THE BUSINESS OF SUSTAINABLE DEVELOPMENT IN AFRICA

Human Rights, Partnerships, Alternative Business Models

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CONTENTS

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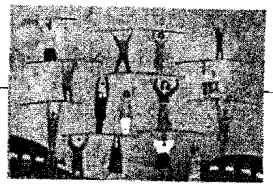


VidaGás:

Powering health clinics and households in Mozambique with liquefied petroleum gas

COURTENAY SPRAGUE & STU WOOLMAN

Introduction[1]

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. One major challenge: northern Mozambique's health clinics lack reliable fuel to provide lighting for surgery and routine operations. As a result, most clinics can only operate during daylight. However, accidents and births take place at all hours. Reliable fuel is also important for the immunisation of children. The storage of vaccines requires refrigeration within a fixed temperature range. Such fixed temperatures are extremely difficult to maintain with kerosene refrigerators that frequently break down. Without proper immunisation, many children will die of preventable diseases.

The absence of reliable fuel sources affects other aspects of existence in northern Mozambique. Less than 2% of households run on electricity. Many households are dependent on wood or charcoal for cooking. Burning so-called 'biomass' fuels increases the susceptibility of individuals to respiratory infections, asthma, and complications related to pregnancy (i.e., low birth weight and stillbirths).[2] In the absence of electricity or other fuel sources, the forests that supply firewood are declining. The degradation of local mangroves imperils the local commercial fishing industry – a chief income-earner for the population in northern Mozambique.

Does this concatenation of health and environmental challenges sound intractable? To mere mortals, perhaps. But take a former minister of education from Mozambique, Graça Machel, whose commitment to children's health is unshakable, and pair this two-time first lady with a visionary social entrepreneur named Blaise Judja-Sato and his sophisticated, Seattle-based NGO, VillageReach. Add a handful of Seattle philanthropists who are willing to back a new fuel source company. Throw in a Ministry of Health that, together with one dedicated Governor of the pilot province, is willing to provide state funding and eliminate state bureaucracy to

improve the health of Mozambicans in the north. And, as a final ingredient, add a community foundation called FDC (Fundação para o Desenvolvimento da Comunidade), whose expert staff actually understands the complex development needs of Mozambicans. And now, you may just have a recipe for success and the solution to the absence of reliable fuel sources in northern Mozambique.

Through a Memorandum of Understanding with Mozambique's Ministry of Health (Ministério da Saúde or MISAU), FDC and VillageReach launched a pilot partnership project in the province of Cabo Delgado in northern Mozambique. MISAU's mandate was to identify those initiatives that would improve the health status of residents in the north. FDC would provide community partners and local experts, while VillageReach would manage the technical design and implementation of the pilot project. At the core of the project's success lay the improvement of the immunisation program. Such improvement required ensuring the integrity of the 'cold chain'. The cold chain encompasses the network of freezers, refrigerators and cold boxes used in the transport and storage of vaccines according to a specified temperature. Exposure to excessive heat or cold may cause a vaccine to lose its potency. Impotent vaccines must be discarded. Due to unreliable refrigerators, vaccines had often become unusable in northern Mozambique. VillageReach and FDC introduced an improved cold chain. They replaced decrepit kerosene refrigerators in remote health facilities in Cabo Delgado with Liquefied petroleum gas (LPG)-powered refrigerators outfitted with automatic change-over valves. The results? Read on.

The Mozambican context

At the outset, three main problems in the healthcare system in northern Mozambique were identified: (1) a lack of reliable infrastructure (roads, vehicles and electricity); (2) insufficient human resources; and (3) a lack of the necessary processes, plans, and systems to underpin health policy and practice. The result was the delivery of sub-optimal healthcare service. The partners found this array of inter-related problems required a combination of solutions. First, the initiative would have to identify a reliable source of energy to keep vaccines cold and to meet the energy needs of the clinics (e.g., sterilisation, lighting and heating). To this end, they found that LPG-powered fridges and lamps were easy for healthcare workers to use and to maintain and that a fleet of dedicated vehicles could deliver the goods. Secondly, the initiative would have to train staff to deliver medicines and supplies. The training requires a system of supervisory support whereby field teams provide feedback and mentoring to clinic employees each month. Third, the initiative would have to create a logistics platform that delivered the vaccines, medical supplies and propane to clinics on a regular basis. Nine key metrics are gathered monthly. These metrics inform the partners of the field context and help to pinpoint any problems in its constituent parts.

The initiative led to the creation of VidaGás. While the company was first established to supply public health clinics in Cabo Delgado with LPG, the company has begun to supply LPG to large commercial and industrial consumers in Cabo Delgado. In addition to supplying hotels (8), restaurants (6) and a commercial prawn operation in Pemba (the capital of the province),[3] 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, and based in Pemba. VidaGás' core business is to sell and distribute liquefied petroleum gas to rural, urban and peri-urban residents in northern Mozambique. Its broader social vision is to marry the Mozambican need for reliable fuel sources to a commitment to using cleaner, alternative forms of energy that will improve environmental conditions, generate employment and advance the general socio-economic development of Mozambicans.

The company's LPG distribution plant became operational in November 2002. VidaGás now distributes LPG to clinics, households and businesses.

VidaGás has expanded its operations to Nampula province and soon plans to service Zambezia province. On the back of its LPG sales and distribution network it now sells a range of other commercial products: freezers and refrigerators (for sale to health clinics, restaurants and other commercial operations); large gas ovens (for restaurants); a four burner stove; a three burner stove; a two burner stove; a single burner stove; and LPG lamps.[5]

VidaGás has thus far created 23 direct jobs and generated indirect employment in related markets. As the consumption of LPG expands, retail outlets (selling VidaGás LPG) will step in to further diversify the sale of the gas. Given the nature of LPG, the company sees women (who do most of the cooking), cooperatives of fishermen, farmers and artisans as the primary target markets for LPG.

VidaGás faces no strong competition from other suppliers of LPG. The company sells LPG in 5.5 kg cylinders. These cyclinders are more likely to be purchased for household use. The primary competition – GALP – distributes LPG in 11kg and 45kg cylinders. Moreover, GALP's distribution occurs only at its petrol or gasoline stations and through a limited number of scattered and small re-sellers. Petrogás also sells 11kg and 45kg cylinders of LPG. However, Petrogás is considering exiting the market due to insufficient sales.[6]

Despite the absence of real competition from other LPG suppliers, there is very real competition in the form of traditional biomass fuels that individuals are used to relying on for fuel. Indeed, VidaGás must overcome a number of barriers to market entry and expansion. These barriers encompass 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 about the benefits of LPG. The price of LPG is also an impediment, especially given the impecunity of the population.[7] The GNP of the province is estimated at US$148m (2002 data) and the GNP per capita is US$97.[8]

Liquefied petroleum gas (LPG) and its benefits

> 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 current indoor air pollution.[9]

Autogas, propane and butane are typical names for liquefied petroleum gas. LPG is used for heating, cooking and other forms of fuel. It is, for example, compatible with internal combustion engines. LPG is often referred to as a 'green' fuel because it emits less greenhouse gas emissions than other fuels: LPG vehicles emit about 20% less CO2 or carbon dioxide. It is also lead-free, sulphur-free, clean burning and effectively odorless. LPG is highly portable and can be packaged, stored and utilised with great ease in rural destinations.[10] The downside of LPG is that it is a fossil fuel and is therefore a non-renewable source of energy extracted from crude oil and from natural gas.

VidaGás provides reliable fuel that allows for effective vaccines, sterilisation, and lighting in 88 health clinics in Cabo Delgado. These clinics serve 1.5 million people. Its market and services have recently expanded to 163 additional clinics in the neighbouring province of Nampula. Between the two provinces, VidaGás now serves a total population of over 5 million. Most importantly, given the original purpose of the partnership initiative, participating clinics in Cabo Delgado reported a 47% increase in the number of children immunised. This increase is a direct function of the introduction of VidaGás' LPG-based cold chain and the accompanying logistics platform created by VidaGás' two NGO partners, FDC and VillageReach.[11]

The increased efficacy of the sterilisation process for medical instruments is of critical import. Each clinic houses a steam steriliser, also known as an autoclave. The autoclave uses hot steam to sterilise medical equipment. Clinic workers rely upon a propane-powered burner to heat up the steam sterilisers. As Jennifer 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.[12]

Before VillageReach and FDC's involvement, the public health clinics in Cabo Delgado experienced a regular shortage of essential medicines. Most maternal deaths globally result from infection and hemorrhage due to complications in pregnancy; oral antibiotics and rehydration solutions can stave off infection and overcome the deleterious effects of blood loss.[13] However, such medicines need to be ordered, supplied and stocked. The supply chain introduced by the partners means that stocks of these essential medicines are more reliable. The reliable fuel supply, the cold chain and the improved distribution of medicines all directly support the goals of the Ministry of Health, the UN Millennium Development Goals, and ultimately, public health in Mozambique.[14]

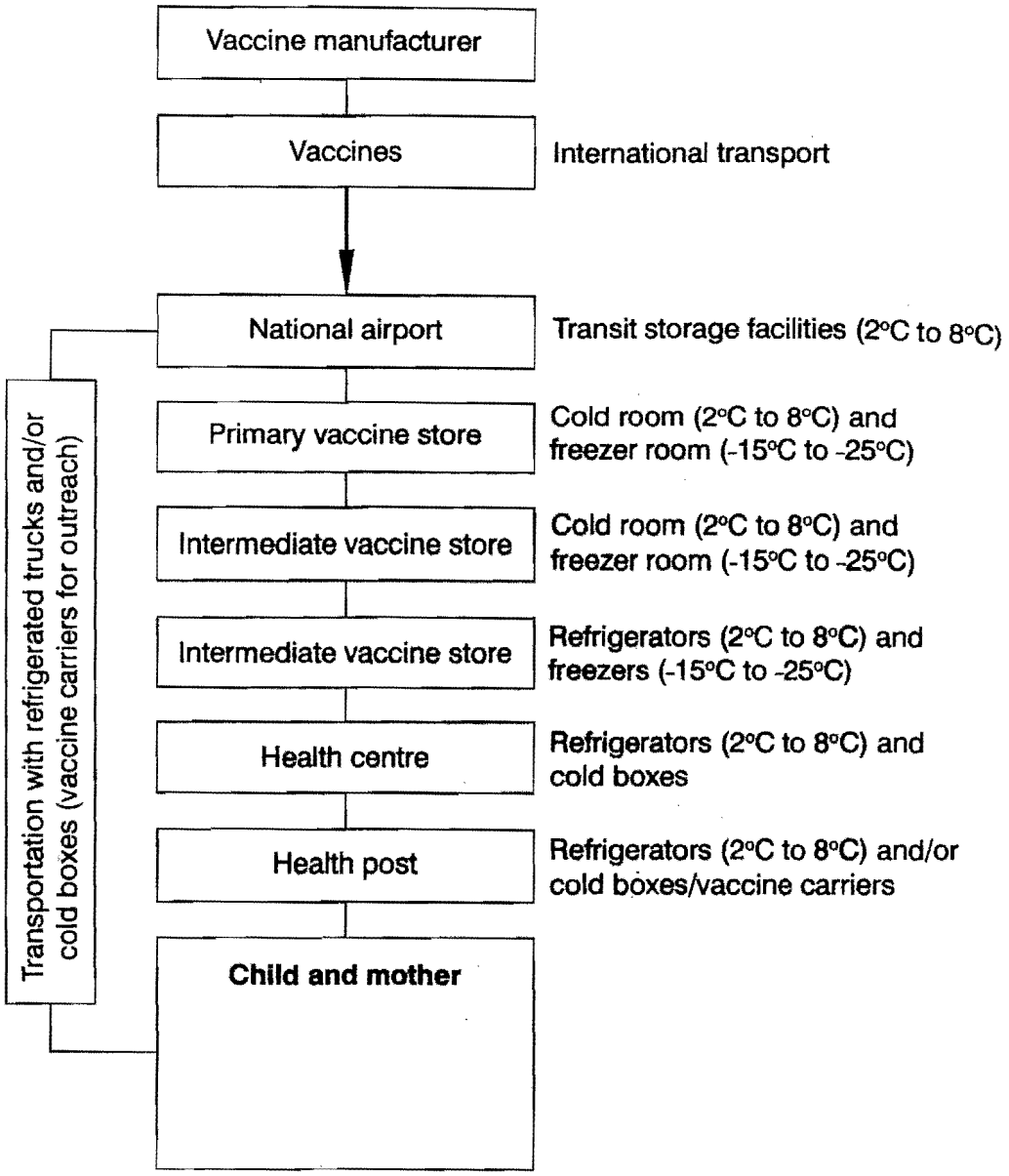
Efficacy of the VidaGás model

> 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.[15]

The following indicators are used by the partners to assess the success of the project.

Refrigerator reliability. Of the 88 refrigerators in 88 clinics served in Cabo Delgado in 2005 and 2006, a nominal number of repairs were reported following the introduction of LPG. Only 2% of refrigerators required repair in 2006.[16]

Figure 1: A typical cold chain



Source: 'WHO Vaccines, Immunizations, and Biologicals', VillageReach.org

Vaccine wastage rates. Quantitatively, closed-vial vaccine wastage rates are tracked to monitor effectiveness. The current 'waste' rates for Cabo Delgado LPG powered clinics are consistently low: they average below 3% for each type of vaccine. This is in keeping with World Health Organisation standards.

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 the nine key metrics at the 251 current clinics served. The importance of accurate data – in a post-civil war context in which data systems and record-keeping fell into total disrepair – cannot be over-emphasised.[17]

Integrity of supply chain. Based upon the data provided by the clinics, medical supplies are ordered by the Ministry of Health, and transported to a MISAU warehouse shared by staff of VillageReach and FDC in Pemba. The vaccines are 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 to the 163 clinics in the province of Nampula. Staff members repair 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.[18]

Challenges to establishing a market for LPG

The long term success of LPG as a reliable fuel source for healthcare clinics will require greater economies of scale. Given the current operating structure of VidaGás, its break-even point is estimated at sales of 25 to 30 tonnes per month. The company is currently selling only 14 tonnes of LPG per month. To achieve its target of 25 to 30 tonnes, VidaGás is serving customers in Nampula. However, this expansion naturally raises the current break-even point, which now stands at 50 tonnes per month.[19]

Figure 2 (LPG sales in Mozambique from 2000) indicates 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'.[20] In addition to the general challenges of doing business in Mozambique – the World Bank ranks Mozambique 134th out of 178 countries in terms of the 'ease of doing business' – a range of specific impediments for LPG sales need to be overcome.[21]

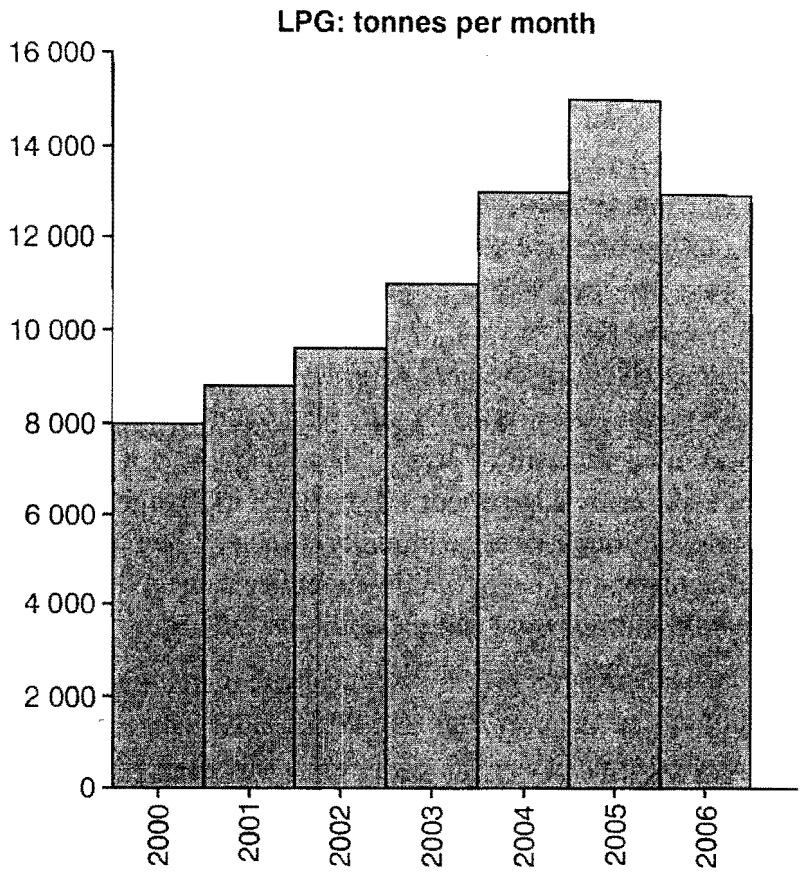
Infrastructure and supply of LPG to northern Mozambique

LPG is not produced in-country. Neighbouring South Africa supplies Mozambique with LPG (produced in a natural gas separation plant). LPG is shipped overland by rail and truck to the capital of Maputo. The procurement and the delivery of all LPG imported from South Africa is coordinated by IMOPETRO (a co-operative company that operates on behalf of its members). VidaGás procures LPG through IMOPETRO by the container load (10 tonnes).[22]

The next leg of the trip is the most arduous. 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. Only 10% of the roads are tarred; 60-70% of the untarred roads are barely passable. The rail network is also in a state of decay.[23] Such a weak transportation infrastructure translates into higher pricing of LPG. The price of LPG at the Maputo port is US$785 per metric tonne – significantly higher than international prices. US$15 is added by IMOPETRO to cover operational costs. Transport costs from Maputo to Pemba further increase the final price in the north. In addition, because South Africa lacks adequate physical storage space for LPG, it is unable to store large quantities. This limitation, in turn, restricts Mozambique's supply and results in fluctuations in price.[24]

While reducing Mozambique's reliance on its neighbour might appear attractive,[25] Mozambique's low GNP dramatically curtails its ability to develop large-scale distribution networks for LPG in the north and in the interior. At the same time, the relative poverty of its residents

Figure 2: LPG sales in Mozambique



Source: IMOPETRO 2006.

limits the capacity of VidaGás to ramp up production and distribution.[26] Although the local currency has strengthened in the last couple of years, between 1998 to 2003 it lost more than half of its value against the US dollar. 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.'[27]

Consumer pricing and energy efficiency of LPG

If the aforementioned barriers can be overcome, then an untapped consumer market may well await. A 5.5 kg cylinder or container of LPG would be the optimal choice for households and provide fuel for up to two weeks. The cost of the cylinder is US$11. By comparison, an equivalent amount of charcoal costs US$33.[28]

Consumer behaviour and perceptions

USAID funded a market research study in 2005 of 400 households in Pemba, Cabo Delgado. The purpose of the survey was to gain insight into those factors that influence residents' attitudes towards cooking, lighting and heating. The survey revealed that most residents thought LPG was too expensive and that its multiple benefits were unappreciated. Most Mozambicans

were concerned with LPG's suitability for cooking.[29] Product availability and safety were also deemed important considerations.

The study revealed other forms of uncertainty regarding the use of LPG. Only 36% of respondents knew that LPG was available through VidaGás. Just half of those surveyed understood that LPG could be used for cooking or lighting, and an astonishing 79% of those surveyed believed LPG to be toxic, explosive or dangerous.[30] Its price and its continued availability were cited as potential problems by 50% of respondents.

However, in spite of the negative associations attached to LPG's safety and price, 80% of respondents indicated that they would be willing to try LPG under the right conditions. Based on these findings, USAID observed: 'This points to the need for an intensive awareness campaign to make people aware of the uses and benefits of LPG.'[31] 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'.[32] Respondents suggested a variety of methods that would expand consumers' knowledge about LPG: direct campaigning and demonstrations, as well as word of mouth through local community leaders.[33] The data suggest the need for an aggressive marketing campaign using multiple media channels (radio, cellular phone text messaging, newspapers and billboards) and the ability to make consumers aware of both the economic and the health benefits associated with LPG.

Opportunities to scale-up and increase profitability

VidaGás can achieve financial sustainability – and thus accomplish its primary goal of improved healthcare – if it is able to realise a number of complex initiatives and meet several important benchmarks.

Maritime harbour

A USAID study suggests that a new maritime harbour in Nacala, off the coast of Nampula, could be used by companies that operate in the northern region of Mozambique. USAID estimates the required investment at roughly US$1.5m. Such a harbour would reduce transport costs and increase reliability.[34]

Expansion to other northern provinces

The provinces of Nampula and Niassa have slightly higher per capita incomes than the population in Cabo Delgado. Taken together, the two provinces have a population of 4.5 million. If VidaGás were able to establish the requisite distribution and sales network in these provinces, then the 'potential for LPG sales in Nampula/Niassa could well be in the region of 100 tonnes per month'.[35]

Microfinance

The experiences of another Lusophone country may prove instructive for VidaGás. About 35 years ago, Brazilian companies wishing to penetrate the interior rural markets of Brazil with LPG began micro-finance schemes. Companies financed both the LPG stove and cylinder with an agreement that the money would be paid back to the lender within a one to two year period. Because the upfront costs of purchasing a stove and cylinder can be prohibitive, the initial

financing of those set-up costs can make LPG a more attractive option. (The advantage of charcoal is that it can be purchased in small quantities. Users of LPG – mainly women – may find that the canisters are too bulky to carry or they may wish to buy a smaller quantity of gas.)[36]

Government subsidy and regulation

The Indian government subsidises LPG as a fuel for households. As of 2001, an estimated 18% of households in India (roughly 34 million households) used LPG for cooking. The Indian government offers a subsidy to low-income families at a rate of an estimated US$3 per month. This subsidy enables 4.5 million families to benefit from a cleaner, healthier fuel.[37] A subsidy is but one potentially necessary intervention on the part of the state in this public–private initiative. At the moment, Mozambique lacks the requisite legislation to regulate bottling, storage, safety, use and distribution of LPG. A legal framework governing the use of LPG is necessary to ensure consumer protection and quality control.

Conclusion

This public–private partnership initiative is already a success – if success if measured by its ability to contribute positively to the healthcare outcomes of residents throughout Cabo Delgado. However, the ultimate success of the venture rests on the sustainability of LPG as an alternative fuel. Those who might wish to replicate the achievements of VidaGás in other environments should pay particular attention to a number of critical success factors:

1. LPG has demonstrated that it is a superior product: it outperforms competitor fuels in terms of price, storage, efficiency and environmental sustainability.

2. Although the financial capital to launch this start-up venture was secured through a small number of local Seattle NGOs, larger partners emerged as the project grew. These partners included the Hunter Foundation of Scotland, the Dutch government's bilateral organisation and anonymous donors.

3. The improved supply chain designed by VillageReach and FDC has enabled VidaGás to move people and goods through a regular monthly cycle that anticipates stocks, supplies, equipment, maintenance, and other needs. Yet, as most development projects illustrate, the difference between brilliant on-paper planning and in-the-field execution can be stark. The successful implementation of the cold 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 achievement is testimony to the vision and ingenuity of Blaise Judja-Sato and the staff of VillageReach and FDC.

4. A fourth critical success factor was the intervention of Graça Machel. In her home country, she is more famous, even more revered, than her husband, Nelson Mandela. Graça Machel brought in the strongest local partner: FDC. FDC's staff enabled VidaGás to succeed largely due to their tacit understanding of how business and politics in Mozambique actually work.

5. If VidaGás can build on its healthcare networks, then it has the potential to survive as an independent privately-held company that – in addition to making a profit – also achieves important health, employment, ecological and social-environmental goals. However, the need to make a profit to sustain the more lofty goals cannot be under-estimated. In order to survive, VidaGás and its partners must realise growth in the household cooking and heating market, as well as the medium to large scale commercial market for generators, refrigerators and freezers.

Editors' reflections and questions

The case study explores the innovations achieved by VidaGás in establishing a profitable business that supplies liquefied petroleum gas (LPG) to poor consumers in northern Mozambique. VidaGás is a company owned and controlled by two NGOs (one in Maputo and one in Seattle) that was initially established to support health clinics in the region. Based on the significant health and environmental advantages, and a feasibility study of LPG, VidaGás was established to sell LPG to small businesses and consumers in the region, with a view to creating a long term solution to fuel shortages, while delivering other social and environmental benefits. To ensure a sustainable supply of LPG in northern Mozambique, VidaGás must achieve its stated goal of becoming a revenue-generating entity within three years. This requires the establishment of a viable market and the uptake of LPG by poor consumers. Key challenges include the need to achieve economies of scale, competition with traditional sources of fuel (perceived to be less expensive), high transport costs, and the dearth of government policy and private sector incentives.

1. LPG must compete with traditionally dominant sources of fuel (such as charcoal and wood 'biomass' fuels), which have well-established markets, and around which villagers have long-held patterns of use. What are possible methods for introducing alternative fuels and making them attractive to the consumers being targeted in northern Mozambique?
2. The case illustrates the value of a partnership approach, involving government and NGO stakeholders. Could companies aiming to achieve similar objectives be successful without such support? Could such political support be considered anti-competitive?

Notes

1 This reasearch was commissioned and funded by the UN Development Program. A dozen interviews were conducted by Courtenay Sprague with VidaGás and FDC key personnel at two sites in December 2006 and January 2007: Maputo and Pemba (Cabo Delgado). These interviews were supplemented by numerous e-mail exchanges with FDC and VillageReach staff. Translation for interviews with Portuguese speakers in Pemba was kindly provided by João Rodrigues, general

manager of VidaGás. The authors are grateful to VidaGás, FDC and VillageReach staff for their co-operation.

2 World Health Organisation (WHO), *Fuel for Life: Household Energy and Health* (Geneva: WHO, 2006).

3 E-mail correspondence with VillageReach, 7 March 2007.

4 Ibid.

5 VidaGás Domestic Gas, *Proposal Document* (undated).

6 Nexant Inc. and United States Agency for International Development (USAID) 'LPG Market Assessment Study' (June 2005).

7 Ibid.

8 Ibid.

9 E. Rehfuess, C. Corvalan and M. Neira, 'Indoor Air Pollution: 4 000 Deaths a Day Must No Longer be Ignored' (Geneva: WHO, 2007).

10 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.' Scottish Environmental Protection Agency 'Green Tips' (2007), available at http://www.sepa.org.uk/publications/sepaview/html/20/green_tips (accessed July 2008). Also Conoco Phillips, 'LPG is Best Green Option' (2008) at http://www.conocophillips.co.uk/stations/autogas/Latest_News/LPG_is_best_green_option (accessed July 2008).

11 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–46.4°F (2°C–8°C). If vaccines are exposed to heat or freezing temperatures, they lose their effectiveness and become unusable. It is imperative to maintain an unbroken cold chain from the point of manufacture until the point of use. See VillageReach, 'Project Spotlight – Mozambique' (2003), available at http://newsletters.worldbank.org/external

12 E-mail correspondence with Jenny Hannibal, VillageReach, 9 February 2007.

13 A. Costello, K. Azad and S. Burnett, 'An Alternative Strategy to Reduce Maternal Mortality', *The Lancet,* 28 September 2006. Medical opinion has it that: 'It is essential that pregnant women in whom complications develop have access to the medical interventions of emergency obstetrical care. Programs 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.': A. Rosenfield, C. Min and L. Freedman, 'Making Motherhood Safe in Developing Countries', *New England Journal of Medicine,* 356, 14 (2007): 1395–97.

14 DFID, *Reducing Maternal Deaths: Evidence and Action: First Progress Report* (London: DFID, 2005.)

15 VillageReach 'Biography of Blaise Judja-Sato' (2007), available at http://www.villagereach.org/bioblaise (accessed July 2007).

16 VillageReach, available at http://www.villagereach.org (accessed July 2007)

17 As Mozambique's government report states in its assessment of progress made toward achieving the UN 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): *Report on the Millennium Development Goals* .

18 VillageReach website, available at http://www.villagereach.org (accessed July 2007).

19 'LPG Market Assessment Study'.

20 E-mail correspondence with Jenny Hannibal, VillageReach, 9 February 2007.

21 World Bank Group, *Ease of Doing Business Index* (2007), available at http://www.doingbusiness.org/economyrankings (accessed February 2008).

22 See 'LPG Market Assessment Study'.

23 Ibid.

24 Ibid. Sample costs associated with LPG transport from South Africa to Mozambique are as follows: The transport of a 9-tonne container from Maputo to Pemba is US$2 500. The return of the empty

container costs US$500. The costs at port are US$70 per tonne. This translates into a cost per tonne of US$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 tonne capacity tankers to transport LPG by road from Maputo to Cabo Delgado would require an estimated US$7 600, leading to a delivered cost of US$422 per tonne. The transport cost of LPG in cylinders is higher still. Galp transports 350 x 11kg capacity cylinders at a cost of about US$520 per tonne.

25 'LPG Market Assessment Study'.
26 Ibid.
27 Ibid.
28 E-mail correspondence with Jenny Hannibal, VillageReach, 9 February 2007.
29 Consumers also evaluated the product in terms of its affordability, availability, convenience, ease of use, safety and other factors: 'LPG Market Assessment Study'.
30 Ibid.
31 Ibid.
32 Interview with Ester Ferreira in Pemba, 16 January 2007.
33 'LPG Market Assessment Study'.
34 Ibid.
35 Ibid.
36 Ibid.
37 Ibid.