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Renewable energy investment by the World Bank

Eric Martinot*

Stockholm Environment Institute—Boston, 11 Arlington St., Boston, MA 02116, USA

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Abstract

World Bank Group lending for renewable energy accelerated in the 1990s and resulted in 17 approved projects with $700 million in Bank loans and $230 million in grants by the Global Environment Facility. The Bank's 1999 energy-sector strategy *Fuel for Thought* charted new directions for renewable energy investment. The present paper considers the implementation challenges of *Fuel for Thought* strategies and the opportunities for carrying them out. The paper distinguishes between agendas in the energy and rural-development sectors, and reviews limitations to implementing these agendas. Lessons from projects are just emerging, but suggest five areas of support for renewable energy by the Bank in the future: renewable energy financing, electric power policy frameworks, rural energy enterprises, regulated rural energy concessions, and domestic technology manufacturing. Interviews with the private sector suggest additional forms of support: assist with business plans, finance pre-feasibility studies, reduce commercial risks, support joint ventures, build market volume and stability, and pilot and test innovative business models. The effectiveness of the Bank in following through on its ambitious agenda fundamentally rests on the willingness and commitment of developing countries to pursue these strategies and the degree to which renewable energy applications are seen to serve countries' development priorities.

Keywords: Electricity; Rural energy development; Multilateral development banks

1. Introduction

World Bank Group lending for renewable energy projects in developing countries accelerated during the 1990s as a confluence of development, environment and social factors began to convince the Bank and its client countries that renewable energy projects were viable investments.[1] By 1999, assisted by grants from the Global Environment Facility (GEF), the Bank had approved 17 renewable energy projects with a total cost of $3.2 billion, which includes Bank loans and credits of $700 million and GEF co-financing of $230 million. An additional 13 projects had been awarded about $210 million in grants by the GEF but not yet approved by the Bank (see the appendix for a description of the Bank's renewable energy project portfolio).

Three milestones stand out in the evolution of renewable energy within the Bank during the 1990s. In 1992, the Bank established the Asia Alternative Energy Program (ASTAE) to bring renewable energy and energy efficiency into the Bank's power sector lending in Asia.[2] Funded primarily from outside the Bank by bilateral donors and other partners, ASTAE greatly facilitated preparation and implementation of a broad portfolio of renewable energy projects and activities throughout Asia. ASTAE experts also assisted with renewable energy projects in other operating regions of the Bank and were able to boost renewable energy activity by enabling Bank task managers to proceed with greater confidence in developing the new project approaches demanded by renewable energy and in working with new local country counterparts.

In 1996, the Bank published *Rural Energy and Development: Improving Energy Supplies for Two Billion People* (World Bank, 1996a). This small book emphasized the connection between energy services and rural poverty alleviation. It highlighted the fact that two billion people

* The research underlying this paper was conducted when the author was an Associate of the Stockholm Environment Institute—Boston. He now works for the Global Environment Facility.

E-mail address: emartinot@worldbank.org (E. Martinot).

[1] The term "Bank" refers to the World Bank Group throughout the paper. The term "renewable energy" refers to solar, wind, biomass, geothermal and mini-hydro technology applications; large-scale hydropower is excluded.

[2] For more information see www.worldbank.org/astae.

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still lack access to modern energy services like electricity. This book, and the work that preceded it, helped to launch preparation of more than 10 Bank projects for providing energy services to rural populations lacking access to electricity, through the use of solar photovoltaics and other renewables (see appendix for a review of the early studies). This book outlined an 8-point action plan for broadening energy access in rural areas, including a greater emphasis on rural energy throughout the Bank and a new rural energy initiative for Africa.

In 1999, the World Bank board of directors adopted a sector-strategy paper entitled *Fuel for Thought: Environmental Strategy for the Energy Sector*. This paper promised to promote energy sector reform that makes renewables more competitive with conventional energy sources (often called "leveling the playing field"). It also promised to promote renewable energy projects "as mainstream activities where they are cost-effective solutions to energy and environmental priorities" and to "expand support for the identification and preparation of renewable energy … projects" (World Bank, 1999a, p. 35).

Fuel for Thought also proposed a new "strategic partnership" with the GEF for renewable energy. The proposed strategies under this partnership recognized the experimental, iterative and time-intensive nature of effective models and strategies, along with the need for rapid response to private sector proposals. Four key features of the proposed program were: (a) *adaptable program loans* to provide long-term policy and investment programs (up to 10 years) in a particular country with flexible tranches and adjustable designs; (b) *policy tools* that facilitate supportive regulatory frameworks for grid-connected renewable energy in developing countries; (c) a *rapid response envelope* to allow quick investment decisions on private-sector opportunities meeting pre-agreed criteria; and (d) *country-based intermediaries* to identify and appraise projects. As an interim target, the Bank proposed $150 million annually in GEF resources combined with $600 million per year from the Bank and other sources. This commitment was far larger than historic lending patterns.

Although the emerging renewable energy project portfolio and the plans in the 1996 paper and in *Fuel for Thought* are laudable, the prospects for renewable energy investments by the Bank are still uncertain. What challenges does the Bank face in continuing to finance renewable energy investments in its client countries? What are the strategic opportunities for carrying out an ambitious renewable energy program, particularly in partnership with the private sector? Interviews conducted by the author with Bank task managers, private-sector renewable energy firms, and energy/environment researchers and advocates, combined with emerging project experiences from Bank projects, help to address these questions. This paper is based partly on a series of interviews conducted during 1998 and 1999 while the author worked as a consultant for the Environment Department of the World Bank. Nevertheless, the views expressed are strictly those of the author and do not necessarily reflect the views of the World Bank Group or any of its client governments.

2. Agendas for renewable energy investment by the Bank

Renewable energy and environmental advocates have often encouraged the Bank to lend more for renewables (Kozloff and Shobowale, 1994; Flavin and Tunali, 1996; Flavin, 1997; Institute for Policy Studies, 1998; PCAST, 1999).[3] Typical was the US President's Committee on Science and Technology (PCAST) 1999 report, which called upon multilateral development banks to begin a transition "from conventional technologies to supporting clean technologies" (p. 3–36). While this report did not call for specific targets, others have advocated targets like 15% of total Bank energy-sector lending devoted to renewable energy. These "supply-side" views see the Bank in a position to supply greater aggregate amounts of investment capital and other assistance for renewable energy projects in the energy sector.

The "supply-side" agenda of renewable energy and environmental advocates is often shared by technology manufacturers, R&D planners and bilateral assistance agencies pushing technology exports. These players often think of renewables by specific technology type — wind, solar, biomass, small hydro. Together with environmental advocates, their agendas may include combating global climate change, expanding market opportunities for technology suppliers in developing countries, and stimulating technology advances and cost reductions engendered by greater technology deployment.

A common response to the "supply-side" view is that client countries must be willing to borrow for renewables before the Bank can lend — the "demand side" of the equation. This means countries must understand the costs and benefits of renewable energy technologies and their potential to solve the most pressing development problems before they are willing to borrow, say Bank managers. "Borrower commitment" is constrained by lack of familiarity with renewable energy technologies, lack of understanding of the costs and benefits and

[3] During the 1990s, renewable energy markets in developed countries accelerated rapidly as renewables became competitive with conventional energy supplies in some applications and as favorable policies towards renewables were enacted — see for example Grubb (1995), Shepherd (1998), and IEA (1997, 1999). Developing countries' experience has been more moderate but quite varied in the range of applications and experiences — see for example Goldemberg and Johansson (1995), Ramana (1997), and ESMAP (2000a, b).

international experience, perceptions of increased risk, and entrenched political interests which bias policy-makers towards conventional energy supply. Borrower commitment also can be affected by other factors:

- energy prices may be too low for renewable energy to compete on economic grounds (perhaps because of explicit or implicit subsidies for conventional energy);
- Ministries of Finance (the official counterpart for Bank lending) may be conservative, may not understand renewable energy, may be reluctant to provide guarantees, and may not trust new financing arrangements like credit lines;
- countries may be reluctant to borrow for renewables when they are able to receive bilateral grant money for the same thing;
- the "shadow" cast on renewable energy by failures of rural electrification projects in the 1970s and 1980s may dampen enthusiasm for the current generation of projects;
- private-sector project developers may be unable to absorb financing and conduct projects if the private sector is not strong enough;
- urban utilities may be in poor financial condition and unable to afford work in rural areas; and
- renewables may be perceived to have an insufficient technological track record.

Nevertheless, renewable energy investments may be consistent with the agendas of developing country governments. For example, governments may wish to reduce local air pollution as part of environmental policy, or promote domestic renewable-energy-based businesses and industries as part of industrial or technological policy. They may wish to accelerate rural electrification with renewables through the private sector in the absence of sufficient public resources to do so. They may wish to attract grant financing for certain technologies from bilateral and multilateral donor agencies. And some developing countries, such as China and India, are beginning to embrace ambitious plans and quantitative targets for future renewable energy development, and look to the Bank and other multilateral agencies for both financing and assistance with policy development (Gupta, 2000; SDPC, 2000; SETC, 2000).

Off-grid renewable energy applications highlight a disparity between energy-sector agendas and rural-development agendas. Consider the case of rural electrification. By 1999, the Bank had approved a portfolio of 12 "solar home systems" projects. These projects by and large support the private sector to provide small amounts of electricity to individual homes for lighting, TV, radio, and other small appliances through the use of solar photovoltaic systems (Martinot *et al*., 2000a, b). Initially, these projects were driven by a "supply-side" agenda which went something like this: (i) electrification is necessary for rural development; (ii) despite large gains in rural electrification in developing countries over the past few decades, providing grid-extension to the 2 billion people currently without access to electricity is going to be very costly and will take time; (iii) solar home systems represent least-cost ways of providing rural electrification in the short or medium term while also satisfying environmental concerns; and (iv) solar home systems are "commercial" because their lifecycle costs are comparable to the costs of avoided kerosene, candles, and batteries, and so can be "delivered" by the private sector.

But despite the fact that rural home lighting meets an important development need, "rural electrification" is still fundamentally an energy-sector agenda. The question "how to most cheaply provide electricity to rural households?" is not the question rural development professionals ask first. Instead, they ask how renewables offer advantages to people in developing countries in meeting basic everyday needs. A "development" view focuses on the productive applications of renewable energy (i.e., water pumping in agriculture, lighting in residential housing and public schools, vaccine refrigeration, cottage industries, and telecommunications services), particularly those that result in new income generation or better ways to provide social services. And funds spent on energy services from renewable energy must be weighed against competing priorities for rural development finance — such as clean water, sanitation, health care, education, transport, and housing.

As the Bank more strongly began to embrace a mission of poverty alleviation in the 1990s, the role of renewables within the Bank started to become less driven by an energy-sector agenda and more driven by a rural-development agenda. Still, there are obstacles to both agendas — the subject of the next section.

3. Factors limiting renewable energy lending by the Bank

Borrower commitment to grid-connected renewable energy and the productive use of renewable energy in rural development may overcome many of the internal barriers to renewable energy within the Bank. Nevertheless, these barriers still exist. Many internal barriers result because renewable energy projects are *not* simple investment projects. Rather, projects may develop new financing and institutional mechanisms, support rural energy enterprises or private-power-project developers, conduct extensive training, promote consumer awareness, facilitate codes and standards, and undertake other so-called "barrier removal" activities that are often part of elaborate technical assistance strategies rather than pure financing (see Martinot and McDoom, 2000 for detailed descriptions of project approaches). In interviews with a number of Bank managers by the author during 1998 and 1999, several types of internal barriers to renewable energy were revealed.

3.1. Pressure on project preparation resources

Task managers and investment officers are under pressure to deliver projects in the shortest possible timeframe, and often lack the resources, knowledge, and time to pursue renewable energy projects. Preparation time and expense for renewable energy projects can be substantially more than for conventional projects (one manager estimated 30–60% more), which makes them unattractive to a manager with fixed resources and time pressures. Managers under pressure to deliver new investments in the shortest possible time will tend to avoid renewable energy projects, all else being equal.

3.2. Nontraditional project risks

In additional to traditional project risks (procurement, construction, future energy prices, and cost overruns), renewable energy projects often require new technology experience, new institutional development, new financing/contractual mechanisms, and technology acceptance by financiers and stakeholders. Building new institutions in projects is often an expensive, difficult and time-intensive activity. Many project features could be considered "experimental" because an accepted set of best practices for the kinds of project interventions needed to develop renewable energy markets simply does not exist. These nontraditional project risks require a risk-taking mentality and incentives that do not penalize managers when parts of projects do not turn out as expected.

3.3. Lack of appropriate skills

Renewable energy projects can be quite different from traditional energy-sector investment projects. Task managers in the energy sector and their normal set of consultants may not possess the necessary skills or knowledge. Relevant lessons and "best practices" must be identified and incorporated into project design, for example institutional development, test activities, and social surveys. Task managers, as engineers and economists, may not be trained or skilled in institution building. They may have to hire consultants outside of the normal skill set or qualifications to which they are accustomed. In the Asia operating units, ASTAE has assisted task managers with best practices and in doing so has played an important role in facilitating energy projects.

3.4. Lack of attention in country assistance strategies

Rural and renewable energy are not often explicitly called out in the Bank's formal country assistance strategies. Consequently, country directors — who control preparation and manpower budgets and assignments — have no mandates or strong managerial incentives to devote their resources to renewable energy projects.

3.5. Limited experience and interest in the social and rural development sectors

Renewable energy is still seen as primarily an energy-sector activity. The social and rural development sectors still have limited experience with renewable energy, despite being in a good position to implement rural energy projects and utilize community-based institutions. As an indication of how far the social sectors have to go, a 1999 Bank review of current thinking on rural infrastructure issues did not mention solar home systems or renewable energy (Pouliquen, 1999).

3.6. GEF project preparation burden

All Bank renewable energy projects in the 1990s were facilitated by GEF grants (many said none of these projects would have happened without the GEF). Yet additional burden comes from the need to prepare separate GEF documentation and get GEF Council approval for these grants. Even though special GEF project-preparation resources are available, the process can be burdensome for Bank managers. They generally do not want the added complexity, and, if unfamiliar with GEF procedures, do not want to have to learn another set of rules.

3.7. Corporate reorganization

During the 1990s, renewable energy expertise accumulated within the Bank's central Energy Department. During the period 1998–1999, as part of a corporate-wide reorganization, most of the Bank's renewable energy experts not in ASTAE were moved from the central Energy Department to Africa, Latin America/Caribbean, and South Asia operating regions. Although these experts became tied together through a Bank-wide "Rural and Renewable Energy Thematic Group", the success of these new groupings remained to be seen. Perhaps the ASTAE concept can be replicated in each region through this process, but the potential downside is the dilution of a previously existing core group of expertise.

4. Opportunities for the Bank: lessons from emerging experience

Lessons from Bank renewable energy projects are just beginning to emerge. Of the 17 projects approved since 1992, only one project had been formally completed by the end of 1999 (Mauritius Sugar Bio-Energy). Two others were essentially completed (India Renewable Resources Development and Phillippines Leyte-Luzon), three had substantial implementation progress (Small and Medium Scale Enterprise Program, Sri Lanka Energy Service Delivery, and Tunisia Solar Water Heating), and the remainder were in the early stages of

implementation. Thus the volume of available experience is still small relative to the potential for future project assessments and lessons as the portfolio matures (Martinot, 1998).

Nevertheless, emerging lessons point to at least five areas where the Bank has been effective in lending and technical assistance for renewable energy (Martinot and McDoom, 2000; Martinot *et al*., 2000, 2001). These are highlighted below. Further analysis and experience has and will likely point to areas beyond these five as well.

4.1. Support for renewable energy financing

Project financing for developers of grid-connected renewable energy projects has been one barrier to renewable energy that Bank projects have helped overcome. The India Renewable Resources Development project occurred in parallel with the explosive market growth of wind power in India in the mid-1990s, fuelled by favorable investment tax policies and a supportive regulatory framework. By 2000, more than 1200 MW of wind turbine capacity had been installed in India and dozens of wind turbine manufacturers had emerged.[4] During the 1990s, the project directly financed 41 MW of private-sector wind turbine installations in India. More importantly, the project strengthened the capabilities of the India Renewable Energy Development Agency (IREDA) to promote and finance private-sector investments, and more than 360 MW of wind projects were financed through IREDA. The project also promoted the acceptability of wind power among investors and banking institutions. As a result, along with favorable market conditions, many sources of finance became available for wind power, which was a key project goal.

In Sri Lanka, the Energy Services Delivery project was providing financing to private-sector small-hydropower developers and was innovating microfinancing schemes for installations of rural solar home systems. By 2000, the project had financed, through commercial-bank intermediaries, more than 21 MW of small hydropower by independent power producers (IPPs).

Business financing for delivery of rural energy services and credit to improve the affordability of those services among rural households have been significant barriers to renewable energy in rural areas. The Sri Lanka project was also providing business financing for rural solar home enterprises through commercial banks and was demonstrating the initial viability of a "microfinance model". Under this model, piloted through the project, solar home systems enterprises market, sell, service and warrantee their products to rural consumers through their own local sales/service offices. Consumers obtain loans (at typically 2–5 year terms) to purchase the systems from a separate non-profit microfinance institution with many local branches and strong ties to the communities in which it operates. By 1999, over 1000 systems had been installed and arrangements were in place for installation of an additional 5000 systems with microfinance through 2000.

4.2. Support for electric power policy frameworks

Frameworks that enable IPPs to invest in renewable energy and sell power to a utility network are fundamental to development of grid-connected renewable energy (other policies are also helpful; see Martinot, 2000). Experience in Mauritius and Sri Lanka suggests that the Bank is able to facilitate such frameworks.

In Mauritius, the Sugar Bio-Energy project indirectly catalyzed dramatic changes in electricity generation from bagasse. The project financed efficiency investments in sugar mills to provide surplus bagasse for power generation. The project also provided technical assistance and technology demonstrations to promote private/public sector cooperation in power plant ventures and to optimize the use of sugar cane for power generation. Partly as a result of the project, electricity generation from bagasse in Mauritius increased from 70 GWh/yr in 1992 to 118 GWh/yr by 1996. A project completion report stated that "extensive dialogue between the public and private sector on design work, the least-cost power development plan, and power purchasing agreements have directly or indirectly led to the development of other power plants".

One of the lessons from the Mauritius project is how creating an investment climate for renewable energy power projects, and creating public–private partnerships, can lead to supportive regulatory frameworks. In this case, the project led to the establishment of an IPP framework and an administrative focal point for private/public sector partnerships in IPP development. A project evaluation states that "the project's major accomplishment was progress in helping to establish an institutional and regulatory framework for private power generation in Mauritius and the provision of technical studies and trials to support technologies for improved bagasse production and improved environmental monitoring". A planned demonstration bagasse plant under the project was never constructed, which suggests that technical demonstration can have less of an influence on promoting renewable energy than other types of project interventions.

In Sri Lanka, the project successfully developed IPP frameworks and standardized "non-negotiable" power-purchase tariffs and contracts for power from small-hydro, biomass and wind. The project provided enough incentive for the national utility to adopt IPP frameworks and agree to private-sector small hydro developers, which together with the demonstration effects of

[4] The late 1990s saw a marked downturn in wind power development in India. See Jagadeesh (2000).

prior mini-hydro installations and new incentives for project developers (such as import duty waivers and income tax concessions) spurred private small-hydro developers.[5]

4.3. Support for rural energy enterprises

The Bank has had initial success supporting rural enterprises in providing energy services based on renewable energy. In addition to the Sri Lanka case mentioned above, business financing for rural energy enterprises was being provided under the Small and Medium Scale Enterprise (SME) Program to three rural solar home systems businesses in Bangladesh, Vietnam and the Dominican Republic. The Bangladesh project was demonstrating a business model in which the dealer (Grameen Shakti, legally a non-profit) performs marketing, sales, service, credit provision (up to 3-year terms), credit collections, and guarantees. From 1997 to 1999, Grameen Shakti installed 1500 systems using this model, and planned to install 2000–2500 systems in 2000. In Vietnam, sales by a private dealer were being assisted by a complex credit delivery scheme financed partly by the SME program involving the Vietnam Women's Union (VWU), an NGO, and the Vietnam Bank for Agriculture and Rural Development (VBARD), a development finance institution.

In the Dominican Republic, SME Program business financing helped a private firm to develop a successful fee-for-service business model. The firm charges rural households an affordable monthly fee for electricity from a solar home system and expects to be able to serve up to 50% of the population in the rural communities it serves. As of April 2000, the firm had installed over 3500 systems and had passed the break-even point where revenues covered the direct costs of operations. The firm was developing a business model that would support 25,000 customers and was seeking additional assistance for such "business-model R&D", which it found very difficult to fund from operating revenue alone.

Technical assistance to rural energy enterprises to help develop sustainable local sales and service infrastructure is also part of many rural energy projects. For example, in Sri Lanka, the project helps train technicians, develop business plans, and market solar home systems. In the Comoros, technical assistance through an ESMAP project assisted with developing the rural market for solar equipment there (ESMAP, 2000b).

4.4. Support for regulated rural energy concessions

There appears to be a clear role for the Bank to assist local and regional governments to establish and regulate private-sector rural energy service concessions. The Argentina Renewable Energy in Rural Markets project was the first to pilot such an approach — which was also being adopted in several other countries in Latin America and Africa (Reiche *et al*., 2000). In Argentina, 15-year concessions are to be regulated by provincial governments and selected competitively. These concessions are obligated to provide energy services to rural households in the concession territory upon demand. They must carry out all necessary maintenance, repairs or replacement of components as needed to ensure the continuity of the electricity service to each and every customer, and must charge standard regulated tariffs for energy services. The Bank- and GEF-supported project is helping to resolve numerous issues associated with such a scheme, such as setting tariffs, finding and attracting capable bidders, conducting competitive bidding procedures, and ensuring service quality standards.

4.5. Support for domestic technology manufacturing

A few projects explicitly target support to improve domestic technology manufacturing capabilities. For example, the Renewable Energy Development project in China finances 190 MW of wind farms. Project developers will construct the wind farms and sell power to utilities through commercial power-purchase agreements. These investments would practically double the installed wind capacity in China. Procurement will occur through international competitive bidding to provide the lowest commercial prices possible, and the project strengthens the ability of Chinese wind turbine manufacturers to compete in such procurements. The project includes a $90 million technology improvement component to assist domestic wind-turbine and photovoltaic manufacturers to innovate, improve quality, and reduce costs — with both technical assistance grants and production investment loans (World Bank, 1999b).

5. Strategies for involving and supporting the private sector

In the past three decades, "donor-driven" renewable energy projects, mostly through bilateral assistance, have resulted in significant equipment installations in developing countries. But an "equipment demonstration"

[5] However, one of the lessons from the Sri Lanka project is that variable power-purchase tariffs can hinder market development. In this case, tariffs were tied to *short-run* avoided utility costs based on the international price of oil. In 1997 and 1998 tariffs were set at the equivalent of 5 cents/kWh and mini-hydro development flourished. However, because of the downturn in oil prices during 1998–1999, prices were only the equivalent of 3.5 cents/kWh in 1999. As a result, all development essentially stopped in 1999. And this fluctuation has seriously hurt the longer-term interest of private mini-hydro developers in Sri Lanka (Bandarenke, 2000).

mentality has prevailed, in which the main objective has been simply the installation and maintenance of a certain number of systems or installed capacity. While there are exceptions, these projects have generally failed to promote commercial sustainability and replication. In fact, the expectation of continued equipment demonstrations through bilateral assistance can hinder the formation of commercial markets. In addition, there are examples of growing markets for renewable energy applications in developing countries that have emerged through private-sector initiative and favorable national policies with little explicit development assistance, such as the solar photovoltaic market in Kenya (Barnett, 1990; Foley, 1993; Kozloff and Shobowale, 1994; Goldemberg and Johansson, 1995; Kammen, 1999; Duke *et al*., 2000).

In view of the lessons from bilateral assistance programs, and the potential for private-sector investment to eclipse development assistance for renewable energy, the Bank and GEF have sought to involve and support the private sector. As illustrated in the previous section, recent Bank renewable energy projects have been designed to promote commercial, sustainable markets and regulatory frameworks for a variety of renewable energy applications. These projects are aligned with the GEF Operational Program "Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs" (GEF, 1997). Within this program, support for the private sector can take several forms:

- Support private firms by providing financing, technical and business assistance, equipment subsidies, and marketing support. This support helps firms expand their business, innovate and test new business models (i.e., demonstrate profitability), and lower costs.
- Build capacities of government agencies and NGOs to promote renewable energy development, often in conjunction with studies, resource assessments, and market characterization.
- Create new financing vehicles like revolving funds, credit lines, and contingent business loans that are forgivable under specified conditions.
- Develop or strengthen regulatory frameworks for grid-based independent power producers, transparent power-purchase tariffs, and off-grid utility concessions that provide energy services to rural areas using renewable energy technologies.[6]

Beyond these general topics, interviews with 21 private-sector renewable energy technology manufacturers, trade associations, project developers, and industry observers in the United States and Europe by the author in 1998 and 1999 suggested a number of specific areas where the Bank and GEF could support the private sector with renewable energy development.

5.1. Assist firms with business plans

Firms want help with implementing their own business plans, for which they may have already expended considerable resources to develop. These business plans may lack certain elements to become "bankable", thus companies want to get grant assistance to support their plans. For example, grants could be used for developing market infrastructure (site surveys, distributors, dealers, service, marketing (demonstrations), for subsidizing capital equipment costs, and for guaranteeing financing risk by local financing institutions.

5.2. Support favourable regulatory policies

For grid-connected projects, firms welcome electric power regulatory frameworks that support renewable energy. Generally, firms cannot influence these frameworks themselves, so this is a high-value-added activity for the Bank from their perspective. Some brought up the "Electricity Feed Law" approach that has been used in Germany and Spain. "If you want market volume, there is no substitute for a feed law" said one firm. Firms also want the Bank to push for elimination of subsidies to conventional generation to create a more level playing field for renewables.

5.3. Finance pre-feasibility studies for small companies

Many smaller companies work on very short time horizons and identify specific project opportunities on a case-by-case basis. Firms need funding for pre-feasibility studies to support their project development work, often lacking the resources themselves to invest in studies with uncertain outcomes. One company suggested providing forgivable loans for pre-feasibility work; the loan would only be repayable if the resulting project was viable and was financed. Smaller project developers especially look to grants or forgivable loans to finance pre-feasibility studies because of the risks involved.

5.4. Reduce commercial risks and provide financing guarantees

Private project developers were generally not concerned about technical risks because they had confidence in their skills, technologies, and marketing ability. Commercial risks are the real problem, they said: contractual mechanisms and enforcement, cash flow, currency issues, uneven competition, etc. For example, one firm suggested

[6] For treatment of the Bank's policies related to electric power sector reform, see World Bank (1993).

the Bank could provide a "secondary mortgage market" to provide guarantees against project risks. Another said the Bank could induce governments to guarantee power purchase agreements with utilities, so that project developers could more easily obtain commercial financing based upon the power purchase agreements.

5.5. Support joint ventures

Firms were interested in joint ventures. Joint ventures to produce equipment locally will be critical for some technologies like wind turbines, where the costs of local production may be significantly lower than the costs of imports. Smaller companies need help to identify joint venture partners. Local joint venture partners need capital and technical assistance and training.

5.6. Build market volume and stability

One firm said, "we need larger projects to get volume up .... The future looks potentially rosy if we can build up the volume". With increased volume, private investments in market infrastructure, service, and marketing become commercially viable. Companies want a long-term market in which their investment to enter the market is not jeopardized by a market collapse after outside support ends. They do not want one-time interventions or short programs (i.e., 1–3 years) that will leave them hanging at the end. They want "market involvement risk" to be reduced through long-term programs lasting 5–10 years.

5.7. Pilot and test innovative business models

Especially for rural markets, firms believed that proven organizational and businesses structures and models to effectively deliver energy services using renewables do not yet exist. The Bank could help pilot different business models, even with small-sized grants. "There is a high degree of risk involved, as some models won't work; but to learn we need to try many different approaches", one firm said. Another agreed: "there's a high value-added in terms of developing and improving business models .... You want to stimulate markets based on these business models". Yet another said "grants should be tools for taking business risks". Fundamentally, the Bank and GEF should support business innovation because no one else is in a position to take such risks, firms seemed to agree.

The International Finance Corporation (IFC), the private-sector affiliate of the Bank, is implementing four private-sector projects with GEF support that respond to many of these concerns: the Small and Medium Scale Enterprise Programme (SME), the Renewable Energy and Energy Efficiency Fund (REEF), the Photovoltaic Market Transformation Initiative (PVMTI), and the Solar Development Group (SDG).[7] These projects are pre-established conduits for rapidly providing business financing to firms meeting established eligibility criteria or to eligible projects, along with business advisory services. By 1999, however, only the SME program had been under implementation. PVMTI was just starting in 1999 and SDG and REEF were still awaiting further capitalization.

6. Conclusion

The Bank has put much effort and resources into renewable energy in the last 10 years but still has comparatively little on the ground to show for it. The volume of completed investments from all projects is still small relative to their targeted investments. For example, of the more than half-million solar home systems which could be installed as a result of approved projects, only about 8000 had been financed and installed by 1999. Of the several hundred megawatts of grid-connected wind power, biomass and small-hydro in approved projects in the 1990s, less than 100 MW total had been installed.

Several factors have limited and continue to limit the ability of the Bank to lend for renewable energy. Still, one could argue that past efforts, conducted together with client countries, have raised awareness, understanding, interest, and commitment among these countries to consider renewables more seriously in the future and to enact domestic policies and programs more inclusive of renewable energy. Through studies and dialogue, the Bank appears able to develop borrower understanding and commitment to renewable energy applications. GEF and bilateral financing for studies, project preparation, and project financing has also been a key factor facilitating project decisions on both the Bank and borrower side, especially in the face of risk. The Bank should continue to use education, technical assistance and persuasion to increase client demand for renewables while at the same time removing internal barriers to increase the Bank's ability and willingness to lend for renewables.

But these are difficult tasks, and no one should expect the Bank to be able to expend adequate resources and time needed to do so — there is clearly a role for others here. It may be difficult for outside agents to help the Bank to increase internal support for renewables and overcome internal barriers. But NGOs, bilateral donors and other international agencies can work with developing countries and countries in transition to increase

[7] IFC has also financed, without GEF support, hydro projects in several countries, PV manufacturing in China, and biomass cogeneration and geothermal power plants in Guatemala. A variety of additional geothermal, wind, biomass, and PV projects were under consideration.

Table 1
World Bank Group renewable energy project portfolio (end of 1999)

Project (year approved by Bank)	Bank finance ($ mil.)	GEF finance ($ mil.)	Total costs[a] ($ mil.)	Technology applications
India: Alternate energy/renewable resources development (1992)	190	26.0	450	PV for home/commercial; wind & mini-hydro for grid
Mauritius: Sugar bio-energy development (1992)	15	3.3	55	Bagasse power for grid
Costa Rica: Tejona wind power (1993)	0	3.3	31	Wind power for grid
Philippines: Leyte-Luzon geothermal (1994)	227	30.0	1334	Geothermal for grid
Tunisia: Solar water heating (1994)	0	4.0	21	Solar hot water for home, public, commercial markets
Small and Medium Scale Enterprise program (IFC, 1995) [figures for renewable energy subloans only]	0	1.6	5	PV home systems for rural off-grid markets
Lithuania: Klaipeda geothermal demonstration (1996)	6	6.9	18	Geothermal for district-heat production
Indonesia: Renewable energy small power (1997)	66	4.0	141	Mini-hydro, biomass
Indonesia: Solar home systems (1997)	20	24.0	118	PV home systems for rural off-grid markets
Renewable Energy and Energy Efficiency Fund (IFC, 1997)	0	30.0	130	All applications possible
Sri Lanka: Energy services delivery (1997)	24	5.9	55	PV home systems off-grid; wind/mini-hydro for grid
PV Market Transformation Initiative (IFC, 1998)	0	30.0	120	All applications of PV
Argentina: Renewable energy in rural markets (1998)	30	10.0	120	PV and wind for variety of rural off-grid applications
Lao PDR: S. provinces renewable energy pilot (1998)	1.5	0.7	2.1	Village power for off-grid
Cape Verde: Energy & water sector reform and development (1999)	18	4.9	65	PV home systems for off-grid; wind power for grid
China: Renewable energy development (1999)	100	35.0	445	PV home systems for rural off-grid markets
Solar Development Group (IFC, 1999)	6	10.0	50	PV home systems off-grid; other PV applications
Projects with GEF grants approved (and year); still to be approved by Bank (financing subject to change)				
India: Solar thermal electric (GEF, 1996)	0	49.0	254	Solar thermal power plant
Brazil: Biomass power commercial demonstration (GEF, 1997)	53	40.5	122	Biomass integrated gasification/gas turbine
Benin: Decentralized rural energy (GEF, 1998)	2.2	1.1	6	PV home systems for rural off-grid markets
Togo: Decentralized rural energy (GEF, 1998)	2.2	1.1	6	PV home systems for rural off-grid markets
Guinea: Rural energy (GEF, 1999)	3	2.0	10	PV home systems and village-power for off-grid
Hungary: Szombathely CHP/biomass (GEF, 1999)	10	2.5	28	Biomass power for grid
India: Biomass energy for rural India (GEF, 1999)	0	4.2	9	Biogas for rural use (lighting, cooking, water)
Mexico: Hybrid solar thermal power plant (GEF, 1999)	n/a	49.4	178	Solar thermal power plant
Mexico: Renewable energy for agriculture (GEF, 1999)	14	8.9	31	PV and wind for electricity, water pumps in agriculture
Morocco: Solar based thermal power plant (GEF, 1999)	n/a	43.9	114	Solar thermal power plant
Philippines: CEPALCO distributed generation PV (GEF, 1999) [$21 m. financing facility for CEPALCO]	[see left]	4.0	8	Distributed grid-connected PV
Poland Geothermal and Environment (GEF, 1999)	44	5.4	85	Geothermal for heat supply
Thailand: Removing barriers to biomass power/CHP (GEF, 1999)	0	6.8	73	Biomass power for grid

[a]Total project costs may be rounded and may include amounts for other, non-renewable-energy components.

understanding of the contribution renewables can make to development priorities, and to enact policies that support renewables.

The Bank needs to devote considerable attention and resources to integrating renewable energy into the development agenda of its social and rural development units. It should also consider additional strategies for involving and supporting the private sector. The lessons and experiences from existing projects have the potential to contribute substantially to an understanding of the most effective approaches to developing markets for renewable energy in developing countries while meeting pressing development needs. But many of these lessons still remain to be learned in the future as the project portfolio matures.

Appendix. World Bank Group renewable energy project portfolio

After a number of geothermal projects in the 1970s and 1980s, renewable energy lending by the World Bank

Group began more seriously with the India Renewable Resources Development Project approved in 1992. Since then, 17 projects with renewable energy components in 16 countries have been approved (see Table 1).[8] All of these projects are partially financed with grants from the Global Environment Facility. Table 1 also contains an additional 13 near-term pipeline projects with grants already approved by the GEF but not yet fully prepared and approved by the Bank (GEF, 1999; Martinot and McDoom, 2000). In addition, other projects are in earlier stages of preparation (in the "pipeline").

Financing for the 17 projects amounts to $700 million in Bank loans and credits and $230 million in GEF grants, and leverages total project costs of $3.2 billion. Financing for all 30 projects could amount to $1.3 billion in Bank/GEF loans, credits, and grants, and leverage total project costs in excess of $4 billion. In most projects, substantial shares of project financing come from other donors, client countries, and/or the private sector.

Projects target off-grid photovoltaics (PV) for rural markets; wind, biomass, bagasse and mini-hydro power generation for utility markets; village-scale power from PV, wind, mini-hydro and biogas; solar hot water heating for home, public and commercial markets; geothermal for electricity or heat production; solar thermal central-station power plants; biomass integrated gasification/gas turbine power plants; and distributed grid-connected PV.

Besides formal projects, the Bank supported several renewable energy technical papers and studies (Ahmed, 1994; Liebenthal *et al*., 1994; Anderson and Ahmed, 1995; Foley, 1995; Stassen, 1995; Cabraal *et al*., 1996, 1998; Piscitello and Bogach, 1998). The joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP) program contributed to or sponsored many of these studies, and also conducted renewable energy development activities in several countries (ESMAP, 1999, 2000a, b).

Country-specific renewable energy studies, technical assistance and outreach were also conducted in particular countries. China is perhaps the most prominent example. Several ESMAP studies on rural energy in China in the early 1990s, along with a major greenhouse-gas mitigation study in 1994 funded by the GEF and other sectoral studies eventually led to the current Renewable Energy Development Project there (World Bank 1994, 1996b; ESMAP, 1996; Taylor and Bogach, 1998).

As concern about global climate change increased in the 1990s, the Bank conducted a retrospective review of energy projects — a "backcasting study" — to look at alternatives to traditional Bank energy projects (World Bank, 1998). The study reviewed project preparation reports for a sample of Bank energy loans between 1990 and 1996, in part to analyze whether assigning a monetary value to carbon emissions would encourage investment in low-carbon alternatives. The study developed plausible alternative options to reduce carbon emissions in the sampled projects using wind, mini-hydro and biomass.

[8] Project preparation reports were formerly called "Staff Appraisal Reports" and now are called "Project Appraisal Documents". These reports dated prior to 1997 are not public, but a policy change made the final versions of reports issued in 1997 or later available to the public from the Bank's public information center (www.worldbank.org/pic). Descriptions of all projects discussed in this paper can also be obtained from Martinot and McDoom (2000), which can be downloaded from www.gefweb.org. Project descriptions are available for some projects from www.worldbank.org/astae.

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