.co.uk/</a></p>

SunLight Power International Holdings, Inc. (SunLight Power, 1998 and W. Rodenhiser, personal communication)

Seeing a large market opportunity in the “fee for service” (i.e., leasing) model for delivery and financing of energy services, SunLight Power International Holdings was established in 1997. The concept is to bring affordable pricing and service for the use of solar systems. SunLight Power offers fee-for-service, cash and credit payment plans for packaged solar systems and follow-up services to homes, schools, health clinics, shops religious institutions and other community centers in unelectrified regions of developing countries. Their services include delivery, installation, customer education, and follow-up maintenance.

Their goal is to create in-country operating companies by investing in local entrepreneurs who will act as a fee for service company and in turn Sunlight Power will hold an equity stake in each in-country business. To ensure uniformity and consistency in the in-country operations, Sunlight Power will provide support for start-up of the companies, including assistance with management, training, procurement of equipment, and attracting additional capital. Sunlight Power’s strategy is to infuse a large amount of capital into the rural areas and specifically their plans call for expanding to a level of 750,000 customers, 75 regional service centers in five countries in the Asia, Africa, and Latin America regions in seven years. Currently they are raising capital from institutional investors to support their efforts and two large companies, Swiss Reinsurance and GAIA Kapital have invested a total of US\$4.75 million in Sunlight Power International Holdings.

Sunlight Power’s first operating company, Sunlight Power Maroc, was established in Morocco in May 1998 with an initial capitalization of US\$1 million. In addition to its operating company interests, Sunlight Power has recently placed a US\$500,000 equity investment in Soluz Dominicana, a solar energy services company based in the Dominican Republic and US\$250,000 in Soluz Honduras. The fee-for-service business model that SunLight Power is using is based on the experience of SOLUZ, which has been developing and implementing a fee for service model for solar-based rural electrification and which has been successful in demonstrating that this model is important in addressing the affordability and market penetration issues for rural energy markets. For a more detailed discussion of SOLUZ’s operation, see the case study at the end of Chapter 3. SunLight Power’s investment will help expand the operations of Soluz Dominicana and Soluz Honduras to meet the growing demand for their systems in rural areas and to prove the viability and profitability of a larger fee for service operation.



## SunLight Power International Holdings, Inc.

<b>Primary funding Institution</b>	Institutional investors, such as insurance companies and venture capital firms
<b>Mission</b>	Provide affordable, high-quality, and profitable solar electric services to unelectrified populations world-wide
<b>Year initiated</b>	1997
<b>Capitalization</b>	US\$4.75 million in equity capital raised and seeking an additional US\$5-7 million in equity and US\$10 million in debt finance
<b>Type of financing available</b>	➤ Equity and debt
<b>Average size of financing</b>	Financing for in-country operating companies ranges from US\$500,00 to US\$1 million. End-user fees for energy services are US\$10-20 per month, administered by the operating company
<b>Technology Focus</b>	Photovoltaics-solar home systems
<b>Country Focus</b>	Initial focus on Dominican Republic, Honduras, and Morocco, but expecting to establish operating companies in four other countries, possibly in the APEC region
<b>Types of projects</b>	Creation of in-country operating companies that sell prepackaged solar systems for cash and credit, but the market focus is to offer a "fee-for-service" (or leasing) option for delivery of solar products and energy services
<b>Who is eligible</b>	In-country local entrepreneurs that are interested in establishing new business enterprises using the SunLight Power fee for service model.
<b>Contact information</b>	<p><b>Name:</b> Mr. Jeffrey A. Serfass President</p> <p><b>Address:</b> 1800 M Street, NW Suite 300 Washington, DC 20036-5802 USA</p> <p><b>Phone:</b> 1-202-293-6238</p> <p><b>Fax:</b> 1-202-223-5537</p> <p><b>E-Mail:</b> <a href="mailto:sunlight@ttcorp.com">sunlight@ttcorp.com</a></p> <p><b>Website:</b> <a href="http://www.ttcorp.com/sunlight/Index.html">http://www.ttcorp.com/sunlight/Index.html</a></p>

Although Grameen Shakti is not a program that can provide financing for APEC member economies, it serves to illustrate the innovative approach to micro-credit that has been developed by Grameen Shakti to provide affordable energy services to people living in rural areas (Box 4-1). The approach of linking Grameen Shakti with an established intermediary such as Grameen Bank for the distribution and financing of renewable energy systems could be replicated in the APEC member economies.

**Box 4-1**

**Making micro-credit work in rural areas**

Grameen Shakti is a non-profit affiliate of Grameen Bank that was established in 1996 to promote and supply renewable energy systems to rural households in Bangladesh. The Grameen Bank is one of the world's best examples of how to deliver credit to the people living in poverty in rural areas, and the Grameen family of financing now includes telecommunication and energy. Grameen Shakti is a private company funded by the Grameen Fund (a venture capital fund), donor agencies, and multilateral funding sources.

Grameen Shakti has established five operating divisions in different regions of the country, along with rural offices to sell pre-designed photovoltaic packages on both a cash and credit basis. Their plan is to first target sales for people who can afford the systems under the initial financing plans, and then broaden the reach of the program to other areas and other types of consumers. The goal of the initial effort is to sell 5400 solar systems in the first three years of operation, and gradually to expand the operation to include local manufacturing of the components.

Customers who wish to buy solar home systems from Grameen Shakti are eligible for two years credit at 8% interest and a 25% down payment. The typical sizes of the loans are US\$300-500. Grameen Shakti can usually work within the social network of the surrounding community to ensure repayment. To date, there have been no problems with defaults on the loan repayment. However, in order to encourage customers to pay cash up-front for the systems, they offer a discount of 1-3% on the total price of the system for a cash purchase.

In addition to solar, the Grameen Shakti will make financing available for small wind turbines (1.5-10 kW) used to set up micro-enterprise zones and sell power to a group of entrepreneurs and bio-digesters and equipment for briquette production in rural areas.

**Contact information:**

Mr. Dipal Chandra Barua  
Grameen Shakti  
Grameen Bank Complex  
Mirpur Two, Dhaka-1216  
Bangladesh

**Phone:** 880-2-801222 or 880-2-9005257 through 69  
**Fax:** 880-2-803559  
**Email:** g\_admin@citechco.net  
**Website :** <http://www.grameenfoundation.com/shakti.com>

## *Government bilateral support*

Various governments can provide support to local governments for renewable energy development. Although this is a way to infuse capital into the renewable energy sector, care should be taken to avoid market distortions and difficulties in sustaining the projects. Typically a government will allocate money to an in-country regional agency that is responsible for procuring renewable energy systems. Rather than donor-aid projects, which will undermine any private sector activity, most programs are now including cost recovery and cost-sharing in their project design. This includes mechanisms whereby the bulk of cost of equipment is borne by the end-user by setting up a financing mechanism that includes service, maintenance, and administration. In order to make the program financially viable and sustainable, usually a down payment on the system is required along with monthly charges that will lead eventually to ownership of the system.

There are many bilateral programs to support the dissemination of renewable energy systems. For example, the Government of Australia (AUSAID) has provided soft loans to Indonesia for the manufacture, supply, installation, commissioning, and warranty maintenance of 36,400 solar home systems that will be installed in nine provinces within East Indonesia. The Dutch government has co-financed a project with a loan from the Development Bank of the Philippines to provide 200 solar home systems to residents of a remote village in the Philippines through a local cooperative. The German Agency for Technical Cooperation (GTZ) as well as the US Agency for International Development (USAID) have also been actively involved in renewable energy projects in developing countries. One example of how these bilateral programs can work against the overall objective of private sector investment has been demonstrated in the Philippines. There the Philippines Department of Energy along with the CDA (Cooperative Development Authority), the Development Bank of the Philippines, the Philips company and Shell Solar are planning to install 15,000 SHS in Northern Luzon. Under this project, beneficiaries would enjoy a 60% subsidy on the imported hardware costs of their system that is paid for by the Dutch government. Understandably, private sector developers have raised concerns regarding the practice of extending subsidies to the level of the end-user because it will directly undermine private sector activities and eventually destroy the market for solar home systems.

Norway has also been very involved in bilateral aid programs in developing countries. For example, they have one fund that is dedicated to assistance to Asia, The Special Grant for Expanded Environmental Cooperation (Norwegian Ministry of Foreign Affairs, 1998). This fund supports environmental cooperation in solving environmental problems of a regional and global nature, including climate change, biological diversity, regional air pollution, reduced effluent discharges into the sea, etc. Funds can be used for the implementation of environmental measures, research, resource mapping, technology transfer and management, through government authorities, the business sector and private organizations. The grant can also be used for feasibility studies, infrastructure investments and training support in connection with investment projects. Specifically, the efficient use of energy resources and sustainable energy are emphasized in this

program. The grant can be combined/co-financed with other development assistance allocations or funds from multilateral channels. In fact, the underlying objective is to combine the grant with international funding mechanisms and/or private sector financing. This will ensure that the development aid funding will pave the way for subsequent cooperation on a commercial basis.

## **Chapter 5 CREATING A BUSINESS ENABLING ENVIRONMENT**

Private sector financing of Asian energy projects has typically been focused on generation rather than distribution (World Bank, 1996). Until the private sector feels that reasonable returns are possible from offering energy services to new areas, this situation is unlikely to change. To increase the profit potential for private rural electrification efforts, governments can implement reforms that will improve the business environment. These reforms can, at the very least, “level the playing field” for a variety of energy choices or, proactively, promote adoption of renewable energy technologies. The underlying premise behind these policy reforms is that energy choice is best decided by a free market.

### ***Reforming energy subsidies***

Government policies regarding energy production and consumption currently tend to steer markets along conventional supply paths and to form market barriers to the introduction of renewable energy technologies. The problem goes beyond the fact that energy prices do not incorporate the costs of environmental, social and health impacts associated with different energy sources. In many cases, governments provide direct or indirect subsidies which encourage fossil fuel production and consumption and discourage alternative energy choices.

Since access to electricity is critical for economic and social development, ensuring the provision of sufficient electricity for expanding residential and industrial use has come to be viewed as a key responsibility of governments. Lack of energy services limits employment and educational opportunities, as well as access to health care, clean water and sanitation. Reform of energy subsidies which distort market choices, combined with energy pricing which incorporates the full social and environmental costs of various technologies, could help create a level playing field on which all potential energy options could be judged on their merits. It could also reduce the substantial financial burdens borne by taxpayers and governments in developing countries that support under-priced electricity services or over-priced energy production.

#### Extent of subsidies in Asia

Most countries have subsidized energy to some extent in order to extend electricity service into remote areas, to hold down costs for consumers, to promote industrial development and to encourage domestic production for trade and security reasons. Because existing energy subsidies provide benefits to a wide range of economic and social groups within a country, however, there may be considerable political resistance to their removal. Some governments fear that sudden removal of electricity subsidies will trigger public uprisings and political instability. Yet, in most situations, the original

policy goals behind the government intervention can be met more efficiently with other, more targeted measures.

World Bank researchers found that in the early 1990s fossil fuel subsidy rates for developing countries in Asia were as high as 33%, estimated as a proportion of the unsubsidized price for fossil fuels (World Bank, 1997b). Even higher rates applied in Eastern Europe, Russia and among the oil producing countries. In the period 1990–1991, these fossil fuel subsidies amounted to almost US\$30 billion in Asia’s developing countries, over half for coal and the rest for petroleum (World Bank, 1997b). Since then, energy subsidies have declined due to a combination of fiscal constraints, pressures towards privatization and market liberalization. By 1995–1996, total fossil fuel subsidies in the Asian developing countries fell to less than US\$15 billion, almost all them for coal. Yet fossil fuel subsidies are still a source of market distortions in many countries, significantly affecting investment choices by electricity suppliers and consumers.

Energy subsidies can take a variety of forms. The most obvious are direct government payments to hold down consumer prices or to decrease production costs for energy suppliers. But there are other types of government intervention with similar effects. These measures include: tax credits and exemptions; government equity investments, preferential loans and guarantees; monopoly protections; price regulation; tariffs and import quotas; and domestic procurement preferences.

#### Direct Subsidies

Direct government subsidies affect not only the amount of energy used, but also the choices available among possible energy sources. Policies curtailing energy choices have greater impacts on environmental quality than those only affecting the volume of energy consumed. Current policies overwhelmingly support the use of fossil fuels, especially coal. Removal of existing energy subsidies supporting the use of fossil fuels can lead to changes in investment patterns which will promote the adoption of cleaner energy technologies such as renewables and allow developing member economies to exploit the unrealized energy potential available from renewable energy sources.

#### Indirect subsidies

Energy price controls have been a common form of consumer subsidy in many developing member economies. These can effectively operate as a tax on the energy producer, limiting its ability to reinvest funds for improved or extended services. Price controls can also deter potentially competitive market entrants. In many cases, price controls have also been combined with the establishment of national monopolies for electricity supply, thereby ensuring that there is no consumer choice among energy suppliers. Privatization and increased competition can provide much-needed resources for developing clean energy sources where such investments are beyond the means of financially strained governments.

The benefits of tax policies accruing to energy producers or consumers generally are

harder to identify than those of direct subsidy payments. There is no easy way to determine what would be a “correct” tax rate in a particular situation. Nevertheless, differences in the relative rates of taxation on sales on different types of equipment can have a steering effect regarding technology choices. Similarly, tax credits, exemptions and rebates for producers or purchasers of particular goods can have the same effects as cash subsidies.

The availability and cost of capital is another area of government intervention in the energy sector. In the past, governments have been the primary source of funding for energy infrastructure. Capital market reforms will be needed to allow competitive private financing of renewable energy projects. It is very difficult to attract private sector capital investments for energy production in a government-controlled context, especially when private competitors have to pay significantly more to raise investment capital. In many areas, public financing of utilities through tax exempt bonds and low interest loans has led to over-investment in large-scale coal-fired power plants which have high capital costs.

#### How subsidies can work

Reform of subsidies does not always require their removal entirely. Government policies can be redirected to discourage energy practices that create environmental and social harms and to promote environment-friendly technologies for development. In some cases, different subsidies can meet the original policy aims of governmental intervention with reduced environmental costs and increased market competitiveness.

In order to provide more specifically targeted assistance, some developing countries have begun offering special “lifeline rates” for electricity service to poorer households. These rates provide steep discounts for small amounts of electrical usage, so that poorer consumers can afford at least a minimal amount of daily service. These low rates for very small consumers may be subsidized directly by the government or paid for through increased costs to other, wealthier, consumers. Through measures such as this, governments can help those who really need it, while reducing countrywide subsidies and discouraging wasteful use of cheap electricity by consumers who can actually afford to pay market rates.

Almost all countries providing universal electricity service have used some form of public support. In some cases, government-mandated actions by utilities to promote rural electrification have been financed through overall rate increases. This creates a cross-subsidization situation where urban consumers help pay utilities for the costs of rural expansion.

Government-mandated rural electrification programs, combined with support for capital-intensive power plants, have encouraged grid extensions in situations where it would be less expensive and more efficient to install stand-alone remote systems using solar or wind-powered technologies. Rural electrification subsidies could be applied more effectively, and with better social and environmental results, if they supported

competitive suppliers of these renewable energy systems and other small-scale initiatives instead of perpetuating the primacy of the central power plant model. Existing utilities could even be required to purchase energy from small producers using renewable technologies, thereby creating market opportunities for local entrepreneurs and helping to build an infrastructure for renewable energy systems.

In some cases, temporary investment subsidies for renewable energy technologies may be called for in order to break the momentum toward continuing preferences for energy systems powered by fossil fuels. Tax incentives, investment grants, consumer rebates or government purchasing programs could support the development and use of innovative technologies. Subsidies designed to overcome market barriers that impede the commercialization, financing and distribution of renewable energy technologies could actually make markets work more efficiently. Over time, these transitional subsidies could be reduced as competitive market opportunities for renewables expanded.

### ***Reduction of import duties***

Governmental trade policies specifying import duties have been a serious impediment to the adoption of renewable energy technologies in emerging economies. Import duties have been used to restrict the flow of goods into a member economy in order to protect a local industry. Such duties raise the price of imported goods for the purpose of giving domestic goods a relative price advantage. However, in many emerging economies, needed equipment is not manufactured locally and therefore would not be available without importing it. As sufficient market penetration occurs and the size of the markets increase, local manufacturing will take over. In some cases, duties favor goods from a particular country, giving it unfair trade advantages over competing companies from other countries. Because duties serve as a source of governmental revenue, they are difficult to remove.

Renewable energy systems have relatively high capital costs, and import duties are typically assessed on the capital costs. Whereas conventional power systems have low capital costs relative to their fuel costs, renewable energy systems have higher capital costs but no fuel costs. Since taxes are not usually charged on fuel, the duties for capital cost on conventional power systems are therefore less significant than for renewable energy equipment, and those duties can make renewable energy equipment too expensive. In addition large power infrastructure projects are sometimes granted waivers on all import duties, making the case for renewable energy even more difficult. Duty rates for imported renewable energy equipment can be up to 40%, seriously impacting the economics of projects. However, more and more member economies are beginning to enact special programs or policies that involve relaxing duties on imported renewable energy equipment because of the increased importance being placed on protection of the environment and sustainable energy development.



deLucia and IFREE (1996) points out that in order to understand renewable energy duties it is necessary to consider:

- How renewable energy technologies fit into the existing duty structure;
- How individual components are taxed;
- Whether there are special incentives for renewable energy imports; and
- How the duties are changing to a favorable policy toward renewable energy.

Duty rates vary considerably in the APEC member economies for the importation of renewable energy equipment (Table 5-1). The industrialized economies have relatively low duties, ranging from 0 to 10%, with the exception of Canada, which has rates as high as 14%, whereas duties in the emerging economies average at about 20%. Specific duties on renewable energy components (e.g., photovoltaic modules, turbines, and batteries) range from 0-10% in the APEC member economies, with a few as high as 25%. Despite much resource potential in emerging economies, high import duties on equipment may deter investors and project developers. It is important to note that the information in Table 5-1 was compiled in 1996 by deLucia and IFREE (1996), and that since then many member economies have revised their duties spur renewable energy technology markets and investments.

In order to further accelerate adoption of renewable energy technologies in the APEC region, it is necessary to seriously consider modifying their import duties. It has been shown in numerous places that once the tariffs are reduced or eliminated, the market increases significantly and naturally leads to more interest by private sector investors and manufacturers. Possible actions in this area that have been undertaken by some member economies include:

Waiving of import, export, and value-added tariffs for the production of high technology products, such as renewable energy products;

- Waiving of the need for import permits for imported raw materials and spare parts used for producing products that will be exported; and
- Exemption of duties on imported equipment and materials which use foreign government loans; and
- Exemption of duties on all imported equipment, spare parts and other materials which cannot be produced by domestic means.

In summary, market demand for renewable energy technologies will be enhanced if import duties on equipment are reduced or eliminated by the APEC member economies. Once the market demand is established in the member economy, local entrepreneurs will be spurred to develop local manufacturing capacity. This manufacturing capability will be strengthened because of previous operational and marketing experience with the systems and the ability to improve upon the technology.

**Table 5-1: Comparison of duties relevant to the renewable energy sector in APEC member economies—1996 figures**

<b>Member Economy</b>	<b>Import duty</b>
Australia	0- 5%
Canada	8-14%
Chile	11%
China	20-25%
Indonesia	5-40%
Japan	0%
Malaysia	0-30%
Mexico	10-20%
New Zealand	0-11.5 %
Philippines	10-20%
Singapore	0%
Korea	8%
Chinese Taipei	5-12.5%
Thailand	5-20%
United States	3-7.5%

Source: deLucia and IFREE (1996).

### *Where is the grid going and when?*

For years, the mainstay of rural electrification efforts has been grid-based electricity. From the days of the Rural Electrification Act (REA) in the United States, when low cost, long-term loans financed the rapid extension of the electricity grid, national governments have sought to bring power to remote areas by connecting them to a national grid. However, the increasingly high cost of serving remote communities and advances in alternative energy sources have made such ambitions unnecessary, expensive and

impractical. There is no reason that underserved rural households and businesses should wait for the grid to arrive before they enjoy the fruits of electric power and modern energy services. A large share of rural needs for household lighting and small power requirements can now be met by renewable energy technologies. Yet, governments frequently give false promise that the national grid will reach all corners of the member economy in a reasonable time frame and thereby undermine the market for alternative energy sources.

Where renewable electrification is an economically viable option, governments must explicitly and emphatically support it, in lieu of holding out the promise of grid extension. If consumers expect that grid electricity will arrive shortly, then they will be unlikely to purchase an energy system that they view as a short-term solution. Clearly such expectations undermine efforts to market renewable technologies. Even if there is a political cost in doing so, the government needs to designate areas that will not be reached by the grid in less than 5 years. With such a designation, the private sector will be able to proceed with efforts to market alternative energy sources without fear that they will be undercut by the grid.

An clear forecast of where the grid is headed and in what time frame is critical to efforts to get rural consumers to consider investments in renewable energy. A study by the World Bank has shown that so long as grid power is seen as a near-term option, the end user is reluctant to make a significant investment in alternatives (World Bank, 1996).

### ***Keeping an eye on tied aid programs***

The prospects for renewable technologies are also weakened, ironically, by tied aid programs that seek to introduce renewables at a price that does not reflect true costs. In most cases, these programs involve either a country or a large manufacturer that donates energy systems or components to a developing country or a non-governmental organization as part of an aid/development agenda. These organizations argue that tied aid is justified in order to create larger markets in the long-term and to enable renewable energy manufacturers to fully benefit from economies of scale, which will in turn reduce costs, reduce prices, and expand the market. Gifts of renewable energy systems can be distributed for free or sold for a price that does not reflect the true cost. Usually arrangements have been made so that installation and limited maintenance is provided. However, in most cases, provisions have not been made for ongoing service or repairs. As a result, the energy systems become less reliable over time and customer satisfaction decreases. Too often, the end-user of the system is left with a product that is not properly maintained and is unaware of the actual costs involved in maintaining and operating the system.

Despite the prevalence of tied-aid programs in the APEC region, it appears that they actually retard the long-term development of the renewable energy market. It is extremely difficult for an entrepreneur to sell to potential customers that have grown accustomed to paying less than full cost for a system. While the seller may be offering

systems with a standard markup, the price will most likely strike potential customers as exorbitant if it is significantly more than what was paid during the period of the aid program. Furthermore, if the donated components have not been maintained correctly, then negative rumors regarding the reliability and performance of renewable energy equipment may spread, further weakening the market.

Before agreeing to tied aid projects, an assessment needs to be made as to who the long-term beneficiaries may be and over what time frame the projects will be allowed. Is the manufacturing company concerned foremost with getting into the market or simply unloading low-quality products? Is the donating country using the program as a way of subsidizing one of its industries? Or does the program actually foster the long-term, sustainable growth of rural electrification? If it does the latter, then the program should be embraced.

## **Chapter 6 INNOVATIVE WAYS TO PROMOTE RENEWABLE ENERGY**

### ***Impact of Kyoto Protocol on renewable energy markets***

Over the next decade, implementation of the international climate change treaty is expected to be a driving force in building new markets for renewable energy technologies. The demand for low carbon-emission power sources has already been stimulated as a result of commitments made by developed countries in Kyoto in December 1997. Although the target dates for greenhouse gas emission reductions are set for 2008 to 2012, achieving those goals will require near-term actions to change worldwide energy production and use patterns.

One of the key areas of contention in Kyoto was the role of developing countries in climate change abatement efforts. As a group, they are currently responsible for only about one third of annual greenhouse gas emissions, but they are projected to produce a much higher percentage if they proceed on a fossil fuel-driven path toward development. Given their rapid projected population growth and already large numbers of households without electricity service, most developing countries are reluctant to agree on reducing or even capping their emission levels. They are concerned that agreeing to emission limits will put unfair constraints on their social and economic development. Yet, a de-linking of energy production from fossil fuel combustion would permit environment-friendly economic growth.

Even though developing countries have not entered into binding commitments to reduce emissions, the Kyoto Protocol contains implementation provisions that may help create private sector market opportunities for sales of renewable energy technologies. Assuming that abatement costs are generally lower in developing countries, an international system for trading emission reduction credits could reduce the implementation costs for industrialized countries while at the same time mobilizing unprecedented resource flows to developing countries for clean power generation.

There are two types of international markets for greenhouse gas emissions that are contemplated in the Kyoto Protocol. One is an informal system by which companies in one country could get credit for achieving emissions reductions through activities undertaken in other countries. The second type is a more formal multilateral market for trading standardized emission-reduction credits.

#### Joint projects involving developing countries

Provisions for joint projects between industrialized and developing countries are outlined in a section of the Kyoto Protocol describing a "Clean Development Mechanism." This provision would allow companies from industrialized countries to enter into cooperative projects designed to reduce emissions in developing countries. There are no details

explaining exactly how the mechanism will work; those have to be negotiated at future meetings of the parties to the protocol.

The potential promise of the Clean Development Mechanism is that it would give private companies within industrialized countries an incentive to make clean energy investments in developing countries. If a company's emissions were capped as part of an overall domestic reduction plan, it could get credit for emissions reductions in another country if that proved to be less expensive than decreasing its own emissions. For developing countries, there could be a substantial acceleration of the rate of diffusion of renewable energy technologies, as well as other carbon emission reduction measures.

For the moment, however, the incentives for private companies to undertake joint projects are not clear enough to spur rapid engagement. Business decision-makers are unsure about exactly what their responsibilities will be for emissions reductions during the target period, and exactly what sorts of projects they will get credit for. In the meantime, uncertainties about future regulatory requirements make it difficult to project the costs of different energy systems over time. There are several factors that will be important in implementing joint projects:

- **Timing:** In general, abatement costs are lower in developing countries that are now making decisions about power supply sources in unserved or underserved areas. It is cheaper to introduce clean technologies before costly fossil fuel power infrastructures are established, rather than trying to retrofit existing facilities. Opportunities for technology substitution are consequently more numerous in developing countries than in those which are already heavily industrialized.
- **Financing:** For joint abatement projects, financing would come primarily from major greenhouse gas emitters in industrialized countries. These would include large factories, utilities or power plants that might find it cheaper to invest in or finance emission reduction activities in other countries. For example, a company might provide financing to set up a wind-powered plant in a different country where a fossil fuel-powered plant would have otherwise been constructed.
- **Rules:** The system adopted for establishing, verifying and accounting for abatement credits will also be critical for private sector involvement. It will first be necessary to establish baselines for current and projected emissions, for countries, plants and particular projects. In the meantime, before credit allocations are determined, private investors might be attracted by public relations opportunities, early market presence and penetration, product recognition, or the advantages of being involved in setting the framework for joint projects.
- **Transaction costs:** Even when credits are available, transaction costs for joint projects will be substantial. Companies will have to seek out partners in other countries and negotiate deals subject to a variety of national and international constraints. In some cases, the project will be between a private company and a public entity in the host country, requiring a complex joint venture agreement. The

Clean Development Mechanism can facilitate these projects by allowing developing countries to bring forward potential projects for matching with interested partners. It would be helpful to have a pool of approved pre-selected projects that support the development needs of the host country, but would not otherwise be funded by the host country.

- **Selection criteria:** Criteria for selecting projects will have to be formulated within potential host countries. Prospects for investment will be limited to the extent that developing countries resist participation in joint projects. Beyond the complexities of arranging the deals, developing countries may also be deterred by suspicions about the fairness of the transactions and the adequacy of the compensation they are offered. In addition, many developing countries have expressed concerns that the most cost-effective abatement measures will be exploited by outsiders, leaving them with higher emission reduction costs in the future.

### Emissions trading

A more formal multilateral market for emissions trading could potentially avoid some of the transaction costs and uncertainties involved in bilateral joint projects and provide greater market efficiency through competitive trading. The Kyoto Protocol authorizes emissions trading among countries with established targets, but specific rules regarding trading, verification, reporting and accountability are to be discussed at future meetings.

An emissions trading system would be very complicated to set up on an international scale where there are an extremely large number of possible participants and a great variety of activities producing, or absorbing, carbon dioxide. As of now, developing countries are not included in the plans for emissions trading because they have not made specific commitments to targets and timetables for reducing or limiting the growth of their emissions. To be included in the emissions trading scheme under current treaty arrangements, a developing country would have to assume a binding emissions target voluntarily. Yet, if it could be structured properly, emissions trading could provide powerful economic incentives for cutting greenhouse gas emissions and could direct a large flow of resources into developing countries for renewable energy projects.

To induce developing countries to participate in an international emissions trading system, their targets for carbon dioxide emissions would have to be set high enough to allow for projected economic growth along conventional energy paths. This would give them a budget of allowances to sell, and would provide a stream of revenue for acquiring clean technologies. If prices were fairly established, developing countries could find that they have a significant product for sale: carbon reduction projects. In any event, setting up an international trading system will require substantial time and effort. It is more likely to attract the necessary resources if it has a chance of becoming a truly global system. Without developing country participation, the transaction costs of constructing and monitoring the market could outweigh the benefits afforded in terms of low-cost abatement opportunities.

In general, developing countries have been suspicious of both joint implementation and emissions trading schemes because they perceive industrialized countries as unwilling to make changes in their own energy production and consumption patterns. Acceptance of these systems will be facilitated if developing countries see increased energy conservation and reliance on renewable energy technologies within industrialized countries.

Although emissions trading and joint projects may ultimately provide financing for renewable energy systems in developing countries, the greatest short-term impact from the Kyoto Protocol is the market signal it has given to industry leaders concerning the need to move toward clean, renewable energy sources for the future. World acknowledgement that climate change is a real problem requiring major technological changes is helping to spur demand among consumers for environment-friendly sources of energy. Future agreements in this area, and increased public awareness about the risks of climate change, will further enhance future demand for renewables.

### ***Resource Concessions***

Resource development concessions have been used by the oil and gas industry over the last several years to explore and develop new projects. The concept involves the government delineating a region for prospective resource development, and then exploration and development rights are bid upon by interested parties. This concept can be duplicated in order to spur markets and accelerate the development of renewable energy projects in the APEC region. Concessions could be a way to achieve economies of scale and offset transaction costs associated with purchasing individual systems. Resource concessions for rural energy development have already been initiated in Argentina and there is a wind resource concession program being developed in China.

The Argentine government has initiated a program with the provincial government to develop rural energy systems using a concession approach. The program gives priority to photovoltaic panels, small windmills, micro-hydropower, and diesel-driven generators. Through this program, competitive concessions with exclusive development rights in a delineated region are granted to one or more private sector enterprises on the basis of the lowest subsidy required per supplied user, technical qualifications, and financial qualifications (Kozloff, 1997). In exchange the supplier must meet certain requirements of the provincial government. The types of business entities that participate in the concessions are established utilities elsewhere that are seeking entry into the rural markets.

Granting concessions as a way of developing large, high-quality wind resources in remote areas is being considered in China (Brennan, 1996, Reddy et al., 1997). The plan is to develop the wind resource with very large wind farms (greater than 50-100 MW) and transmit the power over long distances. By focusing on large-scale wind power development, the government hopes to attract large companies to the project and encourage joint ventures with local companies. The concept involves the government



granting concessions to companies for the exploration and development of wind resources in a selected area over a certain period of time. The concessions would be issued through a competitive process (e.g., bidding) and the government would be responsible for enforcing the regulations, ensuring the issuance of long-term power purchase agreements, managing the payment of royalties, and establishing the specifications for technology transfer. Because the project developer assumes all of the risk in evaluating and developing the concession, the government mitigates their risk and also receives the benefits associated with attracting new industries to remote areas and eventually lowering costs because of the economies of scale for large wind turbines. In order for this to succeed, the government will have to ensure transparency in the negotiation process so that competition is enhanced and the financial risks to the project developer are minimized.

Concessions are an emerging opportunity to develop rural areas with renewable energy systems using primarily private sector capital. The commitment of the government to clearly defining and enforcing the rules and regulations of the concession will be an assurance to the project developer or investor that the business environment will remain stable and equitable. The private sector will likely be able to attract financing because of these assurances and the large-scale size of the project will help offset transaction costs. By promoting a true private sector approach, rural areas can be developed in a cost-effective and profitable manner.

### ***Joint Ventures***

Policies and regulations can be put in place to encourage partnerships that will help spur the renewable energy sector in the APEC region. Forms of partnership include technical assistance, distributorship, licensing arrangements, manufacturing and joint venture agreements. Joint ventures between foreign entities such as renewable energy manufacturers and in-country partners can be conducive to member economies' development goals and help accelerate the economic benefits of investment. In addition by having access to advanced energy technologies and equipment through the joint venture, a member economy can "leapfrog" to using advanced energy systems that are more efficient, better for the environment, and usually more cost-effective.

As the APEC member economies are becoming more liberal in terms of their foreign investment laws, the governments are in some cases allowing 100% foreign ownership in industries that are not prohibited or restricted by the state. While it may be legal for a foreign entity to have a wholly owned venture, establishing a joint venture is usually the preferred path since it ensures local ownership and serves to enhance the new business. By partnering with a local company that may be firmly established with the local utility, the joint venture is able to more easily access the market and sell its power to the utility. If the company is state-owned, then typically a foreign entity may control only a limited portion of the venture, perhaps up to 49%. However, despite the economic transformations, a large number of industries are still state-controlled and closed to private investors. Some of these industries are legally closed to foreign investors while

others are restricted. In China, for example, prohibited industries include media, domestic commerce, foreign trade, insurance, postal service, telecommunications, and electricity transmission and distribution (US/ECRE, 1997). However, it is expected that as the market economy system becomes more established, these restrictions will be lifted or modified in the coming years.

In the developing economies of the APEC region, there are laws and regulations, both at the local and central government levels, which encourage foreign companies to establish joint ventures with local firms (Box 6-1). One area where renewable energy technologies can benefit is through tax incentives provided for joint ventures. As another example in China, all joint ventures which have operation agreements over a period of ten years are exempt from state income tax for the first two profitable years. From the third to the fifth year of operation, the joint venture will only have to pay 50% of the required income tax. Local income tax can be waived during the first five years. As an additional incentive, joint ventures established in remote and developing areas can continue to pay 15 -30% less income tax for an additional ten years after the fifth year of operation.

#### Box 6-1

### Provisions for establishing a joint venture in Xinjiang Province, China

- The local authority can approve a joint venture if it is worth US\$ 30 million or less. Otherwise, the venture must seek Central government approval;
- Barter trade is allowed and there is no limitation of products exchanged in barter;
- Construction equipment is duty-free, and construction equipment does not need approval for imports and exports;
- No customs duties for exported products from a joint venture firm;
- Assembly line components for manufacturing and products manufactured by those assembly lines are exempt from all customs duties. For example, if the joint venture imports the production line of PV modules and exports the finished PV modules to the international market, both the assembly line components and the finished product are exempt from customs duties;
- For a long-term joint venture enterprise (more than 10 years), the first 2 years of the joint venture is exempt from income taxes. During the third through fifth years of the venture, the joint venture pays only half of the required 15% income tax. For reference, the income tax rate is usually 33%;
- There are no taxes on money repatriated by the foreign partner.
- A joint venture has a ten-year tax holiday on the land utilization tax;
- A joint venture receives priority in the approval process for converting money into hard currency;
- Money earned from a joint venture can be used for any purposes;
- The prices of the products produced in a joint venture (excluding the price negotiated in a power purchase agreement) do not need to be approved by the pricing bureau;
- Joint venture companies operate autonomously—stipulating salaries and maintaining the right to hire and fire its employees;
- Joint ventures *must* be approved or rejected within fifteen days;
- When a joint venture exports its products, it is exempt from Value Added Taxes. However, all domestic sales must still pay the VAT;
- If the enterprise is involved in new technology which is deemed significant for China's development, then the price of land will be provided at a discounted rate; and
- Equipment is exempt from all duties when it is given as a grant. Usually, these taxes are 20% plus 17% Value Added Tax.

### ***Education and Outreach***

One of the key aspects of catalyzing investment in the renewable energy sector is ensuring that there is a market-pull for the technologies. Much is being done through multilateral development agencies such as the United Nations Development Programme to provide training to technicians and policymakers on renewable energy. However,

efforts to stimulate the end-user market have been limited. Without market demand for the product in rural areas, there will be no interest generated in the private sector to invest.

As the technical issues surrounding renewable energy are better understood and innovative financing mechanisms are put in place to provide access to capital in rural areas, the next most pressing issue is the awareness and acceptance of renewable energy options by the potential customer. There is still no clear market signal arising from rural areas indicating a strong demand for renewable energy products. This is mainly due to lack of awareness of the better energy services that renewable energy technologies provide, not knowing what the various applications are, questions about reliability, and lack of access to capital to pay for the high up-front costs associated with a purchase. Renewable energy systems have typically been deployed in rural areas mainly through government and multilateral aid programs rather than purely as private sector ventures. This is beginning to change as some entrepreneurs and larger energy companies have recognized the possible business opportunities that exist in the rural areas.

One way that demand could be expanded is through more proactive involvement by the APEC member economies in promoting and advocating the use of renewable energy systems. Currently the local entrepreneurs are doing this on a case-by-case basis, however due to their capital constraints they are not able to do extensive marketing and consumer education. In order to have a significant impact in expanding the market an extensive public education campaign is required to make the benefits, applications, and access to renewable energy systems well understood in the rural areas. In Thailand, there was a concerted effort through a public education campaign to educate the public about the importance of energy conservation (Box 6-2).

**Box 6-2**

**Thailand's Public Relation Campaign**

In response to Thailand's recognition that changing consumer behavior is an important factor with regard to the achievement of energy savings objectives, they instituted a countrywide public education campaign. Specific campaigns designed to draw the public's attention to the government Energy Conservation Programme and create public awareness in conserving energy were undertaken in 1996. Their program to get the message out to the public included:

- Public service announcements on television
- Student camps to carry out energy conservation activities
- Energy conservation concerts
- Energy awareness media contests

An education campaign would help consumers analyze their energy options, and would seek to stimulate consumer interest in and demand for environmentally superior and

reliable energy sources. An essential aspect of the campaign would be to inform consumers about renewable energy sources, their environmental benefits and sustainability, and the economic reasons for making this choice. This effort could be funded by the APEC member economy governments and implemented through various channels such as the media, non-governmental organizations, environmental and consumer groups, and others. The target audiences could be residential and business consumers as well as aggregators (such as municipalities). The goal would be to have rural households drive the market demand for renewable energy products by being able to fully consider the options and then purchasing the systems.

## ***Training***

Another aspect to stimulating the market for renewable energy systems is training in the field as well as at the policy-making level. Building this capacity with local people will help to reinforce the coalition of support as well as to broaden the reach of the technologies. Although outside expertise can be useful initially for training and education, in the long run it will be most beneficial if the knowledge is transferred to people in the country so that they in turn can train others.

In order to make projects sustainable and replicable, one of the key findings from existing operations in the rural areas is the need for service and regular maintenance of the renewable energy systems. For example, regional service centers have been one of the key aspects to the success of Sudimara in Indonesia (see case study at the end of Chapter 3) in selling solar home systems in the rural areas. Training of local people to install and maintain systems is important to the reliability and long-term operating efficiency. Many of the multilateral and government funding programs that are available today include the requirement that service must be incorporated into the project plans. Whereas the private sector views it as in their best interest to include service with their sales so that future sales and market share will be guaranteed.

In addition to providing service, it is also necessary to make policy-makers aware of and educated on the technical, legal, regulatory, and institutional issues associated with implementing renewable energy projects. Because most government energy planners have focused on large-scale grid-connected power projects involving the utilities, government ministries and agencies, the approach needs to be modified to include issues that are specific to rural energy development. For example the link between economic and social development and access to energy services needs to be emphasized. For governments it will be important to ensure that all appropriate ministries (e.g., environment, finance, energy, etc.) are adequately informed and educated on how renewable energy can play a role in their overall energy development strategy; policies that will facilitate the penetration of renewable energy into their economy; and ways in which to make the energy strategies meet the needs of the rural population.

## ***Product and Service Ratings***

Customer satisfaction must be the goal of both the manufacturers and the dealers of renewable energy technologies in order to make sustainable and profitable business ventures. End-users in the rural areas are being asked to spend a significant portion of their monthly income on this energy service and they deserve performance and reliability. Until they have confidence that they will get their money's worth, rural consumers are likely to be slow to adopt these new technologies regardless of how much time and effort is spent extolling their virtues.

Satisfaction stems from owning or using a system that is well designed, easy to maintain, well serviced, long lasting, expandable, capable of meeting power expectations and easily repaired. Unfortunately, many renewable energy customers have not had good experiences in these areas. In some cases this is because dealers have exaggerated upon the capabilities of the systems, used faulty parts or have not provided post-sales service. In other cases, aid programs have provided subsidized energy systems but have not arranged for ongoing service once the project is completed. In both cases, the reputation of renewable energy is undermined.

While not responsible for the character of the dealers and promoters, both the government and the manufacturers of renewable energy technologies have a role to play in improving the customer's experience. Governments and agencies responsible for setting standards can establish performance and efficiency standards for renewable technologies or require that they meet internationally recognized standards. A labeling system could be designed that would convey these standards to the customers, thereby increasing their confidence. In the United States, the Department of Energy, the Environmental Protection Agency and many companies have joined together and designed the Energy Star label. The US government defines minimum standards for energy consumption for many consumer products such as major appliances and computers. In order for one of these products to receive an Energy Star rating, it must exceed these minimum Federal standards by a certain amount. Clearly, setting standards is only valuable if there is adequate consumer outreach and education and verification.

Another example of voluntary labeling is the National Water Conservation Labeling Scheme in Australia. This label is designed to assist in the conservation of water by providing consumers with reliable information on the relative water efficiency of various appliances. For an appliance to be labeled its manufacturer or distributor must have the appliance tested by an independent approved laboratory for both water efficiency and conformance to the relevant Australian standard for performance. The results of these tests must then be submitted to Quality Assurance Services who will award the appropriate Water Conservation Label.

In both these examples, the government agency determined the standards and industry then had the choice to adopt these standards or not. The APEC member economies could conceivably join together to establish bilateral performance and testing standards and create a labeling program. Such an action would do away with the need for costly

duplicate testing and would help raise the credibility of the technology itself. Hopefully, the customer would benefit by having an independent source monitor system performance rather than having to rely on the dealer's promises.

Mandatory warranties and a 30-day period for consumers to change their minds about a purchase are other ways to ensure that customers get products that meet their needs and expectations. Warranties would provide incentives for the dealer to sell the best equipment that is available in the market. Currently, most manufacturers offer a 10-year warranty on PV panels and a lesser term on the other components of a solar home system. It is important that warranties are enforced. Providing a dissatisfied customer with a convenient way to voice a complaint about service and product would help root out less reputable dealers. Word of mouth will eventually get the job done but, in the meantime, the reputation of the entire industry can suffer.

Equally important to rating the renewable systems is a means to rate suppliers of the systems. Arranging financing for the purchase of equipment is going to be made easier if the lending institution can get an independent appraisal of both system and supplier. Although such an appraisal won't eliminate the transaction risk, it will reduce it.

A creditable secondary market for renewable systems would also help both buyers and lenders feel more comfortable. Lending institutions are often unwilling to consider the system itself to be collateral since if the consumer defaults, it could be difficult to resell it. Buyers, too, might want to resell their systems if their needs change, for example, grid connection becomes an option. Without access to a secondary market, their system loses most of its value.

Voluntary associations of companies could also give the industry a stronger voice with which to express views before regulators and legislators. An association of companies involved in rural energy would be likely to have a greater influence on public policy than would any one company on its own. This influence could be used to promote energy policies that support renewable energy technologies. In the United States, manufacturers of home appliances have had a lobby group, AHAM, that in one form or another has represented their interests for over 75 years. Such a lobby group for the renewable energy manufacturers involved in the APEC region could be a voice calling for the removal of unfair trade policies, subsidies and biases. Or it could organize marketing efforts to raise public awareness of renewable energy technologies in general.

### ***Renewable Energy Website***

The Internet has become a valuable tool in accessing information and sharing experiences about renewable energy technologies. Thousands of websites exist that promote renewable energy and energy efficiency. Whether it is government policies on rural electrification, technical specifications on systems, tips on writing business plans or filling out loan applications, large amounts of information on related topics can be found on the Internet from sources all over the world. However, it is not organized in a way

that is going to be useful to any but those wishing to dedicate a significant amount of time browsing through all of the information. Creating a website that specifically addresses the issue of rural power and access to private capital could be a useful tool for consolidating much of the information that is available on the Internet.

This website would serve as a clearinghouse where both investors and project developers could go to learn about programs and initiatives that are changing the business climate for renewables or creating entrepreneurial opportunities. Project developers could gain access to financial and business resources that might help them shape their plan. Investors and lenders could study schemes that have successfully dealt with the risks related to renewable energy technologies. Hyperlinks could make it easier to contact useful related resources.

To be useful, a website would need to be very focused on financing for renewable energy projects. Otherwise the search on a topic such as renewable energy yields an unwieldy number of sites. Although the universe of people focussed on developing rural renewable energy projects using private capital is relatively small, it is very difficult and time consuming to narrow down a search to the most relevant Internet sites. The goal of a website dedicated to this specific issue would be to serve this much smaller group by providing a forum for the exchange of information and ideas on the projects in which they are involved.

The site would derive its authority by the level of interest it had from manufacturers, government officials, investors and developers involved in the rural energy issue. If it had broad support from these people, the site could become an unofficial platform for exchange of information and discussion on project design, best practices, funding sources, innovative policies, and other issues.

Since the activities related to financing and the rural energy sector are fairly limited and geographically dispersed, the Internet would be an ideal way to bring together the existing body of knowledge on this topic. With increased exposure about investments being made in the renewable energy sector and the ways in which financing is being structured for the projects, information about the pitfalls and opportunities could reach a broad and diverse audience. Through a website dedicated to this subject, the overall understanding of the technologies, risks, and investor concerns would be enhanced and could facilitate the flow of ideas and potentially lead to flow of capital.



## Chapter 7 CONCLUSIONS

Renewable energy resources appear poised to play a much larger role in meeting the energy needs of APEC member economies. Falling costs, growing environmental awareness and focusing political attention bring promise that renewable energy technologies may at last live up to their potential, especially in the rural areas. One critical piece of the puzzle is lacking: capital to expand the market and develop rural energy services.

In recent years, a general trend has been seen in the APEC region to move toward market economies. The trend to privatize industries, build infrastructure and establish capital markets, has led to a growing number of business opportunities in the renewable energy sector. While large, capital intensive energy projects are already attracting the international financial markets, renewable energy projects have so far failed to attract private investment dollars to the extent project developers would like to see. Despite this, some companies are currently making headway in developing sustainable business ventures in the rural areas through innovative financing mechanisms and unique project structures. Four of these companies are highlighted in Chapter 3 in the case studies. Learning through experience and trying to replicate models that work will help to expand the renewable energy markets. Although availability of private capital on strictly economic terms for renewable energy projects is currently limited, the potential opportunity is very large in both the rural and grid-connected urban areas. In talking with investors, manufacturers, project developers, non-governmental organizations and development agencies, a number of general themes emerge concerning renewable energy development and financing in rural areas of the APEC region.

### ***There is a large market potential for renewable energy***

Since the technical characteristics of renewable energy systems make them well-suited for rural applications, there appears to be ample opportunity to use these systems to meet the needs of the large number of people in the APEC region that remain without modern energy services. Renewable energy can be cost-competitive, can significantly improve the quality of life for people living in the rural areas, and has environmental benefits. Nonetheless, the market is still very small and is mainly being led by both bilateral and multilateral aid-based programs.

The expansion of the renewable energy market on more commercial terms will be driven by three things. First, the prices for the systems will continue to decline as production increases and efficiency improves. The ability to manufacture the systems and components locally, rather than importing them will also drive down the prices. Second, after-sales service will be essential in providing customer satisfaction and creating additional sales. It has been shown that the most successful programs are those that have responsive service and maintenance programs in the rural areas, which helps to alleviate

concerns about product reliability and performance. Third, investments made in modern energy services in the rural areas can have more impact if socio-economic development is proceeding in tandem and per capita incomes are rising. There is a clear link between the overall economic well being of a country and the expansion of energy services to the rural areas to support socio-economic development and the transition to renewable energy systems.

### ***The challenge is to link the investment community with renewable energy projects***

Although there is a large market opportunity in the rural areas for renewable energy development, this sector has not been able to attract large amounts of private capital or investors. That situation is beginning to change. Private sector investment in renewable energy is at an early stage, however multilateral agencies are trying to catalyze that capital through a variety of programs. There are now dedicated funds to help leverage private sector capital (e.g., the International Finance Corporation), new financing mechanisms well-suited to renewable energy projects, and an increased emphasis on structuring projects to meet the needs of the potential investor. The challenge is to match the project with the investor and the appropriate financing mechanism.

In order to attract sufficient private capital to fully develop the energy opportunities in the rural areas will require that investors be assured that project developers have addressed their concerns regarding risk, rate of return, management, and market size. Projects will need to be well-thought out such that prospective investors are convinced that risks have been anticipated, realistic business and marketing strategies have been devised, and that management possesses the experience to execute their plan. The investor also needs confidence that rates of return are reasonable when compared to the risk taken. The increasing sources of capital for renewable energy projects provide the project developers with an excellent opportunity as long as they can structure their deals in such a way that the investor has the necessary information and comfort level in order to embark upon this new venture.

### ***There is a need for stable economic conditions and sound business practices to spur private sector investment***

To infuse capital into the renewable energy sector requires that the investment climate be such that money can flow into the member economy and capital markets can fully function. The establishment of sound financial markets and economic stability in the APEC member economies is a crucial issue linked with socio-economic development and attracting capital.

One of the more fundamental aspects of creating well-functioning markets is the need for appropriate legal, regulatory, and technical infrastructure. It is well understood by the financial and development community that for this to happen there is a need for

transparency in legislation and regulation, privatization, full disclosure of economic and financial information, and accountability. As APEC member economies begin to develop open, well-regulated capital markets, they will be better positioned to increase their own assets as well as attract foreign investment. This will serve to strengthen the overall economic conditions of the member economy and create a business-enabling environment that is dependent on market forces rather than political whims. By encouraging the growth of robust financial markets, governments can increase the rural population's access to capital, which will improve the prospects for socio-economic development generally, and energy projects specifically.

***It is important to increase the demand for renewable energy services and improve their affordability***

The market-pull of the rural consumer for renewable energy products will ultimately control the strength and sustainability of the market. One of the key aspects of developing the rural energy markets is making the renewable energy systems affordable for the customer through access to credit and financing. Not only will the expansion of the rural energy markets be driven by access to credit, but also by the general economic growth occurring in both the rural and urban areas of the developing member economies and, secondarily, by the ability of renewable energy technologies to compete with other electricity options on an even playing field. Though costs of renewable energy systems have fallen significantly, they have the potential to be reduced even further. Evidence shows that the rural consumer will buy renewable energy if the product is affordable, reliable, effective, and competitively priced. Easier access to credit alone will not be enough to support a rapid expansion of the renewable energy markets. What is needed is not only the ability to buy but also the desire of the consumer to spend their limited capital on these systems.

Micro-financing is such an important issue because a large part of the rural population will only be able to afford systems if credit is available. However, it has proven challenging to offer this credit given that traditional lenders have not yet fully embraced renewables or extended their services to rural borrowers. As the renewable energy markets are developing and maturing, there are now several business models for offering financing or leasing to rural consumers that have demonstrated that the rural customer is a good credit risk and that there is a large potential market promising good business opportunities.

***The profit margins from rural energy projects are improving in the long-term***

With the potential draw of a large market for renewable energy technologies, entrepreneurs and investors are attracted to the opportunities offered in the rural areas. However, so far this opportunity has been developed only on a limited basis by a few determined individuals. Entrepreneurs are figuring out ways in which creative financing

can put energy within the reach of rural customers, but the profit margins are still very small and their businesses are growing slowly. On the other hand, manufacturers are seeding the market with their systems on the hope that by getting systems on the ground and spurring demand, a market for their product will develop in the medium- to long-term. Multilateral and bilateral agencies are providing loans and grants to leverage capital from the private sector because the returns are not attractive enough at the point to create a fully commercial venture. Most project developers see a need for seed funding from these agencies in order to help overcome the first-cost barriers associated with renewable energy technologies which will help jumpstart their businesses.

Although the current profit margins for renewable energy projects in rural areas of developing member economies remain fairly small, there is a sense that there is great potential and that the margins will reach a point to attract large amounts of capital in the medium- to long-term. As good business models are replicated and markets expand, the renewable energy sector will mature and purely commercial ventures will likely replace aid-based ventures. Attention should be paid to programs where systems are introduced at below cost because this can seriously undermine the efforts of the entrepreneur and can destroy any potential for a competitive market.

## ABBREVIATIONS AND ACRONYMS

Btu	British thermal unit
CNG	compressed natural gas
CO <sub>2</sub>	carbon dioxide
DSM	demand side management
GDP	gross domestic product
GW	gigawatt (10 <sup>9</sup> watts)
kg	kilogram
kW	kilowatt of electricity
kWh	kilowatt-hour of electricity
LNG	liquefied natural gas
MDB	multilateral development bank
MMBFOE	million barrels of fuel oil equivalent
MW	megawatt (10 <sup>6</sup> watts)
MW <sub>p</sub>	peak megawatts of electricity
NGO	non-governmental organization
NO <sub>x</sub>	nitrogen oxides
PPA	power purchase agreement
PV	photovoltaics
Quad	quadrillion Btu (10 <sup>15</sup> Btu)
SHS	solar home system
SO <sub>x</sub>	sulfur dioxides
Twh	terawatt-hour (10 <sup>12</sup> watt-hours)
W	watt
W <sub>p</sub>	peak watt of electricity



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## **APPENDIX A CHARACTERIZATION OF THE APEC REGION**

### ***Business environment***

The developing member economies in Asia are experiencing rapid expansion in their energy demand compared to the industrialized member economies. These dramatic increases have been attributed to high rates of economic growth, increasing energy intensities, the rapid pace of industrialization, growth in the energy-intensive industries, electrification of industries and households, and increases in the number of motor vehicles. The expected increases in energy demand will have impacts on the developing member economies' environment, infrastructure, financial markets, and the global energy economy.

Economic development and growth is the primary goal of the developing member economies in the APEC region and this development is integrally linked to the provision of energy services. The developing member economies in Asia are undergoing dramatic changes in the structure of their economies and industrialization. As a whole the member economies in Asia showed growth in their GDP on average of 5.4% in 1997, although this is expected to decline in 1998 (Energy Information Administration, 1997). To varying degrees, the Asian member economies have taken steps to liberalize their economies, reduce subsidies, privatize state enterprises, and control inflation. This has resulted in increased competition and efficiency. Much of the growth can be attributed to the modification of government policies to spur investments, the liberalization of trade and foreign investment policies, structural changes in the economy, and the increased emphasis on socio-economic development.

Economic growth in the developing APEC economies was phenomenal in the 1990s, during which time they experienced growth rates on the order of 8% a year and foreign capital investment reached as high as 35% of gross domestic product (The Economist, 1998a). In contrast, the industrialized economies have historically shown markedly lower growth rates, averaging only 3.5% in 1997 (Table A-1). This economic boom led to overheating of the economies and subsequent economic crises in some of the developing member economies in the APEC region. As the currencies and stock markets have begun to stabilize through structural reforms, the high growth rates in the developing economies will not be sustained in 1998, and may be as low as 1%, however they are eventually expected to rebound to a level of 5% per year (The Economist, 1998b). The rebound will be driven by reforms of the legal and regulatory systems to make business transactions more transparent, increased flexibility to adjust to changes in the global markets, and the establishment of sound financial markets. In addition to the large gap in growth rates, the per capita GDP in the developing economies is as much as thirty times lower than in the industrialized economies (Table A-1). It is expected that as the developing economies further integrate and expand their financial markets this gap will be reduced.

If this level of growth in the developing economies is to be sustained, there will be great demand for infrastructure to support that growth, namely in the telecommunication, transportation, water supply and sanitation, and power sectors (OECD, 1997). Energy is central to all of these concerns in the APEC region, in both the urban and rural areas. Therefore, massive investments will be required in the near future to meet the growing demand for energy supplies and energy services.

**Table A-1: Comparison of economic indicators for the APEC member economies**

Member Economy	1997 Gross Domestic Product (billions US\$)	1997 Real GDP growth rate (%)	1997 Per Capita GDP (US\$)
Australia	357.2	2.9	19410
Canada	650.3	3.7	21460
Chile	49.0	6.5	3380
China	802.0	8.8	650
Indonesia	185.4	5.0	880
Japan	3346.3	0.9	26620
Korea	408.9	4.9	8910
Malaysia	75.0	6.8	3660
Mexico	318.1	7.0	3290
New Zealand	50.9	2.3	14140
Philippines	54.5	4.7	720
Singapore	65.2	7.6	19180
Chinese Taipei	248.1	6.3	11430
Thailand	136.1	-0.5	2290
United States	6726.4	3.7	25100

Source: U.S. Energy Information Administration (1998).

### *APEC's energy profile*

APEC economies account for nearly half the world's consumption of energy. In 1996, APEC member economies consumed 196 quadrillion British thermal units (Quads) of

energy, 52% of the world's total. Oil is the dominant fuel, accounting for 39 percent of 1996 total energy consumption in the region, followed by coal and natural gas, 29 percent and 18 percent, respectively (Table A-2), U.S. Energy Information Administration, 1998). In 1996, APEC member economies collectively consumed over 53% of the world's oil, 42% of the world's natural gas, and nearly 61% of the world's coal. The high percentage for coal is mainly due to the inclusion of China, which alone accounted for 29% of the world's total coal consumption in 1996.

**Table A-2: Comparison of energy and electricity consumption in APEC member economies**

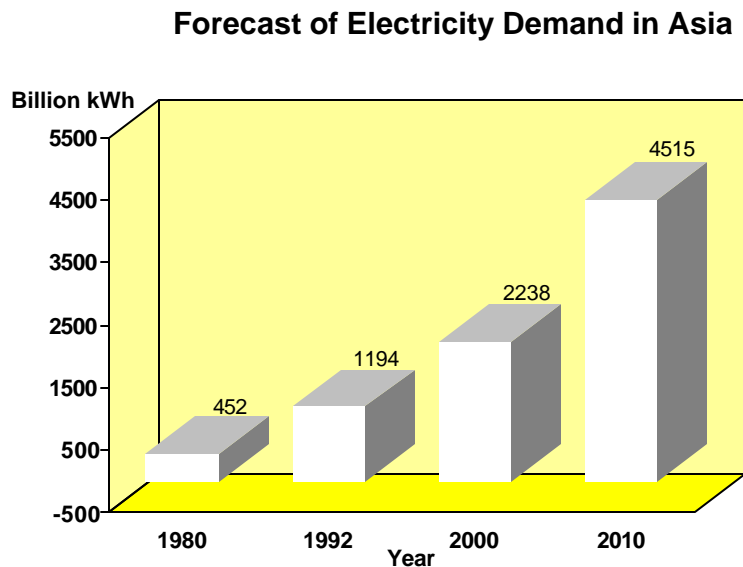
Member economy	1996 Total Energy Consumption (Quadrillion BTU)	Petroleum (%)	Natural Gas (%)	Coal (%)	Nuclear (%)	Hydro-power (%)	Other (%)	1996 Electricity Generating Capacity (million kW)	Per Capita Electricity Consumption in 1994 (kW-hours)
Australia	4.08	39	18	39	0	4	0	39	9363
Canada	12.2	29	26	11	8	30	0	115	17510
Chile	0.79	50	8	14	0	27	0	6	1798
China	37.04	20	2	73	0	5	0	204	780
Indonesia	3.51	59	36	10	0	3	1	20	315
Japan	21.37	56	12	14	14	4	0	205	7726
Korea	7.16	63	7	19	10	1	0	32	4174
Malaysia	1.66	52	40	4	0	5	0	11	2032
Mexico	5.62	67	20	4	1	6	2	36	
New Zealand	0.88	30	22	11	0	32	5	8	9180
Philippines	0.98	73	0	7	0	7	12	8	399
Singapore	1.22	95	5	0	0	0	0	5	7297
Chinese Taipei	3.11	54	5	27	12	3	0	24	
Thailand	2.33	61	18	17	0	3	0	18	1294
United States	93.36	38	24	22	8	4	3	770	12711

Source: US Energy Information Administration (1998).

## ***Energy supply vs energy services***

Asia's electricity capacity addition from 1993-2015 is projected to be on the order of 769 GW, roughly half of the world's expected growth. The associated electricity demand is projected to grow on average 8% per year in the region. This high growth rate in electricity demand is projected to grow to 4515 billion kWh from a current level of about 2000 billion kWh (Figure A-1).

**Figure A-1**



Source: APEC "Survey on the Successful Examples of Rural Electrification" March 1998

However, unless this huge increase in generation capacity and electricity demand is matched by a dramatic improvement in the delivery of modern, efficient energy services, it is unlikely to result in a substantive betterment of living standards for many residents particularly rural ones.

The common measure of development is energy demand - an approach that implies that the task of energy planning is to make projections of energy consumption into the future and to design supply mixes to meet these projected energy requirements. What is needed instead is a new approach to energy in which the indicator of development is the level of energy services. In this approach, access to energy services, rather than simply the amount of energy consumed, determines the satisfaction of basic human needs, the quality of life, and the standard of living.

Current approaches to energy production, distribution and utilization are unsustainable in economic, social and environmental terms. Energy strategies that provide a better balance between conventional sources, energy efficiency improvements and energy services can have a profound impact on the issues being faced today in rural areas, such

as environmental degradation, poverty, lack of income-producing activities, health problems, and others. As stressed by Reddy et al. (1997), access to energy services is linked to socio-economic development and without adequate energy supplies and services, it is unlikely that the goals of sustainable human development can be met, in the developing member economies, or indeed anywhere.

A fundamental change in how energy is supplied and delivered must be made in order to achieve a sustainable energy future. Reddy et al. (1997) summarizes the problems that member economies face related to the conventional energy sector. They suggest that import dependence and foreign exchange constraints, price vulnerability, inefficiency in use and distribution, negative environmental consequences, contradictions between modern sector vs. traditional sector energy use patterns, and increased marginal costs to put the most remote areas on the national grid all lead to the need for a different approach to energy development.

In the APEC region, where rural areas form such a large part of the energy development picture, the access to modern technologies will be a key aspect of the choices being made now and in the coming years. Developing member economies can take advantage of the availability of modern, highly efficient technologies, such as renewable energy systems in order to pursue a different technology path than that chosen by the industrialized member economies. This path relies on the more efficient use of energy and a shift to renewable energy resources such as solar, wind, biomass, fuel cells and micro-hydropower. Because of the small size of typical rural renewable energy applications, their energy contribution will be small when viewed against the total increase in Mw that is needed in the developing member economies. However, these are the types of systems that will have the largest impact on the lives of the rural people who have little or no access to energy services.

### ***The APEC Rural Energy Situation Today***

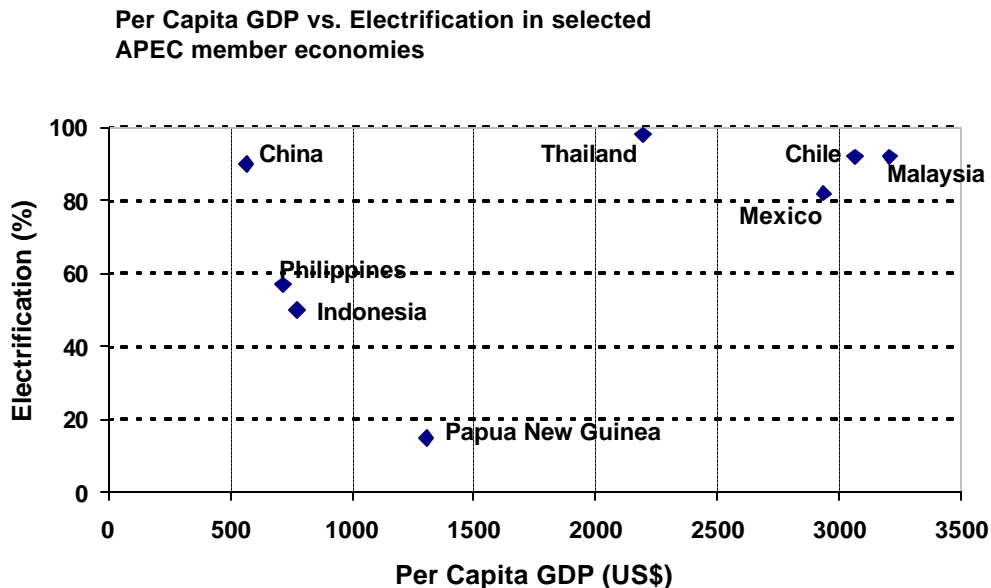
The pressing search to bring electricity to the rural areas of the APEC member economies is driven by the scope of the problem. Today, worldwide, estimated two billion people lacks access to modern sources of power. Over two thirds of these people live in rural areas. The APEC nations are right to focus on this issue for the absence of reliable, efficient power brings with it far reaching human and environmental consequences.

Whether it is the woman who must search two hours a day to find cooking fuel, the child who develops respiratory ailments from breathing dirty air, the student who must put down the book because of darkness, or the farmer who watches the crops wither from lack of water, each stands to benefit from access to power. Modern energy can play a part in freeing these people from drudgery, lack of opportunity and bad health. This untethered human energy can then be a positive force in the development of a member economy and its resources.

Unfortunately, for many rural residents access to modern energy sources isn't an option. Traditional rural electrification schemes cannot change this situation quickly. Often, the electrical grid ends a great distance from the rural populations and given the cost of extending it, little likelihood exists that the grid will reach many isolated and lesser-populated areas for years, if ever. At the same time, efficient energy sources such as liquid fuels, liquid propane gas and renewable energy sources that could make an immediate difference are underutilized due to both inadequate delivery systems and prohibitive costs. Without these sources of energy, rural people remain dependent on traditional fuel sources. Millions of households still meet their energy needs by the collecting and burning of inefficient fuels. In East Asia and the Pacific, 33% of the total energy used is estimated to be generated by bio-fuels. This number is expected to still be greater than 20% by 2010. (World Bank, 1996)

Dependency on biomass and other inefficient fuels such as kerosene has a proven link to poverty. As household incomes rise, people typically switch to modern fuels if they are available. That this correlation between having access to energy service and increasing prosperity exists means that efforts to spur rural economic development cannot focus on one issue while neglecting the other. Programs and policies that strive to improve energy options are likely to fail if other policies prevent economic growth. At the same time, economic development will likely be stunted if modern energy is not available. (Reddy, et. al, 1997 & World Bank, 1996). To further illustrate this point, it has been shown that there is a positive correlation between the percentage of people that have access to electricity and the per capita GDP (Figure A-2)

**Figure A-2**



Source: APEC "Survey of the Successful Examples of Rural Electrification", March, 1998



From Figure A-2, it is clear that member economies that have much more dispersed populations (e.g., in remote island communities) such as Philippines and Indonesia have fairly low overall electrification rates because of the difficulties and expense involved in providing rural power. In addition, it has been noted that investments made in modern energy services in the rural areas can have more impact if socio-economic development is proceeding in tandem and per capita incomes are rising (World Bank, 1996). The World Bank (1996) has indicated that there is a threshold of about US\$1000 per capita income, where substitution to modern fuels takes place, and the overall trend is that a 1% increase in per capita income corresponds to 0.6% of the population changing to modern fuels. There is a clear link between infusion of capital into the rural areas, the overall economic well being of a country, and socio-economic development that will positively influence the transition to renewable energy systems.

The APEC member economies and many other countries can rightfully take great satisfaction in the accomplishments they have made in bringing modern energy choices to their rural populations. In the past 25 years more than 500 million rural residents in developing countries have received access to electricity services (World Bank, 1996). But the problem is unabated. The World Bank (1996) notes that rural populations continue to grow faster than the spread of electricity and they estimate that the population of developing countries will grow from three billion today to more than five billion in 40 years. If per capita energy use in these countries is to even begin to approach the use in developed countries then huge strides in energy generation will need to be made. Whereas the average per capita consumption in developing countries is 600 kWh, in industrial countries it is closer to 13,000kWh. In underserved areas, consumption is considerably less than 600kWh.

To improve energy services to the rural areas will require an enormous capital investment that, given the current climate of austerity the public sector is not in a position to make. Since the debt crisis of the 1980's, increasing restraints on public spending has limited what previously had been the greatest source of funding for the power sector. (Reddy, et. al, 1997). However, by developing policies that create the proper enabling conditions the public sector can encourage the private sector to invest the necessary capital. If investors and entrepreneurs can realize profits while improving rural energy services, then both public and private agendas will have been advanced.

The good news from the entrepreneur's perspective is that the rural areas present strong markets. Much evidence suggests that people are willing to spend a significant portion of their incomes on higher quality energy services that improve their standards of living or enable them to become more productive (World Bank, 1996). When electricity is available the uses for it are broad. The low-income households use electricity mainly for lighting, television, radio and ironing. As incomes rise, demand grows for refrigerators and other appliances. Electricity is rarely used as for cooking because it is expensive and inefficient (World Bank, 1996).

Energy choice is also important for rural productive uses. Typically, 60 to 80 percent of the electricity used in agricultural areas is consumed by farms, agro-industries and small

commercial and manufacturing establishments (for irrigation pumping, water supplies, crop processing, refrigeration and motive power) (World Bank, 1996). Whether for household or productive uses, a rural market for electricity exists but its availability is limited. For this to change, modern energy systems must prove their superiority in terms of price, reliability and availability. If the private sector is to fund the spread of these systems then it must be convinced that servicing the rural consumer can be profitable.

### *Engaging the private sector*

Historically, private sector investors have been more comfortable financing large-scale energy projects that target larger concentrations of households or industrial concerns. Generally, these are large fossil-based power plants or dams which have been financed as typical bulk power projects, allowing them to secure long-term debt maturities, subsidies, and other incentives and attract foreign investors. These projects have yielded large fees that more than offset the high transaction costs. These projects will continue to make the largest contribution in electrifying the rural areas. However, the large scale undertakings are not likely to impact the lives of large segments of the rural population for years if ever since it is difficult to economically justify extending the grid, due to the inaccessibility of certain areas. Until recently, the private sector has had little experience financing these low load or remote energy projects. This is changing. Renewable energy projects, so well suited to meet these off grid needs, are becoming increasingly attractive to private investors.

From the community-based energy service companies to the international manufacturers of renewable technologies and from the local entrepreneur selling appliances to the global investment banker, the private sector is looking at the need for energy in the rural areas and seeing opportunities. Each is at work creating tactics and techniques to access the capital required. And they are making progress. At the local level, entrepreneurs are figuring out ways in which creative financing can put energy within the reach of great numbers of people. At the international level, investors are beginning to see that they can get competitive returns from risking money in rural energy ventures.

Success will require knowing the rural markets well. It is essential that this market not be thought to share just one economic profile. Income ranges exist in rural areas just as they exist everywhere else. Attempts to serve the rural market must be very clear as to which groups are being targeted. For example, it is generally thought that up to 10% of the rural market is willing and able to pay cash for energy services. An additional 20-30% are potential consumers if access to affordable loans are offered. Up to 55% will be users of a fee-for-service model where no upfront payment is required, depending on the amount of the monthly fee. The remaining “bottom poor” (Ramani, 1997) are probably not buyers of energy services regardless of the financing model used.

Even if up to 55% of the rural population can afford energy services in some form, other barriers to the acceptance of renewable energy solutions continue to make potential buyers resistant. These are: the high initial cost of the system when compared to other

energy sources, unfamiliarity with the technology, and a concern about both the reliability and durability of the energy system. Marketers of renewable energy must address these concerns as well if they are going to enjoy widespread sales.

Once the end users are willing and able to invest in renewable energy solutions, the next step is to make the private sector comfortable risking capital in loans or investments in this market. Private investors have long struggled with erroneous perceptions about renewable energy. Most of these relate to unfamiliarity with the customer and the technology that makes assessing risk difficult. Just as important, the investor needs confidence that rates of return are reasonable when compared to the risk taken in order to make these investments attractive. The renewable energy project developer's challenge is to provide the necessary information and comfort level.

How much comfort an investor requires is determined by the investor's agenda. At this early stage of private sector involvement in rural renewable projects, finding an investor willing to risk capital on purely business fundamentals is unlikely. Chances are much better if the investor approached has a personal or mandated interest in the area. Fortunately, many such investors exist. Whether it is from the World Bank acting for development reasons or from an insurance company attempting to hedge its bets against global warming, money can be accessed if the project makes sense. The challenge is to match the project with the investor.

### ***Role of governments in the APEC region***

The APEC governments can do much to support efforts to get the private sector involved in financing rural renewable energy development. By supporting macro-economic policies that encourage private investments and by investing in the complementary infrastructure such as roads, sanitation, and water systems, that are necessary if a community is to prosper, local and national governments will be contributing mightily to attracting the private sector to opportunities in rural areas whether they are energy related or not.

If public policies support an environment conducive to the spread of renewable technologies then entrepreneurs and investors should be attracted to the opportunity offered in the rural areas. Yes, much building of infrastructure will be required but doing so represents an entrepreneurial opportunity. A need will exist for manufacturers, installers, designers, financiers, salespeople and managers. Clearly, capital will be required to build this infrastructure. So far this opportunity has been developed only on a limited basis by a few determined people. To go further requires capital. The challenge for renewable energy project developers is to turn the private sector's willingness to invest into action and thereby harness the sources of free power that could so dramatically change life in the rural areas.



## APPENDIX B RURAL ELECTRIFICATION CHOICES

### *Rural Electricity*

When thinking about rural power, it is important to distinguish between power supplied by the grid and isolated off-grid power systems. Historically, most rural electrification programs have centered upon grid extension from the urban to rural areas even though this is not always the most cost-effective alternative for the utility. The cost of grid supplied power in rural areas can actually be much higher than in urban areas due to decreased load density and lower load growth in rural areas, which are typically characterized by dispersed, remote communities. To accommodate this disparity, energy services are sometimes cross-subsidized so prices in the rural and urban areas are comparable.

The World Bank (1996) has shown that the costs of grid-connected energy supply in the rural areas are actually much higher than the rates being charged to the customer. The results, shown in Table B-1, demonstrate that the cost of this subsidy to provide power to the rural areas is 1.5 to 3 times higher than the price that they are charging the customer. In some member economies, such as Thailand, the utility was able to absorb this cost of this subsidy for rural power through a rate structure based on the monthly kWh consumption and income.

**Table B-1: Comparison of cost of rural energy supply and prices in selected APEC member economies**

Member Economy	Fuel cost (US¢/kWh)	Generation & transmission cost (US¢/kWh)	Distribution cost (US¢/kWh)	Total cost of electricity supply (US¢/kWh)	Average tariff in rural areas (US¢/kWh)
<b>Indonesia</b>	3.8	4.1	9.8	17.6	5.8
<b>Malaysia</b>	2.3	8.8	4.4	15.5	7.2
<b>Philippines</b>	5.0	2.8	7.5	15.3	9.2
<b>Thailand</b>	5.0	3.8	8.3	17.1	7.0

Note: These figures are for long-run marginal cost of electricity used in rural areas at low voltage

Source: World Bank (1996, 1994).

It important to note that these types of subsidies in the long-run are probably not needed, because it has been shown in previous studies that rural people are in many cases willing and able to pay market prices for energy services (Reddy, et. al, 1997). A noteworthy finding of the (World Bank,1996) study on rural energy is that people need to be free to

choose the form of energy that is most appropriate for them. In the past, interventionist financial and regulatory policies have restricted people's ability to make choices and ultimately undermined energy services. Experience has shown that if energy services are available and reliable, rural people are willing to use different types of energy sources and will usually opt for the one that most satisfies their daily demands. Currently the choices are limited in the rural areas--mainly diesel power, kerosene, and traditional biomass. Renewable technologies offer a potential electricity supply option that will in many cases be a more cost-effective alternative.

### ***Diesel generators***

A significant percentage of rural electrification in APEC member economies is provided by small diesel generator sets, which provide power to a village or installation either in stand-alone or in mini-grid configurations. Unfortunately diesel generators can be expensive to operate and maintain and require technical expertise that is not locally available. These systems which are usually in remote areas, also have problems because of the difficulty in getting spare parts to repair them and in getting fuel delivered to these areas in a reliable and timely fashion. In addition, the cumulative emissions from the numerous generator sets in operation can represent a significant source of greenhouse gas emissions produced by the individual member economies. High fuel costs often mandate that the generator sets be operated only during part of the day, meaning that the local population is without electrical service during sizeable parts of the day.

### ***Renewable energy technologies***

Much of the APEC region is blessed with plentiful sources of renewable energy. Wind, hydropower, biomass and solar resources exist in abundance. They are generally clean and sustainable sources of power. But their appeal goes far beyond the clear environmental benefits. Recent developments in the technologies that convert these resources into useable power have made them much more suitable for rural applications. These developments include technical progress (greater efficiencies), cost reductions and improved modularity. These improvements make them potentially much more appealing to customers seeking affordable, scaleable, reliable sources of power (World Bank, 1996). In rural areas, where there are smaller more localized electrical loads, renewable energy systems offer a viable and cost-effective alternative to conventional fuels.

One of the important considerations when attempting to open up the rural markets for renewable energy is the need to correct the myth that they are free because the resource is free. For example, in rural areas of the Philippines, community-based organizations involved with installing renewable energy systems have noted that the claims made by project developers and manufacturers that there will be no additional costs to end-user once the system is in place has caused problems. Because the resource is free (e.g., sun, water, wind) the consumer is led to believe that there will be no collateral costs once the system is paid for, when in fact replacement parts, batteries, and lights are needed to

maintain the system. Full disclosure and education about the ongoing costs of maintenance and replacement parts will be essential for customer satisfaction and future market development.

Although the contribution of renewable energy is still relatively small in the APEC region, as in the rest of the world, it is projected to grow because of the declining costs, improvements in the technologies, increased awareness of the benefits to the environment of clean energy and the interest in diversifying the energy supply portfolio. Each renewable technology has attributes that make it suitable for certain rural applications and limitations that must be recognized before being deployed.

### Photovoltaics

Photovoltaic (PV) technology involves the direct generation of electricity from sunlight. PV systems are already used in a broad array of rural energy applications in the household, agriculture, communications, and public service sectors. Since there are over two billion people without access to modern energy services, rural electrification using photovoltaics is an attractive option because of its modularity, applicability in remote areas, ease of use, varied applications, and their cost-effectiveness over the long-term. Households and small businesses can benefit from energy services such as lighting, refrigeration, and entertainment provided by PV systems. The agriculture sector can use PV for water pumping and the public services that can be provided for with PV include public lighting, water purification, and electric power for public facilities such as schools and rural health facilities.

Solar photovoltaic cells are semiconductor devices that absorb light energy from the sun and convert it to electric energy. The PV cells are interconnected to form the modules that deliver voltage and current. These modules which are mounted on frames are encased between a transparent window and a moisture-proof backing to insulate and protect them. Standard PV modules are sized to give a power output of 50  $W_p$  in full sun and to have a lifetime of around 30 years.

In remote, unelectrified regions, solar home systems are an attractive option. Currently in these areas, most households use kerosene lamps for lighting and batteries are used to operate small appliances, televisions, and radios. Given that the cost of these energy services is on the order of US\$10-30 per month and the quality of the energy service provided is inferior, solar home systems offers a cost-effective alternative (Cabraal, et al., 1996). A typical solar home system includes a 20 to 100  $W_p$  photovoltaic array, rechargeable batteries for energy storage, a battery charge controller, interconnection wires, switches, and possibly an inverter. The amount of electricity that will be produced depends on both the array size and the solar resource in the particular area. Costs vary widely from member economy to member economy, depending on type of system; the market environment; in-country capacity for manufacturing, sales, and service; consumer awareness; and demand profile of the consumer. For example, the price of a 50  $W_p$  SHS in Indonesia is US\$425-700, in the Philippines US\$900, in Mexico US\$700, and in China US\$700 (Cabraal, 1996). These costs are difficult to bear for the average household and

necessitate dealer or third party financing to purchase and/or lease the solar home systems.

## Wind

Wind technologies use the wind to turn blades, which are connected to an electric generator. Wind systems provide intermittent power according to the availability of wind. For rural areas, wind is well suited for rural electrification, water pumping, and remote telecommunications applications. The configurations can be either small standalone wind systems with energy storage or centralized hybrid systems with a local mini-grid distribution network. Typically, in these hybrid systems wind turbines are used in conjunction with photovoltaics and/or diesel generators. When wind energy can be integrated into small-scale systems that are suitable for remote, off-grid locations, it can reduce a community's dependence on high-cost imported diesel fuels. The small wind turbines can range in size from 0.85 to 10 kW. These systems can include one or more turbines (depending on the load and the wind resource) a bank of batteries, an inverter/battery charger, a microprocessor controller, and a back up diesel generator. The batteries are typically configured to supply 18-48 hours of load support. Although wind systems have high initial capital costs, the designs have been improved to provide ease of operation and lower maintenance costs.

One of the most promising applications for wind power in rural areas is in the retrofitting of diesel mini-grids with renewables. In many rural villages, the energy services are provided by diesel generators. Solely relying on diesel presents a range of problems for the rural community. Diesel generators are expensive to maintain; the fuel can be costly and difficult to obtain in rural areas, and power is usually not available the entire day, and they are noisy and pollute the air. However, some of these rural areas have wind and/or solar resources that are sufficient to produce electric power that can be cost competitive with the life-cycle cost of diesel generators. In these cases, it can be cheaper and quicker to build local wind energy systems than to expand the national grid.

The advantage to retrofitting the diesel plants is the reduction in fuel consumption, reduced dependence on diesel, reduced maintenance costs, and reduced pollution. In addition, typically diesel generators only operate for a portion of the day (i.e., 6-12 hours per day), and with the renewable energy added to the system, it is possible to provide power 24 hours per day. The availability of power 24 hours per day greatly enhances the possibilities for the community to develop productive-use operations (e.g., small industry, water pumping, micro-enterprises, etc.). The cost-effectiveness of hybrid systems is highly dependent on the renewable energy resource, diesel maintenance costs, and the diesel fuel prices (Baring-Gould, et al., 1997). Small wind systems in rural areas are still relatively few in number and as more experience is gained in the field with respect to the sizing of the systems, characterization of wind resources, and the technical aspects of using wind power in a hybrid configuration, the more viable this option will be in the APEC region.



## Biomass

Biomass is plant-derived material that can be used to generate energy by direct combustion or converting it to either a liquid or gaseous fuel. The most common use of biomass in rural areas is in the burning of traditional biofuels (e.g., wood, charcoal, crop residues, and dung). Biomass or biomass-derived products such as agri-waste materials (e.g., rice hull, bagasse, wood wastes, coffee hull, coconut husk, and coconut shells) are the largest, most diverse, and readily exploitable of the renewable energy resources. Biomass can be used for power generation by burning the material to produce steam and using the steam to drive a steam turbine or biochemical and thermochemical degradation of biomass can produce biogas and liquid fuels that can then be used directly for fuel or converted to electric power. An advanced technology for biomass that shows promise in rural areas is biomass integrated gasifier/combined cycle that use biomass gaseous fuels in combined cycle gas turbines (Williams and Larson, 1996).

The increasing cost or unavailability of conventional fuels and their potentially decreasing availability in the future has led to more favorable economics for biomass power. In many member economies in the APEC region, the agriculture and forestry industry is already using biomass residues to generate power and heat for on-site.

In addition, waste heat from these plants could be captured for drying and process heat applications. Another opportunity with biomass in rural areas is the selling of excess power from an industrial plant to a mini-grid for household use. The obstacle to be overcome is ensuring that there is an adequate fuel supply to provide reliable power for the consumer and assurances on the cost per kW of power and cost recovery. Utilization of these resources will significantly reduce dependence on imported oil as well as provide a secure a continuous supply of energy. Biomass also has the benefit of reducing the production of pollutants such as SO<sub>2</sub>, NO<sub>x</sub> (acid rain), thereby, helping to mitigate global warming.

## Fuel Cells

Although fuel cells entry into rural markets is premature at this point, they do offer a potential opportunity in rural areas. Fuel cells offer a unique alternative for producing electricity very efficiently. A fuel cell is similar to a battery. It uses an electrochemical process to directly convert chemical energy into electricity and hot water. The fuel cell technology produces electricity from hydrogen without combustion by combining hydrogen and oxygen in the presence of an electrolyte. The hydrogen gas that is the fuel source can be produced from renewable resources, making the emissions virtually zero. Besides the low to zero emissions associated with fuel cells, other environmental benefits include the avoided impacts of grid extension and the avoided need for diesel generators in rural areas.

It has been shown that of the energy stored chemically in the fuel (e.g., hydrogen), fuel cells can convert between 40-60% into electricity. If the heat released in the process is captured and used, then fuel cells have the potential to achieve efficiencies of 85-90%

(Energy Innovations, 1997). This compared to combined electric and thermal efficiencies for internal combustion engines and gas turbines of 60% makes fuel cells an important emerging technology.

For rural areas, fuel cells could offer reduced cost for power and improved energy services. As mentioned above, fuel cells are more efficient than other small-scale generators operating on diesel and also offer a more reliable power source. In addition fuel cells are small, modular and quiet. The units range in size from 1 kW to 250 kW, making the smaller units potentially suited for rural villages. However, at this point the costs are still high relative to other renewable energy technologies and especially fossil fuels. For example, the currently commercially available units cost US\$300,000 (\$1,500/kW) and maintenance costs are on the order of US\$0.015/kWh (Energy Innovations, 1997). However, as the technology advances and the costs come down, fuel cells will be important to consider in rural energy development.

### *Costs of renewable energy power*

As costs have declined significantly over the last 10 years, renewable energy technologies have become competitive with conventional technologies in many locations and applications. Many of the renewable energy technologies are now fully commercial or are on the threshold of commercialization pending the development of adequate marketing and support services to arrive at the economies of scale afforded by wider dissemination. Costs are expected to continue to decline as technologies are further developed and the number of installations increases. The prices of renewable energy systems, as compared to the more common diesel generators used in rural areas, are currently very competitive (see Table B-2).

Although renewable energy systems have high initial capital costs, it should be noted that savings in fuel and other operating costs could offset the higher up front costs. Because of the short-term horizons by which investment decisions are currently evaluated and the unfamiliarity with the technologies, these excellent options are currently not as widely used as they could be. The cheapest technologies in the short-term are often not the most efficient nor cost-effective when evaluated in the medium-term and when environmental and social costs are included. Moreover, it will be important to consider these technologies on a life-cycle cost basis rather than a first-cost basis. In addition, to make these modern energy services available to people in rural areas, it will be critical to develop mechanisms that make credit and capital available to make these systems affordable.

If energy services are examined instead of only electricity costs, renewable energy systems tend to be even more cost-effective. Using rural energy data from six developing countries, Martens (1997) compared the performance of renewable energy systems with conventional energy systems for seven end-use services: water pumping, village electricity, household electricity, communal cooking, household cooking, enterprise water heating, and household water heating. It was found that in 32 out of the 36 cases a

renewable energy system was the most cost effective option. However, large cost differences exist between technologies for each specific end-use service; illustrating the importance of specific local conditions on the cost effectiveness of renewable energy systems. Moreover, the energy costs between services varied significantly. Martens (1997) found that water pumping and electricity provision are the most expensive end-use services in terms of costs/kWh.

**Table B-2: Comparison of costs of electricity from selected renewable energy resources in rural areas**

Technology	Cost of Electricity (US¢/kWh)
Photovoltaics	80-\$1.00
Wind	40-70
Biomass-combustion	15-25
Biomass-gasifier	8-14
Fuel cells <sup>1</sup>	5-8
Diesel	35-45

<sup>1</sup>Note: For advanced systems with solid oxide fuel cells coupled with biomass gasifiers

Source: World Bank (1996) and D. Barnes, World Bank, personal communication.

An opportunity exists for developing member economies to benefit from a transfer of technology from the industrialized economies. Over time, as the market for renewable energy expands, there will be a need to build up the local manufacturing capacity of energy systems. Possibly, this could be done through joint ventures where a foreign company joins with a local partner to produce and market parts or whole systems.

***Further information on renewable energy and rural energy development***

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## **APPENDIX C INDIVIDUALS AND ORGANIZATIONS CONSULTED IN THE PREPARATION OF THE APEC GUIDEBOOK FOR FINANCING NEW AND RENEWABLE ENERGY PROJECTS**

Mr. Patrick Adcock  
President  
Econergy International Corporation

Ms. Helen A. Chaikovsky  
Senior Vice President  
Environmental Enterprises Assistance Fund

Ms. April Allderdice  
Staff  
Grameen Shakti

Mr. Dipal Chandra Barua  
Managing Director  
Grameen Shakti

Mr. Douglas F. Barnes  
Energy Planner  
Industry and Energy Department  
The World Bank

Mr. Rob deLange  
President  
PT Sudimara Energi Surya

Mr. Hermenegildo Bautista  
Program Manager  
Development Bank of the Philippines

Dr. Pascal DeLaquil III  
Director  
EnergyWorks

Mr. Ron Benioff  
Energy and Environment Team Leader  
National Renewable Energy Laboratory

Mr. Toshihiko Doi  
Deputy Director  
Project Department, Energy Sector  
The Japan Development Bank

Mr. Michael Bergey  
President  
Bergey Windpower

Mr. Michael T. Eckhart  
Managing Director  
Solar Bank Development Fund

Dr. Timothy Brennan  
Professor  
University of East Anglia

Ms. Christine Eibs Singer  
E&Co  
Energy House

Ms. Carolyn W. Breslin  
Project Officer  
International Finance Corporation

Mr. Prodipto Ghosh  
Senior Environment Specialist  
Office of Environment and Social Development  
Asian Development Bank

Mr. Marshall N. Carter  
Chairman and Chief Executive Officer  
State Street Corporation

Mr. Ashok Gupta  
Senior Energy Economist  
Natural Resources Defense Council

Mr. J. Gururaja  
Interregional Adviser  
Energy Planning and Management Branch  
United Nations

Dr. Eric Larson  
Professor  
School of Engineering/Applied Science  
Princeton University

Mr. Mark Hammonds  
Global Product Manager  
BP Solar

Ms. Alice LeBlanc  
Emissions Trading Consultant  
Environmental and Economic Consulting

Mr. Edu Hassing  
Senior Project Officer, Energy Division  
Asian Development Bank

Dr. Jeremy Leggett  
Executive Director  
Solar Century

Mr. Dan Jantzen  
Program Officer  
Winrock International

Mr. Art Lilley  
Community Power Corporation

Professor Thomas B. Johansson  
Director  
Energy and Atmosphere Programme  
United Nations Development Programme

Mr. K.R. Locklin  
Managing Director  
Renewable Energy and Energy Efficiency Fund  
Energy Investors Fund

Mr. Roberto C. Julian  
Financial Advisor  
Preferred Energy Incorporated

Ms. Victoria Lopez  
Executive Director  
Sibol ng Agham at Teknolohiya Inc. (SIBAT)

Mr. John Kadyszewski  
Director  
Renewable Energy Program  
Winrock International

Mr. Rene Magermans  
Project Manager  
Triodos Deelnemingen

Ms. Gail Karlsson  
Sustainable Energy Specialist  
United Nations Association

Mr. Stefan Magnusson  
Vice President  
Credit and Risk Management  
Republic National Bank

Ms. Dominique Lallement  
Manager  
Energy Sector Management Assistance Program  
The World Bank

Mr. Jan-Willem Martens  
Research Assistant  
Energy and Atmosphere Programme  
United Nations Development Programme

Mr. Philip LaRocco  
E&Co  
Energy House

Ms. Mary McClellan  
Project Finance Specialist  
International Institute for Energy Conservation

Ms. Susan McDade  
Technical Specialist  
Energy and Atmosphere Programme  
United Nations Development Programme

Dr. David Renne  
Manager  
Resource Assessment Program  
National Renewable Energy Laboratory

Mr. Peter McKenzie  
Consultant  
ASE Americas, Inc.

Ms. Wendy Rodenheiser Aulakh  
Manager  
Communications and Project Development  
Sunlight Power International

Mr. Hiroaki Nagayama  
Staff Researcher  
Asian Market Research Department  
Mitsubishi Research Institute, Inc.

Mr. John H. Rogers  
Global Transition Consulting, Inc (joint venture  
between Enersol and SOLUZ).

Mr. Kazuo Nishinoiri  
Senior Engineer  
Solar Energy Team  
The Institute of Energy Economics

Mr. Christopher J. Rovero  
Program Officer  
Winrock International

Mr. Masao Otsuka  
Chief Manager  
Structured Finance Division  
The Bank of Tokyo-Mitsubishi, Ltd.

Dr. Richard Sandor  
President and Chief Executive Officer  
Centre Financial Products

Mr. Mohan Peck  
Economic Affair Officer  
Energy Planning and Management Branch  
United Nations

Ms. Grace Santibanez-Yeneza  
Managing Director  
Preferred Energy Incorporated

Mr. Michael Phillips  
Editor  
Clean Energy Finance

Ms. Camilla Seth  
Senior Associate  
EA Capital

Mr. Daniel Ponzi  
Programme West  
Asian Development Bank

Ms. Judith Siegel  
Senior International Market Analyst  
Asia Alternative Energy Program  
The World Bank

Mr. Robert Lopez Puckett  
President  
Solar Electric Company, Inc.

Mr. James Sprockett  
Manager  
Energy West  
Asian Development Bank

Mr. Ross Pumfrey  
Director of Renewable Energy Programs  
Office of Energy and Infrastructure  
U.S. Agency for International Development

Mr. Roger W. Taylor  
Manager, International Programs  
National Renewable Energy Laboratory

**Dr. Griffin Thompson**  
Director, Global Climate Change  
International Institute for Energy Conservation

**Mr. Ron D. White**  
Senior International Market Analyst  
National Renewable Energy Laboratory

**Mrs. Marilou van Golstein Brouwers**  
Manager, Triodos-Doen Foundation  
Triodos Bank NV

**Mr. Neville Williams**  
President  
Solar Electric Light Fund

**Mr. Hidehito Wakabayashi**  
Manager, New Energy Division  
Photovoltaics Business  
Showa Shell Sekiyu K.K.

**Mr. Paul Wormser**  
Director, International Marketing and Sales  
ASE Americas, Inc.

**Mr. Robb Walt**  
President  
Community Power Corporation

**Mr. Kazuo Yoshino**  
Senior Adviser  
Showa Solar Energy K.K.

**Mr. Jerome Weingart**  
President  
Jerome Weingart and Associates

**Mr. Dana R. Younger**  
Consultant, Global Environment Facility  
International Finance Corporation



