

Small-Scale Renewable Energy in Panama— Current Status, Lessons Learned, and Barriers Faced

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Abstract

Small-scale renewable energy technologies are desirable because they provide electricity to rural residents while protecting the environment. However, a variety of barriers have hindered the growth of renewable energy. This study identifies the problems that have been overcome and those that still remain for the small-scale renewable energy industry in Panama, as seen from the perspective of equipment vendors.

Introduction

There are many types of renewable energy: hydroelectric, solar (thermal and photovoltaic), wind, geothermal, ocean, and biomass.⁵ Renewable energy has incredible potential as a sustainable energy form, as by definition it does not deplete its source. Small-scale

technologies, which can be owned and operated by one or a few individuals, include solar thermal, wind, solar photovoltaic, mini-hydroelectric, and a few types of biomass processors.

Small-scale renewable energy technologies were first introduced in the 1970s, and their use has expanded incredibly since then, with a 19% average annual growth rate since 1990. Current worldwide use of all types of renewables is 13.5% of total energy use, with solar, wind, and tide energy constituting 0.1% of world energy use.⁶ Renewable energy makes up 21.3% of Panama's energy usage. Of that, 31.7% is hydroelectric, 68.3% is biomass, and a negligible amount is geothermal, solar, wind, and tide.⁶

One of the most common uses of small-scale renewable energy is providing electricity for a household, in order to run light bulbs, televisions, radios, etc.¹ Solar thermal energy is also used in the home for heating water, a luxury that can be afforded by some.¹¹ Electricity can also be provided for community use, lighting, charging batteries, or powering training centers, schools, and health centers.⁹ Water pumping (for community or agricultural use) is another common use of renewable energy.¹ Finally, solar energy is used in remote applications for commercial purposes, like telecommunications and marine signaling.⁹

Two and a half billion people do not have access to reliable modern energy sources, and most of these people are located in rural areas, making it particularly costly to extend the electricity grid (which can cost upwards of \$10,000 per kilometer).¹ Most rural residents use biofuels, like wood and dung burning, to meet their energy needs. These fuels are often burned indoors and can cause health problems due to the emission of hazardous chemicals, especially

when ventilation is poor. Biofuels are inefficient and time consuming to collect. They also can be environmentally damaging and contribute to deforestation.¹² Between 19% and 35% of Panama's population of 2.84 million does not have electricity.^{2,4} Small-scale renewable energy technologies can operate off-grid, making them particularly appropriate for rural areas in developing countries.

Methodology

This research focuses on the views vendors (those who sell and install energy systems for individual customers) of small-scale renewable energy equipment and was conducted through face-to-face and phone interviews. Interview questions fell into four general areas: basic information about their business, problems faced and lessons learned, barriers faced by their business, and their thoughts on the future of the industry.

There are seven small-scale renewable energy vendors in Panama (see Table 1). They range in size from small divisions of multinational corporations to business partnerships run out of owners' homes. Most vendors focus on solar photovoltaic (PV) projects, but many also do projects in wind and solar thermal energy, with a very small number doing minihydroelectric projects.

Part 2 Problems Faced and Lessons Learned

Vendors have encountered a variety of problems and adapted to face them. Some of the lessons they have learned are cataloged below; they fall under five general categories: adaptation to local conditions, education,

Table 1 | Renewable Energy Vendors

Interviewee	Business	Location	Staff	Focus
Victor Saldaña	Electrysol	David	2	85% PV
Alejandro Arango	Energía Renovable	Panama City	3	25% wind, 75% PV
Domingo Sanchez	Kyocera Mita	Panama City	2	100% PV
Vicente Puga	PASS	Panama City	7	90% PV
Victor Lewis	Solarpan	Panama City & Santiago	7	100% PV
Rolland Denham	Solartec	David	4	80% PV
Fredy Stadlin	Swisscontrol	Panama City	3	60% hot water, 40% PV

reducing costs and increasing profits, proper installation, and sustainability of installed systems.

Adaptation to Local Conditions

There are a variety of local conditions characteristic to Panama that must be adapted to, including weather and climate, illiterate or uneducated users, and different usage conditions.

Solar Insolation

Problem: The amount of light energy available in a day (known as solar insolation) varies, as the climate in Panama varies significantly from region to region. This variability in the amount of sun makes designing solar systems in Panama particularly difficult.¹⁰

Solution: Vendors have had to learn the amount of solar insolation available in each area through experience. In the mountains of Chiriquí or Darién, there are approximately 2 hours per day of usable solar energy. In San Blas or the Azuero Peninsula, the sun provides up to 5 hours per day of usable energy.¹

Angle for Solar Panels

Problem: Solar panel installation guidelines are tailored for countries in temperate zones and generally suggest an installation angle of about 45°. The angle of the sun is different in Panama, since it is in the tropics, so the installation calculations made according to manufacturers' guidelines can be incorrect.¹

Solution: In Panama, panels should be installed more horizontally, with a small degree of angle to ensure rain does not pool on the panel.¹

Equipment Damage by Insects

Problem: Insects often seek refuge inside renewable energy equipment, as they are attracted to the heat. This can cause equipment damage.¹

Solution: Customers should put a mosquito net around the equipment, ensuring it is able to exchange air and cool itself down, while keeping insects out.¹

Equipment Deterioration due to Climate

Problem: Panama's climate has high humidity and high precipitation, and many locations are exposed to corroding ocean breezes. This leads to rapid equipment degradation.¹⁰

Solution: Vendors should choose corrosion-resistant equipment. For example, casings should be made out of plastic, not metal, and solar panels should be well-sealed to keep water out.¹¹

Digital Controller Readouts

Problem: Digital controller readouts are helpful in providing details on battery status. However, illiterate customers cannot use such a complicated display, resulting in system damage when the controller is used improperly.¹

Solution: The vendor can provide two types of controllers—one with the digital display, for advanced customers, and one with a basic indicator of battery level using red, yellow, and green lights. The latter controller is much more appropriate for illiterate users.¹

Education

All vendors I spoke with participated in initiatives to educate the public about renewable energy and cited ignorance as one of the major problems facing the industry.

Educating the Populace About Renewable Energy

Problem: Most Panamanians are not knowledgeable about the benefits and uses of renewable energy.⁷

Solution: This is addressed through a variety of publicity initiatives, including advertising campaigns, television and radio shows, participating in fairs around the country, and taking part in university classes, seminars, and lectures.³ Some vendors also lend equipment for use in the universities.¹ All vendors produce literature about renewable energy and their business. Finally, many people learn about renewable energy by visiting a vendor's store.¹⁰

Changing Public Opinion About Renewable Energy

Problem: Most Panamanians think renewable energy does not work. This is from the failure of previously installed projects, due to bad design, bad installation, faulty equipment, or failure to account for local climatic conditions.⁸

Solution: A lot of work remains to be done in combating this stereotype. One solution is instituting standards for renewable energy to ensure that fewer projects fail after being installed.¹¹ As more and more quality systems are installed, people will start to believe in the technology when they see the experiences of their neighbors and friends.³ Another approach is via publicity, by showing videos and pictures of successful projects within Panama.¹⁰

Reducing Costs and Increasing Profits

Vendors use various techniques to reduce cost and increase profit, including producing materials locally, running publicity campaigns, and reducing overhead costs.

Competition Among Vendors

Problem: Competition has increased over the last five years, as the number of vendors has increased threefold. As a result, the margins on renewable energy have been steadily decreasing, making covering basic costs like renting office space and paying engineers more difficult.¹⁰

Solution: A publicity strategy helps differentiate businesses from each other and attract customers.¹⁰ Another approach is to lower fixed costs, by running one's business out of the home, or geographic, technological, or funding-source specialization.¹¹ Some vendors focus on David, Santiago, or Panama City, while Swisscontrol focuses on solar thermal technologies and Pass has developed expertise at working with the government.^{8,11} Many vendors also supplement their income from renewables with other types of work.³

Reducing Costs by Producing Locally

Problem: Importing equipment from Europe and the U.S. is expensive, due to shipping costs, import taxes, and higher wages and material costs abroad.¹

Solution: Vendors have purchased renewable energy

technologies from abroad and learned how to construct them so they can be produced locally. This is not feasible for complicated technologies, like solar panels or wind turbines, but is an excellent approach for stands, casings, etc.¹

Proper Installation

Proper installation is essential to ensure the renewable energy system does not fail later because the equipment is connected incorrectly. Improper installation can be costly for the vendor and the customer if the vendor has to return to fix an improperly installed system.¹ Many vendors only guarantee their equipment if they install it themselves. Problems faced include arriving at the installation location, facing emergencies, and working with electricians.

Preparation for Installation

Problem: The installation team has to ensure they have the right tools for the installation, for most installation locations are very remote.¹

Solution: The team should bring a variety of tools and extra supplies, including an electric drill for use on metal roofs, a first aid kit, extra lengths of cable, and extra light bulbs.¹

Transportation to and from the Installation Location

Problem: Most renewable energy buyers live in very remote areas, making getting there difficult. Sometimes the roads are in poor shape or nonexistent, so other forms of transportation (such as traveling on horseback and on foot) must be used. Frequently, rivers must be crossed; when these rise, the installation location cannot be reached.⁹ The installation team may also be stuck at the installation site if weather conditions change, or the installation may take longer than expected.¹

Solution: Some vendors may teach the customer how to install the equipment so they or their employees do not have to travel to the installation site in person. Easy-to-use equipment exists that makes it easier for customers to install the system themselves.¹¹ If the vendor is going to install the system, which is the most common approach (in order to ensure it is done correctly), the vendor has no choice but to be patient in the fact of

obstacles and delays. The installation team is often housed by the customer, in order to save money, but the team should also bring extra food, tents, and bedding in case there are delays or problems.¹

Interactions with Electricians

Problem: Many electricians are not knowledgeable about the design and installation of renewable energy systems. This can result in a poorly designed or inadequate system, or the system may not function due to improper installation.¹

Solution: Most vendors only provide equipment guarantees if they install the equipment. Additionally, vendors can help train electricians on the proper installation of renewable energy equipment, but this has the danger of creating competition.¹

Sustainability of Installed Systems

The technology behind renewable energy is sustainable; it does not deplete the source of energy. However, vendors must be sure the systems themselves are as sustainable as the technology is. The long-term sustainability of a system depends on the ease of and need for maintenance and damage prevention.

System Maintenance

Problem: Certain types of equipment, especially batteries, require maintenance at intervals of 6 months to a year.¹ However, many rural users do not have the expertise or motivation to perform this maintenance, resulting in system failure. Also, many rural users are not particularly careful with the equipment and can damage it relatively easily.⁹

Solution: Vendors switched to using equipment that did not require much (if any) maintenance and was more rugged.⁹ Vendors can also train customers how to repair their own equipment, as has been done with the Kuna Indians.¹¹

Theft

Problem: Theft of solar panels is a problem, particularly with public systems (like those installed on telephones, water pumps, health centers, and schools).

Solar panels are also stolen from signaling buoys in the ocean and the Panama Canal.⁹

Solution: The equipment must be installed very securely and out of reach of thieves. For example, solar lighting was put up in the town center of many Kuna villages; all of the equipment was put on top of tall poles so it would not get stolen.¹

Part 3 Barriers to Be Overcome

Almost all vendors cited high cost, lack of government incentives, government bureaucracy and corruption, and lack of knowledge about renewables as the four major barriers they face. Other barriers include the lack of standards and competition from foreign companies.

High Equipment Cost

Renewable energy technologies are expensive. The cost has decreased over the last 10 years but is still high, especially when compared with the income of an average Panamanian.¹⁰ This has a variety of impacts. First, it reduces demand. Many customers that come to a vendor's store out of curiosity are deterred by the high prices.¹⁰ Also, the high cost makes purchasing equipment a big investment. As a result, vendors cannot maintain a stock of equipment, as they cannot afford the investment without a sure payoff; there is no guarantee that their stock will sell.⁸ Because vendors cannot maintain a stock, they must import equipment as it is requested by customers. Equipment bought piecemeal is more costly than equipment bought in bulk, due to manufacturing economies of scale and transportation and importation costs, which increases the prices even further.⁹ Without financing to import equipment in bulk, small vendors cannot grow, as they are forced to always purchase equipment on an as-needed basis, paying higher prices.¹⁰

Lack of Government Incentives

The high cost of renewable energy equipment is compounded by the lack of government incentives to purchase the equipment; this problem was highlighted by all vendors. Many other countries have reduced import taxes

for renewables in order to promote the growth of the industry, but Panama has not. Import taxes on solar panels are 15%, while those on gas generators are 3%.⁷ This is a particular problem because no renewable energy equipment is made locally; it all must be imported.⁸

A law has been put forward in the Panamanian Assembly to lower import taxes on renewable energy equipment, but it has failed to pass after being introduced three times. This may be due to opposition by large utilities, who would lose money due to competition from the renewable energy industry. While some vendors are confident the law will pass, others do not expect any action until after the May 2004 elections, and still others think that the import taxes will be increased to prevent small-scale renewable energy from competing with existing energy businesses (Confidential Source).

Government Bureaucracy and Corruption

All government-sponsored projects go through a bidding process, with the winner determined by price. Variables like the experience of the company, the quality of the equipment, and the financial security of the company do not have a significant impact. Ignoring equipment quality is especially problematic, as this can result in failed projects. This is compounded by the government buying systems but rarely payin for system maintenance, so the systems fail and are not repaired, as the installation company has no monetary incentive to repair problems with its project. However, there has been a recent trend for the government to include maintenance and training in its project plan, though the success of this largely depends on how it is implemented (Confidential Source).

The solicitation process is also affected by corruption and under-the-table payments, which discourages vendors from participating. This corruption continues in the design process; manufacturers can exclude competitors' products by requesting certain design specifications. The company awarded the project then has to follow these specifications (Confidential Source).

Additionally, when a renewable energy business installs systems paid for by the government, there is

usually a significant delay between the end of the project and the remittance of payment. This can cause difficulties for the business, which may have outstanding debts from the installation.

Lack of Awareness of and Misconceptions about Renewable Energy

As previously mentioned, lack of awareness of renewable energy and its benefits and misconceptions about the technology are significant barriers to the expansion of the renewable energy market in Panama. Customers must know the advantages of renewable energy before they will buy it. This is especially important for affluent Panamanians and foreigners, as they have the capital to spend on renewable energy systems.⁹ Educating government officials is also important because they decide whether to purchase traditional or renewable energy for rural electrification.⁸

Though knowledge is much greater than a decade ago, much work remains to be done, especially in combating the misconceptions about renewable energy. At fairs, some renewable energy vendors have been laughed at because people think the technology does not work.¹¹

Lack of Standards

Panama does not have a body regulating the installation of renewable energy or the standards of the equipment. This lack of standards contributes to the failure of systems, which reduces support for the technology. Equipment in Panama should resist humidity, rain, and corrosion. However, this does make the equipment more expensive.⁸

Competition with Non-Panamanian Companies

Many development projects are funded by outside agencies, like non-governmental organizations, banks, or countries' foreign aid bureaus. Frequently, such external funding requires that materials, technology, and expertise be purchased from the country that donates the money, in order to provide economic benefits to that country. This is problematic because these outside companies may not be aware of local conditions that affect how the system should be designed. As indicated previously, Panamanian companies have learned lessons

regarding climatic conditions, equipment deterioration, and amount of solar insolation. Foreign companies are likely to make these mistakes, as they have not gained a sufficient amount of local experience. Also, it is difficult to get these companies to repair damaged or faulty equipment, as international transportation is very costly. Most importantly, the use of outside vendors and engineers hinders the development of the renewable energy industry in Panama by withholding investment. Occasionally, these projects also work with local businesses or installers, but they frequently do not. One advantage, however, to importing technology and expertise is that it will likely be more advanced than that available locally.⁸

Part 4 Future Prospects

NGO Formation

One initiative with strong potential to help the renewable energy industry is the formation of a non-governmental organization for renewable energy in Panama. This organization is forming with the objective of developing the renewable energy industry and its technology; it should be launched officially in about a year. Members will work together on projects and share information.¹⁰ The organization will also help protect the reputation of member renewable energy vendors by providing a guarantee of quality. This will help overcome bad designs and installations and low public trust in renewable energy. It may also put pressure on the government to reduce the import tax on renewables or pass other types of incentives.⁷

Conclusion

Overall, renewable energy in Panama faces a bright future. Knowledge of the technology is increasing, and as knowledge increases, demand will increase. Many of the people now purchasing renewable energy are foreigners, as they typically have more money and have trust in the technology. This work will open the door for the expansion of the industry; people will see successful examples and be motivated to install their own

systems.⁹ Government incentives would be a great boon, but the industry will still grow, albeit more slowly, without them.

One vendor sees full acceptance of the technology in the future, based on what he has seen in the last seven years.⁷ All vendors are optimistic and expect the industry to grow, especially with new technologies (like flexible solar panels and fuel cells) and with the continuing decrease in price of the technology.⁹

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