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ASSESSING THE POTENTIAL FOR MICROFINANCE INSTITUTIONS TO FINANCE SOLAR PHOTOVOLTAIC SYSTEMS IN THE DOMINICAN REPUBLIC

J. DOUGLAS PARKERSON

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Executive Summary

1.6 billion people live without access to electricity. Only half of the rural population in Latin America has electricity. In this report I assess the potential of reducing these figures by engaging existing microfinance institutions (MFIs) in the Dominican Republic in the financing of solar photovoltaic (PV) power systems for rural households. I gathered the information for this assessment through a literature review, interviews with MFI representatives, and audited financial reports.

The literature reveals that rural electrification is a valuable development tool that leads to improved quality of life in rural areas. It also shows that PV can be the least-cost option for providing electricity to remote, dispersed populations with low energy demands. A barrier to adoption of the technology is the high initial investment required. This can be overcome through financing, allowing the buyer to spread the initial cost over time. MFIs are a potential source of this financing.

The results demonstrate that there is potential for engaging Dominican MFIs in PV financing but identify the problem of accessing remote PV markets as the primary obstacle to overcome. A recommendation for overcoming this obstacle is for MFIs to partner with an existing PV company with a proven rural collection infrastructure.

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List of Abbreviations

ADEMI – Association for the Development of Microenterprise
ADEPE – Asociación para el Desarrollo de la Provincia Espaillat
ADOPEM – Asociación Dominicana para el Desarrollo de la Mujer
AFD – French Agency for Development
AIRAC – Association of Rural Savings and Credit Institutions
COOP-ADEPE – Cooperativa de los Servicios ADEPE
CVR – Cooperativa Vega Real
ESMAP – Energy Sector Management Assistance Program
FDD – Fundación Dominicana de Desarrollo
FONDESA – Fondo para el Desarrollo
GEF – Global Environment Facility
IEA – International Energy Agency
LAC – Latin America and Caribbean
MFB – Microfinance Bank
MFI – Microfinance Institution
MUDE – Mujeres en Desarrollo (Women in Development)
NGO – Non-Governmental Organization
NGO-MFI – Non-Governmental Microfinance Institution
PROMIPYME – Consejo Nacional de Promoción y Apoyo a la Micro, Pequeña y Mediana Empresa
PV – Photovoltaic
SGP – Small Grants Program of the GEF
UNDP – United Nations Development Program
USAID – United States Agency for International Development

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Chapter 1: Introduction

1.1 Living in the Dark

1.6 billion people live without access to modern forms of energy such as electricity and liquid fuels (IEA, 2002). That is roughly the equivalent of the entire populations of China, the United States, and the European Union put together. Four out of five people without electricity live in rural areas of the developing world. The majority of the people without electricity live in South Asia and sub-Saharan Africa, but the problem is not limited to those regions. In Latin America and the Caribbean there are 56 million people without electricity. Only 52 percent of the rural population can access electricity.

1.2 Structure of the Report

In this report, I examine the issue of providing electricity to the millions of rural residents of Latin America and the Caribbean (LAC) in an economically, socially, and environmentally sustainable way. With these goals in mind, I chose to focus on providing electricity through a renewable energy source, seeking to find the least-cost alternative, and making it widely available. These are the criteria that led me to assess the potential for engaging existing microfinance institutions (MFIs) in LAC in the financing of solar photovoltaic power systems for rural households.

I begin the report by reviewing the literature in four areas. The first area concerns the question – What is the impact of electrification on development? Put more simply – Why does electrification matter? The second area that I review concerns the topic of renewable sources of electricity and the conditions under which photovoltaic technology is the best option. I then review the literature concerning the barriers to adoption of PV, and finally I look at the various models used to deliver PV to rural households.

The literature review serves as the foundation for the assessment that follows it. In the remainder of the report I describe my primary research, including the methods, results, and conclusions from my assessment of the potential compatibility of MFIs and rural PV financing in the Dominican Republic.

Chapter 2: Literature Review

2.1 Why electrification matters

Rural productivity in the United States improved significantly due to the creation of the Rural Electrification Administration in the mid-1930s and the subsequent expansion of rural electrification throughout the country. The push for rural electrification was a huge success in the United States and led to a dramatic increase in rural quality of life. (Tobey, 1996).

The success of rural electrification in the United States has not been duplicated to the same degree in the developing world. In *Electric Power for Rural Growth: How Electricity Affects Rural Life in Developing Countries*, Douglas F. Barnes of the World Bank analyzes the impact of electrification on rural societies in the developing world (1988). In the book Barnes describes the evolution of the policy debate about rural electrification. In the 1960's and early 1970's, development professionals and governments placed what Barnes calls "blind faith" (p. 16) in rural electrification. The reports on the subject coming out of this period were overwhelmingly favorable and painted an optimistic picture of the socioeconomic impacts of rural electrification. Following the oil crisis in the mid-1970s an increase in energy research began to produce reports that were critical of the then current policy. As a result of this criticism, a series of new examinations of the impact of rural electrification were undertaken in the early 1980's, and a healthy policy debate emerged.

Advocates in the debate over rural electrification claim that investments in rural electrification are infrastructure improvements that result in increases in productivity and employment, which translate into improved quality of life (25). They believe that electricity is a more efficient and less expensive energy form than the forms of energy commonly available to the rural population in unelectrified areas. The critics of rural electrification that emerged in the 1970's assert that it is too expensive, its benefits are unequally distributed, and it does not directly benefit agricultural and industrial productivity (p. 26).

Finally, Barnes weighs the benefits of rural electrification against the costs. He employs a marginal cost method to evaluate the costs of rural electrification by calculating the incremental expense of supply (p. 157). To evaluate benefits, he uses an incremental benefit approach in which he determines electrification to be the least-cost method to provide energy, and then attributes net incremental outputs as benefits (p. 158). Barnes concludes from his analysis, "Under the right conditions, rural electrification can be one of the least-cost energy alternatives for socioeconomic development, but sparsely populated regions with little potential for productive use are the wrong sites" (p. 182). He later states, "Electrification certainly is not a magical force which will stimulate development in all circumstances" (p. 203).

Despite its rigor and breadth, Barnes concludes that his study has not adequately factored into the benefit-cost evaluation the social benefits of electrification because "they are hard to quantify in monetary terms" (p. 182). His inability to place a monetary value on such benefits as higher quality of rural life, more reading time for children, greater impact on women and children than men, and appliance use in the home to reduce drudgery is the fundamental shortcoming of the study.

In 2002, the joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP) published a report titled, *Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits*, which as the title suggests sought to address the issue of monetizing the socioeconomic benefits of electrification. Barnes was a co-author of the report, seeking to fill in the gaps of his earlier work.

The researchers apply well-established methods taken from resource and environmental economics to evaluate the benefits of rural electrification with an emphasis on development outcomes. The study evaluates electricity as a derived demand whereby "electricity is demanded not for its own sake but because it serves to lower the cost of other goods and services" (p. 13). With this distinction, the study estimates benefits as the area under the demand curves of the goods and services for which electricity lowers the cost. Two examples are that electricity lowers the cost of satisfying a household's demand for lighting and of satisfying a farmers demand for irrigation. The study's approach is better able to measure development outcomes than previous approaches and is therefore relevant to understanding the contribution of electricity to the overall development process (p. 11).

The researchers conclude, "It is possible to measure benefits traditionally considered intangible in monetary terms" (p. 3). Table 1 is a summary of the benefits of electrification for rural households in the Philippines. The values are derived from various sources, and it is important to note that some of these sources may overlap and that summing these estimates would likely result in double counting.

Table 1: Summary of Electrification Benefits for Rural Households in the Philippines, 1998 (ESMAP, 2002)

Benefit category	*Benefit value*	*Unit*	*Total per month (millions)*
Less expensive and higher levels of lighting	$36.75	Per household per mo.	$147.5
Less expensive and higher levels of radio and television use	$19.60	Per household per mo.	$77.5
Adult education and electricity wage- income returns	$37.07	Per wage earner per mo.	$296.6
Time savings for household chores	$24.50	Per household per mo.	$97.5
Improved productivity for home business	$34.00 (existing home business), $75 (new home business)	Per business per mo.	$24.7
Improved health	None	NA	NA
Improved agricultural productivity resulting in increased irrigation	None	NA	NA
Feelings of security	Not quantified in monetary terms	NA	NA
Public-good benefits	Not quantified	NA	NA

The study found that rural populations in developing countries like the Philippines have a high willingness to pay for the benefits of electrification. The researchers conclude, "Even if the estimates were too large by a factor of two, they would still exceed the likely annualized cost of providing electricity service" (p. 75).

Whereas the Barnes and ESMAP studies focused on evaluating the household and micro enterprise benefits of electrification, Alice Shui and Pun-Lee Lam address the issue from a macroeconomic perspective. In their report, "Electricity Consumption and Economic Growth in China" (2004), they attempt to determine the direction of causality between electrification and economic growth because a strong correlation between the two has been observed. The authors conclude that in China electrification has led to an increase in GDP but not the other way around. The results however, do not appear to be universal across all countries. Shui and Pun-Lee site a variety of similar country specific studies evaluating causality. In Indonesia and South Korea, for example, the reverse was found. The summary of causality studies is shown in Table 2. The results show that in some countries economic growth has resulted from electrification, in others growth has provided the means for electrification, while in others the two appear to have occurred in parallel.

Table 2: Empirical Results from Causality Test for Asian Countries or Economies (Shui, Pun-Lee, 2004)

Country	Empirical work	Study period	Causal relationship (method used)
India	Masih and Masih (1996)	1955–1990	Energy→income (error-correction)
	Asafu-Adjaye (2000)	1973–1995	Energy→income (error-correction)
	Ghosh (2002)	1950–1997	Income→electricity (unrestricted VAR)
Indonesia	Masih and Masih (1996)	1960–1990	Income→energy (error-correction)
	Asafu-Adjaye (2000)	1973–1995	Energy↔income (error-correction)
Japan	Erol and Yu (1987)	1950–1982	Energy→income (standard Granger)
		1950-1973	Income→energy (standard Granger)
Malaysia	Masih and Masih (1996)	1955–1990	Non-cointegrated (error-correction)
Pakistan	Masih and Masih (1996)	1955–1990	Income↔energy (error-correction)
Philippines	Yu and Choi (1985)	1954–1976	Energy→income (standard Granger)
	Masih and Masih (1996)	1955–1991	Non-cointegrated (error-correction)
	Asafu-Adjaye (2000)	1971–1995	Energy↔income (error-correction)
Singapore	Masih and Masih (1996)	1960–1990	Non-cointegrated (error-correction)
	Glasure and Lee (1997)	1961–1990	Energy↔income (error-correction)
			Energy→income (standard Granger)
South Korea	Yu and Choi (1985)	1954–1976	Income→energy (standard Granger)
	Glasure and Lee (1997)	1961–1990	Energy↔income (error-correction)
			No relationship (standard Granger)
Sri Lanka	Masih and Masih (1998)	1955–1991	Energy→income (error-correction)
Taiwan	Hwang and Gum (1992)	1961–1990	Energy↔income (Granger and Hsiao)
	Cheng and Lai (1997)	1955–1993	Income→energy (Hsiao's Granger)
	Yang (2000)	1954–1997	Energy↔income (error-correction)
Thailand	Masih and Masih (1998)	1955–1991	Energy→income (error-correction)
	Asafu-Adjaye (2000)	1971–1995	Energy↔income (error-correction)

From this review of the literature on rural electrification there is strong evidence that electrification is an important input into development at both the micro and macro levels. If

that is indeed the case, what role, if any, do renewable energy sources have to play in providing electricity in rural areas? That is the subject that I explore in the next section of this literature review.

2.2 Rural Electrification through Distributed Photovoltaic Power Generation

The conventional method of supplying electricity to end-users is through a national or regional electric grid. Power companies take advantage of economies of scale to generate massive amounts of electricity in a centralized location and then distribute it through a network of power lines. Rural electrification often refers to extending the reach of this power grid farther into rural areas. The power grid system is the most cost effective system in areas of high energy demand, but it is not the best choice in every situation. Table 3 contains a comparison of the various technologies used to generate electricity in developing countries other than the electric power grid.

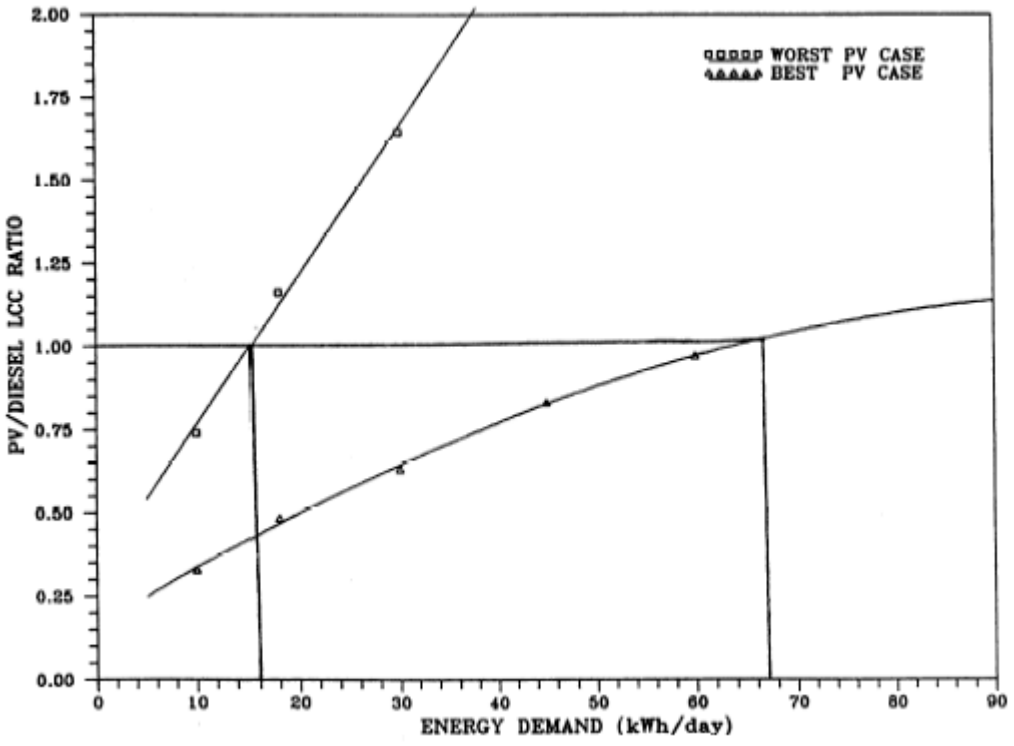
Table 3: Off-Grid Electricity Technologies in the Developing World (Olson, 2004; from Martinot et. Al, 2002; and IEA, 2003)

Technology	Applications	Pros	Cons	Scale
Diesel Engines	• Mills • Pumps • Refrigeration • Lighting, electronics, and communication	• Easy maintenance • Continuous operation	• High fuel costs • CO_2 emissions	Millions of households
Small Biomass	• Mills • Pumps • Refrigeration • Lighting, electronics, and communication	• Continuous operation possible • No fuel cost	• Noxious emissions	10 million households
Mini-Hydro	• Mills • Lighting, electronics, and communication	• Long life, reliability • No fuel cost	• Site-specific • Intermittent	50 million households
Wind	• Mills • Pumps • Lighting, electronics, communication	• No fuel cost	• Site-specific • Intermittent • High cost of batteries	Less than 10,000 households
Solar (PV)	• Basic lighting and electronic equipment	• No fuel cost • Little maintenance required	• High cost of batteries	1.1 million households
Batteries	• Basic lighting and electronic equipment	• Small initial investment	• High cost of batteries • Cost of battery charging	Millions of Households

Diesel generators, solar PV, and battery charging are all well suited for dispersed low-energy needs in rural areas of the developing world. Wind is highly site-specific and is rarely a viable option for year-round power generation at the household level. Transporting a battery to a charging station can be both expensive and inconvenient. PV systems and diesel generators are often the best solution in rural, off-grid areas in the developing world. The initial cost of a PV system is slightly higher than that of a diesel generator but unlike generators PV panels do not require any fuel. The largest maintenance cost of PV is to periodically replace the battery.

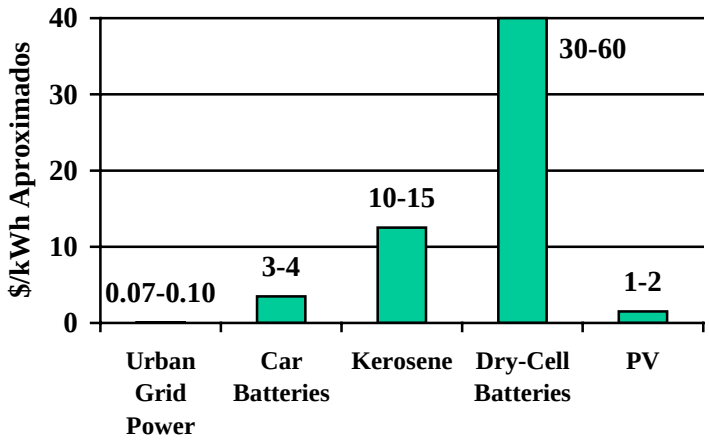
Mohanlal Kolhe, Sunita Kolhe, and J. C. Joshi compared the benefits and cost of PV-powered versus diesel –powered systems in India using a life cycle cost computation and sensitivity analysis. The sensitivity analysis considered the following key parameters: discount rate, diesel fuel cost, diesel system lifetime, fuel escalation rate, solar insolation, PV cost, and reliability. The authors then plotted the ratio of PV to diesel life-cycle costs as a function of energy demand for both the best case PV scenario and the worst case. Figure 1 illustrates the relationships. The study shows that PV-powered systems are the lowest cost option for a daily energy demand of up to 16 kilowatt-hours per day under unfavorable conditions and up to 68 kilowatt-hours per day under optimal conditions (Kolhe, Kolhe, Joshi, 2002).

Figure 1: Sensitivity to PV and Diesel System Life-Cycle Costs to the Best and Worst PV Conditions as a Function of Energy Demand (Kolhe et al., 2002)



In “Servicios Eléctronicos Rurales Inalámbricos con Inversión Privada y Energía Renovable,” Richard Hansen compares the cost of PV with the costs of other energy sources (2001). It is true that the $1 to $2 cost per kilowatt-hour of PV is many times higher than the cost of electricity from the grid in urban areas, $0.07 to $0.10, however in rural areas where the power grid is not an available option, PV costs significantly less than the common alternatives. Figure 2 shows that dry-cell batteries are the most expensive energy source at $30 to $60 per kilowatt-hour. Kerosene costs roughly ten times the per kilowatt-hour cost of PV, while the cost of battery charging is shown to be twice that of PV. The graphic does not include the relative cost of electricity produced through a diesel generator.

Figure 2: Comparison of Energy Costs per Kilowatt-hour (Hansen, 2001)



The review of the literature on distributed power generation clearly shows that there is an important role for PV to play. As Richard Hansen and John Rogers explain in “Developing Private REDCOs to Reach Beyond Distribution Grids: Preliminary Lessons Learned,” “In the absence of the grid, PV is an appropriate choice for dispersed households and enterprises with low energy needs seeking high value from an increased amount of energy at lower cost per unit of energy” (2003, p. 1).

Now that the literature has shown that rural electrification is indeed an important development tool and that PV can have a positive impact in remote areas with low energy demands, I will focus exclusively on PV technology among the various off-grid electricity technologies. See Appendix 1 for a diagram and brief description of a solar PV home system.

2.3 Barriers to Adoption of PV Technology

World Bank and Global Environment Facility solar home system projects are the subject of a report by E. Martinot, A. Cabraal, and S. Mathur published in *Renewable and Sustainable Energy Reviews* in 2001. In the report, the authors address the question of why there has not been a more widespread adoption of the technology in the developing world.

In seeking to address this question Martinot and his colleagues produce a list of ten barriers to adoption of the technology. Of the ten, four concern either the high initial cost of purchasing PV or the financing of PV. The four finance related barriers are:

- High transaction costs
- High first cost and affordability
- Lack of consumer financing
- Lack of business financing and skills

In a document published by the International Energy Agency titled "Financing Mechanisms for Solar Home Systems in Developing Countries: The Role of Financing in the Dissemination Process," the authors identify financial barriers among four categories of barriers to adoption that also include policy, technology, and awareness (2002). The barriers identified in the document are listed in Table 4.

Table 4: Barriers to Adoption of PV Technology in Developing Countries (IEA-PVPS, 2002)

Political	Technical	Financial	Awareness
• Allocation/placement of subsidies • Lack of transparency • Lack of private sector involvement • Lack of responsive service structures/after sales service	• Operational problems, technology transfer and quality management	• Financial schemes often not cost covering • The issue of understanding recurrent costs • No clear picture on the ideal mechanism for solar home system financing • Constraints of microfinance organizations	• Low credit recovery rate as a result of lack of awareness and information • Solar home systems are not the priority of the poorest of the poor

The high cost barrier to broader PV dissemination is also evident in a PV market assessment of the Philippines done by PSRC Research International for the Triodos Renewable Energy for Development Fund (2004). Researchers demonstrated a PV system for rural residents and interviewed them before and after the demonstration. After seeing the demonstration, but before learning the price of the product, 91 percent of the 900 surveyed residents said that they would either probably or definitely buy a system. After learning that the price was around $500 per system, however, the figure dropped to 56 percent, indicating that the high price was a barrier to adoption for many residents.

2.4 PV Delivery Models

In "Summary of Models for the Implementation of Photovoltaic Solar Home Systems in Developing Countries" (IEA-PVPS, 2003), the authors identify three categories of models, cash sales, credit sales, and fee-for-service.

In the cash sales model, the PV system is sold directly or through a dealer to the end-user who assumes ownership of the system on completion of the transaction.

The credit sales model can take three possible forms. The first is the dealer credit model, in which the PV supplier/dealer sells the PV system to the end-user on credit. The second is the end-user credit model, in which the end-user obtains credit from a third party credit institution to purchase the PV system from a dealer; and the third is the lease purchase model, in which the supplier/dealer or a third party leases the PV system to the end-user. The lessor retains ownership of the system throughout the lease period and is responsible for system maintenance and repair. At the end of the lease period, ownership of the PV system may or may not transfer to the end-user, depending on the arrangement.

In the fee-for-service model an energy service company provides the energy system for a fee. The company retains ownership of the equipment and it never becomes the property of the end-user.

In this paper, I will be focusing on the credit sales model that utilizes a third party financial institution to finance PV. In the International Energy Agency document on PV implementation models, the authors describe the model in detail and when it is applicable. They state, "The main factor that makes this model applicable is the existence of credit institutions that have experience with rural credit and have local outlets in rural areas" (p. 12). They go on to say that PV systems are often classified as consumer products, which do not fit well with institutions that focus primarily on credit for income generating purposes. The advantages and disadvantages of this model according to the report are listed in Table 5.

Table 5: Key Advantages and Disadvantages of the End-User Credit Model (IEA-PVPS, 2003)

Advantages of End-User Credit Model	Disadvantages of End-User Credit Model
• The main barrier of the high initial investment is lowered or removed. • The PV company does not need to allocate budget to run the credit scheme, thereby avoiding financial risks and allowing it to concentrate on sales and after-sales services. • The credit institutions - if available - are much better equipped to manage a credit scheme; they have the infrastructure, they know their clients, and they are able to collect their outstanding debts. • The rural network of the credit institution may also be used for promotion and extension work. • Little government or other external involvement required (apart from creating the right environment	• This model is geographically restricted because of the infrastructure needed for the collection of the payments and possible retrieval of the collateral. • Two separate structures may be needed to handle the financial and the technical work, resulting in additional costs, although it is possible for one structure to handle both financial and technical work. • High interest rates and down payments. In some cases the credit institutions have been supported by donors or government programs to keep interest rates low. These credit schemes are characterized by more favorable terms than commercial consumer credits (longer terms of 1 year to 3 years compared to 6 to12 months, lower interest rates of 10 % to 15 % compared to over 25 %, and lower down-

for PV).	payments of 20 % to 40 % compared to over 50 %). • The market is restricted to customers that the credit institution deems creditworthy – Generally those with salaried incomes, those with a guarantor or those who have the required collateral.

Harish Hande and Kamal Kapadia delve deeper into the subject of the third party finance model of PV dissemination in their paper, "The Potential Role for Microfinance to Expand Access to Energy Services" (2004). They make the claim, "Access to modern energy services could be greatly enhanced if people could also access consumer loans and microfinance to pay for these services" (p. 21). Kapadia and Hande distinguish between lending for household uses of energy versus productive or community uses, and point out that a common risk management strategy among MFIs is to lend "for activities that directly augment the income of the borrower" (p. 24). Often energy services are not seen to directly contribute to income generation, so "rural credit agencies are reluctant to lend for such purposes" (p. 24). The authors also point out the similarities between lending for energy services and lending for housing or home improvements, indicating that energy service loans could be considered under the housing category in addition to being considered consumer loans. This would open up the possibility of financing energy services to MFIs that offer housing loans but not consumer loans.

The authors also indicate the difference between the practices of lending to groups versus lending to individuals. Institutions that guarantee their loans through group lending may not be the best fit for PV systems loans, though it is possible. It is also possible for a PV system to serve as the collateral for the loan used to buy the system.

This review of the literature revealed that rural electrification is a valuable development tool that leads to improved quality of life in rural areas. It also showed that PV can be the least-cost option for providing electricity to remote, dispersed populations that have low energy demands. A main barrier to wider adoption of the technology is the high initial investment required to purchase the equipment. This barrier can be overcome in many cases through financing, which allows the buyer to spread the initial cost over a period of time. Microfinance institutions, which operate in most developing countries and extend credit to those who do not qualify for conventional bank loans, are a potential source of this financing.

For an MFI to finance PV systems for rural households and microenterprises it must offer a loan product commensurate with the requirements of PV system financing. Four key factors must exist. The first is that the loan sizes and periods offered by the MFI should be large enough to accommodate the relatively high price of PV systems. The second is that the MFI should offer loan categories that could include PV loans. The literature identifies consumer loans and housing or home improvement loans as such categories. The third factor to consider is the capacity of the MFI to service the rural PV market, which is typically remote and dispersed, and the fourth is how the MFI guarantees its loans. Group lending may not be as effective as individual lending with collateral or a guarantor.

Chapter 3: Learning Objective

The primary objective of my work is to search for a sustainable model for distributing photovoltaic solar technology to rural areas in the Latin America and Caribbean (LAC) region. The most significant barrier to broader dissemination of the technology is the relatively large initial investment required by a household or rural businesses to purchase a system. My focus will be on overcoming this barrier through financing. More specifically, I will explore the question – Can microfinance institutions play a role in accelerating the dissemination of PV systems in rural, off-power grid areas of LAC? To achieve this objective, I limited the scope of the study to the Dominican Republic and focused on two sub topics. First, I focused on determining the potential compatibility of the microfinance industry and rural PV financing in the country. This focus included determining the number and classification of MFIs, the geographic coverage area of the institutions, the type of financial products that they offer, and the markets that they serve. Second, I focused on determining the current and past experiences of MFIs with financing PV in rural areas.

Chapter 4: Hypotheses and Methods

4.1 Hypotheses

Hypothesis 1: Microfinance institutions have not been heavily involved with PV system financing in the Dominican Republic because MFIs are incompatible with rural PV system financing for at least one of the following reasons:

a. The loan sizes required to finance PV systems are larger than the loan sizes offered by MFIs.
b. PV loans do not fit into the categories of loans offered by MFIs.
c. MFIs lack the capacity to provide services to the remote, dispersed populations that characterize the rural PV market.
d. The methods accepted by MFIs to guarantee their loans do not accommodate PV system loans.

Hypothesis 2: Even with MFI financing for PV systems at market rates, the technology is too expensive for most rural households not currently connected to the power grid.

4.2 Research Methodology

To pursue my learning objectives I partnered with Soluz, Inc. Soluz, Inc. is a business and technology development company founded in 1993. The core expertise of Soluz Inc. is in rural energy delivery in developing countries, particularly in the LAC region through the development of what it calls rural energy delivery companies. Soluz Inc. is a leading developer of rural energy development companies that commercializes applications of PV technology in rural markets. At present the company operates a subsidiary in the Dominican Republic and serves an affiliate in Honduras.

In 1995 Soluz launched its first subsidiary, Soluz Dominicana, to pursue a financial innovation that it hoped would overcome the high initial cost barrier to adoption of PV technology in rural areas and create a sustainable, commercially viable business model that could be replicated throughout the region. The innovation was to offer a rental option to its customers to complement the cash sales, short-term company credit, and third party credit that it already offered. The rental innovation proved to be an attractive option to rural customers and Soluz Dominicana has collected over 130,000 monthly rental payments. In 1998 after the rapid growth and initial success of Soluz Dominicana, Soluz, Inc. replicated its rural energy delivery company model in Honduras. However, neither subsidiary has been able to reach the scale required for profitability.

Through my association with Soluz, Inc. I have benefited from the experience and insight of an organization that is not only visionary and innovative within the field of rural energy delivery in developing countries but is also an organization of action. My experience with Soluz, Inc. brought me in direct contact with many of the stakeholders involved in the delivery of rural energy.

The broad approach used to pursue my learning objective was to interview representatives of microfinance institutions in the Dominican Republic. The purpose of the interviews was to identify the potential of each institution to finance rural PV as well as to determine which institutions, and to what extent, have had experience financing PV in rural areas.

My first step in selecting the MFIs to be interviewed was to assess the scope of the microfinance industry in the Dominican Republic. In this step I determined the categories of institutions granting microloans in the country and who the institutions were within each category. This information was systematically gathered through interviews with a prominent second-floor lender, an institution that lends to other financial institutions, called FondoMicro; the umbrella organization for the rural savings and loan cooperatives, AIRAC; and a pioneer of PV technology in the Dominican Republic with over 20 years of experience delivering solar energy in rural areas, Richard Hansen.

Once I had a general understanding of the microfinance industry and the institutions that make up the industry, I selected specific MFIs to be interviewed that were either prominent national players, operated in rural areas, or had experience financing PV. Prominent MFIs were selected because they represent the greatest potential for engaging the sector in PV financing on a large scale. Four institutions were rated by at least one of the leading microfinance rating institutions. MFIs working in rural areas of the country have the greatest potential for overlapping with the rural PV market, and MFIs that already have experience with PV financing offer valuable lessons to be learned from that experience. From this process, I identified and prioritized the microfinance institutions to be interviewed. Prioritizing the institutions was essential due to the time constraints of the study. The list of targeted MFIs to be interviewed remained flexible throughout the study to allow for additional information and recommendations gained during the interviews. During seven weeks in the Dominican Republic from January 25 to March 15, 2005, I conducted 17 interviews to gather information on the 13 institutions included in this study. Time and resource constraints prevented me from interviewing all of the more than 30

MFIs operating in the country, but the participating institutions represent all five categories of MFIs and a wide range of portfolio sizes, PV experiences, and proportion of operations in rural areas.

The interviews consisted of a variety of closed-ended and open-ended questions and were conducted in a flexible, conversational style. Appendix 2 contains a list of questions used to guide the conversations during the interviews.

To ensure the accuracy of the information, MFI representatives with access to the pertinent information such as executive or general managers, credit managers, or presidents were interviewed, and an audited financial report was acquired whenever possible. Appendix 3 is a list the MFIs interviewed, including the person interviewed and date of each interview.

4.3 Caveats and Limitations

There are several limitations that may have biased the results of the study. One is that a non-native Spanish speaker conducted the interviews in Spanish. It is conceivable for some information to have been misinterpreted due to the language barrier. A second limitation is that though great effort was made to select study participants based on the criteria listed in the previous section in a way that optimized the study's resources, it is possible that additional valuable insights or experience may have been attained from meeting with the institutions not included in the study. Prioritizing the institutions with known experience financing PV and those with a significant rural presence mitigated the risk of excluding institutions with valuable PV financing experience.

There are two limitations concerning measurements that may have influenced the results of the study. The first is that I calculated mean loan sizes for the MFIs instead of the median. Median loan sizes would have been a more accurate indicator of a typical loan size for institutions with a wide range of loan sizes but a relatively small number of loans. Median loan sizes, however, were not readily available during the interviews. The second measurement limitation that I encountered was with the approach of determining rural presence by asking MFI representatives what percentage of their institution's loans are in rural areas. The interviewee responses should be viewed as approximations, not as exact calculations based on scientific criteria. One reason for this is the ambiguity of the term "rural." Marina Ortiz of FondoMicro, a widely published researcher on the various facets of the micro and small enterprise sectors of the Dominican economy, defines rural communities as being those with less than 2,000 inhabitants (Ortiz, Poyo, 2002). In the interviews for this study, however, a strict definition of rural was not used because such data are not readily available from most institutions. It was instead left up to the interviewee's discretion. In some instances, MFIs interpreted the question as implying agricultural related loans. FONDESA, for example considers its rural operations as those relating to animal husbandry and production of a select number of region-specific crops. Another issue when determining PV financing compatibility by assessing the capacity of MFIs to deliver services in rural areas is that the rural PV market is a sub-set of the overall rural population. The ideal information to gather would be MFI presence in rural, off-grid areas, but these data are even less available than the more general rural data. Finally, the

responses given were often estimates. In some cases the answer was immediately known, as with Cooperativa Vega Real, but more frequently the MFI representative would pause to consider the question and then propose an estimate. Because of these ambiguities, the results concerning the rural proportion of operations should be considered as estimates of the way that MFIs perceive their rural operations.

Chapter 5: Results

The study's results are presented in four sections. I begin by providing basic information about the rural PV market in the Dominican Republic. In the second section I describe the microfinance industry in the country, including the categories of MFIs and the key institutions within each category. This sketch serves as the backdrop for the analysis in the subsequent sections. It is particularly relevant because it illustrates the microfinance industry in the Dominican Republic as a diverse, competitive, maturing industry. Once the industry is described and the key players are introduced, I present the findings regarding the compatibility of the various MFIs with PV financing. In this section I assess the compatibility in terms of loan size, type of loan products offered, proportion of operations in rural areas, and methods used to guarantee loans. Finally, I relate the specific experiences that each MFI has had financing PV systems in rural areas and seek to describe the lessons that can be learned from these experiences.

5.1 The Rural PV Market in the Dominican Republic

Before portraying the microfinance industry in the Dominican Republic, I will first describe the current state of electrification in the country and then estimate the average income level of the potential PV market. According to the *World Energy Outlook, 2002*, roughly 33 percent of the population is not connected to the electricity grid, which translates to 2.9 million people or 580,000 households. The report also states that the average rate of electrification in urban areas of Latin America is 98 percent, According to the Economic Commission for Latin America and the Caribbean, 63 percent of the population in the Dominican Republic will live in urban areas in 2005. Assuming the same rate of urban electrification for the Dominican Republic as for LAC as a whole, we can calculate that 22,000[1] of these households without grid electricity are urban, leaving 558,000 rural. In 2000 it was estimated that 20,000 PV home systems had been installed in the country (Olson, 2004). Even in the unlikely event that the number of installed systems has doubled since 2000, only seven percent of the off-grid households would have PV systems. That would put the potential remaining rural PV market at 518,000 households. In a poverty assessment of the Dominican Republic, the World Bank uses a more conservative figure of 235,000 unelectrified households, claiming that 100 percent are in rural areas (World Bank, 2001). The two numbers vary greatly but illustrate the magnitude of the rural PV market.

[1] Sixty-three percent of the total population of 8.8 million gives an urban population of 5.54 million. Assuming 5 people per household, this population comprises 1.11 million households. Two percent of these households are not connected to the grid assuming the figure for the entire LAC. This calculates to 22,176 urban households not connected to the grid.

The Dominican Republic is considered a middle-income country. Its per capita GDP in purchasing power parity is $6,000, but the country is plagued by uneven income distribution (World Factbook). The poorest half of the population receives less than one fifth of national income. This translates to a per capital income of $1,198 for the bottom 50 percent of the population. The majority of the 558,000 off-grid households fall into this category. For this segment of the population, the $750 installed purchase price of a 50-watt PV system represents 63 percent of annual income. The $300 price of a smaller 20-watt system is 25 percent of annual income. (See Table 7 for PV system prices.) These prices are significant barriers to the adoption of the technology by the poorer half of the population.

5.2 The Microfinance Industry in the Dominican Republic

The finance institutions currently providing micro loans to consumers and small businesses in the Dominican Republic can be divided into five distinct categories: Regulated microfinance or development banks, non-governmental organizations (NGOs) operating as unregulated microfinance institutions, rural savings and loan cooperatives, government operated lending programs, and international institutions. To discuss the potential for engaging the industry in PV system financing, it is essential to understand the distinctions between these categories, including their limitations. Each of the five categories is described below.

Non-Governmental Organization Microfinance Institutions (NGO-MFIs)

Non-governmental organizations are permitted by law to operate credit programs but are prohibited from collecting savings. Since NGOs are not regulated financial institutions, prohibiting them from collecting savings is in the best interest of the consumer whose savings would be entrusted to the NGO. NGO-MFIs, therefore, do not raise loan capital from their customers or beneficiaries as do banks and savings and loan cooperatives, and are thus forced to raise loan funds from other sources. NGOs are mission driven, which often dictates the nature of their credit programs. For example, the mission statement of Mujeres en Desarrollo Dominicana (MUDE), or Dominican Women in Development, indicates that the organization is almost exclusively focused on serving women (MUDE Annual Report, 2003). Other NGOs have geographic limitation or focus on a specific segment of the population. Some of the NGOs classified here as NGO-MFIs are exclusively microfinance organizations such as FONDESA, while others are more diversified development NGOs that operate microcredit programs as one component of their overall operations, as is the case with MUDE and Plan Sierra, which I describe later.

Regulated MFIs or Microfinance Banks (MFBs)

Regulated microfinance banks are subject to the same government monitoring as commercial banking institutions. Unlike non-governmental MFIs, microfinance banks are able to mobilize savings and raise investment capital. The two regulated MFIs interviewed in this study began as NGOs. The NGO, Association for the Development of Microenterprise (ADEMI) became a regulated development bank in 1998 after 15 years in

existence. By that time, ADEMI had long since reached operational self-sufficiency and its capital was greater than that of five of the 12 commercial banks in the country. The Women's World Banking affiliate, Asociación Dominicana para el Desarrollo de la Mujer (ADOPEM) only graduated to the realm of regulated financial institutions in 2004 when it became Banco ADOPEM (Mixmarket website).

Rural Savings and Loan Cooperatives or Rural Credit Unions

The rural savings and loan cooperatives in the Dominican Republic can be divided into those that belong to the Association of Rural Savings and Credit Institutions (AIRAC) and those that do not. Fourteen rural cooperatives make up AIRAC, and there are three significant cooperatives that do not belong to the association, Cooperativa Vega Real (CVR), Cooperativa San Miguel (CSM), and Cooperativa de los Servicios ADEPE (COOP-ADEPE).

In the mid 1980s, the United States Agency for International Development (USAID) supported the creation and strengthening of rural savings and loan cooperatives through its Rural Financial Services Program. In 1992, AIRAC was formed from seven of these cooperatives. Among other activities, AIRAC provides technical assistance, training, and modernization services to its members and provides a self-regulating standard by which members are required to abide. AIRAC currently consists of 14 member cooperatives (AIRAC website).

Of the three non-AIRAC affiliated cooperatives, CVR is the largest and most prominent. CVR has over 65,000 members (CVR website), which is nearly twice that of the largest AIRAC cooperative, Cooperative San José. COOP-ADEPE is a case of an NGO transforming its credit program into a savings and loan cooperative. Part of its institutional history is as an NGO but its more recent history is as a cooperative. Its operations are still closely tied to the NGO, and it is the only cooperative with such a relationship.

Government-Operated Credit Programs

Government-operated credit programs are another type of MFI in the Dominican Republic. This study considered two state-run credit programs. The first is the Programa de Promoción y Apoyo a la Micro, Pequeña y Mediana Empresa (PROMIPYME) [Micro, Small and Medium Enterprise Promotion and Support Program]. The second is the government agency responsible for the development of the central highlands in the provinces of Santiago and Santiago Rodríguez called Plan Sierra. Plan Sierra operates a micro-credit program in addition to other development activities.

Community Managed Loan Funds

I created this category to include the Small Grants Program funded by the Global Environment Facility (GEF) and the United Nations Development Program (UNDP). The program has been widely involved in small-scale PV financing projects, but does not fit into any of the other four categories.

Table 6 indicates the key institutions in each of the five categories described above with operations in the Dominican Republic. The institutions indicated in bold were interviewed for this study. This section has served to describe the diversity of the microfinance industry in the Dominican Republic and identify the key institutions within the industry. The picture of the industry that was painted in this section will now allow me to focus in on the potential of the MFIs to finance PV systems.

Table 6: Microfinance Institutions in the Dominican Republic, 2005

Category of MFI	MFI
Microfinance Banks	Banco ADEMI – Association for the Development of Microenterprise Banco ADOPEM - Asociación Dominicana para el Desarrollo de la Mujer **Banco BHD Pymes – BHD Pequeña y Mediana Empresa**
Non-Governmental Organizations	**ADEPE – Asociación para el Desarrollo de la Provincia Espaillat** **FONDESA – Fondo para el Desarrollo** **FDD - Fundación Dominicana de Desarrollo** **MUDE - Mujeres en Desarrollo Dominicana** **CDD - Centro Dominicano de Desarrollo** CE-Mujer - Centro de Solidaridad para el Desarrollo de la Mujer Esperanza International FUDECO – Fundación de Desarrollo Comunitario SSID – Servicio Social de las Iglesias Dominicanas Tu Mujer **Other small NGOs**
Savings and Loan Cooperatives	Cooperativa Vega Real **COOP-ADEPE** AIRAC Cooperatives - Asociación de Institutions Rurales de Horror y Creditor: Cootralcoa **Maimón** **Mamoncito** Momon Bueno Neyba Nstra. Señora de la Candalaria Global **Sabaneta Novillo** San José Central Empresariales Médica de Santiago Herrera La Unión
Government Microfinance Programs	PROMIPYME - Consejo Nacional de Promoción y Apoyo a la Micro, Pequeña y Mediana Empresa Plan Sierra

Community Loan Funds	GEF/SGP – Global Environment Facility/Small Grants Program

Institutions highlighted in bold were interviewed for the study.

5.3 Potential Compatibility of MFIs and PV Financing

In this section, I present the study's results concerning the potential compatibility of MFIs with PV financing in four parts. In the first part I assess if the typical MFI loan sizes are appropriate for PV financing. In the second I determine whether PV loans would qualify for the type of loan products currently offered by the MFIs. In the third I evaluate the methods used by the institutions to guarantee their loans, and in the final part I assess their capacity to deliver services in rural areas.

Loan Size

A common mismatch between microcredit loans and those required to finance PV systems is that PV loans are larger than the loans offered by MFIs. To determine the loan size compatibility for PV financing by Dominican MFIs this study compares the loan amount required to finance PV systems in the Dominican Republic to the average loan size offered by the MFIs.

Soluz Dominicana offers its customers a range of PV system options to either rent or buy with cash or credit. The standard rental systems offered include PV power capacity ranging from 20 watts to 100 watts to accommodate people of different incomes. The installed price of these systems ranges from $300 to $1500, as shown in Table 7. One of the most popular system sizes among Soluz Dominicana customers is the 50-watt system. The estimated amount to be financed for a system of this size, after the customer pays a 25 percent down payment, is $563. I used this amount as a benchmark to compare to the average loan sizes of the MFIs in this study.

Table 7: Estimated Prices and Financing Amounts for PV Systems Offered by Soluz Dominicana, March 2005

PV System Size	Installed Price	Financed Amount (After 25 percent down payment)
20W	$300	$225
30W	$450	$338
40W	$600	$450
50W	**$750**	**$563**
60W	$900	$675
100W	$1500	$1125

Of the MFIs in this study, Banco ADEMI is the largest when measured by either gross loan portfolio or number of loans. In 2003 Banco ADEMI had a loan portfolio of over $51

million through 26,414 loans. Plan Sierra's credit program is the smallest, at less than $100,000 and is only included here because of its experience with financing PV. Seven of the 12 MFIs have loan portfolios between $4 million and $8 million. The median portfolio size is $5 million.

The average loan sizes of the MFIs studied range from under $300 for Banco ADOPEM to $5,003 for Cooperativa Mamoncito, as shown in Table 8. The average size of a loan granted by the MFIs is $1097. Of the 11 MFIs showing data, five have average loan sizes below the $563 financing amount of a 50-watt PV system. Most of the rural cooperatives and the state-run PROMIPYME have large variations in their loan sizes. Cooperativa Mamoncito, for example, indicated that its loans range from under $200 to over $100,000.

Table 8: Loan Portfolio and Average Loan Size for MFIs in the Dominican Republic

Institutions (Ranked by Portfolio Size)	Loan Portfolio Size (US$)	Number of Loans (US$)	Average Loan Size (US$)	Source	Year
ADEMI	51,536,114	26,414	1,951	Annual Report	2003
Coop. Sabaneta Novillo	7,490,177	Not available	Not available	Dario Lantigua, *General Manager*	2004
FONDESA	7,861,429	4,216	1,865	Annual Report	2002
ADOPEM	6,753,438	24,558 - 33,767	200 - 275	Sonia Reyes Frías, *VP of Finance and Operations*	2004
Coop. Mamoncito	6,483,301	1,296	5,003	Alfredo Dorrejo, *General Manager*	2004
Cooperativa Vega Real	5,304,519	10,609 - 15,156	350 - 500	Yanio Concepción, *President*	2004
	4,849,101	13,000	373	Annual Report	2003
COOP-ADEPE	4,690,570	2,765	1,696	Ramón Abréu, *Credit Manager*	2004
Coop. Maimón	4,346,758	3,700	1,175	Alifonzo Fernández, *Credit Department Manager*	2004
	3,304,798	Not available	Not available	Annual Report	2003
FDD	2,333,006	5,055	462	Ada Wiscovitch, *Executive Director*	2004
	1,689,780	1,590	1,063	Annual Report	2003
PROMIPYME	933,202	1,200	778	José Fernando Santos, *Business Official*	2004
MUDE	491,159	1,200	409	Virgilio Félix, *Credit Director*	2004
	471,669	596	791	Annual Report	2003
Plan Sierra	92,832	191	486	Annual Report	2003
GEF/SGP	Not available	Not available	Not available		
Total	90,826,328	88,082			
Mean	8,256,939	807	1,317		
Median	4,690,570	3,700	778		
Maximum	51,536,114	29,163	5,003		
Minimum	92,832	191	238		
		Weighted mean*	**1031**		

*The midpoint was used when a range of data was given as with Vega Real. Missing data was estimated for Sabaneta Novillo.

Table 9 examines the five MFIs with average loan sizes below the finance price of a 50-watt system. The percentage differences between the 50-watt financing price and the average loan sizes of these MFIs ranges from -14 percent for Plan Sierra to -58 percent for ADOPEM. Though these differences are significant, if a benchmark financing amount for a 40-watt system is used, all but ADOPEM's average loan size are above or within ten percent of the $450 dollar amount. This indicates that the loan sizes required for PV system financing are within the range of loan sizes for most of the MFIs in the study, though some may be best suited for financing systems smaller than 50-watts.

Table 9: Comparison of Average Loan Size and Amount Required for PV Financing of the Five MFIs with the Smallest Average Loan Sizes

Institution	Average Loan Size	50W Financing = $563		40W Financing = $450	
		Difference from Price	Percentage Difference	Difference from Price	Percentage Difference
ADOPEM*	238	-325	-58%	-212	-47%
CVR*	425	-138	-25%	-25	-6%
FDD	462	-101	-18%	12	3%
MUDE	409	-154	-27%	-41	-9%
Plan Sierra	486	-77	-14%	36	8%
*Average loan size used was the average of the range given by the MFI					

From this analysis it appears that the microfinance industry in the Dominican Republic, with only a few exceptions, would be compatible with PV system financing from a loan size perspective. The price of a PV system is within the customary range of most MFIs.

Type of Loan

When assessing the compatibility of MFIs and PV it is important to consider the type of loans offered. Though there are numerous income-generating applications for PV in rural areas, such as lighting and refrigeration for rural stores, cell phone battery charging, and water pumping for irrigation, the most common application is for household use. An MFI that only offers microenterprise loans would most likely not be interested in financing a typical solar home system. Table 10 indicates the type of loans offered by the participating MFIs.

Table 10: Categories of Loans Offered by MFIs in the Dominican Republic (MFI interviews and annual reports)

	Micro/small enterprise	Personal Consumption	Home Improvement	Commercial	Industrial	Vehicle/Transportation	Mortgage	Agriculture			
ADEMI	✓	✓					✓				
Coop. Sabaneta Novillo		✓	✓	✓		✓		✓			
ADOPEM	✓	✓									
Coop. Mamoncito		✓	✓	✓	✓			✓			
Cooperativa Vega Real	-	-	-	-	-	-	-	-			
COOP-ADEPE		✓	✓	✓	✓	✓		✓			
Coop. Maimón		✓	✓	✓	✓	✓		✓			
FONDESA	✓	✓	✓					✓			
FDD	✓		✓								
PROMIPYME	✓			✓	✓						
MUDE	✓							✓			
Plan Sierra	-	-	-	-	-	-	-	-			

When not directly used to generate income, PV loans are often considered personal consumption loans. All of the cooperatives and banks offer some form of consumer loans. Only FDD, MUDE, and PROMIPYME do not. Data is not available for Plan Sierra. Banco ADEMI is the largest MFI of the group studied. Eighty-seven percent of its loans go to micro and small enterprises, while 13 percent are issued for personal consumption and housing loans.

The other category within which PV would conceivably fall is home improvement. This branch of microfinance appears to be growing judging from the desire of a number of MFIs to include home improvement loans among their offerings. For Cooperativa Maimón, housing and home improvement loans made up one third of its loan portfolio in 2003 compared with 15 percent for personal consumption (Maimón 2003 annual report). ADOPEM plans to introduce home improvement loans in the near future. I did not find any examples of PV loans falling under this category, but some institutions including FONDESA and FDD said that they were open to the concept. FDD's housing loans break down as 43 percent for roof improvements, 19 percent for improvements to the floor and walls, and 38 percent for other improvements (FDD Annual Report, 2003). When asked if she thought that upgrading a home from kerosene lanterns for lighting to solar electric lamps would qualify for a home improvement loan under her organizations requirements, Executive Director Ada Wiscovitch responded that she thought that it should (Personal communication, March 1, 2005).

Method of Guarantee

Table 11 shows the various loan guarantee methods employed by the MFIs. Most of the MFIs accept or even require a guarantor to cosign for a loan. Some institutions require only a cosignatory, but others also require collateral. MUDE not only requires that a third party cosigns the loan but also a two to one collateral to loan value ratio. These requirements, however, are limited to MUDE's conventional credit program and do not apply to their nascent Grameen-style group-lending program. All of the cooperatives and FONDESA require either a cosignatory or collateral in the form of either real estate property or other possessions such as vehicles or machinery. FONDESA tries to be as flexible as possible with the types of guarantees accepted. In addition to the methods mentioned above, they also will grant a loan based on a favorable reference from a reputable source such as a community leader and on an analysis of the applicant's income and vocational acumen.

Table 11: Loan Guarantee Methods Accepted by Dominican MFIs (MFI interviews and annual reports)

	Co-Signatory	Real Estate	Collateral (pawn, vehicle)	Group Guarantee	Liquid assets	Community leader reference	Demonstrate vocational acumen	. Left up to partner MFI			
ADEMI	✓	✓	✓								
Coop. Sabaneta Novillo	✓	✓	✓								
ADOPEM	✓			✓							
Coop. Mamoncito	✓	✓	✓								
Cooperativa Vega Real	✓	✓	✓								
COOP-ADEPE	✓	✓	✓		✓						
Coop. Maimón	✓	✓	✓								
FONDESA	✓	✓	✓			✓	✓				
FDD		✓									
PROMIPYME	✓	✓									
MUDE	✓		✓	✓							
Plan Sierra								✓			

FDD exclusively guarantees its loans with real estate. Applicants must own their property to receive an FDD loan. This type of guarantee can be complicated because few lower-income residents in the Dominican Republic, as in much of the developing world, actually have titles to their land. FDD accepts various methods of proving ownership of a residence even though it realizes that the documentation may not hold up in court. The philosophy is based on the fact that people cannot easily change residences, so the commitment by a loan recipient of his or her residence to serve as collateral is usually taken seriously. If FDD assumes a property through loan default, it typically rents it back to the loan customers to recover the defaulted loan.

Another component of the risk management strategy of many of the MFIs that came up frequently in conversation is the use of progressive loans. Timely repayment of small, short-term loans leads to subsequent, progressively larger loans. This technique is even employed with home improvement loans, where improvement projects are undertaken in distinct steps as well.

Only two institutions, ADOPEM and MUDE, utilize a group solidarity method to guarantee a portion of their loan portfolio. In the case of ADOPEM, group lending makes up 15 to 20 percent of the portfolio. MUDEs group-lending program is only one year old and is based on the Grameen Bank methodology. The fact that a group lending methodology is not used on a very large scale in the Dominican Republic is in stark contrast to microfinance industries in other parts of the world such as South Asia.

The methods used by the MFIs in the Dominican Republic to guarantee their loans do not present a barrier to financing PV. In the cases where institutions accept physical collateral as a guarantee for the loans, the PV panel can potentially serve as at least part of the guarantee for the loan. The case of FDD, where the institution only accepts real estate property as collateral, also does not present a barrier because the potential buyers of PV systems own their property or at least occupy a dwelling and have some claim of ownership to it.

Rural Capacity

To evaluate the rural presence of the various MFI s in the Dominican Republic I took two approaches. The first approach was to ask the MFI representatives in the interviews what percentage of their loans were in rural areas. The second was to evaluate the methods used to collect loan payments to determine if a possible bias against rural areas existed.

Proportion of Loans in Rural Areas

Table 12 lists the responses of the MFIs to the question concerning their presence in rural areas. If the MFIs are ranked by the share of rural customers they service, the median value is between 25 and 30 percent. The weighted mean is 24 percent. It is evident from the table that COOP-ADEPE and MUDE consider the majority of their operations to be in rural areas, and CVR considers its operations to be somewhat balanced between rural and urban areas with 40 percent being rural. The perception of the remaining MFIs that responded to the question is that rural operations comprise roughly one third or less of overall loan activity. ADEMI's focus is explicitly urban. It writes in its 2003 Annual Report that its loans for the year were "distributed in low-income urban sectors throughout the entire country," with no mention of rural lending (ADEMI AP2003). MUDE clearly considers itself as having a purely rural focus.

Table 12: Percentage of Loans in Rural Areas Among MFIs in the Dominican Republic, 2005 (MFI interviews and annual reports)

MFI	Number of Loans	Percentage of Loans in Rural Areas (Estimate)
ADEMI	26,414	Minimal
ADOPEM	24,558*	30%
FONDESA	4,216	19%
FDD	5,055	Not available
MUDE	1,200	100%
COOP-ADEPE	2,765	65%
Coop. Maimón	3,700	25%
Coop. Mamoncito	1,296	20%
Coop. Sabaneta Novillo	Not available	20%
Coop. Vega Real	10,609*	40%
PROMIPYME	1,200	35%
Plan Sierra	191	Not available
	Median	**28%**
	Weighted mean	**24%**

* Calculated by dividing the loan portfolio by the upper limit of the range of average loan sizes given

The limited presence by the MFIs in rural areas presents a barrier to financing PV since the rural PV market is typically a more remote subset of the general rural market. To better understand how the MFIs serve their rural customers, I assessed the methods that they use to collect loan payments. The intention was to look for biases against rural customers. The results of this assessment are detailed in the following section.

MFI Collection Methods

The second approach to assessing the MFI rural capacity was to inquire about loan payment collection methods. I found that many institutions require their customers to bring loan payments in to a branch office. Juan Lantigua, General Manager of FONDESA, explained that this was an additional cost incurred by FONDESA's rural loan customers/beneficiaries but one that they faithfully paid (Personal Communication, February 3, 2005). He even noted that some customers lived as far as 100 km from the nearest branch office. FONDESA also tries to remain flexible on the frequency of loan payments that it requires of its rural customers to account for the seasonal nature of income dependent on agriculture harvests. This would also reduce the cost of delivering monthly payments to a distant branch office. CVR also requires that its members bring loan payments to a branch office but combats the potential inconvenience of this collection method by offering a relatively high concentration of branch offices in the regions that it serves. Three institutions, PROMIPYME, FDD, and Cooperativa Maimón, have increased the number of possible payment location by partnering with commercial banks, which receive loan payments at any of their branch locations. MUDE also accepts payments at banks, but their case is slightly different and is detailed below. Payment at banks is the primary collection method for FDD, which has an arrangement with Banco Popular and BanReserva. FDD's chief complaint relating to this arrangement is that there is a three-day delay between when the bank receives a loan payment and when FDD is notified of the payment. The state-run MFI, PROMIPYME, has a similar relationship with BanReserva, which is also run by the state. Only Cooperativa Maimón said that they accepted payment with a check. Table 13 contains a summary of the methods used by the firms to collect their loans.

Table 13: Collection Methods Used by MFIs in the Dominican Republic, 2005 (MFI interviews)

	Pay at MFI branch office	Pay at a commercial bank branch	MFI visits customer to collect	Pay with check	Pay at an affiliated COOP
ADEMI	✓				
Coop. Sabaneta Novillo	✓				
ADOPEM	✓		✓		
Coop. Mamoncito	✓				
Cooperativa Vega Real	✓				
COOP-ADEPE	✓				
Coop. Maimón	✓	✓		✓	
FONDESA	✓				
FDD	✓	✓			
PROMIPYME	✓	✓			
MUDE	✓	✓	✓		
Plan Sierra					✓
GEF/SGP					

Two institutions, MUDE and ADOPEM, actually visit their loan customers monthly to collect payments. Even though MUDE accepts loan payments at a number of commercial banks, a MUDE official still visits each loan customer every month. If a customer payment was made at a bank, the official collects the payment receipt during the visit. Customers may also pay the official directly. The advantage of this collection system for MUDE is not in reducing the travel and labor costs of its officials but in taking advantage of the established security and processing systems of the banks. MUDE's loans are almost exclusively rural and each official serves as many as 140 customers. ADOPEM employs over 110 loan assessors that evaluate loan customers and are responsible for making sure that they pay on time. Unlike MUDE, ADOPEM's loan customers are mostly in urban areas with higher population densities.

Though a portion of rural customers are able to deliver monthly loan payments to an MFI office or bank branch, the policy eliminates a large portion of the customer base that is unable to afford the additional expense of time and money. This cost is also regressive. More remote customers, who are often poorer than their urban and peri-urban counterparts incur higher cost of delivering payment. MUDE and ADOPEM have greater potential of reaching the remote, rural market due to their collection method, but it is not clear, especially in the case of MUDE, if their approach is cost-effective. As an NGO, they are able to attract soft donor funds that may make their more expensive collection method possible.

Capacity to provide financial services in rural areas does appear to present a barrier to financing PV. Only two of the MFIs provide more than half of their loans in rural areas. Furthermore, most MFIs employ a collection scheme that discourages participation of remote populations that make up the rural PV market. The rural customers that MFIs do serve are most likely those situated on the fringe of urban areas with easier access to the population centers.

In this section I have analyzed the compatibility of MFIs in the Dominican Republic with rural PV financing. I found that the MFIs are compatible with PV financing in three of the four key areas studied. The loan sizes, types of loans, and methods used to guarantee the loans offered by the MFIs all would accommodate PV financing, but the remoteness of rural PV markets presents a problem. The industry does not appear to adequately serve these markets. The approach used in this analysis was to identify key requirements to finance PV systems in rural areas and then determine if the MFIs possess these requirements. In the next section I will take a different approach. I will assess the level of experience that the MFIs have had with PV financing and attempt to draw lessons from these experiences.

5.4 PV-Financing Experiences in the Dominican Republic

The MFIs in the Dominican Republic have had a wide range of experiences financing PV. Nine out of the 13 institutions interviewed have at least limited experience financing PV. Five of these nine institutions have had significant experience, which I define as either implementing a project specifically focused on PV financing or having financed over 50 PV systems. Table 14 illustrates the PV financing experiences for each of the MFIs included in this study. The purpose of this section is to understand why some MFIs have never financed a rural PV system; why those with limited experience have not financed more systems; and what lessons can be learned from those MFIs that have had significant PV financing experience.

FDD, Cooperativa Maimón, PROMIPYME, and ADOPEM have not financed PV systems. PROMIPYME has not financed PV home systems because its mandate is to lend to businesses. Similarly, 90 percent of ADOPEM's loans are to enterprises. Both, however, would be capable of lending to small businesses such as rural stores for the purchase of PV systems. In the case of Maimón, they had simply not seen the demand in their province of operation, Monseñor Nouel. Two of the cooperative's three offices are in towns that lie on the most significant transportation artery in the country, so it is likely that electric grid coverage is high in its region. FDD splits its loan portfolio between microenterprise and home improvement loans. PV home systems would need to be considered home improvement loans to be financed by FDD, and at present there is no precedent for this within the institution.

Table 14: PV Financing Experience by MFIs in the Dominican Republic (MFI interviews)

MFI	Experience Financing PV Systems		
	Yes/No	Extent	Nature of Experience
ADEMI	Yes	Significant	Financed 362 systems through a project partially funded by USAID from 1998 to 2001.
ADOPEM	No	None	None
FONDESA	Yes	Limited	Estimated at 15 to 20 systems.
FDD	No	None	None
MUDE	Yes	Limited	A few water pumping systems for irrigation.
COOP-ADEPE	Yes	Significant	Estimated at 200 systems directly and another 200 through a PV entrepreneur since its creation in 2000. The NGO ADEPE also has experience that predates the creation of COOP-ADEPE.
Coop. Maimón	No	None	None
Coop. Mamoncito	Yes	Significant	Roughly 100 systems in an on-going project through Plan Sierra with support from the French Agency for Development (AFD). A few apart from project.
Coop. Sabaneta Novillo	Yes	Limited	Estimated at 15 systems in 2004. Not related to a specific PV project or program.
Coop. Vega Real	Yes	Limited	Only a few systems financed.
PROMIPYME	No	None	None
Plan Sierra	Yes	Significant	104 systems as of Sept. 2004. Project supported by AFD with financing handled by the cooperatives Mamoncito and San José.
GEF/SGP	Yes	Significant	Over 1000 through community operated revolving funds.

Four MFIs have had limited experience financing PV. CVR has financed only a few systems, which mostly resulted from a fair held in May 2004 in which a variety of vendors, including PV dealers, displayed their products for CVR members. CVR offered its members financing for the purchases that they made. CVR has not rejected PV financing; the opportunity has simply not presented itself. A possible explanation is that the cooperative's rural membership is limited to areas with easy access to urban centers and excludes the remote residents who make up the rural PV market. MUDE's experience is limited to financing PV water pumping projects in the eastern region of the country. MUDE only provides credit for microenterprises and for agricultural production. Financing PV home systems does not qualify as either of these two categories of loans, which is why their experience is limited to productive applications of PV. FONDESA and Cooperativa Sabaneta Novillo have slightly more experience, but it is still limited. Neither has been involved with a project specifically aimed at financing PV systems. Sabaneta Novillo's credit manager, José Cesareo Pérez expressed a concern about the vulnerability to theft of PV panels. He cited several examples of theft of panels in his region including the panels from a large community water pumping system. Because of the risk of theft, PV panels cannot serve as their own collateral for loans from Sabaneta Novillo (Personal communication, February 15, 2005). The reason then that Cooperativa Sabaneta Novillo has not financed more PV systems can be described as a concern with how to guarantee the loans. No other institution expressed a similar concern with vulnerability to theft. The

branch manager of FONDESA's Mao office, Vicente Beltré, was instead concerned with finding a guaranteed secondary market for used PV panels in the event of default if the panels were to serve as their own collateral (Personal communication, February 15, 2005). FONDESA's general manager, Juan Lantigua, indicated that the institution believed that it could have a greater economic impact in rural areas by focusing on agricultural production instead of providing household electricity (Personal communication, February 3, 2005).

The reasons that the MFIs with limited or no experience financing PV have not financed more rural PV systems can be summarized as follows: The cooperatives Vega Real and Maimón have not seen the demand for PV among their members; ADOPEM, FDD, PROMIPYME, and MUDE do not offer consumer loans; Cooperativa Sabaneta Novillo has experienced problems guaranteeing the loans for PV; and FONDESA focuses its rural lending in areas that it believes have greater economic impact, such as agricultural production.

The remaining institutions, COOP-ADEPE, ADEMI, Plan Sierra together with Cooperativa Mamoncito, and the GEF Small Grants Program, have all had significant experience financing PV systems. I will now describe their experiences in detail, and try to determine what catalyzed these experiences and what lessons can be learned from them.

COOP-ADEPE: Institutional Experience with PV and Exogenous Risk Factors

The Project:

COOP-ADEPE's experience with PV financing began over a decade ago with its parent NGO, Asociación para el Desarrollo de la Provincia Espaillat (ADEPE). In the 1990s ADEPE financed PV systems and PV related microenterprises through its microcredit program, which transformed into COOP-ADEPE in 2000. Because of ADEPE's experience in the past with PV, COOP-ADEPE has a more thorough understanding of both the functionality of the technology and the risks of financing it in rural areas than most institutions. COOP-ADEPE's experience with PV since its inception has not been through an externally subsidized project as with the other MFIs in the study that have significant PV financing experience. Ramón Abréu, Credit Manager of COOP-ADEPE, said that the cooperative has financed roughly 200 PV systems directly (Personal communication, February 10,2005). The systems have been financed at market interest rates over a period of 18 to 24 months. In addition to the direct PV financing, COOP-ADEPE has also financed one PV entrepreneur. With the COOP-ADEPE financing, the entrepreneur has purchased roughly 200 PV panels that he has in turn rented to rural customers in the province of Espaillat.

Problems Encountered and Lessons Learned:

Though COOP-ADEPE had a working understanding of the risks involved with rural PV financing it had the misfortune of learning of another exogenous risk factor. In 2003 and 2004 the government ran a PV give-away program that included the province of Espaillat, which severely undercut both their market approach to financing PV and the rental activity

of the PV entrepreneur that they had financed. As a result of this market damaging government program, in which hundreds of PV systems were given away, COOP-ADEPE's PV financing activity has all but completely stopped.

COOP-ADEPE has had significant experience financing PV systems in rural areas due to the early involvement of the non-governmental organization ADEPE. Because of ADEPE's experience, COOP-ADEPE was comfortable with the risks of PV financing and was willing to extend credit for PV system purchases. The cooperative limits its operations to the provinces of Espaillat and Salcedo, which have large rural off-grid populations and therefore a large rural PV market. Unlike COOP-ADEPE, ADEMI was drawn into PV financing by an externally funded project. It was asked to implement a rural project that was outside of its overwhelmingly urban-centered activity, and I will now describe its experience.

Banco ADEMI: Experimenting with a Rural Collection Infrastructure

Surprisingly little has been written or publicized about ADEMI's PV financing project. To gain an understanding of ADEMI's experience with the project, I interviewed the ADEMI employee who managed the project, Regional Manager Wilfredo Céspedes, and a PV dealer named Julio Peralta, who was contracted by ADEMI to run the project in the San José municipality of the province of Santiago.

The Project:

USAID approached ADEMI to participate in the project. The project was funded with a 50/50 match from the two institutions, each putting in $200,000. The original timeframe of 18 months was extended to 36 months at ADEMI's request. The project installed 362 PV systems of varying sizes in 12 provinces. Data are available for the first 258 systems financed from an ADEMI report generated on July 31, 2000. The total amount lent for these systems in July 2000 dollars was $279,000. The geographic distribution of the installations, according to Céspedes, is described in Table 15.

Table 15: Geographic Distribution of PV systems Installed During the ADEMI/USAID PV Financing Project (1998-2000) (Personal communication, Céspedes, 2005)

Region	Portion of Total Number of Systems Installed	Portion of Loan Total	Most Common Application
North	70%	55%	PV home systems
South	10%	15%*	Water pumping
East	20%	30%*	Water pumping

*Calculated assuming the same ratio between the south and east regions for the number of systems installed since the common application was the same for both.

The standard home system financed through the project consisted of one 50-watt PV panel, two 6-volt batteries, a charge controller, voltage regulator, converter for a battery-powered radio, and up to six lights. The cost of a standard system was approximately $750.The

financing terms were 15% per year over a maximum of 36 months. The interest rate used was a substantial discount from the market rate.

In the region around San José de las Matas in the province of Santiago, Julio Peralta was involved with every aspect of the project. He visited communities with ADEMI to promote the project; installed the systems; collected the payments; provided service for installed systems; and tracked down delinquent borrowers. Project participants were required to bring monthly payments to Peralta in San José, who then delivered them to ADEMI's nearest branch office in Santiago, one hour's drive away.

Problems Encountered and Lessons Learned:

ADEMI encountered a crisis when world coffee prices fell over 40 percent in the year 2000. Peralta took a survey and found that 70 percent of the population in the municipalities where he operated received monthly remittances from a family member living abroad. The majority of the remaining 30 percent were dependent upon coffee production for their livelihood. After coffee prices fell, many had difficulties repaying their loans. To account for the situation, ADEMI restructured many of the loan repayment schedules to correspond to the harvests. They experienced similar problems with local economies tied to other cash crops such as cocoa and tobacco in other regions of the country. Some loan recipients paid semi-annually and others three or four times per year. The strategy allowed them to skirt the crisis and drastically reduce the loan default rate.

Céspedes expressed that though the project was deemed a success, it was beyond their natural institutional capacity. He considers the project to have had a more social than economic impact, whereas the Bank's focus is on creating economic benefits. ADEMI's infrastructure is also not set up to serve such remote rural population, as evidenced by the extensive role that PV entrepreneurs like Peralta played in collecting payments. It is Céspedes' opinion that ADEMI is more interested in operating in urban areas where it has more experience and where it is easier to be profitable.

Like ADEMI, Cooperativa Mamoncito became involved with PV financing through a project that was designed to catalyze PV system installations in its coverage area. Its experience differs from ADEMI's in that the cooperative did not create a new collection infrastructure to participate in the project.

Plan Sierra and Cooperativa Mamoncito: Making PV Affordable with a Loan Guarantee Fund and 36-Month Financing

The Project:

The regional, state-run development institution Plan Sierra is the implementing agency for the PV financing project. The French Agency for Development (AFD) supplies a loan guarantee fund, and participating financial institutions contribute the actual loan funds. Three financial institutions participate in the project, the cooperatives Mamoncito and San José, and the General Directorate of Community Development (DGDC). Plan Sierra

dictates the financing terms of 21 percent per year over three years. The interest rate is subsidized and significantly below the market rate of over 36 percent per year. Plan Sierra's project coordinator, Alfredo Jiménez, indicated that according to his records, 104 systems had been installed through the project as of September 2004. On February 15, 2005, Mamoncito had a PV loan portfolio of $28,500 over 71 loans. As with their other loans, Mamoncito's PV loan recipients are required to bring payments in to a branch office.

Problems Encountered and Lessons Learned:

Plan Sierra determined that 36-month financing was necessary to lower the monthly payment to an amount that the target population could pay, even with the subsidized interest rate resulting from the AFD guarantee fund. General Director of Mamoncito Alfredo Dorrejo believes that 36 months may be too long of a period (Personal communication, February 15, 2005). He has found that after about 12 to 18 months, customers "grow tired" of making the monthly payments. This is about the time when system batteries can begin to fail. The trade-off with reducing the loan period is that the resulting higher monthly payments would make the systems unaffordable to many project participants.

Two other observations are that project participants have demonstrated an ability to bring loan payments to the Mamoncito office in Monción and that the project was largely unaffected by the government give-away program that hurt PV projects in other parts of the country because the government's program was not implemented in Plan Sierra's coverage area.

The Plan Sierra project was successful because it reduced the risk to the participating financial institutions through the loan guarantee fund. Without the reduced interest rate resulting from the guarantee fund and the 36-month financing, few rural households would have been able to afford the systems. Because the loan recipients are required to bring monthly payment in to the cooperative office, the monthly payments had to be reduced to a level that included this hidden cost to the consumer.

The last case that I will discuss is that of the GEF Small Grants Program, in which the issue of servicing remote populations is addressed by providing a revolving loan fund that is housed and controlled at the community level.

GEF Small Grants Program: Addressing the Issue of Serving Remote Populations through Community Participation

The GEF Small Grants Program (SGP) was included in this study because it represents a major PV financing mechanism in the Dominican Republic. The SGP funds projects in five areas of global environmental concern, and its PV projects fall under the category of climate change. The funds for many of the smaller NGO PV financing projects in the country come from the SGP.

The Projects:

In addition to the household beneficiaries, there are four key stakeholders involved with each SGP project. The first is a community organization. A committee of community members must form before the projects can proceed. The second is the SGP, which provides a revolving fund to finance PV systems in the community. The third is an NGO that provides matching funds and capacity building capabilities to the project, and finally, a PV dealer to sell, install, and service the systems.

The community committee plays a critical role in the project. Alberto Sánchez, National Coordinator for GEF/SGP, expressed that the rural community capacity building may be the most positive impact that the projects have. The committee is ultimately responsible for managing the PV revolving fund donated by the SGP. It is also responsible for selecting a PV contractor to install and service the systems for the project. The NGO, with the SGP, help to build the committee's capacity for these tasks, which includes training on evaluating a contractor, how to keep records, and how to ensure that community members actually repay the loans that they receive. Another capacity building component of most of the projects is to train two community members to be PV technicians.

With guidance from the SGP, the committee sets the interest rate and other terms of the loans. Beneficiaries are usually required to make a down payment and pay 12 to 18 percent per year for up to three years. The community organizations are not required to pay taxes on the equipment that they purchase. If a project participant misses three consecutive monthly payments, the committee reserves the right to repossess the PV system.

The SGP projects address the barrier to serving dispersed rural populations by housing the funding source in the community. Since the community manages the revolving fund, there is no need for participants to travel to a distant location to deliver a loan payment or for an MFI to devise an expensive collection structure that requires monthly visits to each community that they serve. However, the project model relies heavily on the ability to adequately build community capacity to manage a revolving loan fund.

Daniel Bencosme of SGP stated in an interview for this study that the program had facilitated the installation of over 1000 PV systems cumulatively through the projects it had supported (March 8, 2005).

5.5 Discussion of Results and Hypotheses

The results demonstrate that there is significant potential for engaging existing MFIs in the Dominican Republic in the financing of PV systems, but identify the problem of accessing the remote rural PV market as the primary obstacle to overcome. Three of the four possible reasons given in *hypothesis 1* to explain why existing MFIs are incompatible with PV financing were found to be false. Reason *c*, however, concerning the lack of capacity to provide services to the remote, dispersed populations that characterize the rural PV market, appears to be true.

I found *hypothesis 1a* to be false. The MFIs as a whole are compatible from a loan size perspective. Both the mean and median loan sizes for the MFIs are well above the loan value required to finance a 50-watt PV system. Even ADOPEM, which has the lowest average loan size, could be compatible. If its loan period were extended from its current mean of ten months to 24 months and the amount lent per month remained constant, then the average loan size would be $571, just above the 50-watt PV system financing amount of $563. The issue then to be resolved with an MFI like ADOPEM is one of loan period rather than loan amount. It is also important to note that there are a wide range of PV system sizes and prices to accommodate people of different incomes. I chose the 50-watt system as a starting point to compare PV financing requirements and average MFI loan sizes. The five institutions with average loan sizes below the financing price of a 50-watt system may be compatible with financing smaller PV systems.

The Dominican microfinance industry is also compatible with PV financing when considering the types of loans offered by the MFIs, which disproves *hypothesis 1b*. PV home system loans would most likely fall under the category of personal consumption or home improvement loans, and only PROMIPYME and MUDE do not offer at least one of these two categories. COOP-ADEPE has also demonstrated a model of financing a PV small enterprise that in turn delivers the technology to rural households. This type of model would qualify under the micro and small enterprise category of loans. I also found *hypothesis 1d* not to be true because every MFI accepted a loan guarantee method compatible with PV system financing such as physical collateral or a loan guarantor.

The remoteness and dispersion of the rural PV market presents a significant barrier to MFI PV financing, which supports *hypothesis 1c*. Though the study found that MFIs operate in every region of the country, their operations are concentrated in the population centers. Requiring loan recipients to travel to the nearest branch office can be prohibitive for low-income, rural populations, especially when the number of MFI branches is limited. To reach a broader rural PV market a greater commitment to serving rural populations is required. COOP-ADEPE and MUDE do serve rural populations, and both have had experience financing PV systems. One drawback with COOP-ADEPE is that it has a limited geographic coverage area. The collection method employed by MUDE and ADOPEM of going to their customers/beneficiaries to collect instead of requiring them to come in to a branch office increases the potential for serving rural markets. During its PV financing project ADEMI addressed the issue of reaching a remote population beyond its typical coverage area by contracting PV entrepreneurs to collect for them. ADEMI found this process to be difficult because it was managing the entire process, which was beyond their typically urban sphere of operation. Because I found that at least one of the four component reasons to be true, I conclude that *hypothesis 1* is true.

Hypothesis 2 may offer an explanation for why *hypothesis 1* is true. *Hypothesis 2* speculates that the technology is too expensive. This may indeed be true, especially when the full cost of providing and servicing loans in the remote areas that characterize the rural PV market is included in the price. Because MFIs cannot recover their costs in remote markets, they do not operate in those areas. The experiences of ADEMI, Cooperativa

Mamoncito, and GEF-SGP show that when the financing costs are bought down through a subsidy and the loan period is extended to three years, rural households are willing and able to buy PV systems. I then conclude that some form of a subsidy is necessary to reach a large portion of the off-grid population. *Hypothesis 2* is true.

Chapter 6: Conclusions

There is significant potential for MFIs in the Dominican Republic to finance PV systems for rural households. The study found that most MFIs are familiar with the PV technology and many already have at least some experience financing PV systems. The primary obstacle to overcome is accessing the remote rural PV market, which is underserved by the microfinance industry.

ADEMI offers the best potential for financing PV on a large scale but lacks the rural collection infrastructure to provide financial services in remote areas and does not appear to be interested in creating one. ADEMI operates on a national scale, offers consumer loans, has a large average loan size compatible with PV system requirements, and already has valuable experience financing PV. One possible way to engage ADEMI in rural PV financing would be for them to partner with a rural energy delivery company such as Soluz Dominicana, which already has a rural collection infrastructure in place. Soluz Dominicana has collected over 130,000 monthly PV rental payments in remote areas. Together, the two could drive down the cost of providing loans in rural areas by focusing on areas of expertise. The learning costs of breaking in to a new market would be reduced for ADEMI through the partnership. Soluz Dominicana would benefit from the added credit available to its customers. The relationship could potentially maximize the value of Soluz Dominicana's rural collection infrastructure by offering additional financial products in areas where the infrastructure exists. The partnership may be a way for ADEMI to break in to a new market, beginning with PV and expanding to other products. Soluz Dominicana collection agents could be trained to provide initial screenings for loan applicants.

To foster such a relationship, both parties involved need to benefit. Soluz Dominicana and ADEMI's business opportunities must be increased, or the venture will fail. Convincing ADEMI to participate in the partnership is a critical challenge. ADEMI seeks to create economic impacts in urban areas through its financial services. It considers PV to generate a social rather than economic impact outside of urban areas. ADEMI would have to clearly see the benefits that it would receive by entering into such a partnership. I offer two suggestions to entice ADEMI. First, highlight the potential of expanding ADEMI's operations into a new rural market beyond PV financing. Second, reduce the risk to ADEMI by providing a partial loan guarantee fund. The partnership could take the form of a joint merger in which Soluz Dominicana spins off its collection infrastructure division of its business and ADEMI spins off a portion of its assets to merge into a new MFI that focuses on remote areas.

If ADEMI were unwilling to re-engage in PV financing through a partnership such as the one described above, FONDESA and COOP-ADEPE would also be good candidates for a

similar partnership but in a smaller geographical area. The rural cooperatives could be engaged as a group through their association with AIRAC.

ADOPEM is another national microfinance bank that offers the potential to finance PV on a large scale. Only ADEMI has more loan customers, but there are more obstacles to overcome to engage ADOPEM than with ADEMI, FONDESA, or COOP-ADEPE. ADOPEM's loans are small, 90 percent of its loans are for microenterprises, and it has no experience financing PV. The characteristics of ADOPEM that are favorable for PV financing are that it does offer consumer loans, though they only represent ten percent of all loans, and it uses a collection method that does not require customers to bring payments in to a branch office. It is not clear, though, if the bank offers services in rural areas beyond the electricity grid. Because ADOPEM uses a risk management strategy of offering small, progressive loans, a financial micro lease may be a better product for it to consider than a loan. The bank could offer a series of consecutive, short-term leases. ADOPEM would retain ownership of the PV systems during the leases. Upon successful completion of the series of leases, the customer would have the option to buy the system for a nominal fee. Engaging ADOPEM in PV financing would require covering the learning costs that the bank would encounter financing a new product in a new market. A pilot project would allow ADOPEM to assess the cost effectiveness of its collection methods in more remote areas, increase the institution's familiarity with the issues of financing the technology, expand its consumer lending, and assess the profitability of providing other financial services in this new market.

If PV systems are to be financed on a larger scale in the Dominican Republic, the cost to the consumer must be reduced. Focusing the subsidy on the financing would be a way to reduce these costs and to engage existing MFIs. A loan guarantee fund would enable an MFI to reduce its risk and reduce the interest rate that it charges. Funding to cover learning costs and to foster partnerships would also encourage MFIs to engage in PV financing. More research needs to be done to determine the costs to MFIs of servicing loans in remote rural areas, which would allow us to calculate the full cost of an installed PV system financed by an MFI.

Currently in the Dominican Republic the microfinance industry does not adequately provide service in the remote areas that comprise the rural PV market. Instead of waiting for the industry to extend its services to this market before engaging it in PV financing on a large scale, the opportunity to finance PV in this market could be the catalyst that brings MFIs to the countryside.

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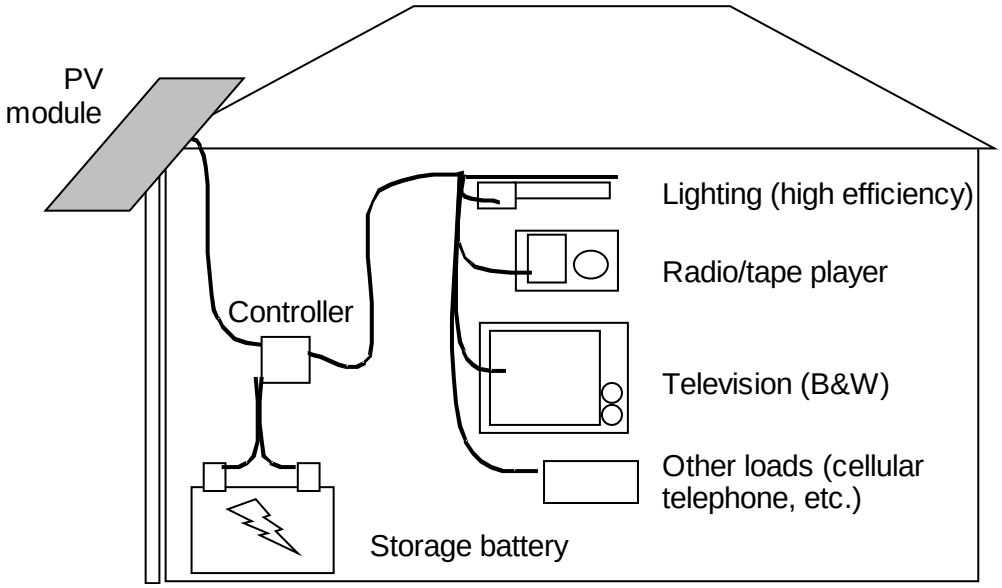
Appendix 1: Description of a Solar Photovoltaic Home System

Solar home systems consist of PV panels that generate electricity directly from sunlight, a battery that stores the electricity generated by the panels, a controller that regulates the flow of energy through the battery, and wiring, lights and other output loads. Figure 4 is a diagram of a solar home system.

Figure 3: Diagram of a Solar PV Home System (Soluz, Inc. internal document)



Appendix 2: Interview Questions

The interviews were conducted in a conversational style. The questions listed here are examples of those used during the interviews to direct the conversation. They were not read in a list as with a survey. In many cases the desired information was attained through the conversation without the need for asking specific questions.

Examples of closed-ended questions are:

- What is the loan portfolio value of the institution?
- How many loans comprise the loan portfolio?
- What percentage of loans granted by the institution is in rural areas?
- What is the geographic coverage area of the institution, including number and location of branch offices?
- What are the methods used by the institution to guarantee its loans?
- What are the categories of loans offered by the institution?

Examples of open-ended questions are:

- What has been your experience financing PV?
- Why has the institution not financed more PV systems?
- How does the institution collect loan payments from its borrowers?

Appendix 3: Interviews Conducted

Institution	Person Interviewed	Date of Interview
ADEPE	Dorca Barcacel, *Executive Director*	February 10, 2005
COOP-ADEPE	Ramón Abréu, *Credit Manager*	February 10, 2005
Coop. Mamoncito	Alfredo Dorrejo, *General Manager*	February 15, 2005
Coop. Maimon	Alifonso Fernandez, *Credit Manager*	March 3, 2005
	Luis Manuel Polanc, *General Manager*	March 3, 2005
Coop. Sabaneta Novillo	Dario Lantigua, *General Manager*	February 15, 2005
Banco ADEMI	Wilfredo Cespedes, *Regional Manager*	February 24, 2005
Banco ADOPEM	Sonia Alt. Reyes Frias, *Vice-President of Finance and Operations*	March 2, 2005
Coop. Vega Real	Yanio Concepcion, *President*	February 8, 2005
PV Dealers	Rafael Vargas, Tecnologia Solar	February 10, 2005
	Julio Peralta, Servicios Ingper	February 16, 2005
FDD	Ada Wiscovitch, *Executive Director*	March 1, 2005
FONDESA	Juan L'Antigua, *General Manager*	February 3, 2005
	Vicente Beltre, *Mao Branch Manager*	February 15, 2005
FondoMicro	Marina Ortiz, *Research Director*	December 1, 2004
Plan Sierra	Alfredo Arangel Jimenez, *AFD Project Coordinator*	February 16, 2005
	Jose Felix Santiago (Tony), *Director of Social Programs*	February 16, 2005
	Benito Bencosme, *Credit Program Manager*	February 16, 2005
PROMIPYME	Jose Fernando Santos, *Business Official, Santiago office*	March 7, 2005
GEF-SGP	Alberto Sanchez, *National Coordinator*	March 8, 2005
	Daniel Vencosme	March 8, 2005
MUDE	Virgilio Felix, *Credit Director*	March 2, 2005
	Lilliana Rodriguez Alvarez, *Microcapital Credit Program Manager*	March 2, 2005
Vision Mundial	Ing. Alvaro Vicioso, *Water and Sanitation Program Director*	March 8, 2005
	Federico Pena, *Operations Director*	March 8, 2005