Sustainable Thermal Energy Partnerships (STEPs)

Case studies on PPP frameworks based on Energy Sector Experience in Sub-Saharan Africa

Financed by grant from

EPSRC/DfID

Grant Ref: EP/L002655/1

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RESTIO ENERGY

November 2014

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Sustainable Thermal Energy Service Partnerships

Case studies on PPP frameworks based on energy sector experience in Sub-Saharan Africa

Experience in Sub-Saharan Africa with Clean Thermal Energy Service Delivery Models in using Renewables and LPG

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Defining Public Private Partnerships

While Public Private Partnerships (PPP) appear to abound, featuring in most spheres of service delivery, it is necessary to look more closely at the mechanics and meaning of a public private partnership, which should in turn provide a better understanding of the respective roles and responsibilities of the public and private partners. PPPs have essentially evolved out of a need to support or 'buffer' public finances with additional investments from the private sector in terms of developing or revamping public infrastructure and services. While attracting private sector investments is the explicit aim, an equally important consideration is the assumed efficiencies with which this sector operates.

An early form of a PPP was the concession contracts dating as far back as the 15th Century[1] with a popular example in the literature being the granting of a river concession to French aristocrat Luis de Bernam who then charged fees for goods moved on the Rhine River[2]. Moving forward a few centuries, in 1792 the brothers Perrier were granted a concession to distribute water in Paris[3]. It is from these small scale and disparate beginnings private capital and expertise has played an increasing role in public investments and service delivery in the period leading up to the nineteenth century, when construction of infrastructure facilities (water channels, roads, railways) in Europe and later in America, China and Japan was funded by private sources under concession contracts. After a period in which government again played a central role in infrastructure management and service delivery between the late 19th Century and the 1970s, public infrastructure was again transformed (post- 1970s) into a more 'market orientated economy[4]' where the private sector participation in delivery was restored.

A key feature of the workings of PPPs is not only investment and efficiency but responsibility as well. The assumption of risk by the private sector in terms of building and operating infrastructure as well as delivering services is essential for ensuring the most efficient financial outcomes[5]. The private sector is adept at handling certain types of risk such as controlling costs of delivery based on bottom-line commitments whereas the public sector tends to adopt an approach that is more risk averse resulting in more expensive outcomes. Staying with the bottom line; private companies – particularly concessions operating over a longer period – are incentivised to deliver a more 'efficient operational outcome' as they assume responsibilities for the operation and maintenance of infrastructure as well[6]. Other benefits mentioned include, importantly, increased service provision[7].

[1] http://www.newshome.us/news-6312747-Ownership-and-management-to-reconcile-agent.html
[2] http://ppp4krakow.net/About_PPP/Definition,_origin_and_evolution/
[3] http://ppp4krakow.net/About_PPP/Definition,_origin_and_evolution/
[4] http://ppp4krakow.net/About_PPP/Definition,_origin_and_evolution/
[5] http://www.claytonutz.com/industry/construction_and_major_projects/docs/PPP_Summit_Paper_May06.pdf
[6] http://www.claytonutz.com/industry/construction_and_major_projects/docs/PPP_Summit_Paper_May06.pdf
[7] http://www.eoearth.org/view/article/156347/

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However, the efficiency, risk management and reduced cost outcomes of private sector involvement through PPPs does not sit well with all involved. A more centralised role of the state, particular in service delivery, is more compatible with the ideologies and political traditions centre-left organisations[8]. Concern about PPPs extends to the question of the balance of power between governments and the private sector particularly where weak governments are forced into signing contracts with adverse conditions for the public. In particular governments with higher indebtedness that seek private sector capital to assist with public service and infrastructure delivery are often in a very fragile negotiating position[9].

Regardless of these ideological differences, PPPs are playing an increasingly significant role of public service delivery and international development co-operation. While they are the vehicle of choice in a range of service delivery and infrastructure development initiatives they are also playing an increasingly important role in International development co-operation.

PPP opportunities in the African energy sector

The opportunities for Public Private Partnerships in the energy sector within Africa are premised on the infrastructural backlogs and the capital investments required addressing them. The overall annual infrastructure funding gap has been estimated at US$35 billion, of which 80% relates to power[10]. The region's energy capacity and infrastructure have developed at a far slower pace than economic growth. Only about 20% of the region's population have access to electricity, which is less than half the rate of electrification access in other developing regions such as South Asia and Latin America. The backlog contributes to the disparity in supply and demand which in-turn leads to considerable power outages.

A good example of this lack of investment in energy infrastructure is Nigeria. This West African country has a population of some 175 million, the seventh most populous country in the world. Nigeria is classified as a mixed economy emerging market and has achieved, according to the World Bank, 'lower middle income status'[11]. It has an abundant supply of natural resources and a developed 'legal, communications and transport sector'[12]. It is the second largest economy in Africa and is expected to exceed South Africa within the next few years[13]. That said; it only has an installed electricity capacity of some 8,500 megawatts

Nigeria
Population: 175 million
GDP: $260 million
Access to grid: 30 million people without
Installed capacity (MW): 8,600
kWh/capita/year: 150

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[8] See, for instance, 'Dissolving the Public Realm? The Logics and Limits of Neo-liberalism'. In Journal of Social Policy / Volume 33 / Issue 01 / January 2004, pp 27-48. Copyright © 2004 Cambridge University Press.

[9] http://www.eoearth.org/view/article/156347/

[10] http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/0,,contentMDK:21935594~pagePK:146736~piPK:146830~theSitePK:258644,00.html

[11] "World Bank list of economies". http: www.worldbank.org. January 2011. Retrieved 27 May 2011.

[12] "World Bank list of economies". http: www.worldbank.org. January 2011. Retrieved 27 May 2011.

[13] http://www.ibtimes.com/nigerian-gdp-will-be-higher-south-africas-gdp-numbers-arent-everything-1553043

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providing a per capita 150 kWhs per year. This is less than countries with considerably smaller GDP such as Cameroon (256), Cote d'Ivoire (212) and Gabon (907)[14]. In short it is facing a crippling energy crisis which requires vast capital investments. Not only in large scale, capital intensive projects such as generation plants and distribution infrastructure but in more dispersed, small scale opportunities as well, as over 30 million people living in rural Nigeria lack access to electricity[15]. The country is in the process of attracting private capital through extensive power sector reforms aimed at providing more effective and supportive regulation frameworks in the process of attracting private sector capital and expertise into the sector[16]. The process in Nigeria is repeated across the continent from Mozambique to Kenya to Liberia. With only around 20% of the SSA population having access to electricity there is immense potential and need for vigorous investment and development in the sector. Importantly, it is not simply to 'close the gap' that investment is required but also to refurbish and maintain existing infrastructure which currently results in an average of 56 days of power outages every year[17], placing huge strain on economic development in general.

The scope for private sector investment in the energy sector of the continent is vast and public private partnerships have a significant role to play. This position was endorsed by the G20 – High Level Panel whose report on the infrastructure gap in Africa made clear reference to PPPs as the preferred vehicle for facilitating investment in the region[18]. There are varying figures that have been put forward in terms of valuing the investment gap, from $4.3 billion a year in order to address this backlog by 2040 (accumulatively $112 billion in today's terms) by the South African energy minister[19] to a far more substantial estimate in a recent publication which suggested that the investment deficit in the power sector is in the region of $30 billion per year[20].

Either way, the requirements of the Sub-Sahara African power sector and concomitant investment opportunities are vast. In the section that follows, the report looks more closely at actual PPP involvement in the African power sector.

[14] http://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[15] http://www.vanguardngr.com/2014/03/30-million-nigerians-lack-access-electricity-fg/
[16] http://www.theguardian.com/global-development-professionals-network/adam-smith-international-partner-zone/nigerian-power-breakthrough-global-development
[17] http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/0,,contentMDK:21935594~pagePK:146736~piPK:146830~theSitePK:258644,00.html
[18] http://www.za.boell.org/downloads/G20_Energy_Infrastructure_Africa_Final.pdf
[19] http://www.sabc.co.za/news/a/67c0e180434fbb2592faff0bfd5d3b76/Africa%E2%80%99s-energy-infrastructure-backlog-remains-very-high:-Martins-20141803
[20] http://www.brookings.edu/blogs/up-front/posts/2013/10/09-financing-africa-infrastructure-gap-sy

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Experiences & case studies of PPPs in African Energy Sector

Between the years of 1990 and 2008, approximately 360 infrastructure projects were implemented using private participation in Sub-Saharan Africa[21]. The combined value of these initiatives was estimated around $70 billion. The energy sector has featured strongly within these developments.

Based on the extent of the investment to-date, there are obviously many investments and projects to speak of. We have identified a number of broadly representative examples or 'case studies' of PPPs within the African energy sector.

Cameroon: The Kribi Gas-fired Plant

The project is designed to meet expanding electricity demands and is part of a medium-term strategic development programme for the supply of electricity in Cameroon. The Project is located in the equatorial region of Cameroon. It comprises a 216 MW gas fired power plant, approximately 9 km northeast of Kribi, and a 100 km long 225 kV transmission line between the plant and the existing Magombe 225/90 kV substation at Edéa. The Project will be fuelled by natural gas from the Sanaga sud offshore gas field. The Project will be owned by a subsidiary of AES SONEL and all the electricity produced will be delivered to the Southern Interconnected Grid (SIG) and sold to AES SONEL through a Power Purchasing Agreement (PPA)[22].

Kribi Project:	216MW gas-fired power plant & 100km transmission line
Technology:	Wartsila engines: 13 x 18V50DF- gas reciprocating engines of 16.6MW gross capacity each Siemens-KEC JV: 100km 225kV double circuit transmission line; step-up 11/225kV sub-station
Fuel type:	gas to be provided from off-shore Sanaga Gas field
Location:	Near coastal city of Kribi, in the South Province of Cameroon
Target COD:	Early 2013, in time for dry season
Off-taker:	AES Sonel, integrated power utility for Cameroon – 100% purchase of supply
Ownership	KPDC is owned by The AES Corporation [private] (56%); Republic of Cameroon (44%)
Cost:	$400 million

[21] http://www1.uneca.org/ArticleDetail/tabid/3018/ArticleId/1191/Public-Private-Partnerships-implementation-in-the-Energy-Sector-in-Africa.aspx
[22] http://www.afdb.org/

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Kenya: Thika Power Plant Project

The project consists of the development, design, construction and operation of a Greenfield 87 MW heavy Fuel Oil ("HFO") diesel power plant on a 20 years Build-Own-Operate ("BOO") basis in Thika, about 35 km from Nairobi, Kenya (the "Project"). The Project will have a 20 year Power Purchase Agreement ("PPA") with Kenya Power and Lighting Company ("KPLC"), the national transmission and distribution company.

The project's prime movers will be medium-speed reciprocating diesel engines, using HFO as primary fuel with supplemental firing of light fuel oil (LFO), and a steam turbine bottoming cycle. The plant configuration will consist of five 18V48/60 MAN diesel generating units with one MAN Model Marc2 C01 steam turbine driven generator (approximately 7 MW). The steam turbine is powered by steam produced using the waste heat of the five reciprocating engines. The net output of the project will be approximately 87 MW. The heat rate of the Project is improved as engine exhaust energy is used to generate steam for the steam turbine[23].

Technology:	Containing five 4-stroke MSD engines 18.9MW, and a steam turbine 7MW
Fuel type:	Heavy fuel oil (HFO)
Location:	Thika, about 35 km from Nairobi
Target COD:	late 2013
Off-taker:	Kenyan Power Lighting Company (KPLC)
Ownership:	Power is a subsidiary of Melec PowerGen Inc., and an affiliate of the Matelec Group of Companies from Lebanon
Cost:	$150 million

[23] http://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/Thika%20Esia%20sum%20-%20ENGLISH_%2026-09-11.pdf

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Mozambique: 107 MW Gas fired plant in Mozambique

Aggreko, along with its joint-venture partner Shanduka Group, has officially opened and delivered power from its 107.5 MW interim gas-fired power plant at Gigawatt Park in Ressano Garcia, Mozambique. The project is the result of a Power Purchase Agreement (PPA) that Aggreko have signed with Electricidade de Moçambique (EDM), the Mozambique power utility and with Eskom, the South African power utility. The project will produce 107.5 MW of power to supply baseload and peak power to both companies until July 2014.

Technology: Gas fired turbines

Fuel type: It is powered by natural gas from the Temane gas fields in Mozambique

Location: The power plant is situated in Ressano Garcia on the Mozambique/South African border, 90 km north-west of Maputo at Gigawatt Park, a development of Gigawatt Mozambique

Target COD: July 2012

Off-taker: Eskom and Electricidade de Moçambique (EDM),

Ownership: Aggreko and Shanduka Group

Cost: $250 million (Phase 1)

South Africa: Renewable Energy Independent Power Producer Procurement Programme (REIPP)

This IPP Procurement Programme has been designed to contribute towards the target of 3,725 megawatts of installed renewable energy capacity and to start stimulating the renewable industry in South Africa. Under the REIPP, government wants independent power producers to generate a total of 3,725 Megawatts of renewable energy for the period from 2010 to 2016 as set out in the Integrated Resource Plan 2010-2030. Under the REIPP Programme, bidders submit bids to construct and operate renewable energy projects and sell power to Eskom. Preferred bidders under the REIPP Programme are required to enter into a PPA with Eskom, the national electricity utility[24].

Technology: On-shore wind, concentrated solar, solar PV and others (1,415MW)

Fuel type: Mostly from environmental resources (wind/solar irradiation) but a small amount of biomass as well.

Location: Across the country (28 projects in Window 1)

Target COD: Phase 1 – 2013

[24] http://www.dlapiper.com/files/Publication/4d9ba3b5-9d73-44f4-bf69-5d3440022561/Presentation/PublicationAttachment/43395ee3-88e1-4670-852c-63fc0c308198/pfi-south-africas-reipp.pdf

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Off-taker: Eskom

Ownership: Each power plant is owned by individual companies or consortium of companies. Revenue is generated through PPAs with Eskom and Department of Energy

Cost: $5 billion (Phase 1)

These examples of PPPs in Africa were fairly randomly selected and demonstrate a range of energy technologies. However, what these and other PPPs in the African power sector show is that power sector reforms have tended to favour large scale, capital intensive investments which are mostly urban based. There have been significant power sector reforms in Africa which have been designed to facilitate private sector involvement and to shift away from the more centralised and vertically integrated parastatal/public control environment which predominated up until the late 1990s. This has resulted in the desired PPP developments within the power sector. However, these developments have tended to be of a large-scale, capital intensive, grid nature which is not always best suited to the energy access challenges that countries in SSA face. While important for energy security and general industrialisation, these developments do not impact significantly on the more distributed rural 'off-grid' communities. The majority of Africa's population reside within rural areas (64%)[25] and do not have access to the grid (90% of rural households in SSA are without access to electricity). The type of large scale grid connected projects discussed here are more showcase or trophy projects that are not, in many instances, designed with the socio-economic and infrastructural realities of most SSA countries. For instance, in Tanzania, 94% of all energy consumed is from solid biomass (wood & charcoal) and most households are rural (73%)[26] and most rural households are unelectrified (93%)[27]. Large scale grid connected power projects are not going to have a significant 'access' impact in these environments. One would expect there would be more dispersed, off-grid energy access initiatives encouraged through PPPs as this aligns more closely with the energy access reality faced in Tanzania and indeed, across SSA.

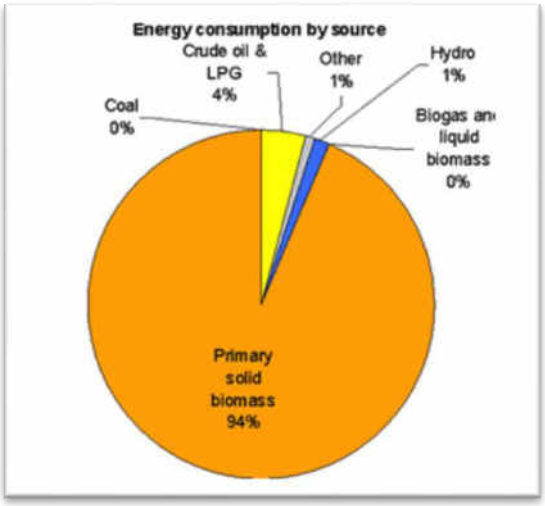

Figure 1: Energy contribution by fuel type in Tanzania

[25] http://www.tradingeconomics.com/sub-saharan-africa/rural-population-growth-annual-percent-wb-data.html
[26] http://www.tradingeconomics.com/tanzania/rural-population-percent-of-total-population-wb-data.html
[27] www.africanreview.com

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Large scale PPPs and small scale realities

Saliem Fakir noted[28]that at the G20's South Korea Summit in 2010, the Multi-Year Action Plan adopted to promote economic growth in low-income countries the panel emphasised large-scale public-private partnership (PPP) projects in order to 'promote economic growth and regional integration'[29]. Why, the question is asked, do the recommendations not give more attention to 'modular and more flexibly deployed renewable energy technologies'[30]? While this has been the situation for some time and has limited the broader impact of these power sector reforms and developments there are some encouraging signs emerging from the continent. The emergence of a number of dedicated 'Rural Energy Agencies' (REAs) in East Africa (Tanzania, Kenya, Uganda, etc.) amongst other regions with similar mandates in 'promoting access to modern energy services in rural areas'[31]. In addition to these government initiatives, there are a number of multi-lateral and bilateral organisations involved quite broadly in improving access to more small-scale dispersed energy interventions such as the Global Alliance for Clean Cookstoves[32], The World Bank/IFC's 'Lighting Africa' initiative which is promoting access to solar PV lanterns to reduce reliance on kerosene[33], there is also the African Renewable Energy and Access programme (AFREN) which is helping to expand access to reliable and affordable modern energy services by 'supporting improved service delivery and the scale-up of innovations in electricity, lighting and cooking'[34]. The US's 'Power Africa'[35] is another bilateral initiative aimed at improving access through expanding mini-grid and off-grid solutions.

What these and allied initiatives suggest is that there is an increasing focus on rural energy access which require more distributed, small-scale interventions than the large scale power generation and distribution projects that have characterised PPPs within Africa's energy sector to date. While an awareness of more dynamic rural energy access requirements is emerging, creating the opportunity for successful PPPs within this sector is not without its challenges. The single technology offering (grid access, solar PV, improved cookstoves, biogas digesters, etc.) and the largely dispersed character of the market creates issues around sustainability as does the burden of over-regulation, inadequate policy developments, etc. A new PPP framework is required to address these challenges and to promote private sector investment in rural energy access initiatives. Interestingly, in Figure 2 below, the disadvantages of PPPs almost captures precisely the challenges faced by promoting PPPs within the rural energy service delivery sector. The market characteristics of rural communities and general narratives associated with service delivery (for instance, single technology) tend to increasingly burden small-scale innovative approaches (which are arguably better suited to rural realities) and favour larger more capital intensive energy sector initiatives which have better capacities to overcome these disadvantages but, as suggested, are not the best options for improving access to services in rural areas.

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[28] http://www.za.boell.org/downloads/G20_Energy_Infrastructure_Africa_Final.pdf
[29] http://www.za.boell.org/downloads/G20_Energy_Infrastructure_Africa_Final.pdf
[30] http://www.za.boell.org/downloads/G20_Energy_Infrastructure_Africa_Final.pdf p2
[31] http://www.rea.go.tz/#
[32] www.cleancookstoves.org
[33] www.lightingafrica.org
[34] http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/EXTAFRREGTOPENERGY/0,,contentMDK:22500298~menuPK:8913746~pagePK:34004173~piPK:34003707~theSitePK:717306,00.html
[35] http://www.usaid.gov/sites/default/files/documents/1860/power-africa-overview.pdf

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Table 1: Advantages and disadvantages of PPPs

Advantages	Disadvantages
Speed of delivery versus public sector delivery	Contracts can be complicated
Value for Money	Bidding costs are high
Leverages the knowledge of private enterprise for social good	Legal costs are high
Accountability	Contract negotiations are complex
Access to additional capital	Long-term commitment is required

Developing a new PPP framework for rural energy access development

There are various challenges faced to incentivising the participation and investment of the private sector in rural electrification and/or energization. These include;

- Very often the single technology approach imposes its own limits as more dispersed rural markets do not present the same market proposition and opportunity as more densely settled and educated urban environments[36].
- Finance institutions are reluctant to invest in rural electrification[37]. The risks are too high.
- Smaller-scale initiatives struggle to reach that critical mass in terms of market penetration.
- At times the transaction costs and red tape are too onerous for small-scale ventures and are best suited to larger scale more capital intensive projects.
- PPP contracts are often too vague (there are political risks which need to be factored in). Unstability of African countries and the long-term requirements of concessions (10 – 20 years) increase the risks.
- Lack of a business orientated legal framework in Africa.
- The need for additional public sector funds to further incentivise private sector investors.

The four following PPP success key factors in rural electrification have been identified[38]:

1. Regarding **"Politics"**: The need for a clear vision/strategy at the scale of the national territory and with a given horizon, precisely describing the role of public authorities in all their instances (central government, local authorities, RE institutions, etc.) to enable private operators to sustainably position and project themselves;
2. Regarding **Regulations**: The need for a regulatory and fiscal framework, sufficiently transparent and incentive for the private sector: simplified authorizations and transparent

[36] 'Guidelines and general documentation for establishing IREUs in Africa' Produced by Restio Energy. Report submitted to REEEP. 2009
[37] Public Private Partnerships in Rural Electrification Programmes in Africa. December 2010
[38] Public Private Partnerships in Rural Electrification Programmes in Africa. December 2010. p. 43

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contractual terms for PPPs, lighter standards, prices that match payment capacities of the greatest number of potential clients while guaranteeing acceptable profits for the operator, etc.

3. Regarding **Financial assistance**: The need for adequate public instruments and means to ensure the financing, not only of part of RE investments, but also of necessary guidance measures during the operation phase.
4. Regarding **Technical assistance**: Technical assistance services to truly boost the RE sector and generate effective capacities within national SMEs who must be mobilized: Preliminary studies, feasibility studies, low-cost construction, impact studies, management and system maintenance tools, etc.

These are fairly high level or even generic considerations which while raising the broad issues, do not provide the level of detailed required in identifying and operationalising solutions. To this end we need to look more closely at the work on the 'Integrated Rural Energy Utility[39]' concept which aims to address the challenges faced in proving services to low-income and dispersed rural households. If modern energy services are going to be made available on a sustainable basis to rural households then there are a number of issues that need to be addressed and the conceptualisation and development of the IREU was intended to do precisely that. There are many challenges to delivering energy (and other) services in rural areas. The intension of the IREU is to address the challenges faced in terms of servicing rural households, to offer the necessary financial sustainability in terms of market access, political support and therefore contract stability, favourable regulatory framework, access to capital, etc. to ensure business stability and in doing so, attracting more private sector investment into rural energy service delivery.

[39] The IREU concept was developed by Restio Energy with the support of the Renewable Energy and Energy Efficiency Partnership (REEEP). Relevant extracts of the final report have been reproduced here.

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The Integrated Rural Energy Utility (IREU): practical frameworks for sustainable rural energy service delivery[40]

Definition of an IREU:

> **"a medium- to large-scale decentralized entity that delivers a range of renewable and other energy services to primarily rural regions (households, social services and productive use applications) – meeting both thermal and grid and/or off-grid electricity needs in an energy efficient manner, and within an institutional framework that has necessary critical mass and long-term financial integrity".**

Benefits and costs of IREUs

Benefits of an IREU from government perspective

Perhaps the most important and informing feature of rural energy service delivery in Africa is that rural households will not receive grid electricity within the next 10 years and, in certain instances, may never receive grid electricity. Acknowledging this means we accept that energy service delivery will depend on a number of different service strategies and carriers. Governments – well certainly in the countries that we have reviewed - accept that rural energy service delivery will be multi-pronged, involving a range of technologies, energy sources and delivery strategies. Given this context, what are benefits of integrated service delivery from the government/project planners' perspective?

- Development planning, on a more general level is becoming increasingly integrated. Indeed, in South Africa Integrated Development Plans or IDPs are legislated by the Municipal Systems Act (2000). And, most recent Rural Electrification Masterplans (see for instance the IREMP, Uganda) contain energy solutions for grid and off-grid areas as well as roll out plans The benefits of a more integrated approach to development plans; namely avoiding duplication, ensuring no-one is left out of the development framework, ensuring each component of development builds towards an overall, long-term vision, etc are similarly relevant to integrated energy service delivery. Integrated delivery models are able to ensure greater customer reach or penetration, access to appropriate energy solutions, more efficient delivery of energy services, etc.

- An integrated utility is a rational response to the stated objective of improving access to energy for all. Given the challenges faced in rural electrification (dispersed patterns, variable incomes, poor infrastructure, etc.) different technologies/carriers will have different roles to play in ensuring overall improvements in access to energy at the household, business and institutional level. With all the different technologies and efforts it seems practical to integrate as many as these as possible into a single company mandate. It will be cheaper. For instance, South Africa has a policy of Universal Access by 2014 – this will have to involve different carriers/technologies,

[40] These extracts have been taken from 'Guidelines and general documentation for establishing IREUs in Africa' Report submitted to REEEP. 2009

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etc. In effect, the policy intentions are laying the groundwork for supporting an IREU in their targets are to be effectively met.

- From a public finance perspective, governments have to ensure that public and donor organisation funds are efficient and effectively spent. A larger more integrated utility has a greater capacity to service more people, can carry out a number of energy service programs simultaneously (offering efficiencies from a cost/reach perspective), would arguably be able to appoint and retained more highly skilled personnel, would in all likelihood have more complex and auditable financial controls, etc. An integrated utility would offer governments and planners a more reliable, more cost efficient and financially judicious delivery option.

- The IREU should be regarded as integrated from two dimensions; spatially and temporally. By 'spatially' we are referring to the integrated service offer at any one time, meaning the utility will carry a range of energy products and services at any single time in its operation. This is arguably the more conventional understanding of an IREU as we have promoted through these reports. The second dimension is 'temporal', offering these integrated services over time. The IREU contains a dynamic in its operation that allows it to develop energy use patterns and service these patterns over time. For instance, if the IREU were to offer Solar Home Systems to an immature market, then strengthen the culture of payment and grow the up-take, it may then offer these households grid electricity. Access to the SHS would be the equivalent of a pre-electrification strategy getting households used to electricity and paying for the service. Applying this dynamic, an IREU would be able to meet the longer-term energy service targets of a region/country through slowly creating, encouraging and growing particular energy service markets. An example of this dynamic was observed in Mali where the concession company could switch customers over from SHS to mini-grid connections once they required greater power supplies and could afford to pay for this improved service[41].

- Managing the competing elements of different services and technologies. As the second report 'NuRa in-depth case study: integrating further?' discussed, there was a sense that the off-grid service provider (NuRa[42]) and the grid service provider (Eskom) were competing for the number of connections made. There were examples cited that households had received grid electrification at a cost of over R20 000[43] (€1700), households that were poor and were not in a position to optimally use the connection. Such households would be arguably greater served by a SHS. If a single company were positioned to make this choice, it is more likely that the most appropriate solutions would have prevailed as opposed to the most rigorously enforced as is occasionally the case within NuRa's concession area.

- Institutional platforms for channelling subsidies and other policy imperatives; a more integrated utility with a greater service offer and customer reach would offer governments and administrators a more integrated platform for delivering technology

[41] Dr Douglas Banks 2008; personal communications with representatives from Yeelen Kura in Mali
[42] NuRa is an off-grid concession established in South Africa. See annex p. 30.
[43] Robert Aitken; Personal communications with Eskom sub-contractor

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and/or market focused subsidies. When governments apply different subsidies to different technologies, an IREU would be better positioned to manage these multiple subsidy scenarios. In addition, IREU will be well positioned to monitor the impacts of government policies focusing of rural energy service delivery.

These are some of the benefits that an IREU can offer to governments and their respective energy service plans. But obviously there are some costs and challenges associated with promoting and working with IREUs.

- Is the necessary legislation in place to support and mandate IREU? What legislative investments/amendments need to be made, what knock-on effect might these amendment have? How does the concept of an integrated energy utility fit with government policy on privatization, smaller scale employment opportunities, etc? All these questions need to be asked in the balanced appraisal of whether or not an IREU is advantageous.

- For the IREU to work effectively it requires political support. While report two 'NuRa in-depth case study: integrating further?' argues that NuRa is well positioned to offer grid and off-grid integrated services, the political environment is not particularly amenable to the proposal. With South Africa's rather stoic commitment to grid electrification, the space for off-grid and alternative energy solutions has not opened up sufficiently. For the IREU concept to take hold within the rural energy service delivery environment, it requires open political support, as evidenced in some other country's energy policy and planning frameworks (Uganda amongst others) where privatisation of energy businesses at all scales is being actively promoted.

Benefits of an IREU from the concessionaires perspective

Some of the benefits discussed under the government perspective will be similarly applicable from a concessions perspective. However, the key foci under the concession review must be the impact on operational performance; how does integration benefit (or otherwise) a utilities operation?

- Our analysis indicates that it makes sense to integrate from a finance point of view (economies of scale, lower marginal costs). Regarding the NuRa concession; NuRa was placed in a difficult financial position due to the suspension of the government subsidy. They could not install more solar home systems and therefore could not grow their revenue base by following the SHS route. NuRa's business model was premised on 50,000 installations and had a breakeven at around 20,000 SHS customers. Its operational footprint, including energy stores, staffing, vehicles etc. was geared towards supporting fairly rapid SHS customer growth. When the installations were suspended, NuRa were left with an operation that was oversized for their remaining SHS customer base. As a result they expanded their service offer to include LPG. What is interesting here, and it supports the general thesis that integration is beneficial from a financial point of view, is the dramatically lower marginal costs of bringing LPG sales online when compared to SHSs. It cost the utility in the region of R7 million (€585,000) to develop the infrastructure for their existing 10,000 SHS customers at a cost per customer of R700 (€60) while it only

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cost NuRa in the region of R120,000 (€10,000) to enable them to sell LPG gas through this infrastructure at a cost per customer of R12/customer (€1)[44]. Income from these two services is roughly equal.

- Integrated utilities would arguably be better able to attract and retain senior staff. Longer-term sustainability is one of the greatest challenges to rural service initiatives and effective human resources are at the centre of this susceptibility. With traditionally low profitability, often depending on erratic subsidies/grants and operating in remote areas, rural service companies struggle to attract and retain senior staff. More integrated utilities with more challenging service offers and greater revenue streams may be better positioned to attract and keep suitably qualified staff. In the NuRa review it was noted that the utility had lost the services of two financial managers within the space of a few years, placing the operation under considerable stress.

- Appealing to the private sector; it would be more encouraging for potential investors if the policy for private participation accommodated more integrated and growth orientated service solutions. The integration of service options potentially allows for greater returns and more efficient use of invested capital. Diversified service potential present greater growth prospects and greater market penetration which are likely to appeal more to the private sector.

- Servicing a greater portion of the market; any single technology will only appeal to a section of the local market. For instance, in the Kanungu concession in Uganda[45], the grid electricity connection is affordable (and accessible) to less than 20% of the household concession population. By encouraging a more diversified service offer, a greater portion of the market can be serviced before access limits and/or saturation has been reached. There are cost efficiencies and business growth implications to this scenario as businesses can pick up a greater number of customers in a particular area, lowering the per customer service costs and ensuring a more densely serviced footprint.

- Making full use of technology and resource management systems; NuRa has developed a fairly sophisticated Energy Service Management System (ESMS) which monitors and tracks technology, service and sales performance within the business. New technology services can readily integrated (as was the case with LPG gas) onto the platform which links all point of sales (POS) with a master station. The ESMS offers the user a full range of reporting options or performance indicators from determining the sales figures from different energy stores, on SHS performance in different geographies, on the number of maintenance visits to SHS households, on the amount of gas sold over time at each store, etc. This kind of management tool is essential for understanding the market, identifying weaknesses in business operations,

[44] To be sure, the selling of LPG does not require the same operational investment as NuRa's fee-for-service model associated with its SHS customers. If LPG was the original service offer it would not have required as much capital investment. However, despite these variables, it is clear that integration can offer significant financial benefits from both a cost and sales perspective.

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of monitoring the performance of corrective interventions, etc. It offers a very useful management platform for an IREU. NuRa is currently investigating the introduction of wood stoves into its service offers. Its use of the ESMS has ensured that it is now eligible for Free Basic Alternative Energy subsidy on these stoves as it has the capacity to monitor sales effectively, a pre-requisite for accessing the subsidy. Kanungu concession has realised the benefits of prepayment system and is a leader in Uganda.

- Diversifying markets not just products; most rural service delivery operations will present with the full range of sustainability challenges. With dispersed markets, consumers with low and variable incomes, inadequate infrastructure, limited marketing and advertising services amongst other challenges, the IREU will have to maximize business opportunities if it is going to survive. One of the strategies available to IREU is to identify and service non-core markets within its operational footprint. For instance, the NuRa concession area includes the large towns of Richards Bay and Empangeni. While NuRa's principle market comprises rural households, these urban centres present NuRa with alternative markets and opportunities. NuRa is investigating the sale, installation and maintenance of Solar Water Heater (SWH) to middle-income urban households. Characterizing these initiatives in a more generic IREU framework, what we are referring to is exploitation of non-core market niches. These niches might be represented by public institutions such as schools, clinics, administrative centres and/or private sector initiatives such as game lodges, hotels, residents of urban commercial centres, etc.

These are some of the principle operational benefits for integrating rural energy service operations. It is about opening new markets, of creating greater service density within existing markets through multiple service offers, it is about utilising management systems more optimally amongst other things. While there is much to consider in terms of the operational benefits, there are other caveat and qualifications which need to be raised vis-à-vis the business and operational challenges of integrating rural service delivery.

- The broad skills set required; for an IREU to be able to provide the full range of services alluded to here, they would require a fairly broad set of technical skills which will not always be able to cross-over technologies and service offers. IREUs will have to closely consider the packaging or clustering of technology and service offers to ensure they have the most appropriate human resource set, ensuring customer satisfaction and a reasonable rate of return for the utility.

- Monopolistic behaviour; in managing the development of IREUs, administrators need to ward against monopolistic behaviour. Rural markets are very sensitive markets. In most cases we are referring to the poorest of the poor and the benefits of development facilitated through improved access to modern energy services will be quickly lost if tariffs are too high and the market manipulated through monopolistic practices. There are already credible levels of ideological opposition to private sector participation in service delivery[46] in South Africa and elsewhere so such threats should be taken

[46] The granting of a water service concession to Biwater, an international water service company, has resulted in much tension and debate over the role of the private sector in delivery basic services in South Africa. Water

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seriously and require appropriate levels of regulation and service agreements to ensure the interests of the poor are not compromised. While this is principally a government issue that needs to be regulated against, it is important that private sector investors understand the terms and conditions of operation.

Benefits of an IREU from the customer perspective

Benefits to the IREU customer are numerous and far reaching. They include the following:

- *One stop shop*; many rural household utilize multiple fuel use patterns in fulfilling their household energy requirements. IREU are better positioned to carry a range of technology and energy carriers enhancing their customer's ability to purchase their requirements from a single shop/vendor. Households frequently purchase their range of energy sources from different vendors incurring additional costs in terms of transport and convenience.

- *Service rather than technology approach promotes retail*; where the IREU assumes a service orientation over specific technology focus this opens up additional retail opportunities to the customer's convenience. For instance, the increasing integration of NuRa service offers have transformed NuRa's energy stores from a point of sale for SHS credit to more integrated retail platforms. These stores now sell LPG gas and appliances, gel fuel and appliances and, more recently, efficient wood burning stoves as well.

- *Cost savings of integration passed on to customers*; while this will be determined by the specific IREU's business ethos, the savings made from lower marginal costs associated with integrating additional services and the economies for scale benefits of purchasing in larger quantities can potentially be passed onto the rural consumer.

- *Developmental*; an IREU offers greater potential for introducing a more complete range of modern energy service options into the rural market. The more singular, technology focused initiatives benefit only a limited sub-sector of the market. This was evidenced in the case of the Kanungu concession where their electrical service connection offered could only benefit 20% of the concession households due to the constraints on consumer affordability as well as the costs of extending the grid. A more multi-tiered approach will enable rural consumers to select from a range of options, enhancing the prospects of acquiring energy services that are more suited to their ability to pay and household energy requirements. Greater access to modern energy services, through an IREU approach, means that more households benefit from the proven social and economic benefits of improved energy services[47].

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supplies in the town of Nelspruit in South Africa's Mpumalanga Province have been privatized by Biwater since 2000. South African trade unions along with local and international campaigns organisations have been challenging this decision, pointing out rising prices, declining service delivery standards and tariff fraud. See, for instance, http://www.queensu.ca/msp/pages/In_The_News/2002/January/samwu.htm

[47] A recent UNDP report on human development reaffirmed this relationship suggesting that 'access to modern energy services is fundamental to fulfilling basic social needs, driving economic growth and fuelling human development' Human Development Report 2007/8 'Access to Energy and Human Development' Amie Gaye. UNDP

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- *Productive use*; while access to a range of modern energy services is crucial for enhancing development prospects and other human development indices, it is also more directly useful in the productive use or income generating opportunities that the IREU business platform affords. Where modern technologies can be applied to productive (as opposed to purely consumptive) activities then local small traders benefit through growing margins, the local economy grows through greater cash/trade circulation and the whole domestic or local market opens up. To an extent then, productive use can be play the role of leaders and market openers within the local economy. This distributes the benefits

We have discussed a number of 'costs' or more accurately the challenges of an IREU. Perhaps the most relevant of these from a customer perspective is the emergence of rural energy service delivery monopolies. Governments need to ensure sufficient regulation – without deterring private sector investment – that serves to protect the rural consumers. While the IREU model is premised on improving business performance, it cannot achieve this at the expense of the markets. The IREUs *are* meant to introduce efficiencies, a more profit centered model, etc into the service delivery market but the IREU model has been developed, and this ethos will have to be rigorously maintained, with the full knowledge that these are sensitive markets, that there is a broader social and economic objective here beyond the profits of the concessionaire. The potential tension between profits and socio-economic benefits need to be carefully managed.

Key factors driving the establishment of successful IREUs

The review and case study outcomes of our research indicate clearly to us that there are various factors, which need to be in place for an IREU to have a chance of being successful. These factors are discussed below.

Appropriate policy and regulatory environment

From the perspective of the private sector investor, partner, and/or concessionaire, it is critical that supportive policy and regulations are in place. Experience throughout Africa indicates that without this 'enabling' environment, investors will tend not to take on the risks associated with establishing an IREU *without* government support. Appropriate policy and regulations may, broadly, include:

Policy

- Genuine interest in rural energy poverty and socio-economic development and sustainability is evident;
    - An understanding of poverty broadly, and rural energy poverty more specifically, is evident;
    - There is prevailing interest in the provision of a sustainable level of energy security for low income households: productive energy use is supported and

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advanced, and assistance in improving efficiency of energy use is forthcoming;
    - Energy policy focus is on rural areas as well as urban contexts;
    - An interest in isolated/mini-grid systems is evident;
    - Energy sub-sector rural energy projects are subject to effective monitoring and evaluation.
- Significant emphasis is place on implementing meaningful renewable energy projects (including initiatives to facilitate adequate financing schemes to make renewable energy technologies more accessible);
- An openness to sub-sector integration is evident;
- Markets in energy technologies and services appropriate to rural contexts are being promoted;
- Policies attract investments while seeking also to achieve national objectives;
- Progressive thought and action, innovation and entrepreneurship is encouraged;
- Rural electrification and transformation programmes and activities are in place and showing progressive development;
- There is active encouragement of capable sponsors initiating/developing electrification projects, on a demand-driven basis;
- Government is seen to be lowering the financial threshold for involvement of private sector players and local communities in rural electrification and/or rural energisation/transformation projects, but also seeking to achieve sustainability;
    - Practical arrangements for private sector participation are in place, and are predictable and consistent;
    - Invitations to the private sector to participate in rural energy service delivery are regularly and consistently delivered, and structures are in place to process these invitations;
    - Incentives to attract private sector investment including, where appropriate, access to loans or concessionary terms, government guarantees, financial investments, and subsidies or grants for infrastructure investments are in place;
    - Subsidies and other support mechanisms should be simple to apply, and then applied fairly (to different customers and technologies).
    - Levies for rural electrification projects are in place;
    - Government is working with a range of financing institutions to establish sustainable financing mechanisms for energy programmes;
    - A long term goal of government is to enable the energy sub-sectors to perform without subsidies from government budgets;
    - Government understands the financial constraints it faces;
- Due consideration has been given to privatising aspects of the energy sector (for instance power sector generation and distribution) to attract capital to refurbish infrastructure, better manage system and improve operation efficiency. A preference for Public Private Partnerships (PPP) has emerged in place of outright privatisation;
- Open and competitive markets in the power and downstream petroleum industries have been achieved;

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- Transparent and dedicated structures are put in place to administer rural energy projects, to disburse funds, to buy down capital costs etc.
    - Initiatives are effectively co-ordinated;
- Energy sector administration and governance is supportive and capable of implementing energy policy framework;
- Government is open to training private sector and local community players in the development and operation of mini-grid and photovoltaic systems;
- Stakeholders are involved in new policy developments.

Regulation

- Energy regulation is independent; licenses are issued on a fair basis, tariffs are established on a fair basis and codes of conduct, performance and quality exist and are enforced;
- Light handed regulation to facilitate investment in rural electrification projects is considered/applied;
- Regulations ensure/protect financial viability of private investments (where appropriate);
- Regulatory framework is consistent and harmonised between sub-sectors (for instance power and petroleum) and with other sectors (existing economic, social, environmental policies);
- Electricity tariffs reflect cost of providing a service, and allowing private capital to make a return on investment;
- Liberalisation and competition is encouraged (monopolies are unbundled and private sector concessions in the generation and distribution sector are encouraged);
- Capacity in regulatory bodies/agencies to provide even-handed and predictable regulation is (being) built up;
- Power and petroleum sectors function under agreed and transparent set of rules;
- Regulators 'talk to each other'.

Private sector players/investors will expect policy and regulatory frameworks to be in place for some time to come, and that no significant shift in policy is planned.

Effective government buy-in

Even though an effective policy and regulatory framework may be in place, it is of little value if the current administration is not actively supportive of it. We argue here that present day government structures must be seen to be designing programmes for success, and not failure. These structures and personnel should be accountable, reliable, accessible and must provide private sector investors with confidence (so for instance, concessions should be granted for longer rather than shorter periods of time). These structures should be conducted in a professional and efficient way. And, they should be dynamic, able to respond constructively to progressive thought and innovation in the energy sub-sectors.

Government structures that exhibit (some of these) qualities are far more likely to attract private sector investment and involvement, and those that are not open to new approaches to rural transformation.

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Enthusiastic private sector partners

There are a variety of different ways in which private sector investors/players and local communities can interact with government to deliver rural energy services. We suggest that these institutional arrangements would be context and country specific (governments' needs, policy structures, and investor interests are likely to be different). A number of these options are briefly discussed in Appendix B, which provides a discussion of what governments may need to do to gear up for the establishment of IREUs in their respective countries.

In the same way that it is expected of government to conduct its energy sector involvements in a dynamic and streamlined way, so too should private sector involvement be enthusiastic. This requirement is particularly relevant to the type of personnel involved in the high-level management and operation of the IREU. We anticipate that it will not necessarily be a straight-forward task to establish a fully-fledged IREU in Africa (and this applies particularly to the development of the first IREUs in Africa). Therefore, the management structures thereof need to be able to respond well to changes in direction and needs. They need to be able to weather difficulties emanating from all directions, and also make the most of prevailing opportunities.

For illustrative purposes, examples of challenging instances IREU investors and managers might be faced with include the following:

- Dealing with rising non-payment issues;
- Negotiating 'tough' deals with government or with suppliers;
- Re-evaluating business decisions when the outcomes of the anticipated course of action does not work out;
- Creating interim arrangements to keep business alive until subsidy-related problems are worked out;
- Developing a business plan which seizes short term lucrative business opportunities without losing touch with core business requirements;

Dealing effectively with these types of instances – and of which there are countless more – might be the difference between the success or failure of the IREU.

Cost reflective energy pricing

We suggest that a new IREU that offers a range of fuels and services will have a greater chance of success when located in a context where grid electricity tariffs are cost reflective, and especially where renewable energy costs cannot easily be cross-subsidised by the large number of existing consumers.

For instance, LP Gas for cooking, heating and water heating may often be more cost effective than using grid energy. Charcoal is widely used even in grid-connected areas as electricity is too expensive. Multiple energy mix solutions exist and can be optimised. The IREU can assist in providing these solutions by extending supply chains to grid and off-grid areas, to the benefit of all consumers. This said, a huge challenge exists in rural Africa, where consumers currently use woodfuel and charcoal at prices that do not reflect the environmental damage caused. Transition to less damaging thermal fuels such as LPG cannot be supported on price alone.

In a strange twist, realistic energy pricing can actually open up markets even in grid supply areas. For example, in IREUs where grid electricity costs more than using LP Gas for thermal purposes, cash constrained IREU customers who used both SHS and LPG, but who have now

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migrated to grid power in place of SHS can actually end up with more money to spend on LPG after grid connection, to the benefits of both customer and the IREU.

Careful technology choices

From the perspectives of government, policymakers, regulators, project designers and private sector players/investors and particularly rural energy customers, it is important that technology choices are made carefully. Given experiences which we have reviewed, we suggest that an 'ideal' IREU would be technology neutral, with a core technology that is considered a long term energy solution. The IREU would then facilitate, promote and provide the least cost technologies, and would aim, importantly, to retain customers in any geographic area as they change their energy mix and migrate up the energy ladder towards modern energy services.

We suggest that a grid-based IREU will always have the long-term objective of providing customers with grid energy where possible. But, where grid expansions are not immediately feasible due to lower population densities or low electricity demand/supply, the IREU could promote more appropriate off-grid or SHS technologies for electricity, as well as the most appropriate and sustainable thermal fuels for those needs. This technology neutral approach would also enable on-the-ground resolution of the so called "grey area boundary" defining grid/off-grid areas. The IREU which offers a range of grid and off-grid energy/technology services acknowledges the level of multiple fuel use and fuel switching that characterises household energy use in the rural locations across the developing world. While the concept of the energy ladder captures peoples' aspirations with regard to improving access to household energy use, it often fails to capture the reality which sees households having to revert back or 'back switch' to less sophisticated energy sources in times of frequent hardship. The integrated service offer of the IREU is able to accommodate the varying and variable energy needs of poor rural households and businesses.

We suggest that, where possible, technologies are chosen through a transparent process in which all of the above stakeholders are, to some degree, involved. Indeed, the focus of the technology choice must rest, not simply on technologies *working* but people benefiting from their application. In most instances, this calls for a further focus on the position of the productive use of energy in energy service delivery, where the direct impacts on livelihood and revenue generation are targeted, beyond the provision of the services.

Clearly, adoption of this type of people centred, productive focus will require tremendous dynamism on the part of the IREU managers, project designers, and policymakers.

Anchor energy client participation

Contrary to a view that IREUs exclusively service rural households, it may in fact be that IREUs service commercial interests as well. Indeed, we suggest that an IREU would do well to be situated where it has access to a large anchor client (such as a retail businesses, factories, agricultural processing, hotels, government offices, mining, quarrying). While circumstances may not always permit the emergence of this kind of model, our analysis clearly demonstrates the added financial and operational stability and reliability that can be added to the IREU, particularly around its start-up phases. IREU risk (importantly in the area of rate of payment) is certainly minimised (unless of course the anchor client is in the public

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service and slow to settle payments). Furthermore, the utility may then be in a position to cross-subsidise (in terms of cashflow) less reliable customers in the household and other sub-sectors of the market. Securing an anchor energy client may also provide the necessary business confidence going forward where the IREU is able to leverage future market/product expansion initiatives off this reliable, low-risk income. And finally, the value add of and to the IREU in picking up more commercial, recreational and institutional customers is far greater with the emphasis being on productive rather than exclusively consumptive uses of energy.

Deep rural/energy store infrastructure

The concept of the "energy store", which is introduced in Box 1 above, and described in detail in a previous report in this series ("NuRa in-depth case study: Integrating further") has worked extremely well for the NuRa utility in South Africa. We suggest that this model be scrutinised when decisions around the operating structure of IREUs are being taken.

There are various operating models around which the energy store concept could develop, and clearly contextual factors are key determining elements here. The energy store, generally, would be situated in a deep rural area. It would be part of a family of energy stores, which would be managed and operated by the IREU whose headquarters could be similarly or differently situated. The energy store could take the form of a green-fields operation newly established by the IREU, or it could be an extension of an existing business such as a PV operators premise, a cell phone distributor, or even an established spaza-shop. NuRa's experience is that a mix of these types of arrangements is worthwhile. Costs are kept down, control is maintained, and rural outreach is achieved. The energy store could be owned and operated by IREU staff members, or could be outsourced in a local entrepreneur who would receive training from the IREU head office and then operate the business in partnership (or otherwise) with the IREU.

Energy store infrastructure is of key benefit to rural customers who tend to spend large amount of time and household budget in travelling to centres to purchase energy and other services. An energy store would be of interest to a rural energy customer if it offered a range of energy services and products, if the energy store promoted the least cost options to the customer, and particularly if the customer was given a reasonable option to swap over to other energy solutions when the technology became available or if the economics of the solution shifted.

Key factors to consider include:

- Type of terrain, accessibility to proposed energy store location;
- Cost of set up, economies of scale when establishing a network of energy stores;
- Level of community interest (in the general concept, in participating in energy store establishment etc.);
- Availability of key personnel to manage energy store operation;
- Type of products to be offered (ranging from PV systems, to advice on efficient use of energy, household wiring, retailing of energy units, operating a multi-functional platform)
- Proposed products on offer in relation to other retailers (for instance, appliances, fuels)

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Grid service offering

The IREU model considers the following workable options:

- An IREU might be effectively established where it does not offer grid electricity, but no other third party must be doing so in the same area (unless possibly the interaction between the IREU and the third party operator is collaborative and in no way competitive);
- An IREU might be effectively established where it offers a grid service in its area, in addition to other energy services. The IREU promotes the least cost energy option to its various clients. The IREU will retain its customers as they move from one energy carrier to another.

Our research indicates that an IREU with grid as a core offering is likely to have a better chance for longer-term sustainability than without this offering. In this regard, we note:

- Grid roll out and investment is usually one large step, from nothing to a substantial customer base (compared to other technologies slower growth). Thus, a viable business is set-up relatively quickly.
- Grid is usually highly subsidised, and thus income is, to a larger degree, "profit".
- Large electricity customers make it even more profitable
- A grid-based IREU provides a sound launching pad for other slower growth technologies (the scale of the grid concessions is usually already viable on its own, and thus taken more seriously)
- Grid is seen as an ultimate rather than intermediate energy solution. It is not generally superseded by other technologies or political choices. Thus the IREU would tend not to be displaced when technologies change.
- A grid based IREU would tend to make rational technology choice decisions based on viability rather than being regulated from a monopoly institution based elsewhere. This integrated approach to energy planning is particularly relevant in the "grey" areas (between grid viable investments, and off-grid concessions), as well as planning for eventual grid investment.

Diverse but manageable product base

Our analysis suggests that an integrated utility offering a range of products and services is likely to present a more reasonable investment prospect that an entity with fewer products and more limited market share. With more products and a greater market footprint, the greater number of product and service lines offer superior scope for business growth and development. It is in the interests of most parties that an IREU offer a diverse range of products and services. Governments would tend to be more supportive of utilities that reach a greater proportion of the rural market and which offers a broader range of energy and other services. This expanded service would include offerings to public service infrastructure such as schools, clinics and courts. Investors would clearly need to optimise market share and revenues. Customers would have a greater choice of energy services and products available.

All this said, the IREU must be cautious in the choice of products and services that it eventually offers. The IREU should include products and services that are synergistic. Wherever possible utility activities should increase revenues without significantly adding to the management and operational complexities of the utility. For instance, and of course,

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depending on circumstance, the combination of LPG and SHS or mini-grid seems obvious, because the staff handling the SHS can also sell LPG. And, to sell pre-paid cards for various services may also be appropriate. But, to maintain a SHS and a water network may be beyond the scope of the IREU.[48] It may also be appropriate for the IREU in start-up phases to conduct a market survey to assist in highlighting the most appropriate product and service synergies.

Service pre-payment

IREUs generally are not able to take on the risk associated with large incidence of service non-payment for regular services. Thus we suggest that where possible, IREU customers – large and small – pay for services and products prior to usage. This would apply to electricity sales, PV system rentals, MFP usage, appliance sales, and most other IREU services. Pre-payment for large capital outlays (such as the purchase of a PV system) may not necessarily apply. Perhaps in these instances a financial intermediary (such as a micro-lender) may be involved in the transaction, again to reduce the risk burden of the IREU. Prepayment options should apply irrespective of the operating model chosen by the IREU.

Subsidy characteristics

It is to be expected that in the case of rural energy service delivery, some form of government/grant funded subsidy will be required. This subsidy might be in the form of a reduction in the capital cost of PV systems, the concessioning of a distribution line or mini-grid where capital costs are the outlay of government and not the concessionaire, or assistance to customers with monthly energy costs (for example the free basic (alternative) electricity (energy), FBE/FBAE, in South Africa).

Level of subsidy requirements and prevailing government offerings will clearly be factored into the financial analysis of the potential IREU. Also of importance is an understanding on the part of the investor/IREU manager that subsidy flows are at best temporarily delayed and at worse unpredictable or unavailable/cancelled at the 11th hour. This uncertainty/risk must be factored into the feasibility of the IREU. And indeed, this is one of the reasons why a diversified product base is generally so important for the IREU: sales from unsubsidised products and services keep the utility afloat when there are 'problems' with subsidy negotiations/flows.

Finally, and ideally, projects should receive sufficient capital subsidy to remove the need to offer an operations and maintenance (O&M) subsidy. Dependency on O&M subsidisation is widely recognised as a "sure way" of making project unsustainable in the long term.

Effective community involvement

An IREU is only as successful as rural customers make it to be. For this reason it is critical that the IREU seek out community involvement, community buy-in and community trust in its operations. It is unlikely that the IREU will ever operate according to the principles of a true business: it will always offer services with a social orientation. Indeed, this has been one

[48] It may be more appropriate for instance for the IREU to establish a joint venture with a water sector company. Selling the energy for water, or selling water units may be the better role for the IREU.

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of the reasons why the NuRa utility in South Africa has continued to operate in the manner in which it has: it has sought at all times to protect the interests of its rural customers.

Indeed, effective energy service delivery to rural communities requires good communication between service providers and both residential and institutional consumers. There is significant scope for improvements in the way in which the IREU and its customers interact. Such include:

- Greater awareness and dissemination of energy fuel, appliance and energy efficiency information to customers;
- Keeping prices as low as is feasible for the utility to promote fuel transition;
- Understanding the nature of the rural energy context, people and needs and acting appropriately on this understanding;
- Joint ventures with community folk – i.e. in the joint or outsourced operation of a multifunctional platform;
- Offering employment, career enhancing opportunities;
- Highlighting customer needs to policymakers, project designers;
- Negotiating subsidies, negotiating lending packages for customers.

Energy services for productive use

In general, rural electrification in Africa is driven by energy for social services and for business and productive use. Some of the un-served consumers are large, including mines, tea and coffee factories, fish processing plants, rural hospitals amongst others. Smaller users include dense villages of retailers, shops, computer centres, electronic workshops, agricultural mills, milk chilling etc. It has been noted that the IREU must offer energy services for productive uses rather than solely for household consumptive purposes (as per South Africa's electrification initiative), and that the main point of doing this is to significantly improve rural folk's livelihoods by giving access to means of production. For the IREU, providing energy services for productive use is also important for the IREU's own purposes – doing so is likely to improve customers' ability to pay for the services, while also increasing the level of electricity and energy required. IREUs can provide energy for productive use to established or emerging businesses, to SMMEs in rural areas or to informal productive activities linked to rural households.

There are various ways in which the IREU could encourage a growing customer base linked to productive uses. These include:

- Demonstrations of productive use activities; such as SHS supporting cash-registers, LPG refrigeration, PV supporting light manufacturing, PV/wind supporting ICTs, so that the market understands and familiarizes itself with such opportunities
- Information in pamphlets and other media about the versatility of particular technologies in terms of end use applications
- Partner with NGO and other organisations offering business development assistance to micro/small businesses.
- Partner with Micro Finance Institutions which offer access to capital for aspirant/existing entrepreneurs
- Ensure whatever the business model (out-right sale, free for service, etc.) that the dissemination of technologies is accompanies by adequate after-sales services.

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- Ensure, where possible, productive use initiatives link with government policy with regard to the promotion and development of SMMEs
- Promote and develop SMMEs within IREU operational framework, including franchise stores, independent distributors, etc.
- Stress the opportunities both 'at the bottom of the pyramid' in terms of developing local economies as well as 'exporting' opportunities within the broader regional economy.

Key operational staff involvement

An IREU will require key skilled personnel. An IREU needs to be established in a location where these skills are available, and where they can be retained. This is generally seen to be a considerable challenge for the IREU, and needs to be afforded due consideration and attention. A way of retaining key utility personnel may be to offer shares/equity in the IREU business for performance and loyalty. Another option may be to locate the IREU in a fairly established centre (where skilled staff are more likely to live) and then to leverage off the energy store infrastructure (possibly requiring staff with different skills) for outreach purposes. A larger utility with a more complex service offer will, all things being equal, be in a better position to offer more competitive salary packages.

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Conclusions

While PPPs have evolved into important vehicles for mobilising private equity investments in public service delivery as well as playing an important role in professionalising the sector, significant challenges remain particularly in the context of improving energy service delivery in rural areas. The bulk of SSA's population reside in rural areas (70%+) and these areas are, in turn, the most difficult to service. Considering the current levels of electrification are around 10% of rural households (see Figure 3 below), household incomes are fairly erratic and/or seasonal, credit is unavailable or largely inaccessible, policy and regulatory frameworks are inadequate to address the challenges of rural energy service delivery.

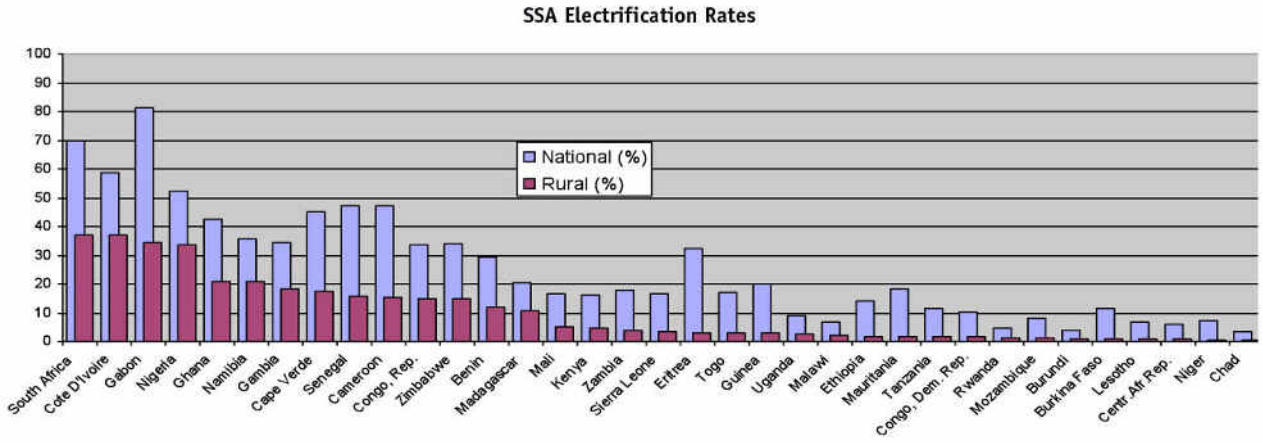

Figure 3: Urban and rural electrification rates in SSA[49]

Arguably one of the greatest challenges is the extension of thermal energy services into rural areas. There have been a number of successful solar PV initiatives in developing countries (IDCOL and SELCO in South Asia, NuRa in South Africa amongst many others) but very few have been able to provide thermal fuels as well, leaving most households still dependent on primary fuels – largely biomass – in fulfilling their thermal energy service requirements. There are many reasons for this several of which point to the challenges faced in providing rural energy services and, related, the kinds of policies required to make this opportunity more accessible to the private sector. For many years grid electricity was considered the panacea to the challenges of rural electrification (and indeed urban), being able to support thermal, lighting and communication services. However, the costs of extending the grid and the unit cost of electricity (increasingly cost reflective) itself have undermined this intended outcome. For a range of reasons including fuel cost, variable incomes, unstable supply environments, transport costs, etc. multiple fuel use practices are common in rural households. It appears that electrical services have been prioritised over thermal services largely because of their 'modernising capability' providing access to education, extending the productive hours of the day, providing information and entertainment, etc. Thermal services on the other hand present a far more utilitarian function in terms of cooking and heating. The effective extension of thermal services to rural communities would have to address a similar range of issues outlined in the IREU conceptualisation. In the section that follows the report looks more closely at a number of actual businesses cases where thermal fuels are being provided to rural communities.

[49] Public Private Partnerships in Rural Electrification Programmes in Africa. December 2010. Club-ER. p14.

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SSA experience with clean thermal energy service models

Below are four case studies of thermal energy service delivery models in Sub-Saharan Africa. All four case studies are LPG-based, an indication of the fuel's appropriateness and acceptance as thermal energy service carrier on the continent, especially vis-à-vis other thermal energy service options.

What these cases illustrate is that, while the private sector is involved in LPG provision on the continent, achieving scale and sustainability is much simpler and quicker when supported by government. This specifically also applies to the Public Private Partnership framework, where the goals of both public and private institutions in the sector are aligned. Where this is not the case, growth is slower, access rates are lower and overall sustainability is limited. What is also shown is that these goals do not have to be specifically energy access related to be appropriately stimulating; in the case of VidaGas in Mozambique, for example, public health goals requiring energy for the refrigeration of vaccines has led to the establishment of a relatively large and successful LPG service provider in some of the country's remotest areas. Energy access goals also do not necessarily have to relate to thermal energy provision, as illustrated by the case of the Nuon-Raps (NuRa) off-grid utility in rural South Africa. The company was established as a public private partnership providing subsidised solar home systems to off-grid households in the country's rural Kwazulu-Natal province. NuRa has used the infrastructure (energy stores, vehicles, personnel) and wide community footprint to also introduce LPG as a thermal energy offer to customers, growing this part of the business into a core part of the company.

We can therefore extract the following lessons from these case studies for sustainable thermal energy service provision:

- Public sector support, while not necessarily essential to the establishment and growth of thermal energy service provision, can and does play a very important role in ensuring increased access and sustainability. Without this kind of support, thermal energy service provision growth will remain slow, limited and constrained by various factors.
- The public sector's support does not have to be clearly articulated as support for a specific fuel or energy carrier. Instead, it should be seen how various public programs, goals and initiatives can be leveraged to increase access to thermal energy services.
- "External" support for these companies (e.g. foreign shareholding) also seems to play an important role in providing access to important resources (whether financial, technical or otherwise).

More details on these case studies can be found in the following section.

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BUSINESS MODEL CASE STUDIES – Thermal Energy Access

The Nuon-Raps Off-grid Utility: South Africa

Case name & location:	Nuon-RAPS Utility - KwaZulu-Natal, South Africa
Energy Access Type:	Electrical (Solar) and Thermal (LPG)
Value offer:	Electricity, lighting, space heating, cooking
Organization type:	Public-private partnership
Status of organization:	Established organisation – running since 2000
Scale of businesses:	<Size of business operations/year in US$>
Major partners:	Nuon (Dutch Utility), Total gas

Executive summary

- NuRa provides heavily subsidised solar home systems to rural, off-grid customers on a fee-for-service basis, as well as LPG for thermal applications.
- The majority of households in the NuRa concession area use wood or kerosene for cooking. Rising energy costs, deforestation, health issues as well as aspirational desires has lead to the need for cleaner cooking fuels. NuRa has substantial presence and infrastructure in the region due to its solar home systems operation; it is leveraging this infrastructure to provide LPG to customers in the area, in essence covering the “last mile”.
- LPG is produced mostly from the refinery of imported crude (although it is often imported as a by-product on its own as well). Some of it also extracted from locally available coal and natural gas. The supply infrastructure in South Africa is well-established in the urban and peri-urban areas, thinning out as it ventures into the rural areas due to less demand. There are 5 major LPG wholesale distributors in South

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Africa -Shell, Afrox, BP, Total and the Black Empowerment Enterprises (BEE) group of companies. The distribution model is market-based with private entities running the chain. Mini-plants in the supply chain represent small dealers within urban and peri-urban areas. NuRa falls within the "mini-plant" category, selling LPG cylinders and refilling them as well.

- NuRa provides solar home systems to about 10 000 off-grid, low-income households, improving health, financial and especially educational outcomes. Through the provision of LPG, NuRa is also reducing the impact of indoor air pollution caused by open fire cooking.

Key performance indicators						
Capacity	80 tons per month					
Capital investments:	None (investment carried by Total Gas)					
Labor requirements:	93 fulltime staff members					
Operation and Maintenance:	Salary of 1 LPG attendant per energy store					
Output:	1150 – 1900 kgs of LPG sold/day					
Potential social and/or enviornmental impact:	93 fulltime jobs, decreased deforestation.					
Viability indicators	Payback period:		Post-tax IRR:		Gross margin:	

National Context and background

South Africa has the highest electrification rate in Sub-Saharan Africa at 87% currently (30% in 1994) – the result of an "aggressive" and politically-backed electrification program, first headed up by the national utility, Eskom, until 2000, after which it was taken over by the Department of Energy (Integrated National Electrification Programme). Currently about 3,4 million households still remain without electricity access – the majority of these concentrated in rural areas. The provinces with the biggest rural populations – Eastern Cape, KwaZulu-Natal, Limpopo – are consequently also the provinces with the biggest electrification backlogs. There are however no large urban centres that still need to be connected to the national grid; the same is also true for industrial sites. Rural electrification in South Africa therefore remains largely a household level issue.

Table 1: Summary Statistics

Summary Statistics	
Electrification Rate	87%
Rural	55%
Provinces/Regions with lowest electrification rates	
Eastern Cape	60%
KwaZulu-Natal	66%
Limpopo	74%
Non-Connected Urban Centres	0
Non-Grid Systems (Solar Home Systems)	46 000 households
% of rural households with Renewable Energy (e.g SHS)	1%
Projected Installations (Non-Grid) achieve universal access	250 000 – 300 000 households
Grid Extension Objectives/ Projections	92%: 2014; 100%: 2025

South African energy policy in general, and also (rural) electrification in particular, is by and large grid-focused. Universal electrification has been set as a government priority since 2000, and although the date for achieving this objective has been moved out a number of times (latest: 2025), it remains *the* target for electrification planning.

The solar PV concession program, which provides rural households with subsidised solar home systems on a fee-for-service basis, is probably South Africa's most "successful" attempt at using renewable energy for rural

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electrification – and even here, there are several fundamental problems. More than 10 years after the program was launched, it is nowhere close to reaching the initial target of 300 000 households (currently: 46 000). While the concession program will be discussed in more detail below (section 1.4), it is important to note that it appears to remain a definite part of South Africa's electrification future. The South African National Electrification Road Map, which is currently being developed by the Department of Energy (INEP), assisted by IFC consultants, potentially sees between 250 000 and 300 000 of the remaining 3 million unelectrified households being provided with Solar Home Systems. The Road Map includes develop of electrification master plans for each province, to identify clear off-grid areas using a least-cost approach, to ensure greater coordination between the different stakeholders and hopefully minimize grid encroachment problems in the future.

Actor	Function(s)
PUBLIC SECTOR	
Integrated National Electrification Programme (DoE)	Plans, funds and coordinates (grid & off-grid) electrification.
Eskom	Responsible for almost all electricity generation, transmission and, to a lesser degree, distribution. Rolls out grid connections with INEP funding.
Municipalities	Responsible for some distribution, and limited generation. Also rolls out grid connections with INEP funding.
National Energy Regulator of South Africa (NERSA)	Regulates South African energy industry, including (grid & off-grid) electricity.
PRIVATE SECTOR	
Concession Companies (Off-grid utilities)	Provide solar home systems on a fee-for-service basis to unelectrified households in concession areas
Nuon-RAPS Utility (NuRa)	Northern KwaZulu-Natal
KwaZulu Energy Services (KES)	Southern KwaZulu-Natal & North-Eastern Eastern Cape
SolarVision	Limpopo
LPG wholesale distributors	Shell, BP, Afrox, Total, BEE group of companies.
INTERNATIONAL DONOR COMMUNITY	
Development Banks (e.g. KfW)	Funding (baseline, capital costs, monitoring etc) of concession area roll-out through earmarked budget support.
Donors (e.g. NORAD, IFC)	Capacity building in government – Planning department, Municipalities etc.

Organizational Context

The off-grid electrification programme was conceived many years back, and a historical perspective may be useful:

- In October 1998 a joint venture between Eskom and Shell Renewables South Africa (trading as Eskom Shell Solar Home Systems, ESSHS) announced that it would undertake to provide 50 000 households with solar home systems over a period of five years. The customer base of 50 000 installations was based on an assessment of commercial viability of the project. The project was launched by the then President Nelson Mandela in March 1999 in the Flagstaff district in the Eastern Cape. It is of interest to note that this project was initiated without any subsidies in place.
- In late 1998 the DME launched a utility based programme in a limited number of rural areas. The call for proposals posted in 1998 invited private sector proposals for the non-grid electrification programme. (28 proposals in total were received, 11 were short-listed.) A selection team of the

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National Electrification Co-ordinating Committee (NECC) adjudicated the proposals, and 6 companies were recommended to the DME in July 1999.

Since the operational framework for these was not in place, the NECC recommended that the licensed distributors enter into agreements with the selected non-grid service providers (NGSP) as part of the overall electrification programme to ensure sound planning and avoidance of conflict of interest, in accordance with the constitution and the then draft Municipality Systems Act. The NER would play a regulatory role in accordance with the Electricity Act.

Eskom, as the distributor in the targeted areas, was not keen to be involved in this programme, as it did not consider this part of its core business. It was only willing to be involved on an agency basis subject to the signing of an appropriate agreement with government. Their involvement in the Eskom/Shell joint venture was mainly for experimental purposes. The ensuing negotiations between the DME and Eskom in brokering this agreement were a long and tedious process. The DME signed an Agency Agreement with Eskom in September/October 2001. Eskom accepted the Agreement in principle subject to an assessment of the risk to them.

In the meantime the NER developed a draft regulatory framework[50] for the inclusion of non-grid technologies and also made preparations for the amendment of distribution licences to make provision for the Eskom (as a government Agency)/NGSP Agreements to encompass the non-grid electrification programme.

In January 2001 the SPs were requested to submit business plans and a financial analysis of their businesses based on their proposals. These business plans were analysed by Deloitte & Touche to establish their commercial viability and to recommend the level of subsidy and the monthly fee-for-service to be charged to the customers. Eskom signed a Memorandum of Understanding (MOU) with the selected SPs on 12 March 2001 where the areas allocated (referred to as Concession Areas) per SP were detailed.

Of the six companies, only the following became active: Electricité de France & Total Fina Elf Group (KwaZulu Energy Services, KES); Nuon RAPS Utility (Pty) Ltd; and Solar Vision (Pty) Ltd. (two merged, one withdrew from the programme and the other REA never became active). Each company was awarded a concession area, with the understanding that the company would have exclusive access to the subsidies provided through the off-grid program in that area.

- **NuRa:** DC23 and DC28 in Northern KwaZulu Natal.
- **Solar Vision:** DC34, DC34 and CBDC3 in the Limpopo Province.
- **KES:** DC23, DC24, DC26 and DC28 in central KwaZulu Natal.
- **ESSHS:** DC 15 and DC 44 in the Eastern Cape, DC31 and DC 43 in South KwaZulu Natal.
- **REA:** DC12 in KwaZulu Natal and DC15 in the Eastern Cape.

Due to the politically contentious nature of the programme mentioned previously, but largely as a result of comparison between grid versus off-grid service offering and customer costs, and also connections per annum made, the programme was evaluated in 2003/4[51], resulting in considerable programme uncertainty and delays.

In 2004, the Eskom/Shell joint venture was dissolved and three smaller local companies were established to continue the operation of the concession: Summer Sun Trading (Pty) Ltd; Shine The Way; ILITHA Cooperative.

In 2007 a further concession was finally awarded via an open tender process to KES (EC) for DC13 and DC14 in the Eastern Cape Province, with grant funding from KfW on behalf of the German Federal Government. The KfW concession's original target was to have installed SHSs for more than 29 000 customers by the end of 2013. However, to date only slightly more than 7 000 customers have received solar home systems – largely due to grid encroachment, which has effectively 'killed off' a large part of the solar home system market in the pre-approved concession areas. Poor coordination between INEP, Eskom and local municipalities has meant that KES now has to wait for the development of the South African National Electrification Road Map and the

[50] NER, Regulatory Framework for Non-grid Electrification in the RSA, Draft 3, November 2000.
[51] Africon Engineering Report for DME (2004): Review of the prevailing framework for the implementation of PV investment projects in South Africa

consequent re-allocation of concession areas. It also means that it is extremely unlikely that KES will be able to reach the 29 000 household target by the end of the project (end 2013).

The role of and stakeholder agreements between DoE, Eskom and the municipalities continues, as it has been from the start, a complicated and unclear relationship, adding considerable uncertainty and tension to the programme. It has been identified as a constraint and priority area for resolution.

The companies provide households with a standard Solar Home System (SHS), consisting of a 50 Wp solar PV panel, a charge controller, wiring and outlets for small (DC) appliances, a battery (105 Amp-hour) and 4 energy-efficient CFLs. (KES EC provides a 65Wp panel and only 3 lights). The systems are based on national standard NRS 052 that defines the quality standard and provides room for own choice and innovation. The systems are provided on a fee-for-service basis: essentially a monthly rental fee covering annual maintenance and battery replacements when necessary; while the concession company remains the owner of the system.

In terms of cost recovery, the Concession companies deliver systems under a regulated tariff determined by DoE. They are paid 80% of the SHS's capital costs from a DoE subsidy, a connection fee from the customer, and the balance is recovered through a monthly fee from customers. In most municipalities the monthly fee is also subsidized by local municipalities concessional funding through the Free Basic Electricity (FBE) grant, although this is not applied consistently. Concession companies establish payment/service offices throughout their concession areas – many of which also retail thermal fuels (e.g. LPG). The figure below provides a visual summary of the business/operational model employed by the concession.

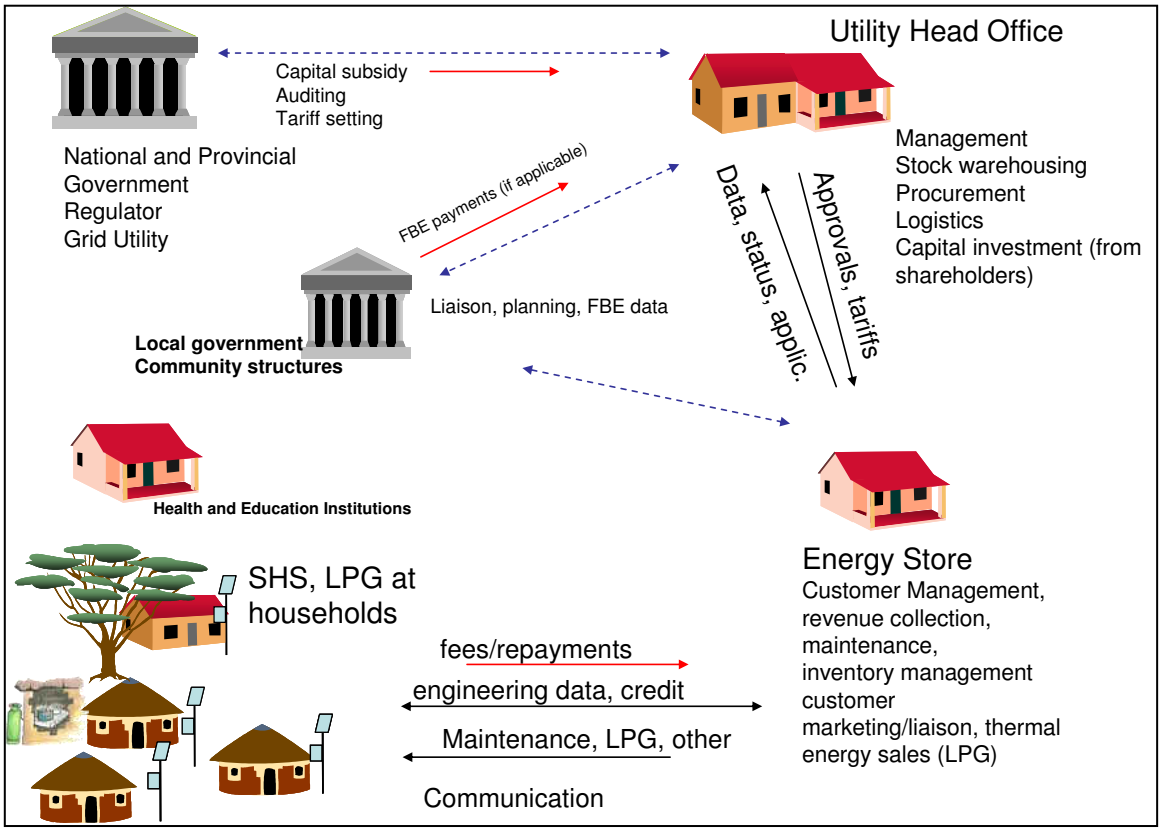

Figure 2: Off-grid fee-for-service utility infrastructure

The off-grid program had an original target of 300 000 customers. At the moment, there are a little more than 46 000 SHS customers in South Africa[52]. Apart from the *ad hoc* payment of the FBE subsidy, the challenges inherent in servicing the poorest of the poor and the difficulties of operating in deep rural areas with poor infrastructure, the concessions have also had to battle non-payment, the illegal use of inverters by customers (severely shortening the lifespan of batteries), stop-start subsidy funding by government and grid

[52] INEP: http://www.energy.gov.za/files/media/presentations/2011/20111206_WolseyBarnard_RE_electrificationPresentationv2.pdf

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encroachment. According to the Policy Guidelines on Non-Grid Electrification, non-grid electrification is provided via solar home systems in areas where grid electrification does not justify capital expenditure; the reality is however far different, with the Department having for example spent up to R25 000 on electrifying a remote household. This lack of consistent application of the off-grid electrification criteria is creating an unpredictable, untenable situation for the concession companies[53].

The policies regulating the off-grid program is also very restrictive and outdated – not having kept track with technological advancements, changing customer preferences and political realities. Because of this, the service provided by the SHSs are regarded as inferior to grid electricity, and the SHS program is therefore seen as lacking political support – both at national and local (municipal) level.

Work is under way to increase the effectiveness of electrification planning and coordination (and therefore limit grid encroachment) via the South African National Electrification Road Map; this should have been released in November 2012, but is being delayed by master plan development at provincial level. The standard SHS service offering has also been revisited to provide an improved level of service from the system. The original system design from 1999 allowed for a 3-4 CFL lights, radio, and black and white TV for 2-3 hours a day. At the time of the project design, the users had a choice between this SHS solution or nothing at all. In time, as the grid and off-grid areas have come to co-exist in closer proximity to each other, the comparison between grid and off-grid service offering has become inevitable. This has made support of the off-grid programme difficult for local politicians too. Surveys and feedback suggest that the original 50Wp system design, while providing a much inferior service to grid electricity, also has not kept up with the times, and cannot power modern appliances now found in most rural houses, which includes colour TV, cell-phones and smart phones. Plans are therefore afoot to expand the service offering to include these, as well as more lights, longer operational hours, into a larger system design. This also includes the possibility for the concession service provider to include a DC television in the package, which should discourage the use of inverters on the system and thereby extend the battery life.

The NuRa business partnership was formed prior to the presentation of proposals Government in 1998. By this stage Raps Utility had partnered up with Nuon (a Dutch utility) who was also shortlisted by the DME as a possible off-grid service provider. Initially, the Nura utility business was a partnership between Nuon through its wholly owned subsidiary Nuon Corporate Sustainability Centre, and Rural Areas Power Solutions (RAPS PTY LTD), through its wholly owned subsidiary Service Provider KZN PTY Ltd. During government's allocation of concession areas in 1999, NuRa was initially awarded the southern Limpopo province area. Investigative work into electrification planning in that area yielded extensive Eskom electrification plans, and with the unrelated withdrawal of the BP Consortium from northern KZN, the NuRa consortium was awarded this northern KZN concession, which covers District Councils 25, 26.27 and 28. It is the northernmost section of KwaZulu Natal and is bordered by Swaziland, Mozambique, and the Indian Ocean (shown below).

[53] Department of Energy, 2009. *Policy guideline on non-grid electrification*.

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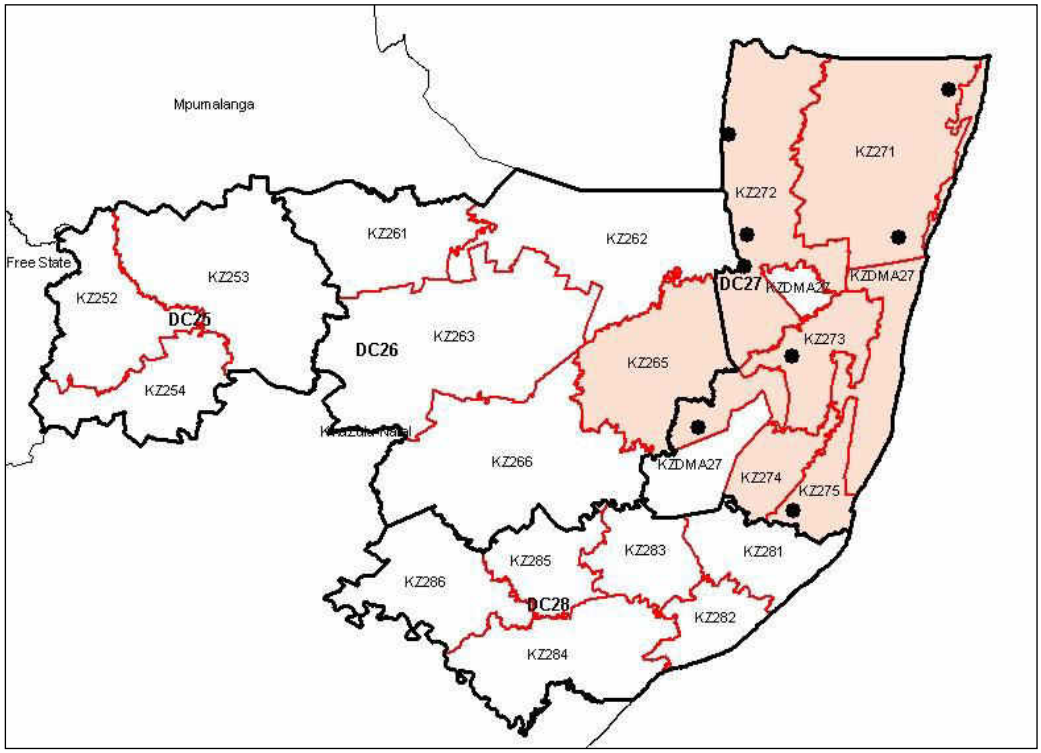

Figure 1: NuRa concession area in Northern KwaZulu Natal, including current area of operation

That government has not been able to commit fully to a long-term off-grid electrification programme has been one of the core reasons why NuRa diversified into LPG sales and other products/services.[54] This diversification process started in late 2002/early 2003, and by and large has been a very successful move for the utility – it could even be argued that sale of LPG has been one of the primary reasons for NuRa staying afloat. Government's indecision around the subsidy has had various other spin-off effects for the utility, including that, for years, its top management has been able to do little else but fight fires largely related to the SHS subsidy. It has not, until now, been unable to consider other important initiatives including product diversification.

The operational set up related to the SHS programme has also been intensive, and made significantly more challenging by the deep rural nature of its concession area.

Business opportunity

Market needs

- LPG use in NuRa's operational area is driven by cooking activities at household level. NuRa is situated in an area with a very large off-grid population and, while NuRa's solar home system offer provides electricity for lighting and communications/entertainment, customers (as well as non-SHS customers) still need a clean, modern energy source for thermal applications.

Opportunity

[54] There were initially long delays in getting up and running, then after a two year period, a planned review started late, and it took 18 months before a second phase of installations was started (following a very similar formula to the first phase, and thus implying that the review results were relatively positive). This second phase stopped in February 2006, and despite significant negotiations, during which officials indicated that the programme would enter a third phase, the installation programme has still not been restarted. Concessionaires, with established infrastructure, responsibilities and systems remain in the field, maintaining their existing base, but for the present unable to expand the programme.

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- NuRa is able to satisfy thermal, lighting, communications and "limited" entertainment energy needs through its service offering in its operational area.

Energy Services Provided

- NuRa provides small quantities of solar electricity on a fee-for-service basis, but sells LPG as a product.

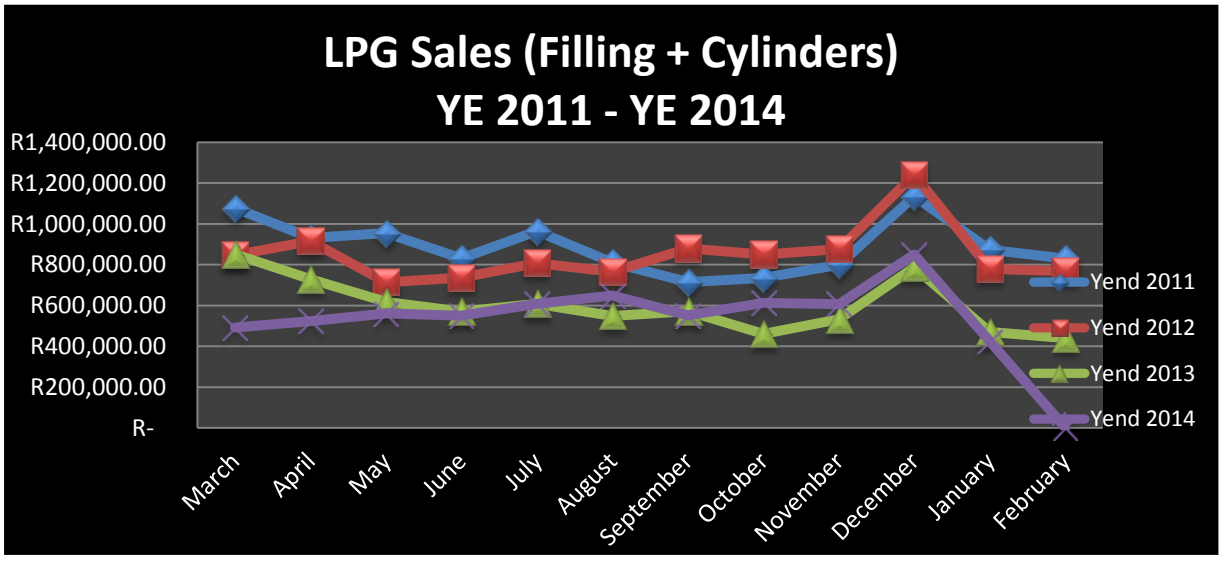
Market penetration and competition

Assuming that 40% of unelectrified households in NuRa's operational area use LPG, this results in a market of approximately 35 000 households. We would estimate that each household would consume on average 4kgs of LPG every month. Looking at commercial operations, we have estimated that there are in the region of 500 commercial entities ranging from spaza shops to game lodges that use LPG within NuRa's operational area. These we estimate consume approximately 20 kgs of LPG per month. The table below summarises these theoretical market demands.

Table 5: Estimated LPG market in NuRa operational area

Sector	Tons/month
Residential demand	140
Commercial demand	10
Total demand	150
NuRa's current sales	60
NuRa' s market share	40%

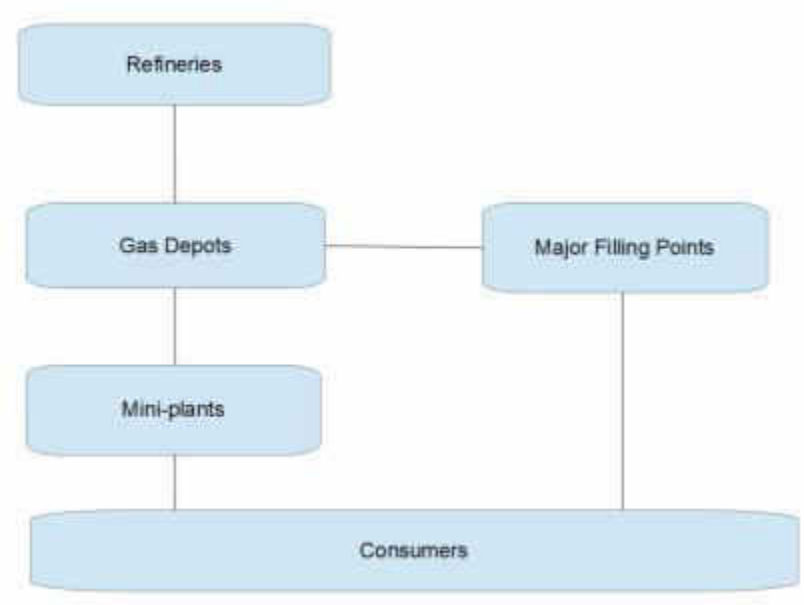
NuRa's sales of LPG have declined quite sharply since 2011, with company selling about 25% less LPG per month compared to 2 years ago. It is not clear what might be driving this decline, although LPG prices have increased considerably over the same period.



Value chain and position

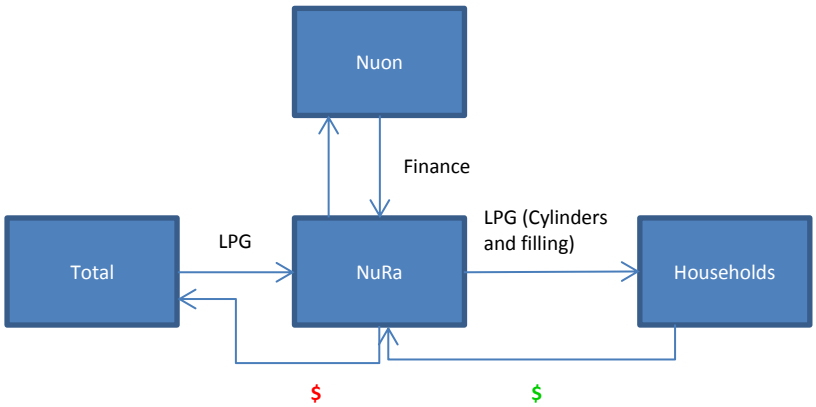
LPG is produced mostly from the refinery of imported crude (although it is often imported as a by-product on its own as well). Some of it also extracted from locally available coal and natural gas. The supply infrastructure in South Africa is well-established in the urban and peri-urban areas, thinning out as it ventures into the rural areas due to less demand. There is also the issue of strong safety regulations for the distribution and refilling

of LPG cylinders as well as safe and efficient gas heating appliances. This necessitates huge capital outlay, thus restricting the extent of the top-level end of the distribution chain. There are 5 major LPG wholesale distributors in South Africa -Shell, Afrox, BP, Total and the Black Empowerment Enterprises (BEE) group of companies. The distribution model is market-based with private entities running the chain (World Bank 2011). The mini-plants in the supply chain represent small dealers within urban and peri-urban areas. The schematic below shows the breakdown of the supply chain. NuRa falls within the "mini-plant" category, selling LPG cylinders and refilling them as well.



- **Figure 5: LPG distribution chain**

NuRa has a sole supplier relationship with TotalGas in its operational area.



Business Model

NuRa has a sole supplier relationship with Total Gas, which supplies all of NuRa's LPG needs directly to the energy stores. Each store offers cylinder filling (electric pumps) and exchange services by dedicated LPG staff. Total Gas has provided all the materials for the gas cages and trained staff in the correct gas handling procedures and gas safety issues. The inventories are managed from NuRa's head office in Richard's Bay where

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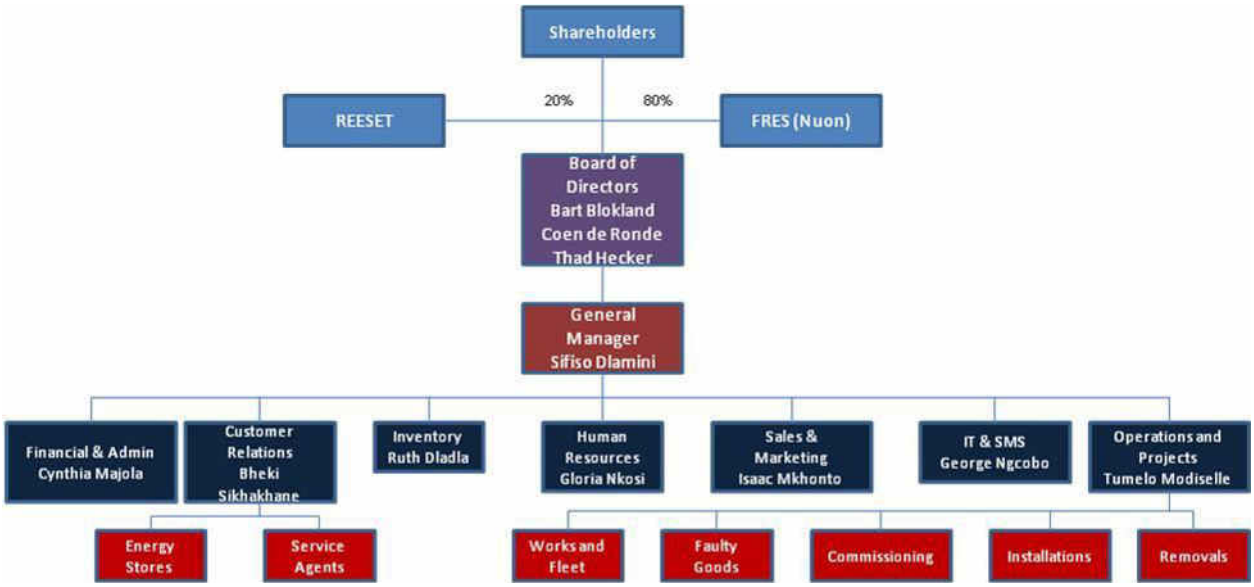
the inventory manager monitors stock levels at the stores and places orders when necessary. NuRa retails about 60 tons of LPG each month.

The energy stores are central to the operating model, providing the main interface with NuRa's customers. The energy stores and its personnel are responsible for revenue collection, for customer relationship development, local marketing, and for maintenance of the solar home systems. The energy stores are also responsible for the local management of the retail side of the business, which sells goods such as paraffin, LPG and LPG appliances to respond to thermal energy needs of households. Each store serves between 2 000 and 6 000 households, of which on average 2 000 customers are generally SHS customers.

Each energy store has a manager, one to three 'point of sale' operators, and several technicians. They also have staff who assist with LPG bottle filling and loading of gas bottles. The 'point of sale' operators deal with fee-for-service payments, customer complaints, data management and customer education, sales of other products such as LPG. Technicians are typically in the field carrying out maintenance and customer education. Light delivery vehicles are used, though the majority of technicians use motorbikes.



LPG is sold at NuRa's 9 Energy Stores. Each store is equipped with an LPG refilling station, and does not only refill cylinders but also sells cylinders – specifically the special 5kg shisha cylinder, provided by Total specially for the rural market. NuRa faces serious issues in the solar home system sector with regards to non-payment as well as theft. About 50% of NuRa's customers are 30 days or more behind in their monthly SHS payments. Theft of panels, batteries or other components also occur, although not as frequently. NuRa has contracts with its customers, which state that SHSs will be removed after 3 months' repayment. However, in practice the costs associated with this are prohibitive, leading to a situation where a great deal of systems are sitting in households that are not paying NuRa has attempted to alleviate this situation in a number of ways, including offering amnesty to non-payers. With regards to LPG, non-payment and theft has not really been a significant problem: all LPG is sold based on upfront payment, and customers pay a significant deposit for the LPG cylinders.

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Nuon Total Gas	Installation of Solar Home Systems Collection of monthly fees	*NuRa offers extensive rural infrastructure, necessitated by its (highly subsidized) solar*	*Customers are provided with solar electricity on a fee for service basis.*	*The majority of NuRa customers*

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<table>
<tr><td rowspan="2"></td><td>LPG retailing (cylinders and refilling)
SHS maintenance</td><td rowspan="2">activities. This enables the company to retail LPG at a relatively lower cost than other rural entities. NuRa also has a substantial number of customers that visit the company's stores on a monthly basis to pay their fees for the solar service – which gives NuRa access to a ready, captive market.</td><td>NuRa therefore interacts with customers on a monthly basis. LPG sales happen at NuRa Energy Stores</td><td rowspan="2">are low-income rural households. While there are a number of larger consumers, specifically retail-based, this is still a very limited segment of the market.</td></tr>
<tr><td>Key Resources

9 Energy stores, with safe storage facilities for LPG

Off-road delivery vehicles, including motorbikes.

Staff of about 70 people</td><td>Channels

NuRa makes use of its existing customer base as well as strategic positioning in terms of accessibility to sell LPG into the rural household market.</td></tr>
<tr><td colspan="3">Cost Structure

Salaries – about 70 staff members
Vehicles – large distances covered on poor roads
Rent and maintenance of 9 energy stores</td><td colspan="2">Revenue Streams

Solar Home Systems – 80% capital subsidy from national government, monthly service fee from customers (some of which is subsidized by local government).
LPG cylinders and filling sales</td></tr>
<tr><td colspan="3">Social & environmental costs</td><td colspan="2">Social & environmental benefits

Decreased deforestation rates

Increased health due to decreased indoor air pollution</td></tr>
</table>

Technology & Processes

- NuRa retails LPG in various cylinder sizes.

Financing

- Key capital costs of the business relate primarily to the solar home system operations, and refer specifically to the setup costs for the energy stores, the vehicles used for installations and maintenance as well as the stock/inventory used for SHS installations. The cages, pumps, cylinders and tanks used for LPG retailing is all provided by Total Gas.
- NuRa's main operational costs relating to the LPG side of the business is the training and salaries of the LPG attendants at each store.
- NuRa's main investor is the Nuon utility.

Financial Projections

- Sales from LPG account for about 20% - 25% of the company's revenue.

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Scalability and replicability considerations

- NuRa faces numerous difficulties: the unreliable, stop-start nature of government subsidies, grid encroachment by Eskom, non-payment by customers, escalating operational and capital costs. The introduction of LPG to NuRa's operations was largely a reaction to these factors, providing the company with a relatively steady income stream. However, LPG sales are declining, largely due to new market entrants as well as rising LPG costs.
- NuRa's scalability and replication opportunities seem to be somewhat limited by its immediate and slightly peculiar context, especially in light of its dependency on government subsidies. However, it does show that state-supported energy access initiatives can have an even greater energy access impact than originally envisioned, through e.g. the introduction of alternative or complimentary products and services.

Socio-economic, Health & Environmental Impact

- NuRa employs 93 full-time staff members, 36% of who are female.
- Switching from wood to LPG for cooking also has significant implications for women's empowerment, especially given the fact that women are primarily tasked with collecting firewood, as well as cooking. Changing to LPG therefore not only increases women's health, but also frees up a great deal of time that they had originally spent collecting wood and preparing meals.
- Using LPG for cooking purposes significantly decreases the Indoor air pollution associated with biomass or kerosene cooking. The cooking fuel also reduces the amount of wood used for cooking (in some cases replacing it completely)

Conclusions

- NuRa has always been faced with a difficult business and operating environment – providing energy services to the base of the pyramid widely dispersed across deep rural areas. Reaching and servicing its customer base comes at a high cost, and when those customers fail to pay their monthly fees (arguably a tall order for impoverished households), it impacts even further on the company's bottom line. In addition, NuRa cannot rely on government subsidies to carry it through, as the original capital subsidies 50 000 customers envisaged at NuRa's inception more than 10 years ago is still nowhere to be seen. This was further aggravated by the uncoordinated nature of electrification in rural South Africa, with major areas of NuRa's concession effectively being eroded by grid extension. However, through all of this NuRa's thermal energy business – selling LPG – has proven to be a relative success, playing an important part in keeping the company going, despite these difficulties.
- NuRa remains very dependent on government policy and political will around the solar home system program – which does not really bode well for its future prospects given the company's experience with government thus far. Unfortunately, LPG sales have also been decreasing significantly, eating away at a once key part of the business.
- NuRa illustrates the viability of thermal energy fuels to carry the introduction of alternative and/or complimentary energy products and services in difficult areas. It also shows one model of how government support can be used to catalyse/stimulate a market for energy services in a specific area.

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Links/References

http://www.nura-energy.co.za

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VidaGas: Mozambique

Case name & location:	VidaGas, Mozambique
Energy Access Type:	Thermal
Value offer:	Cooking, refrigeration, lighting, space heating (LPG)
Organization type:	Private
Status of organization:	Established in 2002
Scale of businesses:	<Size of business operations/year in US$>
Major partners:	Founders and Shareholders: FDC, Village Reach; Funders: Oasis Fund, Luxemburg

Executive summary

- VidaGas sells LPG to rural and peri-urban households, as well as health centers and commercial ventures in Mozambique's Northern region.
- VidaGas was originally started to address the problem of refrigeration in rural health centres throughout Northern Mozambique. The company has since grown and now provides LPG to households (through retailers), businesses, commercial ventures (tourism etc.) as well as the public sector. The company has considerable infrastructure in these rural areas sells LPG in 5,5 kg, 11kg and 45kg cylinders. It also sells 5,5kg cylinders fitted with cooker tops, as well as various LPG accessories (including fridges, lights, cookers etc.)

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- LPG is produced in South Africa, exported to Mozambique and then bought by marketing and distribution companies like VidaGas. VIdaGas has three 23-ton filling plants in Pemba, Nampula and Zambezia. The gas is refilled into 5,5 kg, 11kg and 45 kg cylinders and distributed to retailers, enterprises and public sector customers.
- The company's activities have led to a 27% increase in vaccinations in its operating areas. Inceased use of LPG also displaces/reduces charcoal use, which in turn decreases exposure to indoor air pollution and deforestation.

Key performance indicators						
Capacity	Three 23-ton filling tanks (69 tons)					
Capital investments:	In USD					
Labor requirements:	19 full-time staff employed					
Operation and Maintenance:	In USD <It could be also presented as $ per household or $ per kwh>					
Output:	1400 kgs of LPG sold/day					
Potential social and/or enviornmental impact:	19 local staff currently employed, improved health outcomes due to vaccination refrigeration, reduced indoor air pollution. Reduced deforestation rates.					
Viability indicators	Payback period:		Post-tax IRR:		Gross margin:	

National Context and background

As of 2011, about 18% of Mozambican households have access to electricity, with most of the grid infrastructure concentrated in and around Maputo and the major provincial capitals. Access to grid electicity in rural areas is extremely low (below 10%), with at least 80% of the country's 25 million people cooking with biomass (wood, charcoal, dung or crop residues). Mozambique also has no fuel refining capacity, relying on South Africa to refine and supply petroleum and gas products. Infrastructure in the country is severely limited, especially in the Northern parts of the country.

The major roleplayers in the country's energy sector are:

- The Ministry of Energy (ME) is responsible for energy planning and policy formation, as well as overseeing the development of the energy sector. It is composed of three main sectors (Power Sector, Renewables and Liquid Fuels) as well as a central services management group.
- The Conselho Nacional de Electricidade (CNELEC) is an independent advisory regulatory body for the electricity sector established in 2008. The main priority of CNELEC is to improve the government owned electricity utility, Electricidade de Mocambique (EdM).
- EdM is responsible for the transmission, distribution and promotion of electrical energy in Mozambique.
- The Fundo Nacional de Energia (FUNAE) was established in 1997 as a public institution to promote rural electrification and rural access to modern energy services, in a sustainable manner, and as a contributor to economic and social development in the country. FUNAE has implemented various energy projects using renewable energy resources in rural areas.
- Importadora Mocambicana de Petroleos (IMOPETRO) is a cooperative company that coordinates the delivery of LPG from South Africa.

Mozambique's energy sector is governed by a number of energy policies and regulations. The national Energy Policy focuses largely on increasing the exploitation of indigenous resources for increased local generation and energy use. Almost half of the country's electricity is produced from hydro sources – most of it exported to the Southern African Power Pool. The country has quite a solid Renewable Energy Strategy which focuses on both grid-connected as well as off-grid renewable energy development. The Rural Development Strategy (EDR) is

specifically aimed at developing rural areas in order to promote socio-economic development – also including increased energy access. What is however missing are regulations and standards governing the LPG sector.

Organizational Context

VidaGas was established as a private company in 2002 by VillageReach, a US-based health NGO active in Northern Mozambique. Its establishment and operations was supported by the local organisation Fundacao para o Desenvolvimento da Comunidade (FDC). The company's establishment was in reaction to the need for improved vaccination facilities in Northern Mozambique. While its main customer was the department of Health, the company has now grown considerably to a point where its supply to health centers makes up about 10% of its total sales.

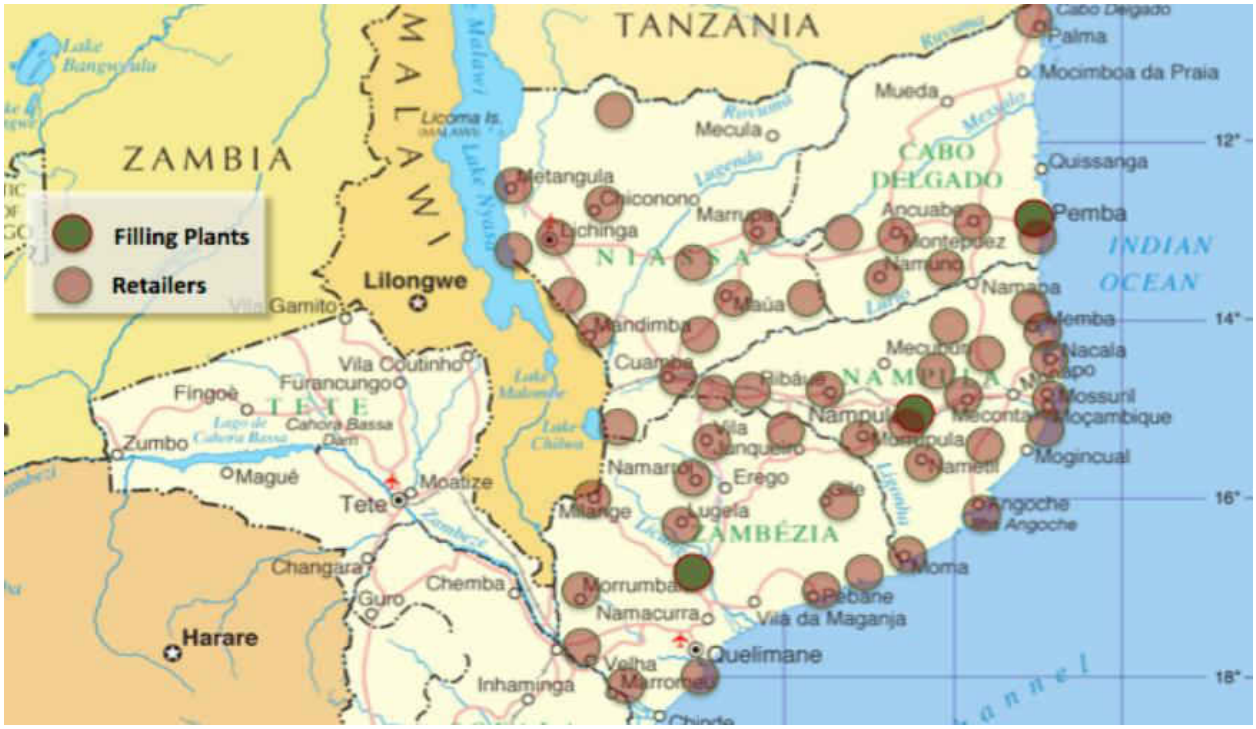

Figure 1: VidaGas Distribution Network (Source: VillageReach)

Business opportunity

Market needs

Refrigeration is essential for the effective operation of the health sector in Mozambique – specifically related to vaccination. LPG is able to meet that need effectively and relatively cost-efficiently. In addition, there is virtually no electricity supply in the rural parts of the country, and most households and businesses are dependent on woodfuel and charcoal for cooking and other thermal applications.

Opportunity

The company has been able to leverage its LPG supply activities for the health sector to provide the fuel to a much wider market.

Energy Services Provided

The LPG provided by VidaGas is primarily used for refrigeration and cooking.

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Market penetration and competition

VidaGas mainly supplies LPG to households (through retailers), commercial operations (especially in the tourism industry) and public health facilities. The company has a compound annual growth rate of 35%.

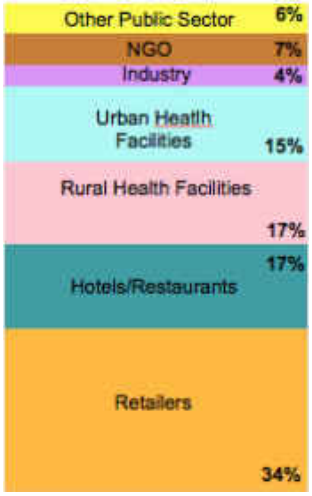


Figure 2: VidaGas sales by sector (Source: VillageReach)

Competition in the sector is very limited. The main competition – GALP Energia, Portugal – only distributes LPG in larger cylinders (11kg and 45kg) and only occurs at its petrol filling stations. Still, LPG's biggest competition in the cooking sector is biomass (woodfuel and charcoal), which is used by the vast majority of the population for cooking. The company's expansion into this market is limited by the upfront costs of LPG, the perceptions around the fuel (especially regarding safety) and the infrastructural challenges that affect the business.

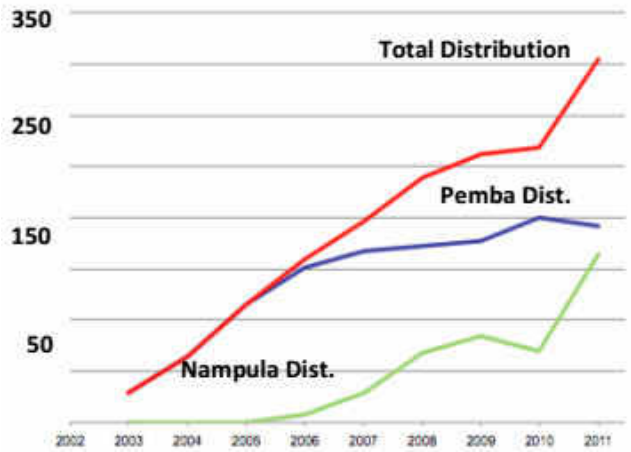
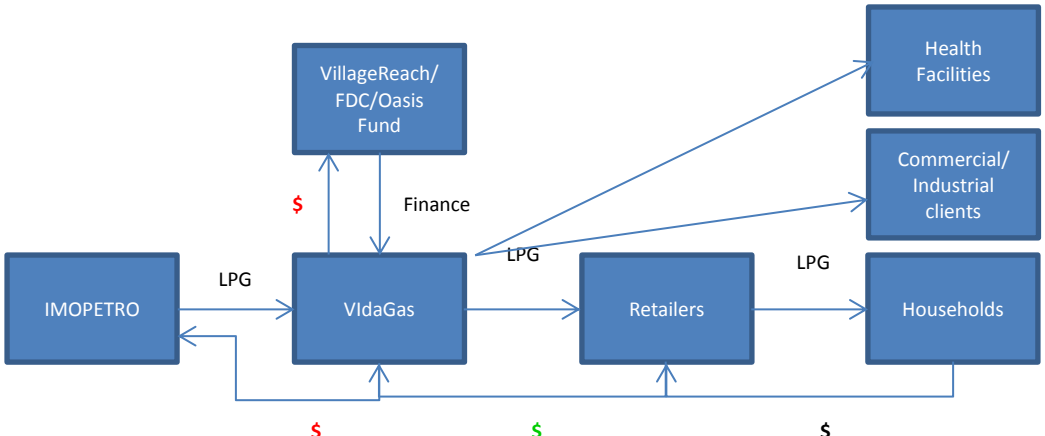


Figure 3: Annual LPG sales: 2003 - 2011 (Metric Tons)

Value chain and position



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Business Model

VidaGas provides LPG to health centers, commercial/industrial clients and retailers (who sell to households). The company owns three 23-ton filling stations, from where cylinders are filled and distributed. The company sells its 5,5kg cylinder fitted with a custom-made cooker top, which makes it easier for customers to use the gas for cooking. The company also retails LPG accessories/appliances, such as refrigerators, lights, cookers and ovens. VidaGas provides LPG cylinders to households on financed terms – they can pay off the purchase over a period of 2 to 3 months.

<table>
<tr>
<td rowspan="2">Key Partners

VillageReach
FDC
Oasis Fund</td>
<td>Key Activities

Bulk purchasing of LPG
Distribution of LPG to three main filling stations
Filling of LPG cylinders
Distribution of LPG cylinders</td>
<td rowspan="2">Value Propositions

VidaGas provides LPG in several cylinder sizes to a vastly underserved market.</td>
<td>Customer Relationships

Main customers:
Health Centers (dept of health)
Commercial/industrial clients
Retailers (supplying to households)</td>
<td rowspan="2">Customer Segments

Public facilities (health centers)
Commercial clients (tourism)
Households (through retailers)
– largely middle-upper income segments</td>
</tr>
<tr>
<td>Key Resources

3 Filling stations

Distribution vehicles

19 staff members</td>
<td>Channels

Direct sales: health centers, commercial/industrial clients.
Supply to households through retailers.</td>
</tr>
<tr>
<td colspan="3">Cost Structure

Inventory (LPG)
Salaries
Vehicles – fuel, maintenance, replacement
Filling stations (maintenance)
Cylinders
Appliances/accessories (inventory)</td>
<td colspan="2">Revenue Streams

LPG sales
Accessory/appliance sales
Cylinder deposits</td>
</tr>
<tr>
<td colspan="3">Social & environmental costs</td>
<td colspan="2">Social & environmental benefits

Increased health outcomes thanks to vaccination refrigeration, as well as reduced indoor air pollution

Reduced deforestation.</td>
</tr>
</table>

Technology & Processes

LPG is provided in standardized cylinders.

Financing

- The key capital costs relate to the filling stations as well distribution vehicles used. The company also buys cylinders for distributing LPG.
- VidaGas spends money on training, operation and maintenance of its fleet of vehicles as well as filling stations, as well as salaries for tis staff.
- VidaGas was initially financed by VIllageReach and FDC – additional investment was secured from the Oasis Fund on relatively soft terms.

Financial Projections

- VidaGas operates

Scalability and replicability considerations

- VidaGas clearly illustrates the potential that exists in the LPG market, especially when it becomes a PPP with a specific aim (in this case, increased healthcare).

Socio-economic, Health & Environmental Impact

- 19 full-time jobs have been created.
- Increasing use of LPG for cooking means that women have to spend less time fetching woodfuel, less time cooking and are also less exposed to indoor air pollution.
- Increased health outcomes due to vaccination refrigeration, reduced indoor air pollution.

Conclusions

- Some of the factors key to the success of the business has been:
    - The support of FDC, which is a widely recognized and supported local organisation that was able to open up many doors for the operation.
    - The link to healthcare services as a key market entry strategy, immediately bringing the public sector on board and ensuring their support.
    - The continued involvement of VillageReach as partner, providing VidaGas with key linkages and resources.
- However, VidaGas still faces numerous challenges, chief among them the low income levels of its market, the continued availability and relative cost of wood and charcoal, as well as perceptions surrounding LPG.
- Future outlook for the business seems relatively good, given the lack of competition in the sector and the clear need for the fuel.
- This case again illustrates the important role that public sector support can have in terms of thermal energy provision, highlighting the potential of PPPs for increased thermal energy access.

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Xpress Gas: Ghana

Case name & location:	Xpress Gas, Ghana
Energy Access Type:	Thermal - LPG
Value offer:	Cooking, space heating, transport
Organization type:	Private
Status of organization:	The business is established, starting operations in 2009
Scale of businesses:	US$ 6.6 million turnover
Major partners:	Persistent Energy Partners (formerly E+Co),

Executive summary

- Xpress Gas provides LPG to households and commercial vehicles in Ghana
- Most households in Ghana still cook with wood, charcoal, dung or crop residues. LPG is a cleaner burning, more convenient fuel for thermal applications. However, LPG availability is a major problem in the country. Xpress gas buys LPG from importers and then distributes the fuel via filling stations. Customers bring their cylinders to be filled at these filling stations and pay for the amount of gas dispensed. Xpress gas also provides LPG for commercial vehicles.
- LPG is produced by the country's single oil refinery, the Tema Oil Refinery. It is then supplied to the major distributors. Xpress Gas buys its LPG from these suppliers, supplying to filling stations that service customers.
- LPG is a clean burning thermal cooking fuel. It reduces the health impacts related to indoor air pollution. The business also employs local people and increases the financial sustainability of local filling stations.

Key performance indicators	
Capacity	800 000 kg LPG/month
Capital investments:	US$ 1,35 million
Labor requirements:	19 full-time staff employed
Operation and Maintenance:	Approximately 7% of revenue
Output:	25 666 kg of LPG/day

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Potential social and/or enviornmental impact:	Reduced indoor air pollution, reduced deforestation rates.					
Viability indicators	Payback period:		Post-tax IRR:		Gross margin:	

National Context and background

About 43% of Ghana's population has access to electricity. 80% of the country's electricity is consumed in cities and major towns. Only 10% of the country's population has access to LPG. More than 80% of the population uses biomass as their primary energy source. About half of the country's 24 million people live in rural areas.

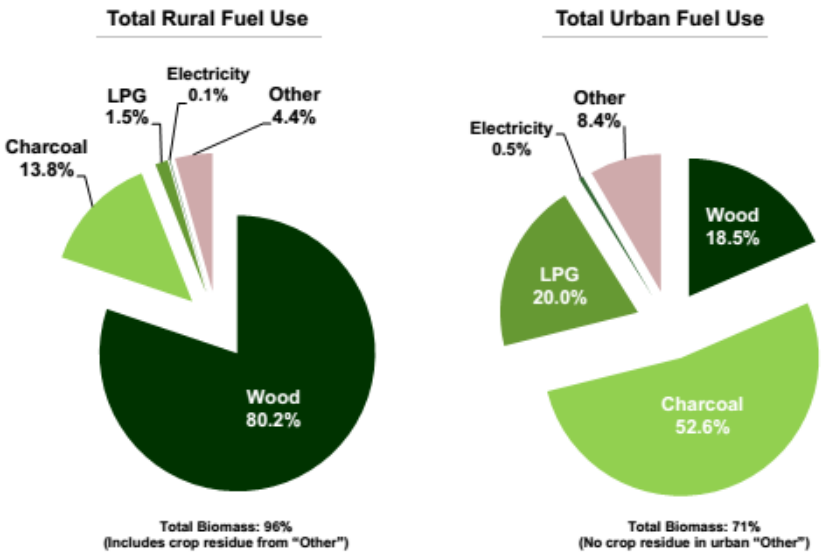

Figure 1: Fuel use, rural vs. urban (Source: Global alliance for clean cookstoves)

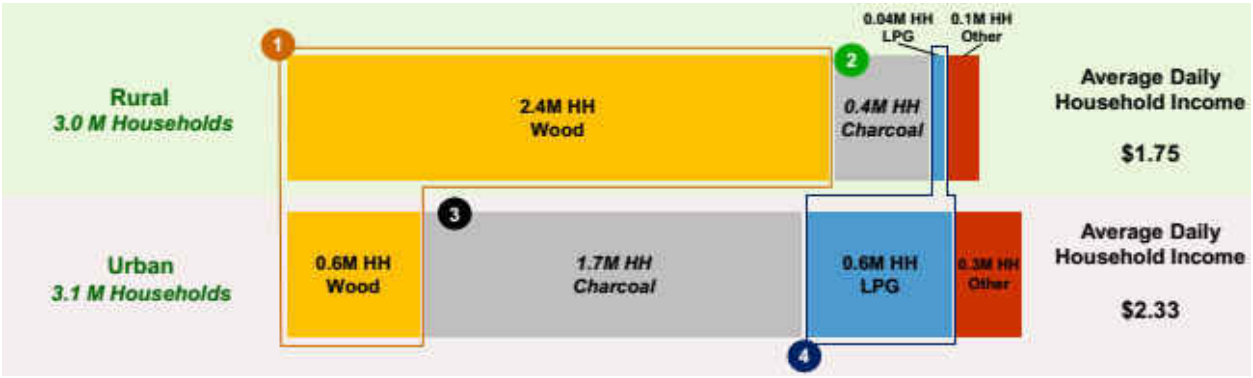

Figure 2: Household primary cooking fuel, rural vs. urban (Source: Global Alliance for Clean Cookstoves)

Power cuts and LPG shortages occur frequently – even in the major commercial centres. This leads to an increased use of biomass to meet energy requirements (especially charcoal), with the country's annual deforestation rate sitting at about 2% and the country's forest having shrunk to about 25% of their original size. Deforestation is the highest environmental priority in the country.

Energy prices have been increasing quite sharply – including electricity, LPG and charcoal. The country also faces relatively high inflation rates and high interest rates, which exerts further price pressure on energy prices. LPG is an energy source priority for the government and the establishment of PPPs with LPG marketing and distribution companies has been established as a priority action under the country's "SE4ALL Action Plan".

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The government is also greatly supportive of and involved in the cookstove sector. However, the government is considering reducing or cutting its current LPG subsidies.

The following policies and regulations have a bearing on energy access in the country

- The Strategic National Energy Plan (SNEP), 2006 – 2020 sets out the government's priorities and objectives for the period up to 2020. The objectives of the plan are to ensure that energy needs are met sustainably, that renewable energy resources increase to 10% by 2020 and that rural electrification via renewables is increased to 30% by 2020. The plan was developed by the Energy Commission.
- The Renewable Energy Act of 2011 supports the development of the renewable energy industry in the country, specifically through establishing feed-in tariffs for localized electricity production, a renewable energy fund, control and management of bio-fuel and woodfuel as well as licensing of companies working in the renewable energy sector.
- The Bioenergy Policy (draft) is focused on promoting the sustainable utilization of biomass, looking at a large range of factors that would improve the sector's long-term operations.

The major role players in the country's energy access sector are the following

- Ministry of Energy – Renewable energy division: tasked with the development of renewable energy in the country, specifically for energy access, including biomass, biogas etc.
- Energy Commission: the commission sits within the ministry of energy and recommends national policies for the development and utilization of energy sources. The commission specifically advises the minister of energy and is made up of 7 commissioners.
- National Petroleum Authority – regulates the petroleum industry, specifically also through licensing of operators in the sector.

Organizational Context

- Xpress Gas was incorporated as a limited liability company in 2009, secured a regulatory license in 2010 and started commercial operations in 2011. The country is was founded by Mr. Kofi Nketsia-Tabiri, who left his position as Regional Manager and Chief Investment Officer at E+Co to focus his efforts full-time on building up Xpress Gas.
- Persistent Energy Partners has provided commercial funding to the company.
- Xpress gas is registered with Ghana's National Petroleum Authority.
- The company was established specifically to provide LPG to Ghana's underserved population, since LPG shortages are rampant outside of Accra and Kumasi.
- Xpress Gas operates in all of Ghana's regions – except for the Upper West and Upper Eastern regions. The map below shows the location of LPG filling stations across Ghana for the entire industry (including Xpress Gas)

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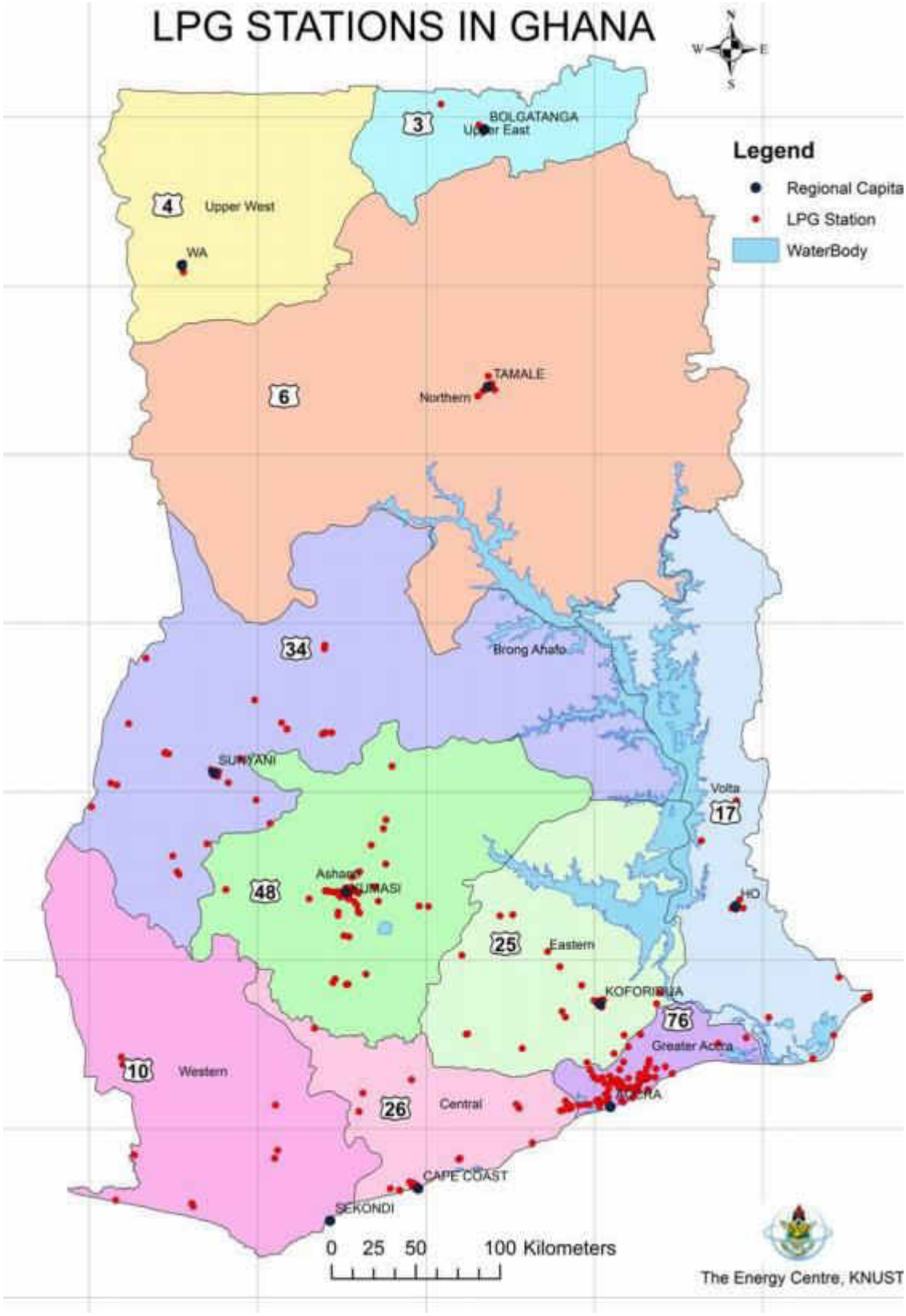

Figure 3: LPG stations in Ghana (Source: EUEI PDF)

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Business opportunity

Market needs

Outside of Accra and Kumasi, there are rampant shortages of LPG. Xpress Gas was established to address this need.

Opportunity

Xpress gas sells LPG to households and commercial vehicles in remote areas of Ghana.

Energy Services Provided

Xpress gas provides LPG to the market. This fuel is used primarily for cooking as well as transport in the commercial sector.

Market penetration and competition

About 60% of Xpress Gas's customers are commercial vehicles (primarily taxis), while the remaining 40% are households (middle-upper class).

Ghana has an electricity access rate of about 43%. Nearly 80% of the population cook with biomass. The percentage of population with access to LPG is only 10%. Xpress Gas is the 4th largest LPG supplier in the market, supplying about 6% of the market. Although LPG is used for a range of applications, including in mining and industrial processes in the country, Xpress Gas sells primarily to households and vehicle owners.

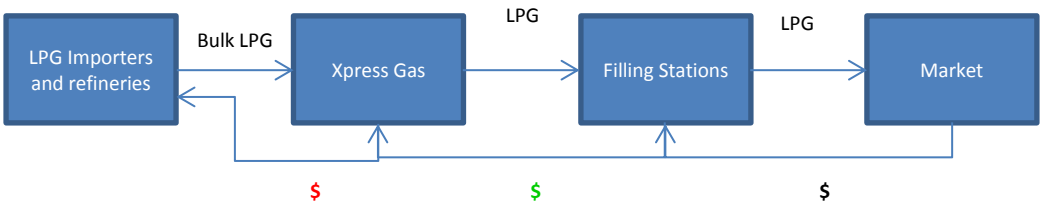
Table 1: Consumption of LPG compared to other petroleum products

PRODUCT	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LPG	45.0	42.5	50.0	56.7	65.7	70.5	88.0	93.3	117.6	220.6	178.4
Gasoline	524.4	535.1	570.2	479.8	575.6	537.8	511.9	544.2	545.0	701.4	737.8
Premix	30.6	27.0	26.8	28.9	27.5	31.4	33.7	41.0	50.7	55.1	32.4
Kerosene	67.6	70.5	74.8	68.8	73.2	74.3	76.5	63.3	34.6	89.3	49.3
ATK	96.9	76.4	90.5	89.8	107.4	119.3	114.7	122.8	119.2	124.7	108.4
Gas Oil	665.8	685.4	717.8	755.3	848.9	880.4	934.0	1,147.0	1,092.1	1,280.0	1,271.9
RFO	57.1	52.0	51.9	45.7	45.2	47.8	56.8	51.3	47.9	40.3	30.9
Total	1,487.3	1,488.8	1,581.9	1,524.9	1,743.5	1,761.5	1,815.6	2,062.9	2,007.0	2,511.3	2,409.1

Source: Energy Commission, 2010

Value chain and position

The Tema Oil Refinery produces LPG, which is then sold onto marketing and distribution companies in the industry. These companies then sell the fuel to more decentralised operators (sometimes forming part of their own operations), who in turn sell the LPG to customers. Customers own their LPG cylinders and bring them to be refilled when necessary. Xpress Gas is an LPG marketing and distribution company with a distinct focus on the more remote regions in the country. It provides bulk LPG to filling stations as well as its own filling establishments, who then sell the fuel to customers.



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Business Model

Xpress gas buys gas in bulk (up to 500 metric tonnes) and wholesales it in quantities of 10 to 30 metric tonnes to retailers and bulk industrial and institutional consumers. LPG is then sold to customers, mostly households and commercial vehicles, through filling stations (retailers). Customers bring their cylinders or vehicles to the filling stations, where they are filled with the LPG. This is basically a fuel sales model, where customers pay for only the amount of LPG they receive.

<table>
<tr>
<td rowspan="2">Key Partners

Persistent Energy Partners</td>
<td>Key Activities

Distribution and marketing of LPG</td>
<td rowspan="2">Value Propositions

Xpress Gas provides access to LPG in remote areas of Ghana</td>
<td>Customer Relationships

Xpress gas's main customers are filling stations.</td>
<td rowspan="2">Customer Segments

Households (middle-upper)

Commercial vehicles (taxis)</td>
</tr>
<tr>
<td>Key Resources

Delivery Vehicles

Filling station partners</td>
<td>Channels

Filling stations</td>
</tr>
<tr>
<td colspan="3">Cost Structure

Inventory – buying LPG
Delivery Vehicles
Salaries</td>
<td colspan="2">Revenue Streams

Sale of LPG</td>
</tr>
<tr>
<td colspan="3">Social & environmental costs</td>
<td colspan="2">Social & environmental benefits

Reduced deforestation

Reduced indoor air pollution</td>
</tr>
</table>

Technology & Processes

Xpress Gas makes use of bulk cylinders and tanker trucks to transport and provide LPG to customers. The technology is proven, robust and has been applied in various contexts. While there are safety risks involved in the transportation and retailing of LPG, these are in truth quite negligible.

Financing

- The main capital cost for the company is the purchase of LPG haulage trucks for distributing the fuel. Apart from the trucks, most funds invested have gone into
- The main costs for the company at this stage is inventory (since it is a cash and carry business) and maintenance of its vehicles.
- Financing options were limited for Xpress Gas, although they were able to secure investment from Persistent Energy Partners, who provide financing specifically to energy businesses on relatively soft

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terms. Other than that, the company has had to make use of commercial financing. Since most of its money is tied up in inventory, or needs to be used for maintenance of delivery vehicles, the company is not in a position to invest funds in crucial marketing activities.

Financial Projections

- The company's only revenue stream comes from the sales of LPG to customers. It has a turnover of about US$6,6 million per year.

Scalability and replicability considerations

- While there is a definite demand for LPG in the country, a great deal of this demand is latent and requires considerable investments in terms of consumer education and marketing. Xpress Gas specifically requires increased funds to be able to invest in these activities. The company also needs to provide training to its downstream customers (filling-station attendants, consumers) – again requiring considerable resources.

Socio-economic, Health & Environmental Impact

- The company currently employs 19 people on a full-time basis, and has also improved the financial sustainability of its downstream customers/retailers through offering them a steady diversified income stream.
- LPG is a clean burning fuel that replaces or reduces biomass or kerosene consumption, thereby reducing indoor air pollution as well as deforestation.

Conclusions

- Xpress Gas was able to use the considerable skills and resources of its founder to build a credible business and access the finance required to start and build this business. However, maintaining and growing the market remains a great challenge. It shows that, while there is an opportunity for the private sector, specifically small business, to get involved in this kind of thermal energy provision (without government support), it is a difficult road without a clear guarantee of success.
- Xpress gas requires investment that will enable it to free up some of its resources for marketing and training purposes, as this is currently reducing the company's ability to grow.
- There is also the potential issue of the government cutting its LPG subsidy, which might impact quite significantly on the company in terms of reducing its customer base. However, details on the exact nature of the subsidy cuts, as well as its current impact, remain vague.
- Contrasting this case with that of NuRa and VidaGas, it is clear that public sector support enables businesses in this field to reach a sustainable scale in a relatively short amount of time. Without that support, operations remain small, limited and under severe strain.

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Wana Energy Solution: Uganda

Case name & location:	Wana Energy Solution, Uganda
Energy Access Type:	Thermal (LPG)
Value offer:	Cooking, space heating
Organization type:	Private enterprise
Status of organization:	Established 2005, fully operational business
Scale of businesses:	N/A
Major partners:	Caltex Gas

Executive summary

- Wana Energy Solution provides LPG to households, businesses and other institutions in Uganda.
- More than 90% of households in Uganda depend on biomass to meet their energy needs. This leads to a host of health and environmental problems, including respiratory diseases and massive deforestation. LPG is a cleaners, safer energy solution that also saves charcoal-using households money. The big problem in Uganda is not a lack of demand, but rather a lack of availability. Wana Energy Solutions therefore provides LPG in various cylinder sizes, as well as does larger installations.
- WES develops the entire LPG value chain, from importing the fuel down to selling directly to the customer.
- LPG is a clean burning thermal cooking fuel. It reduces the health impacts related to indoor air pollution and is cheaper to use than charcoal. The business also employs local people and increases the financial sustainability of local filling stations.

Key performance indicators	
Capacity	400 000 kg LPG/month
Capital investments:	$ 400 000

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Labor requirements:	15 permanent staff, 6 franchisees and 6 delivery personnel					
Operation and Maintenance:	$67,000					
Output:	10 MT/month					
Potential social and/or enviornmental impact:	The business employs 15 permanent staff (projected to be 26 by 2017), as well as provides a viable business opportunity to 6 franchisees and 6 delivery personnel. LPG also reduces deforestation and indoor air pollution.					
Viability indicators	Payback period:		Post-tax IRR:		Gross margin:	

National Context and background

There are around 33,4 million people living in Uganda, of which approximately 11% of households are supplied with electricity. Around 3 per cent of the rural population have electricity, 33% urban access. 91% of the total energy consumed in the country is derived from biomass.

The shortage of supply over demand has partly contributed to the low level of grid rural electrification and partly due to the highly uneconomical nature of such projects. This barrier has led to increased private electrification in many rural areas using diesel generation, car batteries and solar PV systems. Over the last few years, the Ugandan Government has been developing a comprehensive rural electrification strategy to bring the demand for electricity into the official supply loop using a number of innovative approaches. In this and other regards, the Uganda Electricity Distribution Company Limited (UEDCL) has being broken up by the enacted Electricity Act of 1999, which liberalises the power sector by allowing private sector participation in all electricity sub-sectors.

The following policies and acts have a bearing on the Ugandan energy access sector.

- Electricity Act (1999), which ushered in the establishment of the Electricity Regulatory Authority, as well as the promotion, support and provision of rural electricity programmes (incl. the development of a Rural Electrification Strategy and Plan as well as a Rural Electrification Fund).
- The Energy Policy for Uganda, which aims to increase energy access and security in the country through a number of measures, including attracting private investment.
- The Rural Electrification Strategy and Plan, developed by the Ministry of Energy and Mineral Development (MEMD), sets out the formal framework for the development of rural electrification.
- The Energy for Rural Transformation Programme is aimed at improving access to modern energy and is supported by the World Bank. An important part of the program is the development of an Indicative Rural Electrification Master Plan (IREMP), which aims to integrate grid and off-grid rural electrification planning.
- The Rural Electrification Subsidy Policy presents the subsidy criteria that guides the awarding of subsides for rural electrification in Uganda.
- Renewable Energy Policy (2007) sets out targets for power generation, rural and urban-poor electrification access, modern energy services, biofuels, waste to energy and energy efficiency. This includes improved biomass stoves as well as biogas systems (300,000 by 2017).

The main stakeholders in Uganda's energy access sector are:

- Ministry of Energy and Mineral Development is the central decision-making body when it comes to the electricity and petroleum industries (including LPG). The Directorate of Energy, which represents the MEMD at the local government level, looks at a wider range of energy issues, including biomass, the productive use of energy etc.
- The Rural Electrification Agency, responsible for rural electrification projects, is governed by the Rural Electrification Board which controls the Rural Electrification Fund (meant to provide capital grants towards renewable and rural electricity projects).

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- The Electricity Regulatory Authority is responsible for all regulation of the electricity industry in the country.
- UMEME is the operator of Uganda's electricity distribution network.
- Electricity concessions (Kalangala mini-grid, Ngoma mini-grid, Bibaale, Kisiizi Hospital Hydro Power Project, Wenreco etc.) are public private partnerships with relatively small generating capacity (usually below 0.5 MW).

Organizational Context

- Wana Energy Solutions was established in 2005 as a reseller of Caltex gas, and was registered as a private company in 2008.
- The company was established to address the lack of access to clean thermal energy in Uganda.
- WES is operating in 7 districts (out of 111), including Mbale, Mpigi, Kampala and Wakiso districts. It has 40 points of sale across the country.

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Figure 1: Administrative map of Uganda

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Business opportunity

Market needs

- Access to LPG is extremely limited in Uganda, despite the fact that there is a relatively big demand for the fuel. Most households use woodfuel or charcoal to meet their energy needs.

Opportunity

- WES services households (mostly formalized housing), institutions and businesses with LPG.

Energy Services Provided

- WES provides LPG, largely used for cooking and space heating.

Market penetration and competition

- LPG is readily available in most urban centres and larger towns distributed mainly through filling stations. The market is free and unregulated. Typical prices (Shell) for re-filling a 6 kg cylinder are 22,000 UGX (USD12.5) with a deposit on the cylinder of 48,000 UGX (USD27.4) and for a 15 kg cylinder 52,000 UGX (USD29.7) with a deposit of 78,000 UGX (USD44.6). Costs in rural areas are substantially higher.

- LPG is also widely used within the Ministry of Health in the context of the Uganda National Expanded Programme on Immunisation (UNEPI) to provide refrigeration for vaccines. LPG is generally procured at District level through the District Directorate of Health Services.

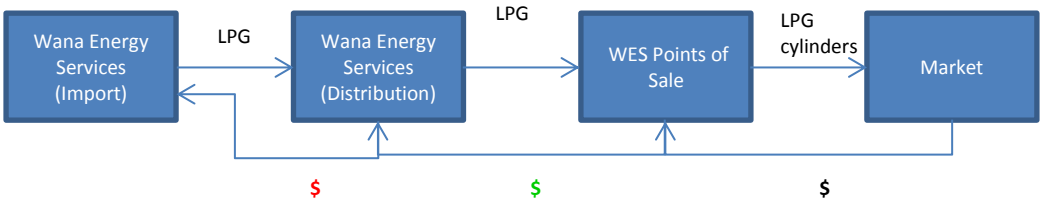
- The proportion of biomass in Uganda's overall energy mix is very high, at 93%. The widespread inefficient use of biomass, especially in cooking, but also in supplying thermal energy for small and medium enterprises, is contributing to the large scale destruction of forests in large areas of the country.

- Huge quantities of charcoal are shipped on a daily basis into Kampala and other urban centres for cooking. A typical urban household will use 2 bags per month at a cost of 15,000 UGX/bag (rural prices are around 8,000 UGX/bag), and assuming only half the 400,000 households (based on population of 2 million, 5 per HH) in Kampala use charcoal for cooking, this equates to 400,000 bags per month. It is estimated that some 100 trucks per day, each carrying as many as 150 bags of charcoal each deliver to Kampala alone.

- The target market consists of households in organized estates, private homes, small commercial businesses and hotels. The company is expanding its reach into lower income areas by offering LPG on credit.
- WES's has captured about 10% of the LPG using market in Uganda.

Value chain and position

- Wana Energy imports LPG and related products (including cylinders, cookers etc.), distributes the fuel to its more than 50 points of sale as well as installs larger LPG units, including pre-payment meters. The company sells primarily to households as well as businesses.



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Business Model

- WES sells LPG in various cylinder sizes as well as does bulk installations with pre-payment metering. The company has also recently introduced a credit option to enable lower-income households to access LPG.

<table>
<tr><td rowspan="2">Key Partners</td><td>Key Activities

Importing LPG
Distributing LPG
Retailing LPG through POS
Installation & maintenance of bulk LPG, including pre-payment metering</td><td rowspan="2">Value Propositions

Wana Energy Service provides LPG in a severely underserved market. It does so in a variety of ways to enable as wide a population as possible to access LPG.</td><td>Customer Relationships</td><td rowspan="2">Customer Segments

Households(formal, property developments)
Businesses</td></tr>
<tr><td>Key Resources

Vehicles

Points of Sale

Personnel

Stock</td><td>Channels

Points of Sale
Bulk Installations on</td></tr>
<tr><td colspan="3">Cost Structure

Inventory
Distribution infrastructure (vehicle, points of sale)
Salaries</td><td colspan="2">Revenue Streams

Sale of LPG (Cylinders, Installations)
Sale of LPG appliances</td></tr>
<tr><td colspan="3">Social & environmental costs</td><td colspan="2">Social & environmental benefits

Reduced deforestation

Reduced indoor air pollution</td></tr>
</table>

Technology & Processes

- Wana Energy Solutions provides LPG in cylinders of 6kg, 13kg, 15kg and 45kg. It also installs large-scale LPG in housing developments as well as business premises, as well as
- WES provides maintenance on the bulk installations as well as training for all POS operators.

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Financing

- Wana manages the whole value chain of LPG, from importing to selling to customers. The company has vehicles, storage tanks,
- The company spends on average $50,000 on operations, plus another $17,000 on maintenance.
- Investment financed has been sourced from friends, personal savings and releasing equity from properties.

Financial Projections

- 68% of the company's revenue comes from domestic customers. The remaining 32% of revenue is coming from businesses supplied with LPG.

Scalability and replicability considerations

The company is facing some cash-flow constraints, not making enough in terms of profit to be able to market adequately, which is in turn constraining their growth. There are also challenges with finding and retaining adequately qualified and motivated personnel. However, the demand for LPG in Uganda far outstrips the current supply; a good indication of potential future growth for WES. LPG does not currently seem to "register" with Ugandan authorities in terms of energy access; if more concerted support from the public sector is provided to this energy carrier, the company (and LPG sector as a whole) should see substantially more growth in the future. The company plans to have 1000 distribution centres across the country by 2020. Plans are afoot to increase LPG access to 20% of the Ugandan population through micro-finance, credit and cost-sharing.

Socio-economic, Health & Environmental Impact

- The company has 15 full-time staff, 6 women franchisees and 6 delivery personnel.
- LPG is a clean burning fuel that replaces or reduces biomass or kerosene consumption, thereby reducing indoor air pollution as well as deforestation.

Conclusions

- Wana Energy Solutions seems very committed to grow the market through various innovations, including bulk installations, credit, micro-finance, cost-sharing etc. The company controls the entire value chain, from importing to retailing the gas, and is therefore able to keep its own costs low, thereby providing access to lower income sections of the community. However, to be able to access this market, margins are kept very low, which in turn means that there is very little resources available for marketing and education. This lack of marketing in turn constrains the company's growth.
- The future outlook for the company does however seem very good: 93% of the Ugandan population still uses biomass to meet their energy needs, yet high rates of deforestation are driving the costs of charcoal beyond the reach of many households. LPG is a cheaper alternative, even though the upfront costs seem prohibitive; the company is positioning itself to overcome this constraint through various financing and cost-sharing options.

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