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CASE STUDY

Sub-Saharan Africa • Mozambique

VidaGás: Powering Health Clinics and Households in Mozambique with Liquefied Petroleum Gas

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Sector • Health & Energy
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Summary

In a country with 500 doctors for a population of almost 20 million, initiatives that can expand the reach of health services to rural populations are in critical demand and short supply. The challenge for northern Mozambique's health clinics is the lack of reliable fuel to provide lighting for surgery and routine operations and to guarantee regular refrigeration for the storage of vaccines. Besides, less than two percent of households have electricity, and are therefore dependent on wood or charcoal for cooking, which increases respiratory infections, pregnancy complications and forests degradation.

Against this background, a wide range of partners gathered in 2002 to launch a pilot project in the province of Cabo Delgado in northern Mozambique, each one providing its own expertise: a former minister of education from Mozambique, Graça Machel, dedicated to children's health; a Seattle-based NGO, VillageReach, dedicated to deliver needed health supplies to remote regions of Mozambique; Northern philanthropists willing to back the start-up; the Ministry of Health and the Governor of the pilot province, eager to provide state funding and eliminate state bureaucracy; and a community foundation, FDC (Fundação para o Desenvolvimento da Comunidade), aware of the complex development needs of Mozambicans.

As a result of the partnership, VillageReach and FDC introduced an improved cold chain and replaced decrepit kerosene refrigerators in remote health facilities with Liquefied Petroleum Gas (LPG)-powered refrigerators. The focus of this case is on the supply of LPG to businesses and households by VidaGás, a for-profit company that is owned and controlled by the two NGOs, and who is now trying to develop a viable business model.

The Mozambican Context

At the outset, three main problems were impacting the health system in northern Mozambique: a lack of reliable infrastructure (roads, vehicles and electricity); sufficient human resources; and the necessary processes, plans, and systems to underpin health policy and practice. The result was the delivery of sub-optimal services and healthcare, particularly in the area of vaccine delivery, which is critical in preventing infant morbidity and mortality. Cabo Delgado maintains the highest child mortality rates across the country. Under-five mortality rates decreased by about 19 percent in rural areas, from 237 to 192 per 1,000 live births, but geographic differences remain. The under-five mortality rate registers 89 in Maputo but stands at 241 in Cabo Delgado (see Appendix A Mozambique's Key Indicators).

The partners found that the key to addressing these inter-related problems was a combination of solutions: first, finding a reliable source of energy to keep vaccines cold and to meet the energy needs of the clinics (sterilization, lighting, etc.), identifying Liquefied Petroleum Gas (LPG)-powered fridges and lamps that would be easy for healthcare workers to use and maintain and procuring a fleet of dedicated vehicles to deliver the goods. Second, identifying and training staff to deliver medicines and supplies, while putting into place a system of



supervisory support whereby field teams would provide feedback and mentoring to clinic employees each month. Third, deploying process and systems solutions by creating a logistics platform that delivered the vaccines, medical supplies and propane to clinics on a regular basis. Nine key metrics are gathered monthly for the 251 clinics served by the partners. These metrics informed the partners of the field context, helping to pinpoint problems and improve the functioning of the overall system and its constituent parts. VidaGás was first established to supply the health projects in the region with LPG. The company initially provided essential health commodities to public clinics. Later, it began to supply the large commercial and industrial consumers in Cabo Delgado, including hotels, restaurants (eight hotels and six restaurants as of March 2007) and the commercial prawn operation in Pemba (the capital of the province).¹ VidaGás is now targeting small and medium enterprises and households for LPG use in urban and peri-urban areas.

VidaGás Company Overview

VidaGás Limitada is a limited-liability (LLC) for-profit private company, founded in 2002 by FDC and VillageReach, based in Pemba, Cabo Delgado (see Appendices B and C for more information about FDC and VillageReach). VidaGás is the lead commercial partner in this partnership, providing the LPG that is fundamental to the success of the venture. Its core business is to sell and distribute liquefied petroleum gas to rural, urban and peri-urban residents in Mozambique. Its greater vision is to promote a Mozambique that uses cleaner, alternative energy, which will improve the health and living conditions of its citizens, improve sustainable livelihoods and advance socio-economic development in the country.²

VidaGás has a filling station in Pemba, which fills 5.5 kg, 11 kg, and 45 kg LPG containers or cylinders (see Appendix D: Photo of Filling Station). The company's LPG distribution plant became operational in November 2002. From a centralized plant in Pemba, VidaGás can now distribute LPG to households and businesses. To ensure that the purchase of these products is affordable, a micro-lending scheme is being initiated. The company has a store in Pemba and has begun to supply a network of dealers with LPG. There is a growing group of small business and domestic consumers. VidaGás has recently expanded its operations to Nampula province, with plans to service Zambezia province (see Maps in Appendices E1 and E2). The range of products it sells includes freezers and refrigerators (for sale to health clinics, restaurants and other commercial operations), large gas ovens (for restaurants), a three burner stove (11kg cylinders priced at \$375), a four burner stove (using 5.5 kg cylinders priced at \$100), a two burner stove (5.5 kg cylinders that cost \$20), a single burner stove (\$9), and LPG lamps (with pole, cylinder deposit and refill the cost is \$73). The establishment of VidaGás has thus far created 23 direct jobs, as well as generated indirect employment effects. For instance, as the consumption of LPG expands, retail outlets (small businesses selling VidaGás LPG) have been established to sell the gas, and entrepreneurial activity expands. Employees of VidaGás earn salaries above the minimum wage of 1,443,170 meticaís (US\$57.70) per

¹ Numbers from VillageReach, provided via email 7 March 2007.

² VidaGás Domestic Gas, Proposal Document



month.³ Additional gas-related businesses and outlets are expected to create value chain effects. VidaGás sees women (who do most of the cooking), low-income people, and cooperatives of fishermen, farmers and artisans as particularly benefiting from LPG. The company's goal is to become profitable within three years. However, important challenges remain.

In terms of competitors, Galp distributes LPG in 11kg and 45kg cylinders but only at its petrol or gasoline stations and through a limited number of scattered and small resellers. Petrogás sells 11kg and 45kg cylinders but that company is considering exiting the market due to insufficient sales. Thus, VidaGás has no real competitors with which to contend. This fact notwithstanding, there is a range of primary challenges, including the following: insufficient storage facilities for LPG, a weak industrial and commercial infrastructure in northern Mozambique, inadequate training of retailers in LPG use, and a lack of consumer knowledge of the benefits of LPG. The price of LPG is also slightly higher for consumers, and in this case, the target consumer for this initiative happens to be relatively poor.⁴ In fact, Cabo Delgado's population of roughly 1.5 million people is classified as poor. There is a 77 percent illiteracy rate, and poor access to public health, education and other services in the province. Roughly 3.5 percent of households have potable water, and only 1.7 percent of households have electricity. Fisheries, agriculture and cattle raising are the dominant economic activities. Agriculture contributes to half of the provincial GNP. The GNP of the province is estimated at \$148 million (2002 data) and the GNP per capita is \$97.⁵

About Liquefied Petroleum Gas (LPG)

More than half the world's population — 3.2 billion people — still burn coal and biomass fuels such as wood, dung and crop residues to meet their basic energy needs.... Preventing deaths caused by polluted indoor air must no longer be delayed. ... the use of cleaner fuels, such as liquefied petroleum gas, biogas or other modern biofuels, can eliminate the current indoor air pollution.

- World Health Organization, 2007⁶

Autogas, propane and butane are typical names for [liquefied petroleum gas](#), depending on where you are in the world. LPG is used for heating, cooking and for fuel- for instance, as fuel for internal combustion engines in vehicles or generators. LPG is referred to as a “green” fuel, because it emits less greenhouse gas emissions than other fuels. It is also lead-free and sulphur-free, clean burning and effectively odorless. LPG is a fossil fuel and is therefore a non-renewable source of energy. It is extracted from crude oil and from natural gas; it is

³ All figures are in US dollars unless otherwise indicated. From *Mozambique News Agency*, “AIM Reports” No. 320, 16 May 2006.

⁴ United States Agency for International Development (USAID), “LPG Market Assessment Study (prepared by Nexant Inc., for USAID),” June 2005. Washington: USAID.

⁵ *Ibid.*

⁶ Eva Rehfuess, Carlos Corvalan, and Maria Neira, “Indoor Air Pollution: 4,000 Deaths a Day Must No Longer be Ignored.” Geneva: World Health Organization, 2007.



constituted by hydrocarbons containing three or four carbon atoms. The normal components of LPG are propane (C₃H₈) and butane (C₄H₁₀), although concentrations of other hydrocarbons may be present.⁷ At atmospheric pressure, LPG is a gas. At normal (ambient) temperatures, it can be liquefied when pressure is applied or when the temperature is decreased.

BENEFITS

LPG's main benefit is the production of less environmental pollution. There is less carbon dioxide, carbon monoxide, nitrous oxide, hydrocarbons and particulates. (LPG vehicles emit about 20 percent less CO₂ or carbon dioxide when compared to petrol). LPG is highly portable, efficient, clean, accessible, cost-efficient and convenient. LPG can be packaged, stored and utilized with great ease, making it a perfect source for a range of applications (ranging in diversity from cigarette lighters to the Olympic torch), including LPG-powered refrigerators in rural destinations.⁸

The province of Cabo Delgado has vaccination rates well below the national average in Mozambique. Roughly 50 percent of the provincial population must walk more than two hours to the nearest public health clinic. Before LPG, these facilities would suffer from shortages of fuel and medicines and the breakdown of refrigerators, which often rendered the vaccines unusable. In response, through the partnership project, VidaGás has provided reliable fuel that allows for effective vaccines, sterilization, and lighting in 88 health clinics in northern Mozambique, serving 1.5 million people with a recent expansion to 163 additional clinics in the neighboring province of Nampula (bringing the total population served to upwards of 4.5 million). Their activities have contributed to a 36 percent increase in the number of children immunized in participating districts. This was primarily achieved through the introduction of a new Cold Chain and accompanying logistics platform by the two NGO partners, FDC and VillageReach.⁹

⁷ Depending on the source of the LPG and how it has been produced, components other than hydrocarbons may also be present. Whenever a LPG container is filled, sufficient space is left to allow for expansion. Normally, the gas is stored in liquid form under pressure in a steel container, cylinder or tank. When one begins using LPG, some of the pressure will be released from the container. LPG will cause natural rubber and some plastics to degrade. Thus, only certain types of hoses and equipment (designed for LPG) can be used. Cylinders or other equipment thus comprise part of the "startup" cost of using LPG. From <http://www.lpga.co.uk/LPGA.htm>.

⁸ LPG emits similar levels of CO₂ to diesel. "*It is simply a cleaner way of burning a fossil fuel, not a way of reducing the need to drill for oil.*" See Scottish Environmental Protection Agency, http://www.sepa.org.uk/publications/sepaview/html/20/green_tips.htm; <http://www.worldlpgas.com/ressources.php?id=01>; and "LPG is Best Green Option" available from Conoco Phillips website:

http://www.conocophillips.co.uk/stations/autogas/Latest_News/LPG_is_best_green_option.htm.

⁹ "Project Spotlight - Village Reach, Mozambique (DM 2003)," available from <http://newsletters.worldbank.org/external/>.



The Cold Chain¹⁰



Old kerosene-powered refrigerators that are unreliable and hard to maintain are in use at many rural health clinics.

The cold chain describes the network of freezers and refrigerators and coolers or cold boxes used in the transport and storage of vaccines within a set range of 35.6°F to 46.4°F (2°C to 8°C). If vaccines are exposed to heat or freezing temperatures, they lose their effectiveness and become unusable (particular vulnerability to cold or hot temperature depends on the vaccine). Once the potency of the vaccine is lost, this process cannot be reversed and the vaccines must be discarded. The success of any immunization programme rests in part on the effectiveness of the cold chain in ensuring the

proper temperature. It is imperative to maintain an unbroken cold chain from the point of manufacture until the point of use.

CHALLENGES

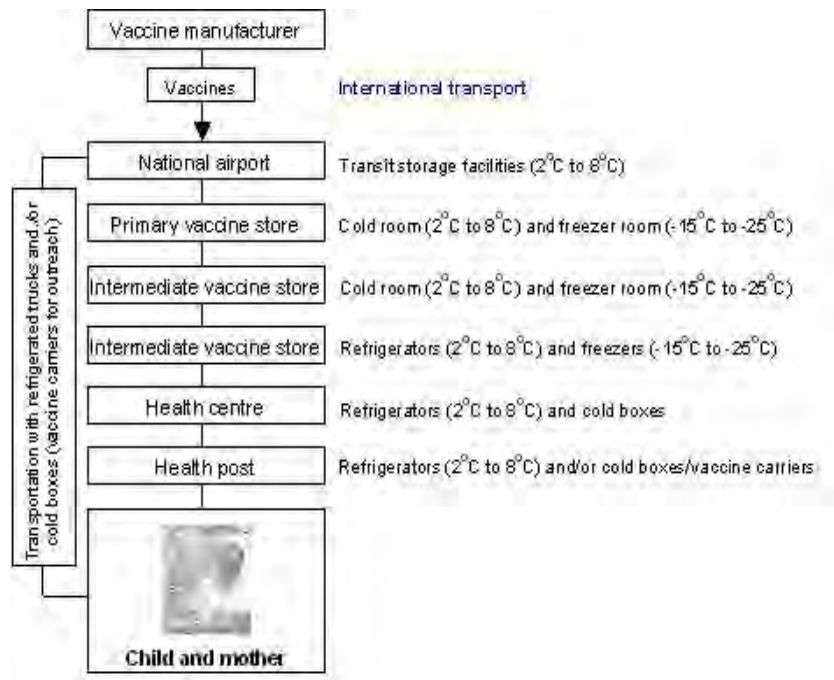
The cold chains in most low-income countries are outdated and in a state of decay.¹¹ Decrepit kerosene-powered refrigerators experience frequent breakdowns and spare parts are simply unavailable. Transport containers may vary widely in temperature, and vaccines become spoiled, thus preventing efforts to increase rates of immunization for children whose immune systems are not developed and are susceptible to diseases such as hepatitis and measles.

¹⁰ Information and photos related to the Cold Chain are provided courtesy of VillageReach. See the website for more information <http://www.villagereach.org>.

¹¹ From VillageReach website, available at www.villagereach.org.



Figure 1: A Typical Cold Chain



Source: [WHO Vaccines, Immunizations, and Biologicals](http://www.who.int/vaccines-immunizations-and-biologicals); from www.villagreach.org

LONG-TERM SOLUTIONS

LPG-powered refrigerators have automatic changeover valves installed. These have replaced kerosene refrigerators in remote health facilities in Cabo Delgado and Nampula provinces. Staff is trained in their operation, maintenance and repair.

Effectiveness

“It's not difficult to get vaccines delivered to developing countries. What's difficult is delivering the vaccines throughout the country. The last mile is just as important as the first.”

-Blaise Judja-Sato, Founder, VillageReach¹²



VillageReach is equipping clinics with brand-new LPG-powered refrigerators to ensure proper storage of temperature-sensitive vaccines and medicines.

Before the partners became involved in the project, many vaccines were disposed of due to problems with the cold chain: 85 percent of the kerosene refrigerators suffered some type of breakdown or malfunction, leading to the spoilage of large amounts of vaccine. With the introduction of the LPG-powered refrigerators, if a problem is noticed, a healthcare worker will transfer the vaccines to a cold storage box or cooler, and then transport the box to a neighbouring health facility where the

¹² Quote from VillageReach website. Available at www.villagreach.org/bioblaise.html.



vaccines are stored until the refrigerator is repaired. As Jenny Hannibal of VillageReach notes, “*This is standard practice and minimizes spoilage due to cold chain problems.*”¹³

INDICATORS

Refrigerator Reliability

Of the 88 refrigerators in 88 clinics served in Cabo Delgado province in 2005 and 2006, there were an infrequent number of repairs, following the introduction of LPG, down to five percent in 2005, and reduced to two percent throughout 2006.¹⁴

Vaccine Wastage Rates

Quantitatively, closed-vial vaccine wastage rates are tracked to monitor effectiveness. Again, portions of vaccines must be discarded for reasons such as breakage, spoilage or expiration. The resulting rates for Cabo Delgado’s clinics are consistently low, averaging below three percent for each type of vaccine. They also track another category of wastage called open-vial wastage. This occurs when a vial of vaccine is opened. If doses are not administered within the World Health Organization-prescribed timeframe (six hours for reconstituted tuberculosis and measles vaccines and four weeks for other vaccines) the vials must be disposed of- in the clinics served by the project open-vial wastage rates range from six percent to 29 percent, which are within internationally accepted standards.¹⁵

Data Collection

Field teams gather data from healthcare workers on a monthly basis. The data is sent to the VillageReach office in Seattle where monthly reports are generated for nine key metrics at the 251 clinics served. The data informs all of the partners– VillageReach, FDC and MISAU– regarding the efficacy of the system; it assists in making course corrections, identifying problems and aids in forecasting vaccine stock needs. As a result of the partnership’s intervention, there is now improved data collection in the clinics. The importance of accurate data in a post-civil war context in which data systems and recordkeeping fell into total disrepair cannot be over-emphasized. As Mozambique’s Government report states in its assessment of progress made toward achieving the Millennium Development Goals, “*There are obvious reasons for the lack of comprehensive... and reliable data... such as the occurrence of the civil war. The first comprehensive household income survey was only conducted in 1997, which perhaps is also the first reliable data point for many other development indicators (e.g. health, education and environment).*”¹⁶

¹³ *Ibid.*

¹⁴ Figures courtesy of VillageReach.

¹⁵ *Ibid.*

¹⁶ Government of the Republic of Mozambique, “Report on the Millennium Development Goals” 2005.



Supply Chain

This refers to the cycle of planning, sourcing and procurement of all essential medicines and supplies, the management of the logistics and related activities. The goal of the supply chain is to deliver needed medicines and supplies on time without waste, inefficiency or ineffectiveness. The execution of the supply chain must be done against the challenge of poor roads, electricity cut-offs, possible floods, and other unforeseen obstacles. Based on the data provided by the clinics, medical supplies are ordered by the Ministry of Health and transported to a MISAU warehouse, which is shared by staff of VillageReach and FDC in Pemba. The storage space is kept in good condition with vaccines kept cold in LPG-powered refrigerators. Three drivers collect the supplies from the warehouse and embark on a two week mission to deliver fuel, medicines, syringes, and related items to each of the 88 clinics in the province of Cabo Delgado. Similar teams are deployed in Nampula province with a total of 163 clinics served. Teams are composed of MISAU staff or joint MISAU-FDC-VillageReach staff. Field teams will eventually become employed as MISAU staff (in both provinces), allowing for the full integration of the programme into existing MISAU operations. Staff members are trained in the repair of refrigerators and other essential equipment. Communities have also been outfitted with bicycles or motorcycles in case deliveries are urgently needed between visits by the lead drivers.¹⁷

BENEFITS

Another efficiency created by LPG is that of improved sterility of medical instruments and time saved by health staff. According to Jenny Hannibal of VillageReach, each clinic houses a steam sterilizer, also called an autoclave, which is akin to a pressure cooker. It uses hot steam to sterilize medical equipment, including the medical instruments used in surgery and the delivery of babies. Clinic workers use a propane-powered burner (similar to a camp stove) to heat up the steam sterilizers. Hannibal observes: *“If they did not have the LPG, clinic workers would gather wood and start a wood fire to heat up the sterilizer – taking valuable time away from the clinic, polluting the clinic area with wood smoke, and contributing to deforestation. Most importantly, wood fires often don't sufficiently heat the water to sterilize the equipment, resulting in a warm water bath in which germs are spread over the equipment in the pot.”*¹⁸

Before VillageReach and FDC became involved in the public health clinics in Cabo Delgado, there was a shortage of essential drugs. In fact most maternal deaths globally result from infection and hemorrhage due to complications in pregnancy: oral antibiotics and rehydration solutions can be of critical importance, but such medicines need to be ordered, supplied and stocked, sufficiently.¹⁹ The improved supply chain introduced by the partners also means that

¹⁷ See the VillageReach website for more information, available from <http://www.villagereach.org>.

¹⁸ Provided via email, 9 February 2007.

¹⁹ Anthony Costello, Kishwar Azad, and Sarah Burnett, “An Alternative Strategy to Reduce Maternal Mortality,” *The Lancet* 28 September 2006. Rosenfield, Min and Freedman emphasize: *“It is essential that pregnant women in whom complications develop have access to the medical interventions of*



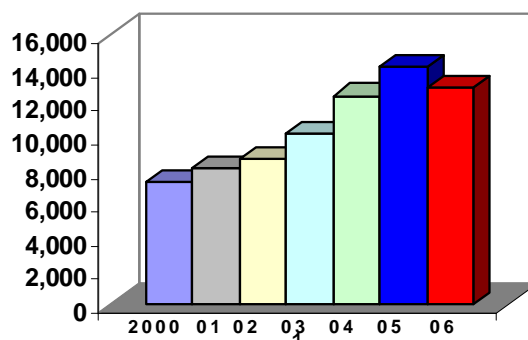
stocks of medicine are more reliable. This is having an impact on the immunization programme. If trends continue over the longer term, improved maternal and child health outcomes should result. The goals of the project align with the Ministry of Health's objectives.

Mozambique's national targets for maternal and child health include: 1) increasing the percentage of institutional deliveries to ensure that births are attended by skilled healthcare workers; and 2) increasing immunizations (see Appendix F: Mozambique's Progress on Selected MDGs).²⁰ The reliable fuel supply, the cold chain, and the improved distribution of medicines all directly support the goals of the Ministry of Health, the Millennium Development Goals and, ultimately, public health in Mozambique.

Challenges to Establishing a Market for LPG

To support LPG as a source of fuel for clinics, economies of scale are required. Given the current operating structure of VidaGás, break-even is estimated at sales of 25 to 30 tons per month. The company is currently selling 14 tons of LPG per month and has moved into Nampula province to serve the Ministry of Health and additional customers. Break-even for the entire operation, after expansion into Nampula, is estimated at sales of 50 tons per month. Chart 1 shows LPG sales in Mozambique from 2000. Sales indicate a steady incline in LPG use through 2005, followed by a slight decline in 2006 "owing to upstream shipping constraints in South Africa, which supplies Mozambique."²¹ In addition to the general challenges of doing business in Mozambique (Mozambique ranks 140 out of 175 countries in terms of the 'ease of doing business'- see Appendix G: Ease of Doing Business in Mozambique), the following are specific impediments to be overcome:

Chart 1: LPG Sales in Mozambique



emergency obstetrical care. Programmes to make such care more widely available involve upgrading rural health centers and referral hospitals and stocking them with the necessary drugs, supplies, and equipment, such as magnesium sulfate for eclampsia, antibiotics for infection, and basic surgical equipment for cesarean sections." See Allan Rosenfield, Caroline Min and Lynn Freedman. 2007. Making Motherhood Safe in Developing Countries. *New England Journal of Medicine* 356 (14): 1395-1397.

²⁰ DFID's Maternal Health Strategy *Reducing Maternal Deaths: Evidence and Action* First Progress Report. DFID: London, December 2005.

²¹ Quote from Jenny Hannibal, VillageReach. Chart from IMOPETRO Ltd., Mozambique.



INFRASTRUCTURE AND SUPPLY OF LPG TO NORTHERN MOZAMBIQUE

There is no production of LPG within the country. Neighbouring South Africa supplies Mozambique with LPG (produced in a natural gas separation plant), which is shipped overland by rail and truck to the capital of Maputo. The procurement and delivery of all LPG imported from South Africa is coordinated by IMOPETRO (a cooperative company that operates on behalf of its members). VidaGás procures LPG through IMOPETRO by the container load (ten tons). The distance between Maputo and Pemba (also a port) is 2,700km (1,677 miles). The physical roads between Cabo Delgado and Maputo are in poor condition with only ten percent of the roads estimated to be paved and 60 to 70 percent in poor condition. The rail network is equally poor. Thus, LPG containers are shipped in bulk from Maputo to Pemba (some 11kg containers are transported by road to Pemba from the city of Beira). Such weak transportation infrastructure translates into higher pricing of LPG. The price of LPG at the Maputo port is \$785 per metric ton, which is higher than international prices. An added \$15 is added by IMOPETRO to cover operational costs. Transport costs from Maputo to Pemba add a huge cost burden to the final price in the north; hence the rationale for exploring options to decrease the price of LPG and ensure a sustainable supply. To this latter end, South Africa seems to lack adequate physical storage space for LPG, which restricts its ability to store large quantities of LPG. This in turn affects Mozambique's supply.

Solutions might include increasing storage in South Africa or reducing Mozambique's reliance on its neighbour.²² Unfortunately, Mozambique's low GNP impacts its ability to develop large-scale distribution networks for LPG, especially in the interior of the nation where infrastructure is poor. At the same time, the relative poverty of its residents impacts their ability to pay more— or what may be perceived as more (due to startup costs associated with using LPG)— for fuel.²³ Over the five-year period 1998 to 2003, Mozambique's currency lost more than half its value against the US dollar. While there has been an appreciation in the value of the currency since then, according to USAID: *“This drop in the value of the currency has important implications for the use of non-traditional fuels such as LPG, which are more expensive compared to charcoal and firewood, which have traditionally been used in households especially in the poorer provinces of the country.”*²⁴

Sample costs associated with LPG transport from South Africa to Mozambique are included in the following scenario: the transport of a nine-ton container from Maputo to Pemba is \$2,500; the return of the empty container costs \$500; the costs at port are \$70 per ton; and this translates into a cost per ton of \$407. The high cost of supplying LPG to Pemba leads to a higher cost of supply. However, according to USAID, other types of transport would not make LPG much cheaper. For example, using 18 ton capacity tankers to transport LPG by road from Maputo to Cabo Delgado would require an estimated \$7,600, leading to a delivered cost of US\$ 422 per ton. The transport cost of LPG in cylinders is higher still. Galp transports 350 11 kg capacity cylinders at a cost of about \$520 per ton.

²² USAID, *op cit.*

²³ USAID, *op cit.*, sections 2-1-2-2.

²⁴ USAID, (Section 2), p.9

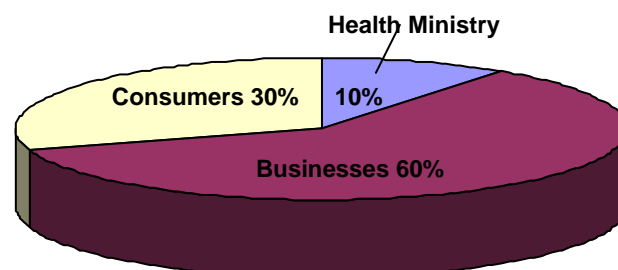


The current breakdown of VidaGás customers is shown below (see Chart 2). This illustrates that growth could come from commercial businesses and sales of LPG-powered appliances (including generators, air conditioning units, refrigerators and freezers) to Mozambique’s commercial sector. This is particularly the case since electricity in northern Mozambique is erratic and, as yet, unreliable. Alternatively, it could come from households— an especially important target market due to the environmental and health benefits associated with LPG.

CONSUMER PRICING AND ENERGY EFFICIENCY OF LPG

A 5.5 kg cylinder or container (see Appendix H: Photo of 5.5 kg cylinder) would typically be the optimal choice for households, because it provides fuel for up to two weeks based on regular daily consumption rates. The cost of the cylinder is \$11 while the equivalent of charcoal costs \$33.²⁵ The fuel efficiency of LPG is much higher than for charcoal or wood. This translates into better value for money, not to mention the health benefits and savings in terms of time (again, valuable time saved for women and children who do not need to collect firewood). An added benefit for anyone who has ever washed a pot or pan: because LPG burns cleanly, pots don’t become as soiled and are easier to clean.

Chart 2: Current Breakdown of Customers (% of VidaGás Sales)²⁶



The key challenge then remains— how to increase VidaGás sales from 14 tons to 50 tons? To meet this challenge, two immediate factors warrant consideration: the potential market for LPG sales in Nampula and Zambezia; and current consumer behavior in Cabo Delgado (i.e., how likely are consumers to switch from charcoal to LPG?). These are two drivers that would boost sales for VidaGás.

CONSUMER BEHAVIOR AND PERCEPTIONS

In 2005, USAID funded a market research study in Pemba, which covered a sample of 400 households. The purpose of the survey was to glean insights into those factors that influence residents’ attitudes vis-à-vis fuel for cooking, lighting and heating. Among the findings was a strong perception that the price of LPG was high and poor knowledge of the benefits of LPG.

²⁵ Figures and information provided via email by Jenny Hannibal, VillageReach, 9 February 2007.

²⁶ Figures provided by VillageReach.



Most important in the minds of Mozambicans surveyed was whether the fuel was suitable for cooking. Following this determination, consumers evaluated the product in terms of its affordability, availability, convenience, ease of use, safety and other factors.²⁷ Product availability and safety were important considerations. Importantly, only 36 percent of respondents knew that LPG was available through VidaGás. Just half of those surveyed had any knowledge of LPG as a product for cooking or lighting, and 79 percent of those surveyed believed LPG to be toxic, explosive or dangerous.²⁸

Half of those surveyed cited price as a major concern. Most of the respondents use charcoal for cooking. Added to this, LPG was not seen as widely available by 50 percent of respondents. Consumers would most likely use public transport or walk, and LPG stores or shops would need to be accessible and LPG made consistently available. Once consumers turn to LPG as the preferred source of gas, VidaGás would need to ensure that shops stock LPG accordingly. Consumers in Kenya have cited shortages in the supply of LPG by shopkeepers as problematic.²⁹ In spite of the negative associations attached to LPG's safety and price, 80 percent indicated that they would be willing to try LPG under the right conditions and if they had the opportunity to do so. Based on the findings, USAID observed: *"This points to the need for an intensive awareness campaign to make people aware of the uses and benefits of LPG."*³⁰ One LPG customer in Pemba, Ester Ferreira, said that she would recommend it to others because *"LPG is faster (than firewood), cleaner and more efficient."*³¹ Respondents suggested methods that would be most effective in expanding consumers' knowledge base of LPG: direct campaigning and demonstrations, as well as word of mouth through local community leaders.³² The data suggested the need for an aggressive marketing campaign using multiple media channels (radio, mobile phone text messaging, newspapers and billboards) to ensure broad coverage that also incorporates education and awareness of the health and other benefits. USAID suggested creative promotional programmes such as providing food vendors and community leaders with free LPG appliances, and organizing public demonstrations to show consumers how to use LPG safely and what the benefits are.³³ The partners are providing public demonstrations and implementing other marketing measures.

²⁷ USAID, *op cit.*, sections 7-4-7-5.

²⁸ *Ibid.*

²⁹ Interview with Caroline Kihato, 3 March 2007.

³⁰ USAID, *op cit.*, sections 6-9.

³¹ Interview with Ester Ferreira in Pemba, 16 January 2007.

³² USAID, *op cit.*

³³ USAID, *op cit.*, section 10-4.



Opportunities to Increase Profitability, Scale-Up & Replication

There are a number of opportunities for VidaGás to achieve financial sustainability.

A MARITIME HARBOR

In terms of a structural intervention to reduce transport costs, the USAID study puts forward the option of developing a new maritime harbor in Nacala, off the coast of Nampula Province. The proposed depot could be used by all of the companies that operate in the northern region of Mozambique. USAID estimates this investment at roughly \$1.5 million. Another critical step would be to expand VidaGás' LPG market and operations to other provinces.

EXPANDING TO OTHER NORTHERN PROVINCES

Significantly, both Nampula and Niassa provinces have a slightly higher income per capita than Cabo Delgado. Taken together, the two provinces have a population of 4.5 million.³⁴ A distribution and sales network, with appropriate personnel to oversee and manage the operation would be necessary. USAID notes: *“Based on demographic data...the gross potential for LPG sales in Nampula/Niassa could well be in the region of 100 tons per month.”*³⁵

MICROFINANCE

Another Lusophone country may prove instructive for Mozambique in this area. About 35 years ago, Brazilian companies wishing to penetrate the interior rural markets of Brazil began a micro-finance scheme. Companies financed both the stove and cylinder with an agreement that the money would be paid back within a one to two year period. The growth of LPG confirmed this approach in spite of some defaults on loans. The initial upfront costs of purchasing a stove and cylinder can serve as a prohibitive barrier, and thus the financing of those setup costs becomes a great incentive.³⁶

GOVERNMENT SUBSIDY AND REGULATION

The Indian Government subsidizes LPG as a fuel for households. As of 2001, an estimated 18 percent of households in India (roughly 34 million households) used LPG for cooking. However, almost 77 percent of these households were based in urban areas. The health and environment benefits of LPG may warrant a government intervention in the market to facilitate the entry of LPG in Mozambique, which would in turn boost sales. The Brazilian Government offers a subsidy to low-income families at a rate of an estimated \$3 per month enabling 4.5 million families to access the benefits of cleaner, healthier fuel.³⁷

³⁴ From www.wikipedia.com.

³⁵ USAID, *op cit*.

³⁶ USAID, *op cit.*, see section 9-2; see also <http://www.wikipedia.com>. The advantage of charcoal is that it can be purchased in small quantities, e.g., 2 kg containers of LPG. Users of the LPG (mainly women) may find that the canisters are bulky to carry or they wish to buy a smaller quantity of gas.

³⁷ *Ibid*.



At the moment, there is no government legislation in place in Mozambique to regulate bottling, storage, safety, use and distribution of LPG. A legal framework governing use and safety is essential to ensure consumer protection and quality control, if LPG is to become fully established as an alternative fuel. Apart from consumer safety, proper guidelines and legislation send signals to investors and companies that correct oversight mechanisms and procedures are in place for LPG use.

Lessons Learned

From this partnership initiative, there were a number of factors that—when they converged—created a formula for success in this context. First was the identification and introduction of liquefied petroleum gas as a structural intervention to improve the supply of fuel in a region lacking reliable energy. LPG has shown itself to be a superior product that will outperform inferior competitors. Once this was substantiated, it was a matter of creating the right enabling conditions to ensure the viability and long-term sustainability of the VidaGás enterprise. Second, the financial capital to launch this start-up venture was essential. While funding was raised from a number of local Seattle sources initially, larger partners emerged as the project grew, including the Hunter Foundation of Scotland and the Dutch government's bilateral organization. Third, the improved supply chain introduced by VillageReach and FDC was crucial. Designing a supply chain that would move people and goods through a regular monthly cycle that anticipates stocks, supplies, equipment, maintenance and other needs, while minimizing cost and waste and maximizing efficiency and effectiveness was strategically deft. Yet, as most development projects illustrate, the difference between the brilliant on-paper plan and its execution against the local context and on-the-ground realities can be stark and bleak.

Here the successful implementation of that supply chain against the background of poor physical transport and infrastructure, logistical challenges, and a lack of human resources (which define the context in northern Mozambique) was nothing short of astonishing. This is a testament to the vision and ingenuity of Blaise Judja-Sato and the staff of VillageReach and FDC. What the partnership was able to pull off defied the odds, which brings us to a fourth critical success factor, Mrs. Graça Machel.

In her home country of Mozambique, to say that Mrs. Machel is more famous, even more revered than her husband, Mr. Nelson Mandela, is no overstatement. She has charisma to rival Oprah and a gentleness and commitment to vulnerable groups to match the most famous humanitarians. When Mrs. Machel points to a location on a hillside in Mozambique, and instructs you to build a bridge there, you do it. No questions asked. What Mrs. Machel brought to this partnership, along with her own knowledge, expertise and capacity to mobilize people, was the strongest local partner around. FDC is composed of a staff of experts in social development; economic empowerment; and health. It interfaces with and advocates for communities. FDC listens to the voice of the people. People like Erik Charas, who managed the project for two years, were prime movers in implementing and executing the supply chain. It is that strange brew that is FDC: an advocate for the poor with strong relationships and a



trusted partner of the Government that has provided much of the glue to hold this initiative together. FDC and VillageReach staff members' skills, problem-solving abilities, ingenuity and commitment were the golden threads holding and binding the venture together. Lastly, a government partner was extremely important. Without the commitment from the Ministry of Health and the Governor of Cabo Delgado, the mechanisms for providing quality health services would never have become standard practice for the Department of Health. The structural changes and improvements introduced would never have become incorporated into health policy and practice in the north of the country.

Conclusion

A close examination of the health and environmental benefits of LPG offers a clear-cut development case for the establishment of LPG. To guarantee its success, there is an imperative for VidaGás to become a revenue-generating business. This goal appears wholly achievable— provided that the required attention is paid to expanding the market and introducing the necessary support structures to govern these operations. Structural impediments such as transportation, storage and supply of LPG to Mozambique will persist. These, however, will not become prohibitive as long as VidaGás can sufficiently increase its sales to cover its costs. This will, in turn, depend on the efforts of the company and its strategic partners to educate and train consumers in LPG use and to market their product. Ultimately, success will depend on the uptake of LPG by the “bottom of the pyramid”³⁸ in Mozambique- poor consumers (households and businesses) in the north. Every effort should be made to ensure that consumers understand the benefits of the superior fuel that is liquefied petroleum gas.

³⁸ This is a reference to C. K. Prahalad's *The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits*. Upper Saddle River (NJ): Wharton School Publishing, 2005.



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Interviews

Twelve interviews conducted with VidaGás and FDC key personnel at two sites in December 2006 and January 2007: Maputo and Pemba (Cabo Delgado), and numerous email exchanges with FDC and VillageReach staff. Translation for interviews with Portuguese speakers in Pemba kindly provided by João Rodrigues, General Manager, VidaGás.



Appendix A: Mozambique's Key Development Indicators

	1997	2003	2015 (MDG Target)
Life expectancy at birth	42.3 years	46.3 years	--
Total population	15.5 million	19.7 million	--
Population in urban areas (2003)	--	35%	--
GNI per capita	--	\$310	--
Per capita expenditure on health (US\$)	--	11%	--
Government budget spent on health	--	20%	--
Births attended by skilled health personnel (rural/urban)	33.9% / 81.4%	34.2% / 80.7%	--
Children immunised against measles (rural/urban)	47.1% / 93.0	70.8% / 90.8%	95%
Maternal mortality ratio (per 100,000 live births)	1,000	408	250
Child mortality rate (under five, per 1,000 live births)	219	178	108
Infant mortality rate (under one, per 1,000 live births)	147	124	67
HIV/AIDS prevalence among adults (15 to 49)	8.2%	16.2%	--

Note: Data are from 2003 unless otherwise indicated.

Sources: Government of the Republic of Mozambique, "Report on the Millennium Development Goals" 2005; "DFID Mozambique: Health Fact Sheet" DFID: London. Available at <http://www.dfid.gov.uk>



Appendix B: The Foundation for Community Development

(Fundação Para o Desenvolvimento da Comunidade)

Mission

The Foundation for Community Development (FDC) is a private, non-profit institution in Mozambique which aims to strengthen the capacities of underprivileged communities, with the objective of defeating poverty and promoting social justice in Mozambique.

About FDC

FDC seeks to partner across sectors of society to achieve development, democracy and social justice. FDC arose from the shared conviction that poverty is not inevitable. Rather, it results from complex mechanisms and structural factors that marginalize and exploit the poor—including a lack of attention to proper use of scientific and technical knowledge and appropriate technologies, and a lack of access to education, the formal economy and other social institutions. This interlocking set of factors has a negative impact on people both physically and psychologically, and prevents them from using the resources that are already available for their own benefit in a sustainable way. These structural and psychological obstacles are the roots of the poverty that the FDC seeks to combat.

History

Near the end of Mozambique's civil war, the Community Development Association (ADC) was established by a group of social activists, with a view to setting up a Foundation. There was a concrete need to set up an institution of Mozambican civil society that would support local initiatives through community investment and strengthen the capacity of communities. In 1994, the Community Development Foundation (FDC) was established as the first institution of its kind in Mozambique.

The Vision of FDC

- Mozambican communities capable of leading local development processes.
- Promoting participative methods of decision-making
- Strengthening, in particular, the role of women and youth, toward the goal of poverty eradication
- Promoting dialogues and partnership with the government, civil society, and the private sector

Donors have included friends of FDC in the US (of which Blaise Judja-Sato is vice president), the Kellogg Foundation, the Mott Foundation, the UN Foundation, the Finnish Government, USAID, Oxfam, and private sector companies operating in the region, such as Coca-Cola, South African Breweries and MCell.

Notes: For more on FDC programmes and activities see <http://www.fdc.org.mz>.

Sources: FDC CD-ROM "Raison d'Être" "Vision" and "Mission" "Creation of the FDC"; interview with Paula Monjane, Directora Executiva Interina, December 2006; and FDC's website, available from <http://www.fdc.org.mz>.



Appendix C: VillageReach

Mission

VillageReach's mission is to save lives and improve well-being in developing countries by increasing community access to health care and other essential services.

Work

VillageReach addresses this need by creating solutions that build local capacity, improve logistics management, fill critical infrastructure gaps and mobilize communities. By partnering with local governments and communities, VillageReach works to improve:

- Supply Chains – building and managing effective transportation networks
- Cold Chains – building and managing refrigeration systems to transport and store temperature-sensitive medical supplies
- Safety – providing training, infrastructure, and equipment to ensure safe injection practices and waste management
- Healthcare Education – training local medical personnel to improve health facility management and improve the quality of care
- Clean Energy – providing energy solutions to improve quality of health services
- Communications – deploying new communications networks to support operations, reporting and emergency response systems
- Community Involvement – partnering with trusted community leaders to increase the use of the public health system
- Economic Opportunities – promoting local development and providing revenues to support healthcare programmes – in Mozambique, VidaGás fills this role

Since 2002, the VillageReach programme in northern Mozambique has provided a logistics platform, cold chain, delivery of vaccines and other medical commodities, energy supply, and health worker education. VillageReach has strengthened the public health system through a strong public-private partnership with the Ministry of Health, the Foundation for Community Development (FDC), and VidaGás. The programme currently serves over five million people through 251 clinics in two provinces, and the region has seen dramatic improvements in immunization rates and healthcare awareness. Headquartered in Seattle, VillageReach has operations in three locations across Mozambique. VillageReach is in the research and fundraising phase of replicating in additional countries.

Leadership

CRAIG NAKAGAWA, Acting President, Seattle

MARIA GOMES, National Director, Mozambique

Board of Directors

NELSON MANDELA, former President of South Africa, *Honorary Board Member*

GRAÇA MACHEL, former First Lady and Minister of Education, Mozambique, *Honorary Board Member*

BLAISE JUDJA-SATO, Founder and Chair of the Board



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JACQUES FRANCOIS MARTIN, President, Parteurop

DR. SETH BERKELEY, President and CEO, International AIDS Vaccine Initiative (IAVI)

DR. PAUL KLEINDORFER, Professor of Management Science, Economics and Public Policy, the Wharton School



Supporters

VillageReach is supported by partners from the global health and philanthropic communities, including the Bill & Melinda Gates Foundation, the World Bank, the Skoll Foundation, PATH, Chiron Foundation, Getty Images and individual contributions.

Source: VillageReach website, <http://www.villagereach.org>.

Notes: For more on VillageReach programmes and activities see <http://www.villagereach.org>



Appendix D: VidaGás Filling Station: Pemba, Cabo Delgado



Source: Photo courtesy of VillageReach



Appendix E1: The African Continent³⁹



Appendix E2: Map of Mozambique by Province



Notes: Arrows indicate the three provinces where VidaGás is establishing operations.
Mozambique is divided into ten [provinces](#) with one capital city (Maputo) holding provincial status.
Source: Map available from <http://www.wikipedia.org>.

³⁹ Source: www.wikipedia.com



Appendix F: Mozambique's Progress on Selected MDGs

Child Mortality

Having achieved a continuous decline in child mortality rates over the period 1997 and 2003, Cabo Delgado maintains the highest child mortality rates across the country. Under-five mortality rates decreased by about 19 percent in rural areas (from 237 to 192) per 1,000 live births, but rates for urban areas only decreased by about 5% (from 150 to 143), and infant mortality rates decreased by roughly 16 percent, from 147 to 124 per 1,000 live births. Hence, geographic differences remain: the under-five mortality rate registers 89 in Maputo but stands at 241 in Cabo Delgado. According to the Republic of Mozambique's progress report on MDGs, child mortality rates are strongly associated with the economic characteristics of their households and the education level of the mothers: "Among children in the poorest households, the under-five mortality rate is twice as high as that among children in better off households (196 versus 108), while children of mothers with no education are 130 percent more likely to die before reaching five years of age than children of mothers with secondary education. While Mozambique is on track to meet the MDG target, the growing AIDS pandemic is threatening the gain recorded in terms of child mortality reduction."⁴⁰

The Government notes that meeting the target will depend, in part, on their ability to accelerate prevention of mother to child transmission and antiretroviral therapy for pediatric AIDS patients. The main causes of mortality among children are malaria, acute respiratory infection, diarrhea, malnutrition and measles, "some of which are preventable by vaccine."⁴¹

Table 1a: Mozambique's Progress on MDG 4 – Child Mortality

<p>MDG 4 Target 5: By 2015, reduce under-five child mortality rate by two-thirds</p> <p>Indicator 13 – Under-Five Mortality Rate</p> <p>Indicator 14 – Infant Mortality Rate</p> <p>Indicator 15 – Proportion of One Year Old Children Immunised Against Measles</p> <p>Will Target be Reached? Potentially</p> <p>Project's Contribution: Reliable lighting, refrigeration of vaccines using the Cold Chain and safe sterilization has enabled vaccination coverage of children to be expanded by 36% in Cabo Delgado, the pilot province.</p>
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Source: United Nations Development Programme. Millennium Development Goals and Indicators. Available at: <http://mdgs.un.org>.

Maternal Health and Mortality

The primary causes of maternal deaths— 75 percent— are attributed to direct factors, such as hemorrhage, rupture of the uterus, eclampsia, sepsis. The remainder (25 percent) is linked to indirect causes such as malaria and HIV/AIDS. However, a number of women suffer from some degree of obstetric fistula: 8,100 to 20,250 women have suffered from some degree of obstetric fistula, with only roughly 700 women treated for this condition.⁴²

In Mozambique, complications occurring during pregnancy and childbirth are among the leading causes of both illness and death for pregnant women. Maternal mortality ratio trends show a decline from an estimated 1,000 per 100,000 live births in the early 1990s to 408 in 2003.²⁹ Mozambique initiated a National Strategy for Maternal Mortality Reduction in 2000, which has created improved access to health services, both antenatal care and family

⁴⁰ Republic of Mozambique, *Second Report on the Millennium Development Goals* (2005).

⁴¹ Ibid.

⁴² Ibid.



planning. These are seen as major factors that explain the decrease in the maternal mortality ratio.³⁰

A related indicator is the institutional maternal mortality ratio. The data reveal a decrease from 181 to 177 per 100,000 live births between 1997 and 2003. Across provinces, Cabo Delgado has the highest IMMR, although a decrease has been recorded (from 512 and 291 per 100,000 live births). Improvements may be due to improved diagnosis, management and notification of maternal deaths.⁴³

Table 1b: Mozambique's Progress on MDG 5 – Maternal Health

<p>MDG 5 Target 6: By 2015, reduce the maternal mortality ratio by three-quarters Indicator 16 - Maternal Mortality Ratio Indicator 17 - Proportion of Births Attended by Skilled Health Personnel</p> <p>Will Target Be Reached? Potentially</p> <p>Project's Contribution: Maternal deaths result from infection and hemorrhage. Reliable lighting allows for delivery and surgery to be provided at all hours. And, the stocking and provision of oral antibiotics and rehydration solutions are provided through the improved supply chain.</p>
--

Source: United Nations Development Programme. Millennium Development Goals and Indicators. Available at: <http://mdgs.un.org>.

Ensure Environmental Sustainability

The constraints of poverty place a tremendous burden on natural resources, which offer the primary source of subsistence for many households in the northern region of Mozambique. The Government recognizes that it is essential to improve the environmental management of natural resources in Mozambique. According to the statistics department, it is estimated that there are 80 million hectares of land, of which two percent are inland waters, 13 percent are national parks and 21 percent is forest. As a proxy for energy efficiency, gross domestic product (GDP) per unit of energy was, on average, US \$2.8 per kilowatt in the period 1999-2001. (There is no information available for carbon dioxide emissions). An estimated 80 percent of the energy consumed in the country comes from woody biomass, which is a solid fuel.

Table 1c: Progress on MDG 7 - Ensure Environmental Sustainability

<p>MDG 7 Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources.</p> <p>Will Target be Reached? Unlikely</p> <p>Project's Contribution: LPG provides a sustainable environmental solution to the problem of using scarce wood as a fuel source in homes (for cooking) and businesses. This disrupts the cycle of environmental destruction while freeing residents from their dependence on wood for fuel. Improved health of households using LPG for cooking, together with a reduction in respiratory diseases.</p>

Source: United Nations Development Programme. Millennium Development Goals and Indicators. Available at: <http://mdgs.un.org>.

⁴³ Ibid.



Appendix G: Ease of Doing Business in Mozambique

Region: Sub-Saharan Africa
Income category: Low income
Population: 19,792,295
GNI per capita (US\$): 310.00
Total number of countries in the ranking = 175



Ease of...	2006 rank	2005 rank	Change in rank
Doing Business	140	137	-3
Starting a Business	153	156	+3
Dealing with Licenses	103	106	+3
Employing Workers	157	156	-1
Registering Property	105	96	-9
Getting Credit	83	76	-7
Protecting Investors	83	81	-2
Paying Taxes	80	78	-2
Trading Across Borders	141	137	-4
Enforcing Contracts	168	168	0
Closing a Business	126	125	-1

Starting a Business (2006)

The challenges of launching a business are shown below. Included are: the number of steps entrepreneurs can expect to go through to launch, the time it takes on average, and the cost and minimum capital required as a percentage of gross national income (GNI) per capita.

Indicator	Mozambique	Region	OECD
Procedures (number)	13	11.1	6.2
Time (days)	113	61.8	16.6
Cost (% of income per capita)	85.7	162.8	5.3
Min. capital (% of income per capita)	10.4	209.9	36.1

Source: The World Bank Group, available at <http://www.doingbusiness.org>



Appendix H: VidaGás Consumer in Mozambique
Carrying a 5.5kg Container of LPG



Source: Photo courtesy of VidaGás



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The information presented in this case study has been reviewed and signed-off by the company to ensure its accuracy. The views expressed in the case study are the ones of the author and do not necessarily reflect those of the UN, UNDP or their Member States.

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