

Teaching Case

Quetsol: Energy and Development.

Key words

Energy, inclusive business, development

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Quetsol – Energy and Development

Abstract

Juan Fermin and Antonio, two young Guatemalan entrepreneurs, enter the renewable energy business providing low-cost photovoltaic solutions to poor rural families without access to electricity. The case describes the development of the company, the business context, the building of partnerships with microfinance institutions and community organizations, and the way the company designs a strategy to face the challenges of competition.

Introduction

In November 2011 Juan Fermín Rodríguez, Manager of Quetsol, based in Guatemala City, wondered what the next steps should be at the end of the fourth year of company operations. He especially remembered the afternoon four years back when he received a call from Antonio Aguilar, his longtime friend and business partner. More than four years had passed since Antonio mentioned the idea of conducting business in renewable energy. To date, they were in the process of assessing and aligning with their strategic goals for the years to come.

Now, after they had managed to establish the company, he wondered what should be done to expand its target-market penetration. Should they remain focused on the rural segment? How had people's access to energy evolved? What elements in their business model had proven to be key and what should be changed? What criteria should be used to assess company success since inception?

Background

In October 2007, Juan Fermín Rodríguez, brand manager of Procter & Gamble for Guatemala, was preparing to submit a monitoring report for the strategic marketing plan. Just a few minutes before starting the meeting, he received a phone call from his school friend, Antonio Aguilar, who at the time was living in the United States and had completed his engineering studies at a renowned New York university.

The call surprised Juan Fermín, but still he was very pleased. Antonio said he would come the following Friday to Guatemala and wanted to discuss a business idea with Fermín. At the meeting, Juan Fermín was congratulated for his excellent work in brand management. Once the meeting was over, the regional coordinator of the company, based in Panama, offered Juan Fermín the opportunity to relocate to a higher position in Panama in recognition of his merit.

Juan Antonio Fermín and had been best friends for life in school and after graduation they remained in contact, although Antonio went to the United States two months after graduation, back in 2000.

In his call, Antonio told Juan Fermín that he was looking for a partner to start a renewable energy business. Although Juan Fermín knew almost nothing of the energy sector, his instinct told him this was a promising idea.

The meeting

The meeting between Juan Antonio Fermín and was very pleasant. After remembering old times at school, Antonio went straight to the point. He planned to start a company providing technology suitable to meet the energy needs of people. Juan Antonio suggested Fermín to look skyward and identify the resource. Solar energy was going to become the basis for their business.

More precisely, Antonio explained to Juan Fermín his business idea, namely, offering an energy solution to the poorest families in Guatemala. Specifically, the idea was to offer solutions through photovoltaic (solar) systems to meet the energy needs of rural communities. A photovoltaic system is a set of elements with specific features connected to turn sunlight into electricity.

In Antonio's view, it was just a matter of time for external variables such as the high volatility of fossil fuel price to lead to the rise of PV systems, making them both economically viable and profitable. Juan Fermín considered the idea and settled his doubts with Antonio. Overall, it seemed a fairly innovative idea. First and foremost Juan Fermín studied to understand Guatemala's social energy and situation.

Six months later Antonio definitely returned to Guatemala and his discussions with Juan Fermín were well advanced. Both were already motivated and involved in developing the firm. At that time, Juan Fermín could devote 30% of his time to the new company, due to his job with the U.S. multinational. He was faced with a dilemma as his opportunities for growth and development at P&G Guatemala were improving by the day.

The two young men, who were 24 at that time, lacked the financial resources required for the business. Needing help, they started writing a business plan that would become their main tool to find financial support (see summary in Exhibit 1.)

The Business Context

Energy and Poverty

Energy was seen to have a huge influence on the lives of poor people, as it is essential for virtually all aspects of well-being, including access to water, agricultural productivity, health, and education among others.

The dependence on the consumption of traditional biomass (firewood) and the lack of access to electricity were the two major indicators of fuel poverty in poor households. According to the United Nations, some 2,400 million people were estimated to depend on traditional biomass as their primary energy source and 1,600 million people were thought to lack

access to electricity. Poor people spend much of their income on energy, which in some countries accounts for a third of household income. In low-income countries, women and girls spent up to 6 hours a day collecting firewood and water, cooking and processing agricultural products. Access to energy services was thought to make a huge difference for those living in poverty.

To some degree, the importance of energy for development had an empirical basis showing the relationship between access to modern energy and human development. It was alleged that in the history of development there was not a country that had succeeded in reducing poverty substantially without massively increasing energy use or without achieving change towards more efficient energy sources. Exhibit 2 relates this access to energy to the Millennium Development Goals. The UN Advisory Group on Energy and Climate Change made a call to reach universal access to modern energy services by 2030.

Guatemala's Energy Situation

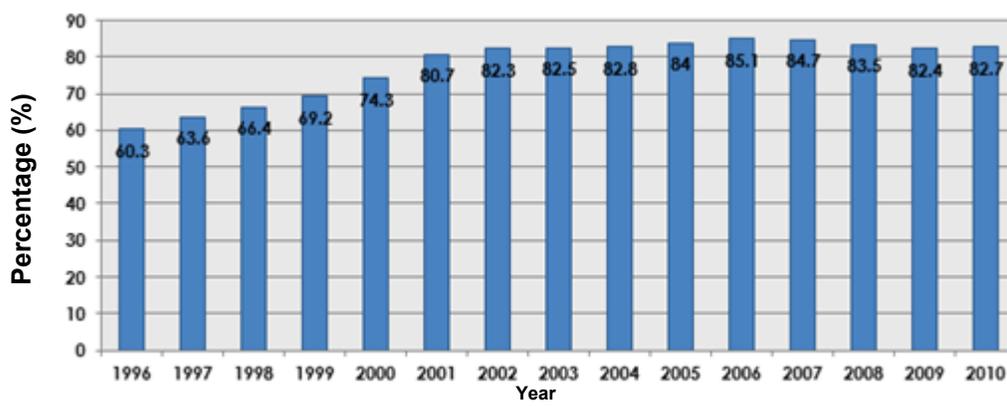
Firewood and oil products were the main energy sources used in Guatemala. According to data from the 2010 Energy Balance from the Guatemalan Ministry of Energy and Mines, firewood accounted for 58.2% of final energy consumption in the country, while oil products accounted for 33%. Electricity accounted for the remaining 8.8% (see Exhibit 3.) Consumption at the residential sector accounted for 61.8% of energy that year, followed by the transportation sector (24.9%) and finally the industrial and trade and service sectors with 7.7% and 3.9%, respectively.

Unlike most Central American countries, Guatemala produced oil, although in relatively small volumes. However, it was exported almost entirely, as the country lacked refining capacity. Thus, all oil derivatives used in the country were imported. Also Guatemala imported coal, primarily to produce electricity.

As for the electricity sector, 45.5% of the energy in 2010 was generated from water, 23.7% from oil products, 12.5% from coal, 10.8% from biomass (cogeneration in sugar mills) and 3.1% with geothermal power. The rest (4.4%) was imported. Reducing dependence on fossil fuels and increasing access, especially for the rural population, were seen as two major challenges for the country's electric power sector.

Recent rural electrification processes in Guatemala have been relatively successful. According to the Guatemalan Ministry of Energy and Mines, the Rural Electrification Programme (PER) was able to increase electricity coverage from 40% to 82.7% between 1996 and 2010. This was achieved thanks to funds from a trust resulting from the sale of state-owned distribution companies as a consequence of asset divestiture in the Guatemalan electricity subsector in 1996. However, the challenge remained to bring electricity to 15% of the population (some 520.000 households.)

Change in the Electricity Coverage Index in Guatemala



Source: CNEE expansion plans, 2012

A major challenge was to bring electricity services to relatively isolated communities, where setting distribution networks were both difficult and expensive (see Exhibit 4.)

Due to population growth some towns still had low electricity coverage (see Exhibit 5.) Photovoltaic solar energy was seen as a very viable alternative in these cases, as it was felt that that the country had great potential in this field.

A report by the Ministry of Energy and Mines (MEM) on the potential of renewable energy in the country put average solar radiation in 5.3 kWh/m²/d (kilowatts-hour per square meter per day). This was a very important indicator to know the viability of solar energy in Guatemala. In this regard, Guatemala had an advantage over other countries as it had an average annual irradiation which was consistently high throughout the year.

Electricity Market Regulation

Since 1996, the electricity sub-sector in Guatemala was ruled by the General Electricity Law Decree No. 93-96, following a competitive, clear, open and stable market model (Exhibit 6.) No prior authorization or condition from the government, beyond those recognized by the country's Constitution and laws was required to generate electricity. However, to use government assets for these purposes (for instance, water resources) authorization from the Ministry of Energy and Mines was required whenever the plant power exceeded 5 MW. Transportation of electricity involving the use of public property and the final electricity distribution service were subject to licensing and regulation.

Prices for the provision of electricity services were free to date, except for transport and distribution, which were regulated, as were energy transfers between generators, traders, importers and exporters that resulted from wholesale market operation.

Quetsol: The Search for the Best Supplier

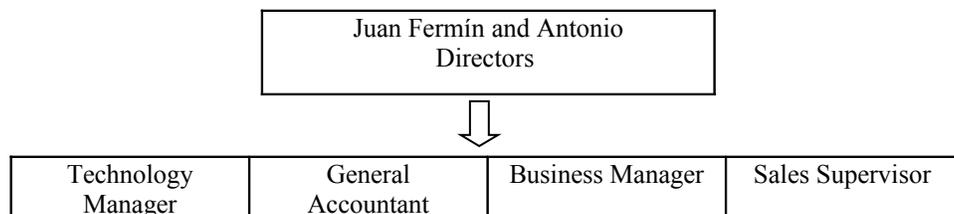
The proposed business plan suggested identifying a supplier in China and negotiating prices, volumes and everything related to photovoltaic technology to open up a space in the Guatemalan market. By late 2007, Juan Fermín took his vacation at P&G and the first thing he did was to buy a ticket to China to visit a number of suppliers. The business plan suggested Juan Fermín would be in charge of the marketing and sales department of the new company.

Three weeks later Juan Fermín returned to Guatemala with several samples of photovoltaic equipment after identifying a supplier which he thought met the specifications and criteria required by the new business. He was convinced of the advantage to import his products from China; he knew the business was competitive to the extent that it generated a large volume of imports at very affordable prices. For much of 2008 Juan Fermín and Antonio continued to refine every element in the new company's business plan. During that time they analyzed the Guatemalan energy sector for more items on the feasibility of their idea.

Company Inception

Quetsol was founded in late 2008. Juan Fermín and Antonio launched it to use solar photovoltaic technology to transform sunlight into electricity for various purposes. For both of them, the use of photovoltaic technology meant a chance to reach remote communities and lower monthly electricity bills for households. Solar energy could produce heat for cooking, heating water for domestic and sanitary use, heating, industrial drying processes for grain, fruit or heating for livestock, in addition to operating several devices.

Quetsol sought to work through two business lines: solar photovoltaic energy and solar thermal energy. The initial venture was devoted to solar photovoltaic energy. Exhibit 6 summarizes the characteristics and differences for both systems. Both Juan Fermín and Antonio envisioned leading a company with the structure shown below,



For the time being just Juan Fermín and Antonio were working at the company, but they envisioned growing and bringing other people on board to increase sales.

The First Big Challenge

After incorporating the company, Antonio received an email about a business competition from a former classmate at college in the U.S. who was linked to an NGO in Quetzaltenango, Guatemala. The winner would take up to \$ 50,000.00 (seed capital and financing) to start a business. The contest came in handy and both Antonio and Juan Fermín were highly motivated to participate and submit their business plan.

The contest was planned by GuateVerde, a Guatemalan NGO sponsored by the Appropriate Infrastructure Development Group (AIDG), a renowned U.S.-based NGO focusing on promoting renewable technology in less-developed countries. After four months of presentations, reviews and analysis of Quetsol's value proposition, a jury of local and foreign energy experts chose Quetsol as the winner and granted U.S. \$ 50,000 for it to continue with its entrepreneurship initiative.

Both Juan Fermín and Antonio were very happy and still more motivated. They had just proved to themselves that their idea was promising and that funding was coming.

The award money was broken down as shown below.

Quetsol Resources	Amount (USD)
<i>Seed capital (non-reimbursable) AIDG</i>	10,000
<i>Loan / funding AIDG</i>	40,000

In addition to creating the company, which ultimately resulted in a corporation, Juan Fermín and Antonio had contributed U.S. \$ 7,500.00 each. However, they identified an opportunity to push sales. They decided to create a parallel foundation called "Fundación Quetsol" to channel donations. This foundation would aim to develop a CSR campaign called Ilumina Guatemala ("Light Guatemala".) Fundación Quetsol was established to promote participation and contribution of individuals and organizations willing to contribute in order to reduce the lack of access to electricity. Its model suggested that the foundation would receive donations to buy from Quetsol kits priced at "a preferential price for those in social disadvantage." Then the foundation would distribute the kits in the most marginalized communities in the country. Juan Antonio and Fermín were clear that their campaign was an ideal complement to the efforts made by some youth in Latin America through the "A Roof for My Country" campaign, aimed order to providing housing for low-income population. In other words, Juan Fermín and Antonio were sure to cover 100% of Guatemala in the future through the business firm and the foundation.

Socio-Economic Characteristics of the Target Market

Quetsol's target market consisted of the poorest families in Guatemala. In his analysis of the environment, Juan Fermín concluded that access to electric lighting was linked to illiteracy. To Juan Fermín and Antonio it was clearly shown that increased access to electricity was a vital component of human development.

In their view, Quetsol's products would have a deep impact on the customers' quality of life by providing them with access to lighting and digital communication. Additionally, the environmental and health benefits (resulting from avoiding kerosene fumes from current lighting, for example) would bring significant benefits to end users. In the medium and long term Quetsol aimed at reaching 500,000 households currently lacking access to electric lighting due to high barriers to entry. According to the ENIGFAM 2009-2010 survey of the National Institute of Statistics (INE), socioeconomic indicators for these families showed an average family income of approximately \$ 482 per month for an average household of 5.6 people. The target market for Quetsol products was made up mainly of poor or extremely poor people. To Quetsol, electricity coverage was directly correlated with the community's rate of development. The following table shows major development indicators for the departments of Alta Verapaz, Quiché and Petén, the three departments with lower electricity coverage in the country:

Table 1

Guatemala - Electrification and Social Indicators

Indicator /Department	Guatemala	Alta Verapaz	Quiché	Petén	Comments
Number of households lacking electricity**	520,000	116,000	46,000	49,000	Accounting for 50% of the population lacking electric lighting
Electrical coverage*	82%	35%	71%	52%	Ranking 1st., 4th., and 2nd. in the country with the lowest rating
Literacy rate**	82%	56%	53%	66%	Ranking 2nd., 1st., and 7th. in the country with the lowest rating
Housing rate **	77%	32%	51%	44%	Ranking 1st., 4th., and 3rd., in the country with the lowest rating
Health rate**	89%	87%	85%	82%	Ranking 4th., 2nd., and 1st., in the country with the lowest rating
Extreme poverty**	13%	30%	16%	16%	Ranking 1st., 6th., and 7th. in the country with the lowest rating
Non-extreme poverty **	41%	47%	50%	47%	Ranking 11th., 6th., and 10th. in the country with the lowest rating
Total poverty**	54%	77%	66%	63%	Ranking 2nd., 6th and 8th. in the country with the lowest rating
Development rate**	66%	43%	45%	49%	Three lowest rates in the country

* Electrical coverage census (Ministry of Energy and Mines, 2009)

**National Survey on Living Conditions (National Statistics Institute, 2011)

Throughout 2009, Quetsol had sold 80% of its products at these three departments. Seventy-five per cent of the total was sold through micro-credit. Eighteen months later, in July 2011, Quetsol conducted a survey which sought the impressions of his first 300 customers with results as follows.

- 69% of them said their economy had improved.
- 75% indicated improvement in their children’s education; 62% said their children were now studying 2-4 extra hours per day.
- 91% said they would recommend Quetsol products to someone else.

Product or Service

Quetsol’s main product was a lighting kit using a solar panel and a battery to supply electricity to a series of highly-efficient LED (light emitting diode) lights, in addition to loading a cell phone and powering small electronics. This product line was Quetsol’s major bet. However, to avoid dependence on a single product line, Quetsol also marketed lighting fixtures such as light bulbs and flashlights also loaded with integrated photovoltaic panels. A picture of the kit follows.



These kits were between 5-50W and all of them had cell charger. Larger models were capable of powering small electronic devices such as radios, TVs and fans. Their life was estimated at approximately 10 years. By 2011, 25% of Quetsol sales were 75-watt kits. Quetsol offered 10-, 30- and 75-watt systems.

As the market grew Juan Fermín and Antonio realized that they had to offer more robust systems, including even AC. Some customers were already thinking of plugging TVs and DVD players. Juan Fermín and Antonio had already planned to introduce 150- and 240-watt kits.

However, Antonio also suggested including portable generators. These were capable to offer up to 300W of electricity generated through a built-in 24W panel. They could be used to power a variety of appliances as they had AC / DC outlets. Their approximate life span was 10 years.

Finally they thought it important to include accessories into their offerings. Through light bulbs and lanterns, Quetsol could provide portable lighting solutions also fed through a photovoltaic panel. By late 2009, Quetsol sales amounted to \$ 50.000 (equivalent to 250 75-watt kits), that is, 20 kits per month on average. Year 2009 had been used to adapt and to better understand delivery logistics. In 2010, the company soared and managed to achieve sales for \$ 143.400.

Quetsol's Sales Force

Quetsol's main strength in its sales strategy was directly promoting and demonstrating its product in communities through their leaders. It had an internal sales force in the field constantly promoting, training and installing solar energy systems. The sales force members had the appropriate tools to provide customers with proper follow-up. However in order to close a sale, Quetsol had to send customers' requests to micro-credit institutions so that their efforts could be processed and cleared. In addition, Quetsol had an external sales force working on a commission basis. These sellers, who were residents of the same communities, knew the product firsthand and had the tools required to promote it. By selling 15 units Quetsol equipment, they could earn the equivalent of a minimum wage in Guatemala.

Importantly, Juan Fermín y Antonio aimed at enhancing their sales force through a trust relationship with COCODES (Community Development Councils), a community structure created to promote public participation in development planning and governance at local level.

The COCODES were a part of the Development Councils System operating nationally. As provided by law, the Development Councils had to operate at community, municipal, provincial, regional and national levels. COCODES presidents were the people Juan Fermín and Antonio had identified for market penetration.

Quetsol Kits- Geographical Distribution

Six of Guatemala's 23 departments accounted for 80% of communities with low rates of electricity service. These included Alta Verapaz, Quiché, Petén, Baja Verapaz, Izabal, and Escuintla.

Quetsol strategically opened offices in Guatemala City, and branches in Alta Verapaz and Quiché. Expansion plans called for branches in Petén and Izabal in 2012. Following AVON business model based on direct sales, Quetsol strategy included

door-to-door visits and demonstration to contact people and win their loyalty. In addition, Juan Antonio Fermín's entrepreneurial vision led them to think of expanding to other Central American countries such as Honduras, Nicaragua and El Salvador, which were very attractive for their business.

Alliance with the Financial Sector

The business grew by 150%. The key to success was the alliance between Quetsol and BANRURAL, the second largest bank in Guatemala in terms of assets. That bank was present throughout the entire country. It had enough coverage in rural areas and branch in all 333 municipalities. Banrural had over 900 branches around the country and it was the bank with the most support to social and rural development in Guatemala. It offered the lowest interest rates for microcredit (1% flat monthly), and it had a business model focused on serving the BOP. At that time, for one Quetsol product such as the 10W-kit it offered credit to be paid in 24 installments of Q. 98 (USD12.00.) This cost was lower than monthly family expenditure for lighting with candles and charging of cell phones at that time. Each product had a 3-year warranty. The alliance allowed the maximum possible scope in terms of distribution and coverage and provided enough credibility when the company was presented in marginalized communities. In addition the partnership also served as a barrier to entry for other competitors.

On the other hand, the largest micro-finance institution in Guatemala, Fundación Génesis Empresarial, also entered into a strategic alliance with similar conditions. The difference between these two organizations was that Banrural requested its customers' tax identification number, whereas Genesis Empresarial did not. Obviously, customers at Genesis were poorer and came from a deeper rural area. Those of Banrural could be closer to the urban areas of Guatemala. However, interest rates at Genesis were higher.

Quetsol ended its third year of operations (2011) with sales of US\$ 200,000 and wanting to expand its market share. By early 2012, its projected sales amounted to \$ 300,000.

Quetsol's Competitive Advantage

Quetsol owners believed that power supply played a key role in the development of the population. Quetsol differentiated itself in the market through comprehensive service including installation and operation of equipment, plus training to community residents for the proper management and maintenance of kits. Quetsol kits provided elementary technical equipment, and were designed to promote human development in isolated rural communities. Moreover, to increase efficiency, Quetsol kit allowed users to manage the use of available energy and to choose pieces of equipment that could run at different times.

Internships

Antonio's contacts from college times in the United States and Juan Fermín's social networks led a number of MIT students to support for several months Quetsol's implementation strategy since 2009. They supported the firm, usually between June and September, through studies, analysis and research on marketing, distribution and logistics. Support of four graduate students from the University of Pennsylvania was expected by 2012.

Competitors

At the beginning of the fourth year of operations, Juan Fermín and Antonio thought that competitors had been neutralized. They had made some empirical polls by visiting some villages in rural Guatemala which were more likely to purchase kits. But they also commissioned a market research agency (M&P Marketing) a formal study that threw encouraging results. This study cost them \$4,000 and the results were as follows: Quetsol had an 80% market share and 90% brand name presence. However there were two companies that Juan Fermín and Antonio saw as competitors. These were:

Illumila: a supplier of lighting solar kits similar to those of Quetsol, but priced 50% higher.

Energía Dinámica, S.A.: Located in Guatemala City, offering solar kits with an average unit price of \$ 1,000. Its market strategy included educating customers about its products.

At the beginning of its fourth year of operations, Quetsol was about to dominate the market. However, after returning from the 2011 Christmas holidays, Antonio turned on the TV while talking with his family at his home in Guatemala City. When he tuned to an open national television channel, he watched a story on the arrival of a solar energy company called Energie Soleil.

In an exclusive interview with Julio Mejía, CEO of ENERGIE SOLEIL, the news report announced the introduction of solar energy equipment, consisting of 12 kilowatt-hours per month battery, allowing to connect three to five light bulbs, and two hours to charge cell phones or to connect a TV, radio or other appliance. This piece of equipment would be available in a month on the market at a cost of Q. 3,000 (US\$ 380.00.) Mejía said they were looking for alliances with banks to provide financing. Antonio immediately called Juan Fermín to tell him the news and asked to meet with him as soon as possible to define strategic actions to counter the arrival of this competitor.

The news report ended by saying that with the arrival of ENERGIE SOLEIL, the market got quite interesting and it now had possibilities to expand. To Juan Fermín and Antonio the presence of a competitor was clear. On the other hand, Juan Fermín and Antonio regularly received e-mail newsletters about important news of the energy sector in Central America. There had been an energy fair in Salvador a few months earlier organized by the cooperation agency of a European country

and the Red de Organizaciones de Energía Renovable de Centroamérica (ROERCA) (Network of Central American Renewable Energy.) The latest bulletin received by Antonio highlighted the news of a young Salvadoran entrepreneur seeking to enter the renewable energy market.

The Salvadoran entrepreneur, Mario Francés, owner of Inversiones Solares S.A. was selling solar water heaters and in the not too distant future saw a transition to solar energy sales in rural communities. Juan Fermín and Antonio did not know him, but had heard of him in recent talks with Costa Rican investors. Francés' record was outstanding. After working for Central American Investments as a consultant and analyst, he learned about the business model used by SOLSHASS, a company devoted to selling energy solutions from renewable sources in Costa Rica. The core business was selling a lighting kit and solar water heaters under the brand name So. The heater operated by taking the sun's radiation to heat water through an efficient and cheap method. The young entrepreneur had invested \$ 45,000 to promote this business model for a year. According to Francés, Guatemala was the most promising country and he wanted to focus all his efforts in this market. Quetsol's fourth year of operations offered highly complex challenges, albeit Quetsol was financially stable.

By late November 2011, Quetsol had managed to sell several hundred kits to some municipalities in western Guatemala. This sale had meant an effort for several months to finally win a bid with a consortium of municipalities in eastern Guatemala. It was the first time Quetsol participated in a government bid and won it. The sale of the kits to the consortium had taken some time because of red tape, but thanks to proper management of the company's cash flow, Juan Fermín and Antonio could properly manage this business with the municipalities. At the same time, the European Union was about to sign a € 20 million-program with the Ministry of Energy and Mines to help the country introduce of energy solutions for rural families. Juan Fermín and Antonio had yet to decide whether this was a threat or an opportunity for them.

Exhibit 1

Quetsol Business Plan - Executive Summary

Quetsol is a new company devoted to providing appropriate, mainly solar, technology solutions to meet basic energy needs. Our mission is to improve our customers' quality of life by providing them with sustainable tools to reduce their economic, social, and health costs.

We focus mainly on providing low-cost, high-efficiency solar energy solutions for basic lighting, power generation and water pumping. All our products have an extremely attractive quality-price ratio. We offer lighting kits providing electricity to a series of high-efficiency LED lights, load a cell phone and power small appliances through a solar panel and a battery. To complement these products we have lighting fixtures such as light bulbs and flashlights, also loaded through integrated photovoltaic panels. We also offer solar-powered water pumps capable of drawing water from wells or rivers. The prices of our products are better than those of our direct and indirect competitors. Currently, our products are designed to meet the needs of low-income people. Because of the network's expansion costs, this situation will give us a chance to enter the market.

We envision expanding our operations to the rest of Central America. To move to the next stage, we are seeking to obtain additional funding for \$ 150,000. This money will be used primarily to purchase more inventories, hiring more staff, and the acquisition of fixed assets.

The combination of the number of people in Guatemala with little penetration of effective, cheap solar solutions make this an excellent time to enter this market which is relatively open. In addition to Quetsol's huge economic potential, we believe that, just as importantly, we will cause a deep improvement in the quality of life of thousands of users. The sky is the limit.

Exhibit 2

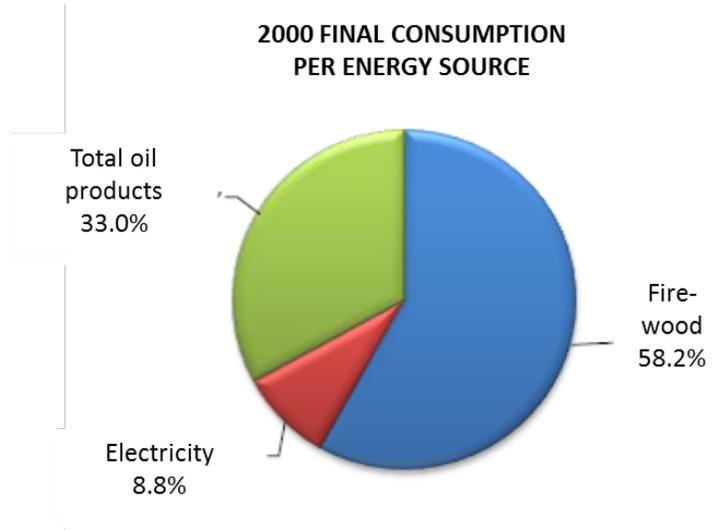
Summary of Links between Energy and the Millennium Development Goals (MDG)

MDG	Link to energy
Eradicate hunger and extreme poverty	Energy inputs, such as electricity and fuel, are of the essence to generate employment, industrial activity, transportation, and trade among others. Most primary foodstuffs require processing, preservation, and cooking, thus demanding energy from various fuel sources.
Universal elementary education	Homes and schools must have electricity in order to attract teachers to rural zones. Lighting is required to study in the evening. Many children do not attend school as they have to collect and carry firewood to meet home requirements.
Gender equality and women empowerment	Lack of access to fossil fuel by women fosters gender inequality. Women are responsible for most home chores such as boiling water and cooking, which takes their time to engage in other valuable activities such as education and social engagement. Access to modern fuel speeds home chores and allows women to engage in educational, economic, and other activities.
Reducing child mortality	Respiratory diseases from air pollution resulting from the use of traditional fuel and stoves, as well as those resulting from water not boiled contribute directly to child and infant mortality.
Improving mothers' health	Women suffer as a result of water and air pollution, as well as from food-related diseases. Lack of electricity at clinics to deal with childbirth by night and the physical hard work to collect and carry fuel have a negative impact on mothers' health, mainly in rural areas.
Fighting HIV/AIDS, malaria, and other diseases	Electricity for communications such as radio and TV can help spread important public health information aimed at fighting deadly diseases. Hospitals, physicians, and nurses require electric power and services (such as light, sterilization, and refrigeration) to deal effectively with people's health requirements.
Ensuring environmental sustainability	Energy production, distribution, and consumption impact the environment in a number of ways at local, regional, and global level. These include air pollution, particles, soil degradation, water and soil acidification, and climate change. Cleaner energy systems are required to counter these effects and contribute to environmental sustainability.
Global partnership for development	The World Summit for Sustainable Development called for new partnerships between government bodies, development agencies, the civil society and the private sector to support sustainable development, including the provision of low-cost, reliable, and environmentally-sustainable energy services.

Source: United Nations Development Programme, Development Policy Bureau, Energy and Environment Group, information available at www.undp.org/energyandenvironment

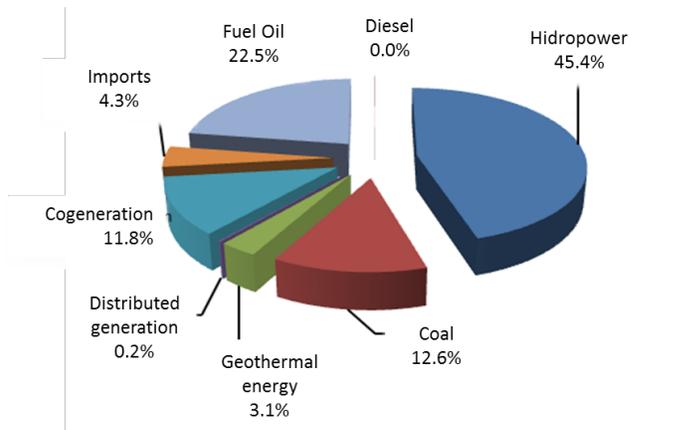
Exhibit 3

Guatemala



Source: Ministerio de Energía y Minas, MEM.

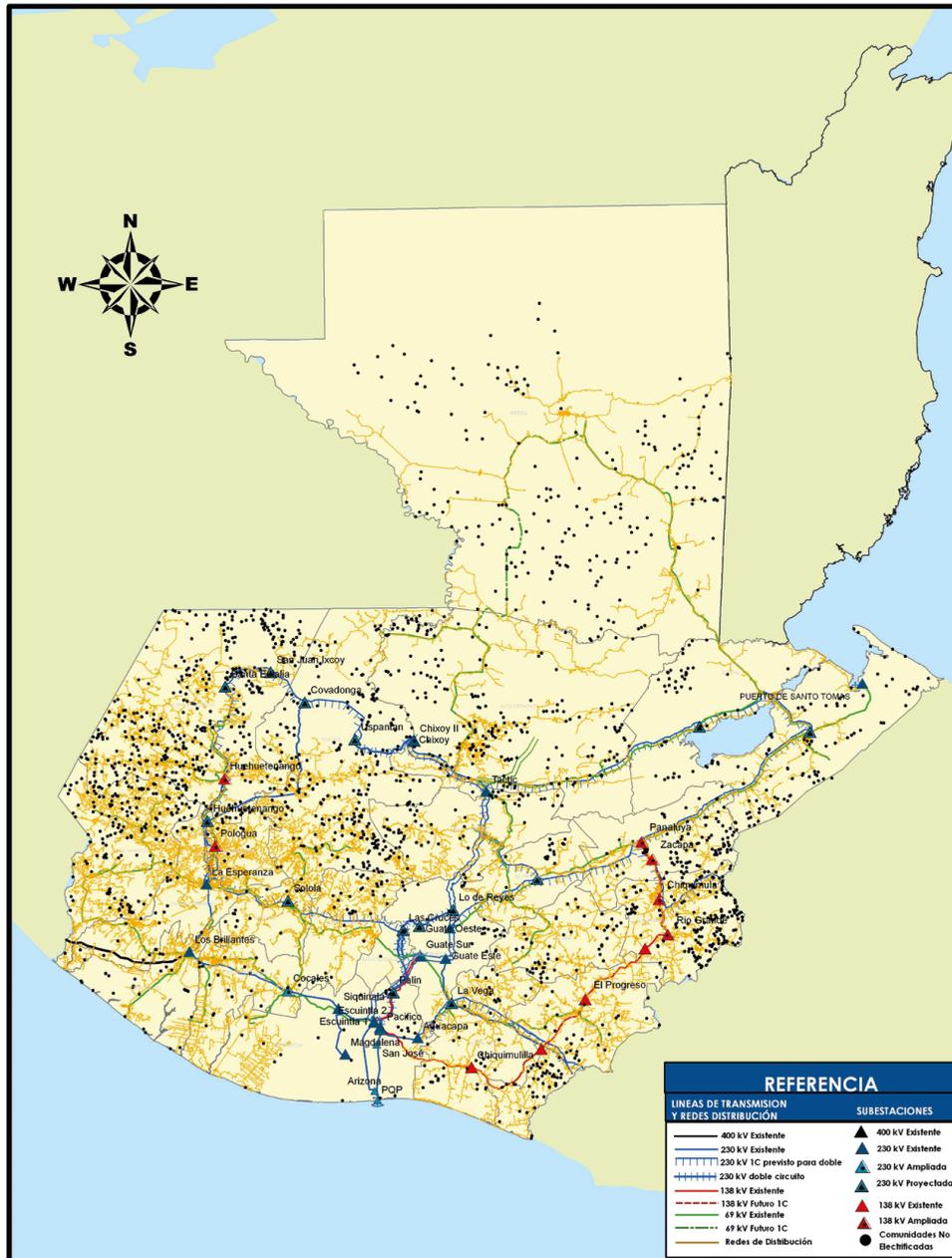
Electricity generation Matrix - 2010.



Source: Ministerio de Energía y Minas, MEM

Exhibit 4

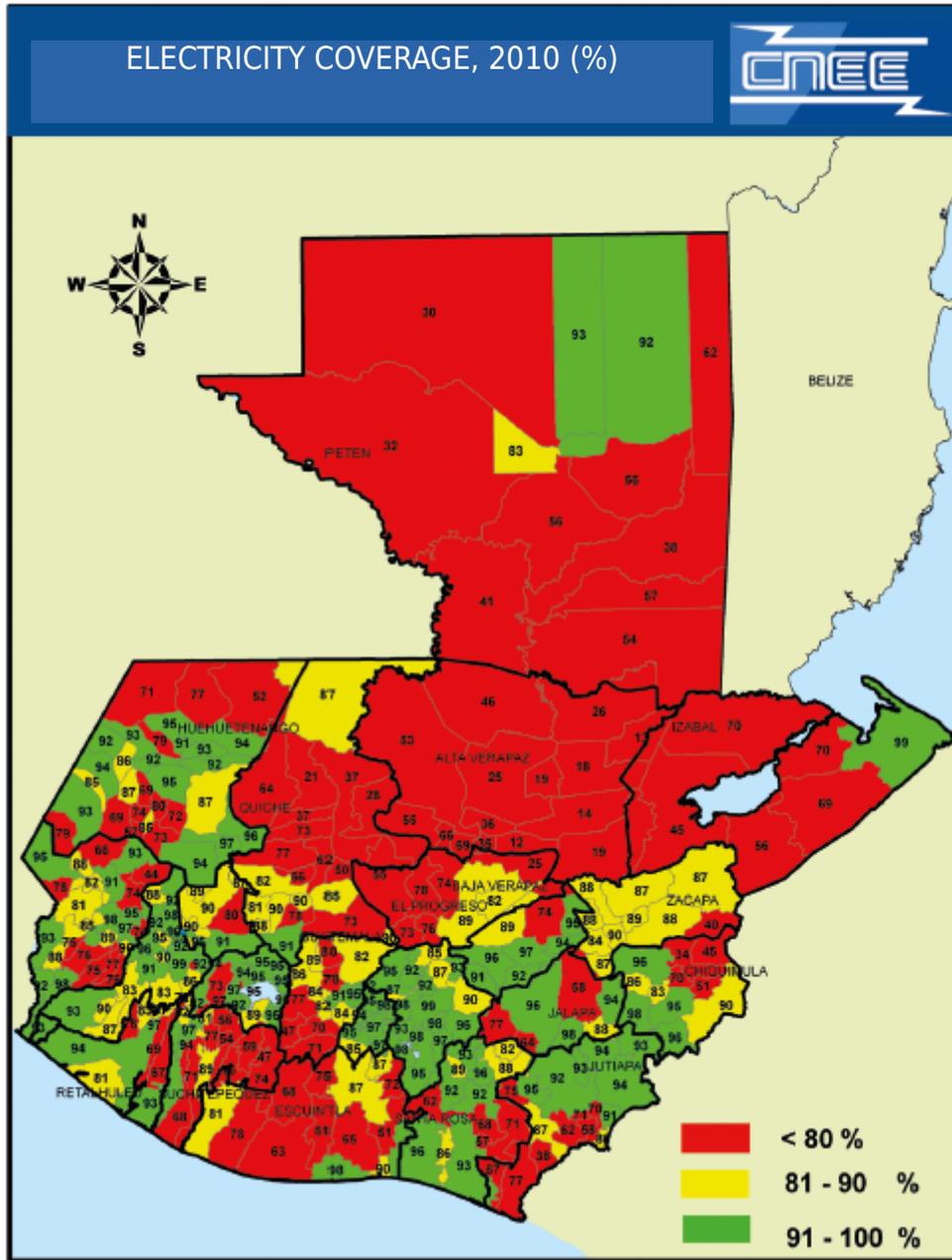
Guatemala: Communities without electricity



Source: Data from INDE (REGEZRA Project, 2008)

Exhibit 5

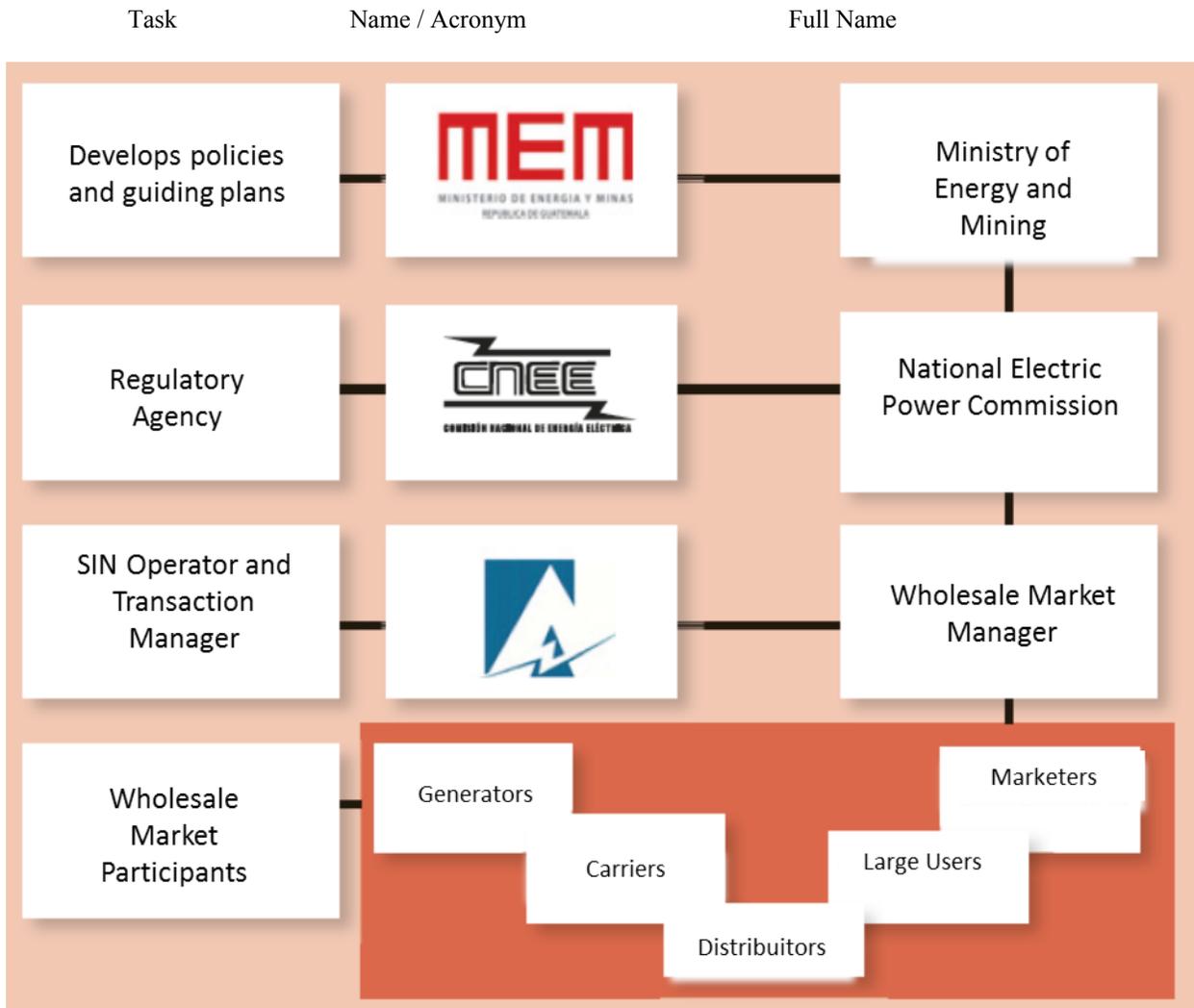
Guatemala: Electricity coverage per Town



Source: Coverage Report, Electric Power Service, 2010, MEM.

Exhibit 6

Electricity Subsector in Guatemala – Regulatory Framework



Source: CNEE – 2012 Expansion Plans Outlook

Exhibit 7

Photovoltaic System Characterization

Solar energy comes from the sun and can be turned into thermal and electrical energy. To do the latter, a photovoltaic (PV) system is used. This consists of a set of element with particular features, connected to turn solar radiation into electricity. The photovoltaic system consists of:

A solar panel: It generates electric energy during daytime, that is, turn sunbeams into electrical current through a photovoltaic process. Panels are sold as 12-volt, 25-50 watt units.

Battery: The battery stores energy collected by the solar during daytime, to be used for lighting, powering equipment (such as TV, radio, telecommunication devices, and refrigerators, among others.) Batteries used in photovoltaic systems are deep-cycle type, allowing them to discharge 80% of their load.

Load controller: An electronic device to protect both the battery and the panel. It connects / disconnects electric current from panel to battery to load it when it reaches a low level of energy and to prevent full discharge.

Photovoltaic System Applications in Rural Areas

The photovoltaic system must be used in rural areas when electrical grids are more than 6.5 miles away, taking into account the high cost of providing lines and distribution networks and under the conditions stated below:

- Small number of users.
- Highly disseminated among housing units (200 meter or more)
- Rough terrain
- Community hard to access
- High cost to provide fuel.

Photovoltaic system advantages.

- Environment-friendly
- Inexhaustible energy source (the sun)
- Lasting (mobile parts do not wear out)
- Easy to install
- The photovoltaic system can be expanded as required

System Life

- Solar panel: 20-30 years
- Deep cycle battery: 4-5 years
- Load controller: 8-9 years
- Light bulbs: 4-5 years
- Light tubes. 3,000 hours

Disadvantages

- A 40-60 watt system to light a home, using three 9-20 watt light bulbs, can be used only 3 hours per day.
- When a 12-volt device is connected (black and white TV or a radio), the lighting system is restricted.

Solar Thermal Energy Characterization

Solar thermal energy (thermo solar power) consists of harnessing the sun's energy to generate heat by using collectors or solar thermal panels. This energy heats water or other fluids at temperatures ranging between 40 degrees and 50 degrees, and should not exceed 80 degrees. Hot water is stored for later use such as hot water for cleaning purposes, industrial use, heating space, pool heating, dryers, and cooling. Thus, solar thermal energy uses directly the energy received from the sun to heat a fluid. The difference with solar PV energy is that it exploits the physical properties of some semiconductor materials to generate electricity from solar radiation. In storing solar PV energy we must distinguish two types of systems:

- Unique medium storage systems. The medium used to store thermal energy is the same fluid circulating through the solar collectors. The effectiveness of these systems is above 90%
- Dual medium storage systems. Heat is stored in a medium different from the fluid heated in the solar collectors. The effectiveness of these systems is approximately 70%.

Currently we also have the ability to feed an absorption refrigeration machine that will use this solar thermal power instead of electricity to produce cold, as would a traditional air conditioner.

Exhibit 8

Guatemala

Electrification Index by Department

Department	Households	Users	Index
Alta Verapaz	185,791	63,867	34.40%
Petén	108,110	55,581	51.40%
Baja Verapaz	58,222	39,876	68.50%
Quiché	160,998	112,666	70.00%
Izabal	79,115	58,243	73.60%
Escuintla	171,039	132,522	77.50%
Chiquimula	79,327	61,549	77.60%
Suchitepéquez	104,337	82,650	79.20%
Chimaltenango	118,549	99,156	83.60%
Zacapa	59,118	49,706	84.10%
Jutiapa	103,726	87,552	84.40%
Retalhuleu	63,380	53,483	84.40%
Jalapa	57,804	49,235	85.20%
Huehuetenango	191,868	164,056	85.50%
San Marcos	186,118	160,431	86.20%
Santa Rosa	79,553	68,544	86.20%
Totonicapán	88,170	79,358	90.00%
El Progreso	39,501	35,790	90.60%
Sololá	74,470	67,978	91.30%
Quetzaltenango	181,126	168,716	93.10%
Sacatepéquez	72,125	69,092	95.80%
Guatemala	799,771	772,067	96.50%
National Electrification Index	3,062,219	2,532,118	82.70%

Source: INE (National Statistics Institute) 1994 and 2002 censuses.

Exhibit 9

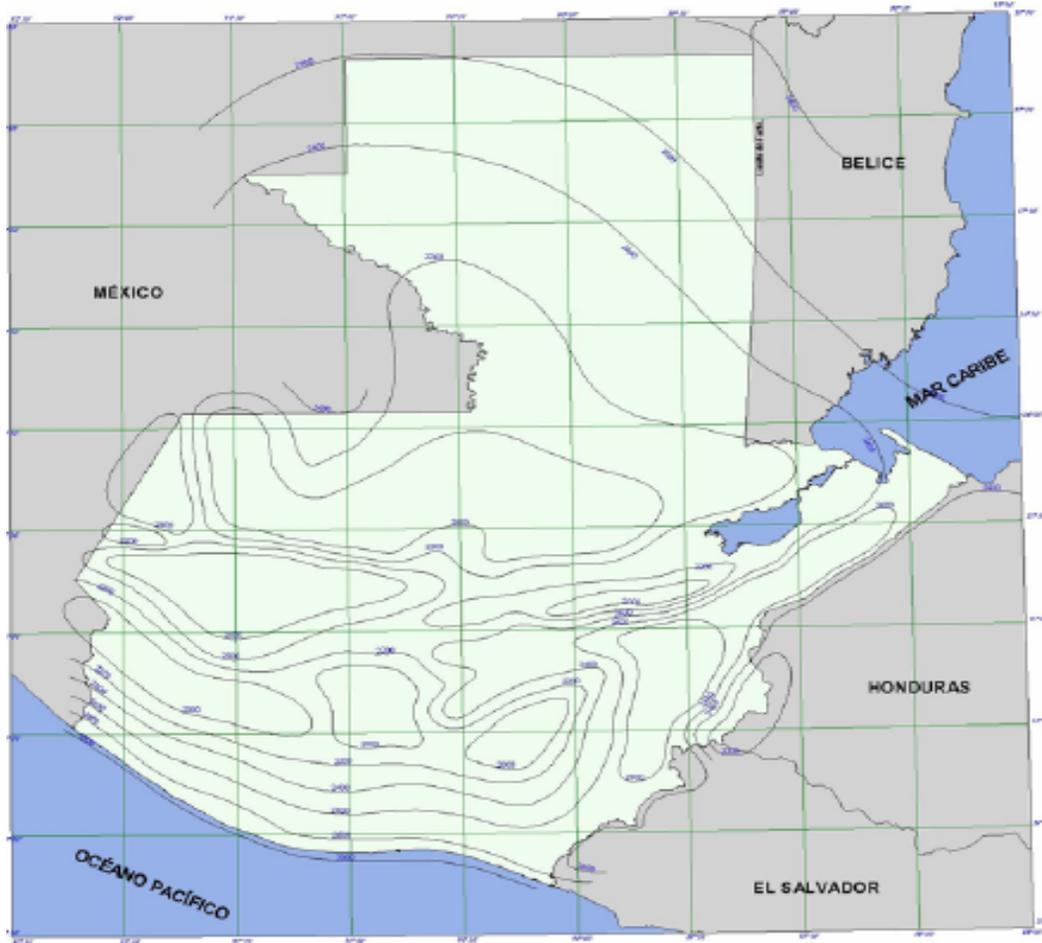
Guatemala Sunshine Map

N° 36



Guatemala

Sunshine Map



Sunshine (sun-hours/year)



Source: Ministerio de Agricultura, Ganadería y Alimentación (MAGA, 2001.)

Exhibit 10

Glossary

Solar radiation

The sun provides nearly 99.71% of the heat energy required for the physical processes occurring in the atmosphere. Every minute it radiates an amount of energy calories called solar constant. The solar constant is usually known as the flux of solar radiation in the upper atmosphere received on a surface perpendicular to the mean Earth-Sun distance

Sunshine

Time during which irradiance greater than 120 W/m² occurs in a given period of time. Unit: hours/day, hours/week, hours/year, depending on the period of time chosen.

Solar constant

Amount of solar energy that falls perpendicularly per unit time on a surface of unit area placed outside the Earth's atmosphere at a distance equal to the average distance from the sun to the earth.

Irradiance

The rate at which radiant energy falls on a surface per area and time unit (W/m²).

Irradiation

Energy falling per area unit on a surface, found by integrating the irradiance over a specific period of time, usually one hour or one day. (The term insolation applies specifically to solar irradiation.)

Exhibit 11

Quetsol Pictures

Juan Fermín and Antonio

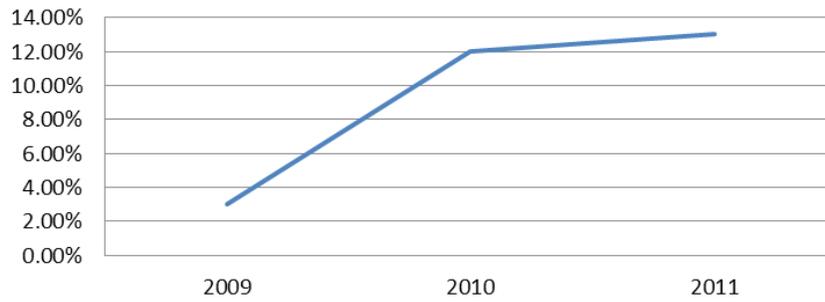


Exhibit 12

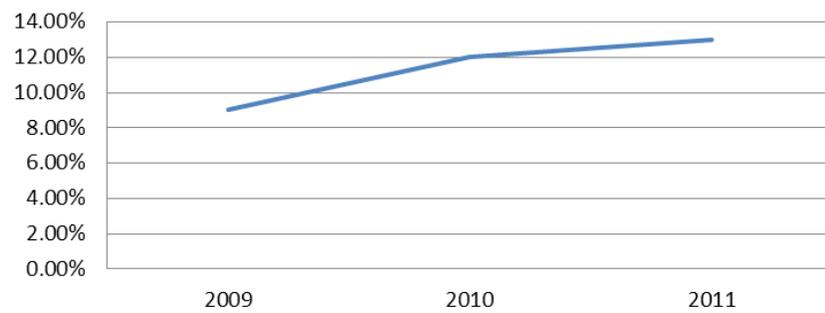
Financial Indicators

Indicator	Index	Formula	2009	2010	2011
Return	Return on assets	Profit after taxes / total assets	3.00%	12.00%	13.00%
Return	Return on equity	Profit after taxes / equity	11.00%	14.00%	16.00%
Return	Operating return on assets	Profit before taxes and interests / total assets	9.00%	12.00%	13.00%
Effectiveness	Operating margin	Operating profit / sales	18.00%	33.00%	37.00%
Effectiveness	Net margin	Profit after taxes / sales	16.00%	22.00%	25.00%
Effectiveness	Accounts receivable turnover	Days	46	31	20
Effectiveness	Inventory turnover (sales)	Days	24	45	31
Solvency	Short-term solvency	Current assets / current liability	8.00	14.00	11.32
Indebtedness	Debt to total assets	Total liability / Total asset	15.00%	18.00%	21.00%
Indebtedness	Debt to equity	Total liability / Equity	15.00%	33.00%	27.00%
Indebtedness	Short-term debt to equity	Short-term debt / Equity	4.00%	7.00%	9.00%
Indebtedness	Total assets to equity (leverage)	Total assets / Equity	1.50	1.65	1.70

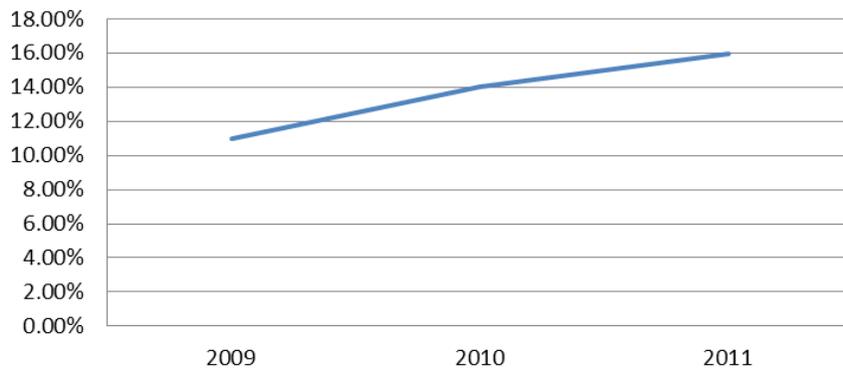
RETURN ON ASSETS



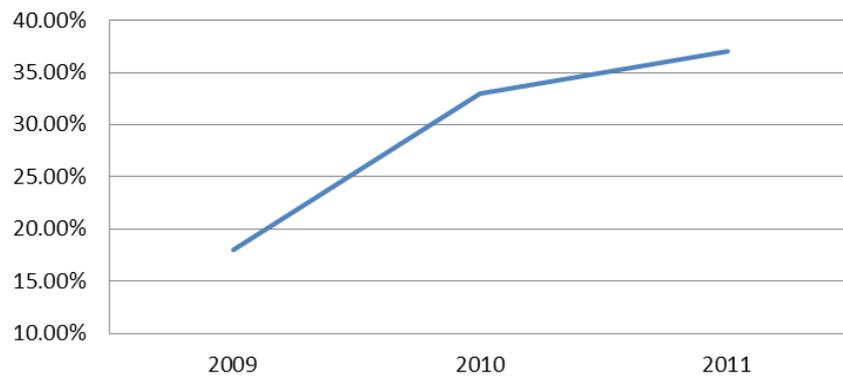
OPERATING RETURN ON ASSETS



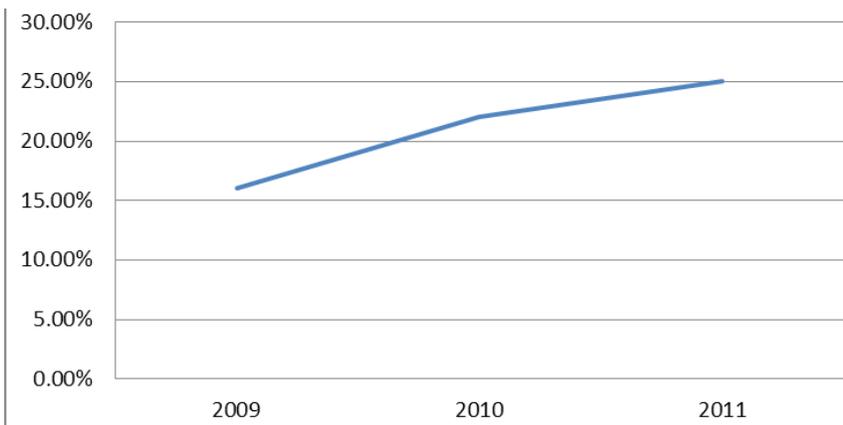
RETURN ON EQUITY



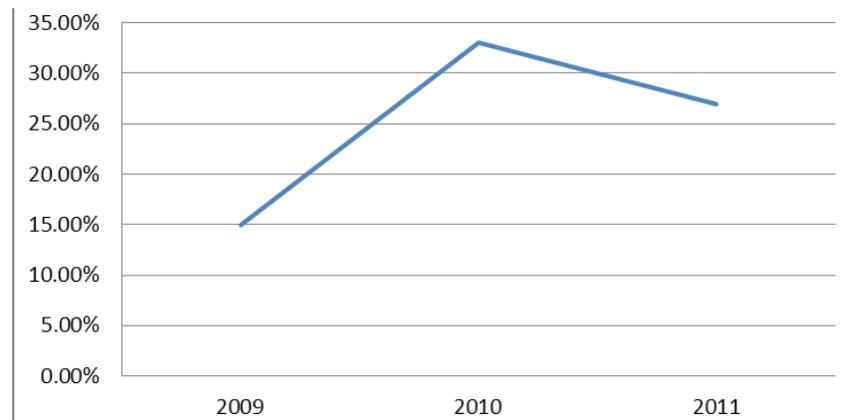
OPERATING MARGIN

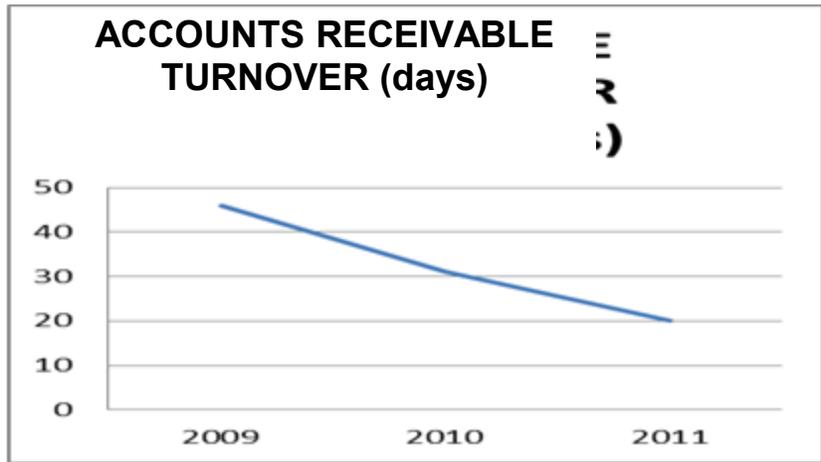
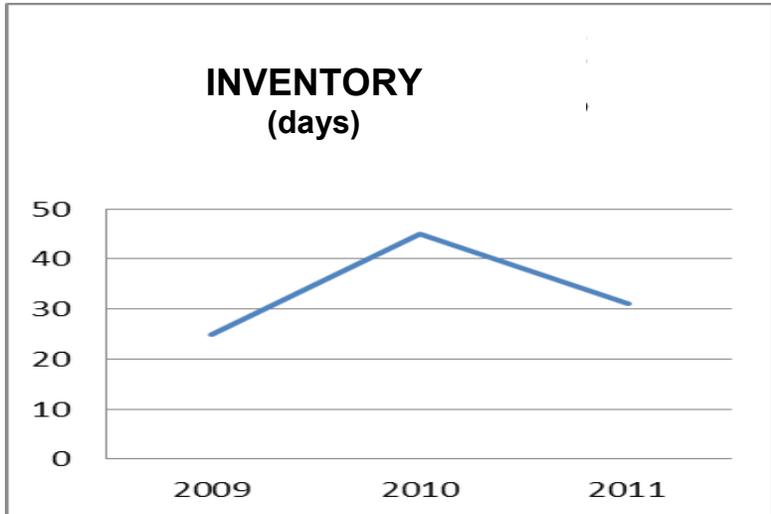


NET MARGIN



DEBT TO EQUITY





**Quetsol: Energy and Development
Teaching Note**

Case Summary

The Quetsol case is about two young Guatemalan entrepreneurs who enter the renewable energy business, providing low-cost photovoltaic solutions to poor rural families without access to electricity. The case describes the development of the company, the business context, the building of partnerships with microfinance institutions and community organizations, and the way the company designs a strategy to face the challenges of competition.

The case poses decisions for discussion in the areas of sustainability, strategy, finance and marketing. The exhibits complement the case to understand the relationship between energy and development, the energy sector in Guatemala, the technical features of Quetsol's main product and the financial performance of the company.

Teaching objectives

The main objective of the case is to discuss the opportunities and challenges of developing inclusive, or bottom of the pyramid (BoP), businesses in the energy sector in Central American countries. The case is set in Guatemala, a country with a large rural population without access to the conventional electricity distribution grid, and looks at alternative decentralized solutions provided by a small local company.

It allows the students to discuss:

- The concept of energy poverty
- Central America's energy challenges
- The opportunities at the bottom of the economic pyramid
- How entrepreneurs of all sizes can contribute to poverty alleviation through successful business ventures
- What are the challenges for businesses in the base of the pyramid
- Strategies to reach the target market of BoP businesses
- The importance of bridging the financial gap
- The value of partnerships

Level of Analysis

This case is designed principally for students of Sustainable Development and Sustainability Management, Entrepreneurship and Business Administration. In addition to the Master of Business Administration (MBA) program, this case can be utilized in seminars in the aforementioned areas.

Suggested Student Assignment(s)

Read and discuss before the class:

- “Quetsol: Energy and Development”
- “Value at the Bottom of the Pyramid”. Martinez, J.L. and Carbonell, M., Business Strategy Review Autumn 2007.

Suggested time distribution

[10 mins]: Introduction

- The bottom of the pyramid – misconceptions and business opportunities
- Energy poverty – concept and indicators
- Electrification indices in Central America – comparison with the rest of Latin America and the world

[15 mins]: Inclusive energy businesses in Central America

- What has been the traditional approach to electricity provision?
- Why that approach has not been effective in reaching the rural population?
- Which factors allow small companies to enter the sector?
- What are the challenges these companies face?

[30 mins]: Discussion of Quetsol

- What is the target market?
- Did Quetsol understand the market?
- Is the product they sell appropriate for the market? Why?
- Is the marketing strategy appropriate for the market? Why?
- How are they making sure poor families have money to pay for the product?
- What kind of partnerships are they building? What is the value of those partnerships?
- Is the company being financially successful? Discuss the situation and perspectives.
- What is the company competitive position in front of similar initiatives?

- Are large government and international cooperation programs a threat or an opportunity?

[10 mins]: Conclusions and recommendations for Quetsol

- What should be the next steps for the company's development?
- What recommendations would you make to Quetsol's management?

[15 min]: Lessons for other entrepreneurs

- Discuss other inclusive business opportunities in the energy sector: solar technologies for productive uses (water pumping, water heating, drying, cooking, irrigation), improved woodstoves, biodigesters.
- What are the key elements that potential entrepreneurs must keep in mind to be successful in this market segment: understanding the needs and purchasing power, bridging the finance gap, building partnerships, etc.

Suggested Additional Readings

1. "The Fortune at the Bottom of the Pyramid", Prahalad, C.K. and Hart S. strategy+business, first quarter 2002.
2. Energy for All. Financing Access for the Poor. Special early excerpt from the World Energy Outlook 2011. International Energy Agency.
3. News piece about Quetsol: http://www.guatepymes.com/recursos.php?doc_id=260

Potential use of the case

The material can be used in class to discuss inclusive business, business model innovations and risk management in small enterprises which decide to follow the path of social entrepreneurship.

Computer support and audio-visual support

Video about Quetsol <http://vimeo.com/12412029>