ENACT

Enabling African Cities for Transformative Energy Access

P A Y G A S - E N A C T

Feasibility study on providing affordable cooking gas for low-income households

in Susan's Bay, Freetown, SIERRA LEONE

19th of April 2022

[Left to right] Susan's Bay (Sierra Leone) and PayGas Operator in Cape Town (South Africa)

This material has been funded by UK aid from the UK government via the Transforming Energy Access programme; however, the views expressed do not necessarily reflect the UK government's official policies

ICLEI Local Governments for Sustainability AFRICA

ENERGY4IMPACT POWERED BY MERCY CORPS

PAYGAS

UKaid from the British people

Transforming Energy Access

1. Executive Summary

PayGas is a French South African start-up which has disrupted traditional household cooking, by dispensing the quantity of gas (LPG) delivered at a patented cashless micro refilling station, to the amount that customers can afford: *PAY AS YOU GAS™.*

With PayGas, customers can easily walk to the closest *Pay as you Gas™* station in their neighbourhood and use their cashless payment or airtime vouchers to buy as much as they can afford. Customers can buy cooking gas with as little as $0.5.
www.paygas.africa

The business model of the PayGas solution relies on 5 pillars:

- **AFFORDABILITY** by breaking the minimum cooking consumption barrier (vs Full cylinder) through a cashless fractional innovative dispensing of gas (minimum $0.50)
- **SAFETY** by protecting customers from hazardous cooking fuels like kerosene, charcoal
- **ACCESSIBILITY** with Hyperlocal refilling station inside low-income communities
- **TECHNOLOGY & IP (TRL 8-9)** by digitizing the customer journey via patented PayGas system
- **ECONOMIC INCLUSION**, each station is operated by a local micro woman franchisee with a profit sharing model

Pay as you Gas™ cashless refilling stations are certified with the highest safety standards by our partners Linde Group and Rubis Energy, highly scalable and 100% locally manufactured with standard shipping containers following a patented design.

Following the success of the 10 first Pay-as-you-Gas cashless refilling stations in Cape Town and Johannesburg, South Africa that are already giving affordable access to clean cooking to more than 165 000 low-income beneficiaries/ 850 tons of LPG distributed in 12 months, PayGas responded to the Terms of reference issued by ICLEI/ENACT ToR on the 20th December 2021, to assess the feasibility of implementing a similar solution in Susan's Bay informal settlement, Freetown, Sierra Leone.

The Enabling African Cities for Transformative Energy Access (ENACT) project is part of the Transforming Energy Access (TEA) programme, funded with UK Aid from the UK government. The TEA programme is managed by Carbon Trust. The ENACT project is delivered by ICLEI Africa, with the support from Energy 4 impact. The project aims to work with local governments and private sector to create an enabling environment for the delivery of safe, reliable, clean and affordable energy to the urban poor residing in informal settlements in Freetown (Sierra Leone) and Kampala (Uganda).

ICLEI Africa was seeking between one (1) and three (3) suitably qualified and experienced service providers, preferably based in Africa, and/or having experience of working within African informal settlements, to undertake an initial feasibility assessment and draft a pilot project implementation plan to support the development of clean cooking solutions in Susan's Bay, Freetown, SIERRA LEONE.

On the 28th of February 2022 ICLEI Africa, through the ENACT project, appointed PayGas as one of the three Service Providers to conduct studies to assess the feasibility of implementing clean cooking solutions in Susan's Bay informal settlement in Freetown, Sierra Leone.

PayGas station in Nyanga (South Africa)

2. PROJECT BACKGROUND

The Enabling African Cities for Transformative Energy Access (ENACT) Project is funded by the Foreign Commonwealth and Development Office (FCDO) of the UK government and is part of its Transforming Energy Access (TEA) programme. ICLEI Africa has been appointed, through Carbon Trust as the lead implementing partner and is working with Energy 4 Impact, in two project cities: Kampala (Uganda) and Freetown (Sierra Leone).

TEA works via partnerships to support emerging clean energy generation technologies, productive appliances, smart networks, energy storage and more. It increases access to clean, modern energy services for people and enterprises in sub-Saharan Africa and South Asia, improving their lives, creating jobs and boosting green economic opportunities.

3. PURPOSE OF THE FEASIBILITY ASSESSMENT

The ENACT project aims to create an enabling environment to improve energy security in Africa's urban areas, with a focus on the urban poor living in informal settlements, by introducing market-led interventions for improved energy access.

The project aims, inter alia, is to foster public private partnerships and, through funding to private energy service providers, enable the testing and implementation of financing and business models for improved delivery of sustainable energy services – for clean cooking and energy access – to households and microenterprises living and operating in informal settlements within the two project cities.

4. OVERALL APPROACH AND METHODOLOGY, LITERATURE REVIEW AND SOURCING OF INFORMATION

4.1. INTELLECTUAL PROPERTY

All information and data are covered by the SLAs agreed between PayGas and ENACT. ENACT project partners are not allowed to share information covered by trade secrets. In addition, all pictures have been made by PayGas and as a result remain the property of PayGas. If ENACT wants to share some photos, it requires written consent from PayGas.

4.2. FEASIBILITY ASSESSMENT

The methodology used to conduct this feasibility assessment included a mix of quantitative and qualitative research methods such as literature review, data collection and analysis, semi-structured interviews, interview with key informants and stakeholders.
Through this work, the following were assessed:

- PESTEL of Sierra Leone with a focus on Susan's Bay
- LPG regulation and context in Sierra Leone
- Social analysis of Susan's Bay population with a focus on cooking, essential needs, and social development (health, gender, employment, entrepreneurship.)
- Environmental and climate change impact

Likewise, interviews were conducted with the following stakeholders:

i. 49 interviews of the households/small cooking businesses to better understand what fuels and technologies are currently used for cooking and how the PayGas solution can be implemented to help it to get a clean cooking solution. Example of questions included:

   - What does this household use for cooking most of the time, including cooking food, making tea/coffee, boiling drinking water?
   - How much did this household pay for this fuel or energy source last month for cooking (the last 30 days)?

ii. 5 interviews of local administration (open discussion with a focus on regulation bodies)
iii. 2 interviews with major LPG companies (open discussion to identify the potential partnerships)
iv. 2 interviews with small business owners (If feasible given the limited time of the planning)

Local regulation analysis and finance inclusion

- Analysis of the different regulation related to LPG usage, safety and distribution
- Analysis of the potential financing inclusion mechanisms

4.3. PILOT PROJECT PLAN

The pilot project implementation plan resulting from this feasibility assessment defines:
- The appropriate business model based on Sierra Leone and Susan's Bay context
- The action plan to be compliant to the LPG regulation and to influence it if needed

- The resources and funds needed to run the pilot
- The different options to set up and run the pilot
- The business plan to forecast a potential deployment

4.4. Objectives

In detail, the objectives are to:

- Conduct research and analysis of the current situation of the clean cooking sector in Susan's Bay, including the strengths (enablers), weakness (barriers and challenges) and regulations to be complied with in implementing the proposed clean cooking solution.
- A market survey to identify the types of users and potential volume of demand for the proposed clean cooking intervention.
- An evaluation of the technical, legal and financial (etc.) viability of the clean cooking solution being proposed.
- A value chain map that identifies the organizations, roles and related activities of all stakeholders (local, national and/or international) relevant to the implementation of the proposed clean cooking solution in Susan's Bay.
- Environmental (including quantifiable reduced deforestation), health, and social (especially gender), economic (including number of potential jobs to be created, reduced cooking time, reduced time spent fetching firewood) impact potential of the proposed clean cooking solution in Susan's bay (and surrounding areas).
- Quantified climate change mitigation benefits in terms of the amount of reduced greenhouse gas emissions incurred via the roll-out of the cooking solution.

5. Stakeholders Consultations and Interviews

This feasibility study provided PayGas and the ENACT team with a well-founded basis for the further development of the project in those potential communities, in which the prerequisites, opportunities and stakeholders have been identified.

5.1. Sierra Leone: Visit in Susan's Bay, Freetown (14 March-20 March 2022)

PAYGAS went to Susan's Bay from the 14th to the 20th March 2022 to better understand and apprehend the situation on the ground.

The PayGas team that went to Freetown was comprised of the two co-founders and Executive Directors of PayGas Holding:

Project manager: Philippe HOEBLICH, CEO and Co-Founder
Project leader: Natalia GUIDA GIAMPIETRI, Chief Operations Officer (COO) and Co-Founder

For the efficiency of the feasibility PayGas recruited 04 local partners:

- Mariama Samai
- Amara Tangabay
- Lamin Swaray, Conex Energy, (ex TotalEnergies), General Trade Executive, who grew up in the neighbored Susan's Bay.

The local partners supported PayGas team by connecting PayGas with the local stakeholders (headmen's) and communities of Susan Bay. Their main tasks were to administer the 49 questionnaires inside Susan's Bay community. They were crucial to interview and collect data to understand the clean cooking context in Susan's Bay community.

5.1.1. THE METHODOLOGY CONDUCTED BY PAYGAS WAS TO

- Gather, analyze relevant data to get a good understanding of the clean cooking context in Susan's Bay under the social, economic, and environmental angles.
- Interview the population of Susan's Bay: 49 questionnaires
- Meet with the local administration: Petroleum Regulatory Agency, Ministry of Energy, Freetown City Council.
- Meet with the 02 LPG providers: Afrigas and NP
- Meet with the main cashless provider: Orange Money
- Meet with Micro Finance Institutions: Ecobank Micro Finance and ACTB (ACTB Loans | ACTB Savings & Loans)
- Meet with Development Financial Institutions: IFC (World Bank)

5.1.2. GAS PARTNERS MEETINGS

5.1.2.1. AFRIGAS

Thanks to a long-established relationship between PayGas and GEOGAS (Antoine GUDEFIN, General Director) which is the main shareholder and LPG supplier of Afrigas, we did a preparatory virtual meeting on the 11th of March between Afrigas, Geogas and PayGas and a 2nd meeting on the 14th of March at Afrigas head office in Freetown.

GEOGAS is an independently owned LPG trader and shipper specialized in demanding and innovative supply schemes all the way from production to bottling plant: About Us | Geogas
Afrigas got a network of about 700 resellers (proximity vendors) very well located inside each neighborhood.

- Afrigas mentioned that it has 70% market shares in term of volume (tons of LPG sold).
- Afrigas owns 61% of the total number of cylinders (400 000 cylinders) in Sierra Leone

Afrigas was created in 2013 with the support of Geogas and IFC financial support (4 million USD).

Afrigas offers clean cooking LPG through a traditional swapping cylinders distribution and got a very strong established brand. Afrigas is servicing customers which can afford to buy a cylinder of 6 kg full, every time the cylinder is empty (120 000 SLL/ 10USD), 12kg cylinders and above for catering businesses, restaurant, middle and upper class.

The challenge of distributing LPG through a cylinder swapping model (full for empty) like Afrigas is the "working stock ratio" of cylinders per clients. The gas company needs a minimum of 4 to 5 cylinders in constant rotation between the reseller and the filling plant to be able to serve 01 client at any time. Meaning that if each cylinder costs 25 USD, the Gas company needs to invest between 100 to 125 USD per customer, which is a significative investment. To reach 1 000 new customers, the Gas company needs to invest 100 000 USD on cylinders only.

GEOGAS mentioned that the price of LPG is quite high compared to the power of purchase of most of the population and the depreciation of the local currency (SLL) is worsening even more the cost of LPG/clean cooking for the poor urban households (Forex).

Following the different meetings Afrigas confirmed its interest to partner with PayGas and look how PayGas' technology could benefit the Afrigas resellers, especially in the provincial cities and in Freetown. It is a key partnership to consider for the potential deployment of a PayGas station in Susan's Bay community. The head office of Afrigas is less than 500 m from Susan's Bay.

5.1.2.2. NP GROUP

PayGas had three meetings with NP in the last 02 weeks. The first meeting was a virtual preparatory meeting on the 08th of March 2022 with the Executive Chairman of NP, Tunde COLE and the Group Chief Financial Officer, Consvonne MACRAE. Below is the compilation of the minutes of the different meetings between PayGas and NP.

NP Group is the 2nd gas distributor in Sierra Leone:

- NP mentioned that it has 70% market shares in term of volume (tons of LPG sold). Mainly in bulk to restaurants, hotels, etc.
- NP owns 39% of the total number of cylinders (250 000 cylinders) in Sierra Leone (households' segment).

NP Group distributes LPG in Sierra Leone, Liberia, Guinea, Gambia and Ivory Coast. The Chairman was interested to partner with PayGas in Sierra Leone but and other countries where NP is doing business (Liberia, Guinea, Gambia, Ivory Coast).

On Monday the 14th of March, we met with the managing team of NP Gas at their head office in Freetown. The following managers attended the meeting:

- Group CFO: Consvonne MACRAE
- Group accounting: Cecil THOMAS
- Gas Department Accounting: Aminata JALLAH
- Sales: Mariama HARVEY
- Marketing: Alfred KAIMA

In Sierra Leone, NP distributes LPG through a unique exclusive national distributor: Thomas Nagimu. This distributor manages a network of hundreds of resellers. NP decided initially to have a unique distributor because of the investment required in the logistic of distribution: fleet of delivery trucks to acquire and manage from the filling plants to each reseller. Very few business partners were able to invest a such a significant amount into a complete fleet of trucks to move the cylinders.

Based on the market analysis of the marketing team of NP "only 1% of the population in Sierra Leone is consuming LPG. Most of the population cannot afford to buy a full 6 Kg cylinder (120 000 SLL/10 USD) every time it is empty but could only buy cooking fuel for 01 or 02days (5 000SLL to 20 000 SLL. With PayGas, the consumption of LPG will definitely increase" (Alfred Kaima, NP Marketing Manager).

"Sierra Leone is a cash economy. People are not using cashless payment really" (Mariama HARVEY, NP Sales). During this meeting (14/03) we explained to NP that in the PayGas system, the customer doesn't even need to have a phone. It is the PayGas station Franchisee/ Operator which is an Orange Money agent and digitalizing the payment at the station. Not the client him/herself.

NP confirmed that the "cross filing" is also illegal in Sierra Leone. Cross-filling is the practice of illegally filling a gas cylinder that is owned by another party. It is technically feasible because the filling valves are the same on the cylinders of the different brand (Afrigas/NP). Some countries legalized the cross-filling to allow the client to buy his gas at any gas dealers. But legalizing the cross-filing prevent gas companies to invest into cylinders to serve new clients, as their cylinders will be used to purchase gas from the competitors, hence, no incentive to invest in new cylinders. The wholesalers (NP and Afrigas) don't exchange cylinders between themselves when a client is coming at a selling point with an "opposition cylinder".

It's the unique distributor who handles all the distribution network in Sierra Leone to the end-users except the hospitality segment (restaurants, hotels, bulk clients…). NP has a direct network of Petrol stations that are selling gas also, but in a small quantity, through the traditional swapping model.

NP has three distribution channels:

1. via a unique distributor (Thomas Nagimu): who distributes full cylinders to the resellers, which serve the final customer (Business to Consumer - B2C)
2. via bulk cylinders to businesses (Business to Business (B2B)), and
3. via NP Petrol stations: full cylinders resellers

NP has a filling plant at the LPG terminal Kissy in the East of Freetown and refills its cylinders, selling to B2C via its unique distributor (Thomas Nagimu – owner of LeoneCo) who is managing the resellers network, which sell to the final customers. NP is also selling in Bulk cylinders to Hospitality (restaurants, hotels): bigger cylinders (55 Kg) supplied full.

Regarding the cashless payment, NP said that Orange was a better option in terms of coverage, reliability. But in the meantime, Africell client's portfolio was more in low-income customers.
NP was wondering if PayGas could use NP existing POS machine (receipt) instead of Orange money cashless payment to avoid the commission to Orange. PayGas needs to discuss with NP Petrol stations and the unique distributor (Thomas-LeonCo).

NP marketing and sales team estimated that one of the main "entry barriers" for customers to move from dirty fuel to LPG is the cylinder Deposit: 240 000 SLL for 6 kg cylinder and 400 000 SLL for a 12 Kg cylinder.

The strategy of NP is to target the following markets: Sierra Leone slums to increase the market consumption and the number of distributors to purchase more gas. NP strongly believes in the efficiency and disruptive distribution model of PayGas to bring affordable clean cooking to the majority of low-income households in Sierra Leone.

While PayGas was exploring potential partnership with NP for the ENACT project in Susan's Bay, NP started early discussions to possibly implement the model, through pilot stations in other geographic areas in Freetown. On the 16th of March we visited 4 potentials sites to deploy the pilots with Alfred Kaima, the Head of Marketing at NP.

NP/PayGas partnership consideration: All the 80 NP petrol stations together represent only 60 tons of LPG/month (swapping cylinders). In comparison, Afrigas is selling 720 tons of LPG per month (over x10 NP).

NP would like to consider giving a space at their NP petrol stations to potentially deploy PayGas stations.NP would like to boost the direct sales of LPG at their Petrol stations in addition to their unique Distributor (Thomas Nagimu) which is managing the indirect sales channel through resellers (corner dealers).

Timeline to be validated and aligned if the phase 2 of the Susan's Bay is confirmed.

In conclusion of the meetings with the 02 potential gas partners, the two companies raised interest to deploy 1 to 5 PayGas Pilots (01 Afrigas+04 NP) for a total investment of $600 000 (TBC) and an estimated impact of 100 000 very low-income beneficiaries for the pilot phase of PayGas in Sierra Leone.

NP Head Office Petro station at Siaka Stevens street (Cotton Tree)

5.1.3. MAYOR MEETING: FREETOWN CITY COUNCIL

On the 16th of March, PayGas attended the ENACT meeting with the Mayor of Freetown at the Freetown City Council. All the stakeholders of the project were attending this meeting:

- ICLEI Africa

- Energy 4 Impact
- CODOHSAPA
- FEDURP
- Afrigas
- ILEM Africa
- PayGas
- Freetown City Council, including the Mayor
- The councilor of Susan's Bay

One of the key concerns raised by the Mayor and other participants were those of accessibility, affordability and sustainability of the solutions. The final clean cooking solution needs to be a sustainable solution to fight against deforestation, which is a huge problem in the City of Freetown.

The Freetown City Council has invested in a program to replant thousands of trees to compensate the alarming rate of deforestation due to harvesting for fuelwood production (charcoal and wood): Tree Town/Freetown. The final clean cooking solution needs to be sustainable, from an economic and environmental point of view for the Mayor.

5.1.4. CASHLESS SOLUTION PROVIDERS FOR THE PAYGAS SOLUTION IN SUSAN'S BAY:

Orange Money – CEO David Mansaray

The PayGas patented technology of fragmenting Gas with digital payment (Pay-as-you-Gas™) required to interface it with local cashless providers in Sierra Leone, to set-up a potential pilot in Susan's Bay and in Sierra Leone. That's why PayGas met with Orange Money SL (Homepage B2C | Orange Sierra Leone)

Orange Money is a mobile phone-based payment system that allows customers to carry out simple banking operations and transactions in total security. It does not require a bank account. It's the financial service branch of the mobile operator ORANGE Sierra Leone.

Orange Money is developed in partnership with commercial banks in Sierra Leone who work with Orange to ensure controls are adhered to, security of transactions and compliance to Bank of Sierra Leone regulations.

Orange Money (SL) is offering different services in Sierra Leone:

- Payments for utilities: electricity bill, water bill, safety ticketing,
- Energy: solar panel consumption payment,

- Lotto/Games: betting
- Micro Loans: for small businesses, digital loans
- Moving Money between bank accounts and individuals: International, remittance (wallet), peer to peer, cash out…

1.5 million customers are registered at Orange (Mobile Operator). Orange Money SL would like to increase the financial inclusion inside the customers of Orange. Orange SL has 500 sites around the country, that are covering 16 districts. As a mobile operator, Orange SL claims 87% of the market share. Their competitor is the African money from Africell.

Initially, the Orange Money's CEO thought that gas is expensive, so it was just for the middle and upper class in Sierra Leone. For the potential deposit barrier (240 000 SLL/$23), Orange Money is proposing to partner with their mobile Microfinance institutions (MFI) that are working with Orange money: Mpaia solution, ACTB. It's the MFI that will provide the micro loan, through Orange Money for acquiring the initial cylinder (deposit).

Orange Money is proposing also to approach Orange Energy (solar energy) and to explore synergies with them.

PayGas integration with Orange Money portfolio: the technical feasibility will require a due diligence agreement between Orange Money SL and PayGas as soon as PayGas could confirm the pilot timeline. Orange is confirming that they can generate a unique code like Flash/ Group (FLASH | (pepkor.co.za)) in South Africa for the interfacing of the Orange Money cashless payment and the PayGas solution. The technical integration doesn't look to be an issue at all. It is quite similar with what they do with electricity: get the token on the phone, enter it on the meter number.

The Orange Money CEO was very interested to integrate PayGas in his portfolio and pioneer the distribution of affordable clean cooking in Sierra Leone. "We have the capacity and willingness to support the PayGas initiative in Sierra Leone".

5.1.5. FINANCING PARTNER

IFC (World Bank)

We met with Giima Mabel Lavaly from IFC, who confirmed the interest of a pay-as-you-go LPG purchased solution to fight against deforestation for cooking. IFC might support PayGas potential investment in Sierra Leone (post pilot phase) with a minimum threshold of 2.6 M USD (fragile country support).

Giima did an introduction with the following Micro Finance Institutions (MFI) in Sierra Leone:

- Ecobank Microfinance/ Managing Director
- ACTB Savings and Loans/ Chief Executive Officer
- LAPO Microfinance Bank/ Managing Director

Ecobank Microfinance 18/03- CEO Raymond Koroma

On Friday 18th of March 2022, we met with the CEO of Ecobank Microfinance and his Risk Director. In 5 countries Ecobank Microfinance serves over 3.5 million micro-entrepreneurs and low-income individuals. Ecobank Microfinance is offering the following products:

- Micro savings, Micro-loans, Bills payments, Transfers and remittances, Mobile Banking

Ecobank Sierra Leone is a wholly owned subsidiary of Ecobank Transnational Incorporated (ETI), a leading Pan-African banking group, employing over 14,800 people and operating across 33 markets across Africa. Ecobank Sierra Leone commenced business in November 2006. It provides a wide range of financial services to: Consumers, Commercial and Corporate Banking customers through its head office and branches in Freetown, Makeni, Kenema and Bo.
Ecobank Microfinance SL has a strong customer base in informal settlements/slums in Freetown, including cooking traders in Susan's Bay. Ecobank Microfinance SL confirmed their interest to increase their customer base in Susan's Bay. They confirmed that PayGas affordable cashless clean cooking solution has a real potential to succeed.

Ecobank initial fears:

- Technology unfriendly- very few customers use mobile money
- Micro credit interests are generally very high for small loan amount
- Accidents with gas?

Ecobank was worried that the minimum 5 000 SLL for PayGas purchase do not last for 1 meal. Ecobank advised us to potentially increase to 10 000 SLL.

6. SCOPE OF THE STUDY

6.1. SIERRA LEONE PROFILE

Sierra Leone officially the Republic of Sierra Leone, informally Salone, is a country on the southwest coast of West Africa. It is bordered by Liberia to the southeast and Guinea surrounds the northern half of the nation.

Sierra Leone has a tropical climate with a diverse environment ranging from savanna to rainforests, a total area of 71,740 km2 (27,699 sq mi) and a population of 7,976,985 as of the 2020. [1]

Freetown is the capital and largest city of Sierra Leone. It is a major port city on the Atlantic Ocean and is located in the Western Area of the country. Freetown is Sierra Leone's major urban, economic, financial, cultural, educational and political centre, as it is the seat of the Government of Sierra Leone. The population of Freetown was 1,055,964 at the 2015 census.[2]

Freetown has grown significantly due to internal displacement during the civil war and economic migration (World Bank, 2013). Most migrants have settled in informal settlements because of their proximity to work opportunities and because land and housing are too expensive for people who are mainly employed in small informal businesses. Depending on the definition and categorisation, Freetown has between 27 and 61 informal settlements, scattered along the coast and in the hills. Some of the larger settlements, including Kroo Bay, Susan's Bay, Falcon Bridge and Moa Wharf along the coast, function as small towns with complex internal economies and their own markets, small industries and docks.[3]

[1] https://en.wikipedia.org/wiki/Sierra_Leone
[2] https://en.wikipedia.org/wiki/Freetown
[3] https://www.slurc.org/uploads/1/0/9/7/109761391/slurc_urban_livelihoods_report_web_quality.pdf

6.1.1. KEY NUMBERS ABOUT SIERRA LEONE (AS OF DECEMBER 2021) [4]

Key Indicators

Population	M	**8.0**	HDI	**0.452**	GDP p.c., PPP	$	**1739**
Pop. growth[1]	% p.a.	**2.1**	HDI rank of 189	**182**	Gini Index		**35.7**
Life expectancy	years	**54.7**	UN Education Index	**0.406**	Poverty[3]	%	**76.0**
Urban population	%	**42.9**	Gender inequality[2]	**0.644**	Aid per capita	$	**76.1**

6.1.2. OVERVIEW OF SIERRA LEONE FROM 1990 TO 2020

World view	1990	2000	2010	2020
Population, total (millions)	4.32	4.58	6.42	7.98
Population growth (annual %)	1.5	2.7	2.3	2.1
Surface area (sq. km) (thousands)	72.3	72.3	72.3	72.3
Population density (people per sq. km of land area)	59.8	63.5	88.9	110.5
Poverty headcount ratio at national poverty lines (% of population)	..	..	..	56.8
Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)	72.9	73	54.7	43
GNI, Atlas method (current US$) (billions)	0.8	0.66	2.69	4.06
GNI per capita, Atlas method (current US$)	190	140	420	510
GNI, PPP (current international $) (billions)	2.99	3.08	7.36	13.51
GNI per capita, PPP (current international $)	690	670	1,150	1,690

[4] https://bti-project.org/fileadmin/api/content/en/downloads/reports/country_report_2022_SLE.pdf

People	1990	2000	2010	2020
Income share held by lowest 20%	..	6.6	7.9	7.9
Life expectancy at birth, total (years)	39	39	49	55
Fertility rate, total (births per woman)	6.7	6.3	5.2	4.2
Adolescent fertility rate (births per 1,000 women ages 15-19)	184	161	134	108
Contraceptive prevalence, any method (% of married women ages 15-49)	..	4	11	21
Births attended by skilled health staff (% of total)	..	37	61	87
Mortality rate, under-5 (per 1,000 live births)	260	225	161	108
Prevalence of underweight, weight for age (% of children under 5)	25.4	23.4	18.5	13.5
Immunization, measles (% of children ages 12-23 months)	..	37	82	93
Primary completion rate, total (% of relevant age group)	..	..	68	87
School enrolment, primary (% gross)	47.6	59.6	113.8	141.3
School enrolment, secondary (% gross)	16	24	39	42
School enrolment, primary and secondary (gross), gender parity index (GPI)	1	1	1	1
Prevalence of HIV, total (% of population ages 15-49)	0.6	1.6	1.6	1.5
Wage and salaried workers, total (% of total employment) (modeled ILO estimate)	8.67	7.73	8.73	9.65
Access to electricity (% of population)		12.334	11.462	22.7
Access to clean fuels and technologies for cooking (% of population)	..	0.1	0.4	0.7
Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (per 100,000 population)	..	..	..	81.3

Mortality rate attributed to household and ambient air pollution, age-standardized (per 100,000 population)	..	..	..	324.1
Mortality rate attributed to household and ambient air pollution, age-standardized, female (per 100,000 female population)	..	..	..	333

Environment	1990	2000	2010	2020
Forest area (sq. km) (thousands)	31.3	29.3	27.3	25.3
Terrestrial and marine protected areas (% of total territorial area)	..	..	..	3.3
Annual freshwater withdrawals, total (% of internal resources)	0.1	0.1	0.1	0.1
Urban population growth (annual %)	2.2	3.4	3.3	3.1
CO_2 emissions (metric tons per capita)	0.08	0.09	0.09	0.13

Economy	1990	2000	2010	2020
GDP (current US$) (billions)	0.65	0.64	2.58	4.06
GDP growth (annual %)	3.3	6.7	5.3	-2
Inflation, GDP deflator (annual %)	70.6	3.3	17.2	10.9
Agriculture, forestry, and fishing, value added (% of GDP)	44	55	53	59
Industry (including construction), value added (% of GDP)	18	27	8	5
Exports of goods and services (% of GDP)	35	18	17	15
Imports of goods and services (% of GDP)	34	39	34	36
Gross capital formation (% of GDP)	13	1	31	12

States and markets	1990	2000	2010	2020
Time required to start a business (days)	..	26	12	8

Domestic credit provided by financial sector (% of GDP)	..	..	..	..
Tax revenue (% of GDP)	..	..	..	..
Military expenditure (% of GDP)	1.3	2.5	1	0.6
Mobile cellular subscriptions (per 100 people)	0	0.3	31.2	86.3
Individuals using the Internet (% of population)	0	0.1	0.6	16.8
High-technology exports (% of manufactured exports)	..	..	..	1
Statistical Capacity Score (Overall Average) (scale 0 - 100)	..	..	52	60

Global links	1990	2000	2010	2020
Merchandise trade (% of GDP)	44	25	43	40
Net barter terms of trade index (2000 = 100)	..	100	69	47
External debt stocks, total (DOD[5], current US$) (millions)	1,197	1,248	931	2,114
Total debt service (% of exports of goods, services and primary income)	10.1	76.4	2.7	8.9
Net migration (thousands)	-450	500	-21	-21
Personal remittances, received (current US$) (millions)	0	7	44	59
Foreign direct investment, net inflows (BoP, current US$) (millions)	32	39	238	349
Net official development assistance received (current US$) (millions)	59.3	180.6	458.3	594.6

The country is divided into five administrative regions, which are further divided into sixteen districts. Sierra Leone is a constitutional republic with a unicameral parliament and a directly elected president for a five-year term, with a maximum of two terms. The current president is Julius Maada Bio. Sierra Leone is a secular nation with a constitution that provides for the separation of state and religion and freedom of conscience (which includes freedom of thought

[5] Disbursed and Outstanding Debt

and religion). Muslims make up about three quarters of the population, although there is an influential Christian minority.

During the few decades following independence, Sierra Leone witnessed an increase in political activities, transformations, turmoil, humanitarian and socio-economic crises.

The country had its first general elections as an independent nation on 27 May 1961. In 1991, a brutal civil war broke out, which went on for 11 years with devastating effects on almost everything that defined Sierra Leone as a nation.

About 18 ethnic groups inhabit Sierra Leone: the two largest and most influential ones are the Temne and Mende peoples. About 2% of the country's population are Creole people, descendants of freed African American and West Indian slaves.

English is the official language used in schools and government administration; however, Krio is the most widely spoken language across Sierra Leone, spoken by 97% of the country's population.

Sierra Leone is rich in natural resources, especially diamond, gold, bauxite and aluminium. The country is a member of the United Nations, African Union, Economic Community of West African States (ECOWAS), Mano River Union, Commonwealth of Nations. Sierra Leone is actively supported by organizations such as IMF, World Bank, WTO, African Development Bank, and Organisation of Islamic Cooperation.

Sierra Leone is home to Sub-Saharan Africa's first Western-style university: Fourah Bay College (established in 1827).

Sierra Leone's economy contracted by 2% as the COVID-19 pandemic led to slowdown in all sectors following global supply chain disruptions and lockdown measures. GDP per capita fell by 4% in 2020, reversing some of the recent gains in poverty reduction. According to the latest updated World Bank analysis in 2021, real GDP was expected to rebound by 4.2% in 2021[6], reflecting the easing of COVID-related restrictions as well as the implementation of the government's fiscal response to the pandemic. On the demand side, growth will be driven by domestic demand (as external demand remains subdued), with private consumption and investment contributing the most.

GDP per capita will recover 1% in 2021 and 2% in 2022[7].

[6] https://www.worldbank.org/en/country/sierraleone/overview#1
[7] https://thedocs.worldbank.org/en/doc/b3502c65235d8c72aef5f34d87ed6298-0500062021/related/data-sle.pdf

Large areas of the country remain isolated, with very limited public infrastructure. During the rainy season (May to November), most roads are inaccessible (less than 10% of roads are paved).[8] The border regions with Guinea and Liberia remain volatile. Non-state security providers (vigilantes, private security companies) control certain regions of the country and organized crime groups operate across the borders.

6.1.3. STRENGTHS & WEAKNESS OF SIERRA LEONE[9]

STRENGHTS	WEAKNESSES
Significant mining resources (diamonds, rutile, bauxite, gold, iron ore, limonite, platinum, chromite, coltan, tantalite, columbite and zircon)	Vulnerable to weather conditions
Coffee, rice, cocoa and palm oil production	Highly dependent on commodity prices
Financial support from international institutions (IMF, World Bank, African Development Bank)	Corruption, inadequate protection of property rights
Tourism potential	Hard for small and medium-sized enterprises to access credit
Significant port activity that is set to expand	Inadequate infrastructure, failing health system
	Risk of renewed Ebola outbreak
	Extreme poverty and high unemployment

6.1.4. CLEAN COOKING IN SIERRA LEONE

By 2030, Sierra Leone has ambition to ensure universal access to affordable, reliable and modern energy services.

Target(s):

- Sierra Leone will enhance its activities in the cooking sector with the main target to increase the use of LPG to an adoption rate of 25% as an alternative to wood fuel

[8] https://awokonewspaper.sl/sierra-leone-news-only-10-of-the-11300-roads-are-paved-pres-bio/
[9] Coface : Sierra Leone profile

- Sierra Leone aims for all households to have access to energy-saving cooking solutions.

Context:

Energy consumption of the 7.98 million people in Sierra Leone is dominated by biomass, which accounts for over 80% of energy used. The largest source of biomass energy is wood fuel, followed by charcoal. Imported petroleum products are the next largest source of energy at approximately 13 %. On-grid and off-grid electricity accounts for the remainder of the power supplied to the country's citizens.

Most of the energy production and use in Sierra Leone is concentrated in the household sub-sector, where biomass, in the form of fuelwood and charcoal is used for cooking and kerosene is used for lighting[10].

LPG is the second most used cooking fuel in the West African region after wood-based fuel. Countries in the region where LPG adoption rate is high (above 30%) have all had to put in place subsidy schemes to bolster initial uptake, but whether Sierra Leone is ready to adopt the same approach is open to discussion[11]. It is clear however that LPG must be made affordable to increase to 25% the number of people using it by 2030 as set out in the SE4All Country Agenda. It is also clear that most potential consumers are not yet convinced of the safety of the product thus making awareness campaigns a necessity.

According to the results of the latest Sierra Leone Integrated Household Survey (SLIHS), firewood was the main cooking fuel of 72% of the population in 2018. 27.7% of the households used charcoal.

According to recent estimates only 1% of the households use mainly Liquefied Petroleum Gas (LPG). Thus, 99% of the population depend on biomass for cooking. Firewood remains the main source of cooking fuel in rural areas, although the percentage declined from 97.2 % in 2011 to 95.2 %in 2018. In contrast, only 32.8% in urban areas used firewood, a decline from 50.1% in 2011. In urban areas, charcoal was the most common energy source for cooking, with an increase from 48.8% in 2011 to 66.7% in 2018.

For rural regions, firewood is the predominant source of cooking fuel. In rural areas, inefficient fuelwood cooking methods are widespread, the most common of which is an open "3-stone-fire". In urban centers, the 3- stone-fires are gradually replaced by clay stoves and metal coal pots in parallel. But it is noteworthy that 3-stone-fires still play an important role, even in urban

[10] Ministry of Energy – Republic of Sierra Leone
[11] Ministry of Energy – Republic of Sierra Leone

centers, because the preparation of food with a longer preparation time (i.e. for festivities), is normally done with a 3-stone-fire.

6.2. SUSAN'S BAY OVERVIEW

Susan's Bay is one of Freetown's largest and poorest informal settlements. A British governor established this settlement and named it Susan's Bay after his wife, hence the name of the settlement. The congested slum of Susan's Bay is located on the east coast of Freetown, close to the Atlantic Ocean and is nearby to Mabella Point and Falcon Bridge Point.

Type:	Bay - a coastal indentation between two capes or headlands, larger than a cove but smaller than a gulf
Mindat.org Region:	Sierra Leone
Region:	Western Area, Sierra Leone
Latitude:	8° 29' 29" N
Longitude:	13° 13' 47" W
Lat/Long (dec):	8.49164,-13.22977
climate type:	Am : Tropical monsoon climate
Major challenges:	Floods, fires, poor housing and infrastructure, lack of access energy
Dominant economy activities:	Fishing, charcoal production, wood sales, petty trading

Susan's Bay is located in wards 377 and 378 and ward 107. The landscape of the community slopes steeply towards the sea. Susan's Bay is bounded by Nicole Creek and the community of Mabella. The most important tribes in this community are the Limba, Fullah, Susu, Loko and Temnes, who are mostly of the Islamic faith.

The main economic activities in the community of Susan's Bay are fishing, selling charcoal and wood, and petty trading.
The social-cultural members practice Bondo society and socially participate in Japan Adele and Airy Big Wharf societies. [12]

The community is subject to seasonal flooding from Nicole Creek and the swelling of the sea.

Susan's Bay is governed by a parliamentarian, a councillor, a community leader and ward committees respectively.

[12] https://sdinet.org/wp-content/uploads/2015/04/State_of_11_Coastal_Slum_in_Freetown_Sierra_Leone.pdf

The approximate density population of Susan's Bay is 27,000/km^2 corresponding to 4576 households[13].Due to the density of the community, most of the area is only accessible by footpaths.

People living in informal settlements, such as Susan's Bay, are at greater risk of fire disasters. Dense housing often constructed with combustible material can cause fire to spread rapidly.

6.2.1. Fire in March 2021

A fire that started on the evening of Wednesday 24 March 2021 destroyed homes and businesses. According to a report by the Sierra Leone National Disaster Management Agency, the fire injured 409 people, including 21 children. More than 7,000 people, including 1,200 children, from 1,600 households were left homeless.

The cause of the disaster is not yet known, but the economic and energy poverty of the settlements increases the risk of fire. People often use open fires or have illegal or faulty electrical connections[14].

The fire destroyed 70% of the settlement's infrastructure. Overcrowding, poor sanitation and lack of water made residents more vulnerable to the spread of Covid-19 and increased the risk of water-borne diseases[15].

In addition to the loss of homes and possessions, more than 70% of those affected by the fire have lost their livelihoods, leaving them vulnerable to extreme poverty and hunger. The National Disaster Management Agency and charities provided some families with materials to start building permanent homes, but many are still living in makeshift shelters.

[13] https://en.wikipedia.org/wiki/List_of_countries_by_number_of_households
[14] Henry Kamara Thu 27 May 2021
[15] Henry Kamara Thu 27 May 2021

6.2.2. FIRE IN MARCH 2017

In March 2017, a quarter of the population of Susan's Bay, or 2048 people, were affected by a large fire. The cause of the fire was reported to be a cooking fire started by someone cooking with a locally made stove on their porch (Jabby, 2018).

6.2.3. UNDERLYING CAUSES OF FIRE RELATED TO COOKING AND POVERTY

Energy poverty, housing, inadequate infrastructure and use of solid fuel for cooking are identified as underlying causes of fire in Susan Bay and typical of densely populated areas.

6.2.3.1. HOUSING

Rates of home ownership are low, with 73% of tenants renting from slumlords. Lack of home ownership is reflected in the use of poor-quality materials that require minimal investment by owners and little or no maintenance. Most homes have only one room where all activities take place. The fire therefore affected all aspects of their lives.

6.2.3.2. ENERGY POVERTY

Susan's Bay energy use patterns reflect the usage in other informal settlements in Freetown, with 15.6% of households using an electricity connection for lighting but 70% using flammable kerosene.[16] The low-income residents rely on cheap but hazardous sources of energy, particularly candles, kerosene stoves, hearth fires and illegal and dangerous electricity connections.

The use of these fuels leads to an increased risk of fire due to their combustibility, inefficiency, unsafe practices and technologies. For example, with regard to electricity, due to the cost and lack of a formal electricity grid, residents connect illegally to the electricity grid, resulting in live and often exposed cables. Data on household energy needs for lighting were difficult to find, but the consensus seems to be that most people rely on paraffin lamps, candles or cheaply made plastic battery lamps (Gooding, 2017).

A 2004 study found that the percentage of households using an energy source for lighting was predominantly paraffin, at about 61% (Government of Sierra Leone, 2007).

6.2.3.3. COOKING FUEL USED IN SUSAN'S BAY

[16] https://www.ucl.ac.uk/bartlett/development/sites/bartlett/files/group_2_fires.pdf

The majority (93%) of households use charcoal and firewood for cooking and heating up water. Charcoal and wood for cooking are also fire hazards, mainly due to the quality of wood stoves, space constraints in huts and lack of awareness of the safe use of modern fuels.

Traditional biomass used, mainly in the form of charcoal and fuelwood, dominate the energy mix for household cooking needs in Freetown, with 72.7% use of charcoal and 26% of fuelwood. Paraffin, LPG and electricity account for less than 1% each for cooking needs (RECP, 2018).

Since the end of the civil war in 2002, there has been a significant increase in charcoal production nationally and charcoal consumption in Freetown (RECP, 2018). Three-stone stoves predominate as households also use firewood.

There are real dangers in using all three block fires, as sparks often fly and if they come into contact with combustible materials, they cause serious fires (Gooding, 2017).
Charcoal stoves are more commonly used by all charcoal consumers, with traditional all-metal stoves being the most commonly used and more recently the increased use of wonder stoves' which are much safer and more efficient (RECP, 2018).

ENACT pictures_ Community engagement at Susan's Bay-17th & 18th March 2022

6.2.3.4. INADEQUATE INFRASTRUCTURE

The population density in Susan's Bay is 962 peoples per hectare. External congestion and the lack of roads with vehicle access did not allow the emergency services to act and limit the damage (CODOHSAPA and FEDURP, 2011).

Energy poverty has other widespread impacts on the health of residents due to indoor air pollution, such as respiratory, heart and other diseases (Bouzarovski and Petrova, 2015). It is also

a highly gendered problem, with women and children bearing the brunt of the consequences of inadequate access to energy. Time use makes women more vulnerable as they tend to spend more time at home and engage in cooking activities (Benerjee, 1985).

The poor-quality fuels that women may use contribute to their lack of time, poor health, increased risk of fire and level of drudgery, all of which are indicators that economic and social development is failing women (Benerjee, 1985).

Children are the most physiologically sensitive because their lungs are growing and developing (which air pollution can slow down) and their activities are time-based. Children spend more time at home, especially young children and children from less privileged backgrounds whose families cannot afford to send them to school (WHO, 2005).

3 stones stove and open fire in Susan's Bay (Sierra Leone)

6.2.3.5. SUSAN'S BAY SURVEY

PAYGAS visited Susan's Bay from 14 to 20 March 2022 to better understand and appreciate the needs of the population in terms of fuel and cooking habits, as well as financial capabilities. Due

to the great interest in PayGas' solution, 19 more people were interviewed than originally planned (20 interviews planned initially).

49 people were interviewed including:

- 36 women with an average age of 41.91 years old
- 13 men with an average age of 47.08 years old
- 33 business owners representing 67% of the interviewees.

As stated in Susan's Bay Overview, Susan's Bay is a low-income community, where the most common livelihood activities are fishing, selling charcoal and wood, and petty trading. As a result, it was not surprising to notice that 67% has a small business. Several respondents stated that they had a small catering business whose customers were fishermen.

Profession [17]	**Number of respondents**
Female profession	**36**
business	10
None	4
Trader	19
No answer	3
Male profession	**13**
business	1
driver	3
None	2
Sea Ferry	1
Security	1
Sport	1
Trader	4
Total	**49**

6.2.3.5.1. FAMILY COMPOSITION

In terms of family composition (4.9 members on average). In total, there are 244 family members, including 202 children. Unfortunately, we found out that some adolescents are already parents, which is consistent with the situation of early parenthood in Sierra Leone.

[17] Business and trader are all food-based businesses

6.2.3.5.2. FUEL COLLECTION

In terms of fuel collection, most of the time the women are in charge of this drudgery.

	Who usually goes to collect the main fuel for the cookstove your household uses most of the time?
Child	1
don't know	5
Female	29
Male	14
Total	**49**

In the last month (the last 30 days), respondents had collected fuel on average 55.32 times for household cooking.

	Average of "In the past month (the last 30 days), how many times has this person collected this fuel for household cooking?"
Child	60.00
don't know	12.60
Female	60.14
Male	60.29
Average	**55.33**

6.2.3.5.3. COOKING FREQUENCY

Respondents cook on average 1.85 times a day for more than 2 hours (134.70 minutes). Given its calorific value, LPG can significantly reduce the frequency and duration given its more energetic power compared to charcoal.
LPG is far more energy concentrated than wood: annual per capita cooking requires 43 kg instead of 400 kg of wood. LPG transfers 50% of its energy content to the pot, compared to wood's 10-20% (SUBSTITUTING LPG FOR WOOD: CARBON AND DEFORESTATION IMPACTS, World LPG Association, July 2018, page 03)

Gender	Average of "How often do you cook per day? »	Average of « How long do you cook per day? Min »
F	1.92	143.33
M	1.69	110.80

Average	**1.86**	**134.69**

Yesterday, how much time was this cookstove used for cooking food, making tea/coffee, and boiling drinking water?	
Number of hours	**Number of respondents**
1h	5
2,5h	1
2h	6
3h	9
4h	3
don't know	5
Number of hours	18
Number of minutes	2
Total	**49**

6.2.3.5.4. COOKING HABITS

99% of the respondents of Susan's Bay are cooking with charcoal (coal pot) and wood

What does this household use for cooking most of the time, including cooking food, making tea/coffee, boiling drinking water?	**Number of "In the past 12 months, did any harm or injury happen from using this cookstove, device or fuel?"**
3 stones stove and open fire	1
Coal pot	46
Coal pot and wood	1
Movable fire pan	1
Total	**49.00**

The respondents mostly cook cassava, soup, rice and couscous and mostly use a charcoal pot.

	Cooking technology/fuel used			
Main meal cooked by household	**3 stones stove and open fire**	**Charcoal pot**	**Coal pot and wood**	**Movable fire pan**
cassava leaves		2		
cassava soup		1		

Cassava/potatoes	1			
don't know		4		
rice		23		
rice and couscous		1		
soup		10		
Soup and Cassava leaves		1		
(vide)		4	1	1
Total	**1**	**46**	**1**	**1**

Even for secondary fuel, charcoal is dominant.

	What other fuels and energy sources does this household use in this cookstove or device for cooking food, making tea/coffee, boiling drinking water and/or starting the fire?
charcoal briquettes	7
Charcoal unprocessed	18
Kerosene	15
other	1
wood	7
woodchips	1
Total	**49**

Most of the respondents cook outdoor which is consistent with the poor housing situation in Susan's Bay. However, it does not prevent from fire outbreak (fire of March 2017).

Is the cooking usually done in the house, in a separate building, or outdoors?	
Place where cooking is done	**Number of respondents**
Inside the house	1
Main house	2
outdoor	39
Separate room	2
Veranda	5
Total	**49**

The majority of the respondent deplore a lack of fuel over the past 12 months.

	In the past 12 months, how often was this fuel or energy source unavailable in the quantity you desired?
does not know	1
never	7
Often	3
Rarely	9
Sometimes	29
Total	**49**

In terms of harm and injury due to cooking, almost all the respondents were harmed or injured. As mentioned in the overview of Susan's Bay, overcrowding due to poor housing and infrastructure may partly explain this situation.

	In the past 12 months, did any harm or injury happen from using this cookstove, device or fuel?
Fire in the house	19
none	7
Person burned	19
person burned/smoke	2
Smoke	1
don't know	1
Total	**49**

6.2.3.5.5. FUEL EXPENDITURE FOR COOKING

The respondents spend on average 467,000 SLL for fuel for cooking per month and 1,130,500 for food which represent 3.8 times the minimum wage in Sierra Leone (420,858 SLL). As a result, it is not surprising that most of the respondents (78%) borrow money to cover cooking expenditure. The budget being very limited, affordability of LPG and an appropriate business model are key for the project.

As LPG is far more energy concentrated than wood: annual per capita cooking requires 43 kg instead of 400 kg of wood. LPG transfers 50% of its energy content to the pot, compared to wood's 10-20%. (SUBSTITUTING LPG FOR WOOD: CARBON AND DEFORESTATION IMPACTS, World LPG Association, July 2018, page 03)

Using 467 000 SLL represent roughly 93 kg of wood charcoal per month (1kg = 5 000 SLL)
With the same amount of 467 000 SLL the consumer could buy 23 kg of LPG (1 Kg = 20 000 SLL).
Considering the conversion above (Wood vs LPG) the consumer could spend 50% less on her/his monthly fuel budget by cooking with LPG (10 Kg of LPG = 200 000 SLL vs 467 000 SLL for wood charcoal))

However most of the respondents tell they can afford the deposit and the burner but…most of the time with a credit.

	What is your average monthly spend/budget for fuel (SLL)?	What is your average monthly spend/budget for food (SLL)?
F	555,238.10	1,227,187.50
M	282,000.00	976,000.00
Total	**467,096.77**	**1,130,576.92**

	Do you borrow money for cooking spend?
don't know	1
no	7
Sometimes	3
yes	38
Total	**49**

	Do you think you can afford for paying the cylinder deposit?	Do you think you can afford for paying the burner?
don't know	2	2
yes	47	47
Total	**49**	**49**

	How do you intend to pay for the cylinder deposit?
After	3
After used	8
By instalment	10
By seeing it :)	6

cash	1
credit	10
don't know	4
when I have the money	1
yes	6
Total	**49**

	How do you intend to pay for the burner?
After	4
After used	18
By cooking with it	1
cash	1
credit	12
Defer payment	1
don't know	5
instalment	5
Laybuy	1
yes	1
Total	**49**

6.2.3.5.6. LPG AND PAYGAS SOLUTION DISCOVER

Only 1% of the population of Sierra Leone uses LPG. However, 41% of respondents have tried it but stopped using it because of the important upfront cost (120 000SLL) to purchase a full cylinder every time it is empty.

37% are convinced it changes the food taste in a positive way : when cooking with charcoal all meals got the same “smoke taste”. When cooking with LPG as there is no odours or particles, it exhaust more flavours

This could mean that the adoption of LPG may not be culturally difficult and, combined with affordability and geographical accessibility may be quickly adopt by Susan’s Bay households..

100% of the respondent are ready to test PayGas solution and surprisingly 53% have already heard about PayGas (probably due to the community leaders and different meetings hold).

	Did you already try LPG for cooking?
no	29
yes	20
Total	**49**

	If yes, does the use of LPG change the taste of your food?
don't know	29
Maybe	1
yes	18
yes. Positively	1
Total	**49**

	Have you already heard about PayGas solution?
no	23
yes	26
Total	**49**

Would like to test PayGas solution?	
Responses	**Number of respondents**
Yes	49
Total	**49**

6.2.3.5.7. CONCLUSION

Disparities in access to energy in Susan's Bay mean that some segments of the population are able to participate more than others. For example, residents who have the capacity to use electricity from the stable grid or private generators are able to pursue income-generating activities, while for households that do not, this has a significant impact on their time budget, labour productivity and income.

This means that households' ability to improve their living conditions is reduced while, at the same time, they spend a significant proportion of their very limited income on expensive and unhealthy forms of energy that provide poor quality and/or dangerous fuel.

This type of consumer in extreme poverty is the target of PayGas, as the sale of gas in a fractional manner will address the affordability issue.
Adoption will need to be addressed through marketing programmes, cooking demonstrations and sponsorship.

To encourage potential customers to start using LPG, PayGas can sell the first kit consisting of the cylinder deposit with 1kg of gas and a single burner (390 000 SLL/ 32 USD).

In addition, to overcome the deposit hurdle, PayGas can offer a mini-savings plan until the deposit is fully paid. This mechanism is in place in South African townships and has proven to be effective.

In conclusion, in Susan's Bay, access to modern forms of energy such as LPG is essential for overcoming poverty, promoting economic growth and employment opportunities, as well as providing safer living conditions by reducing fire hazards and limiting toxic fumes.

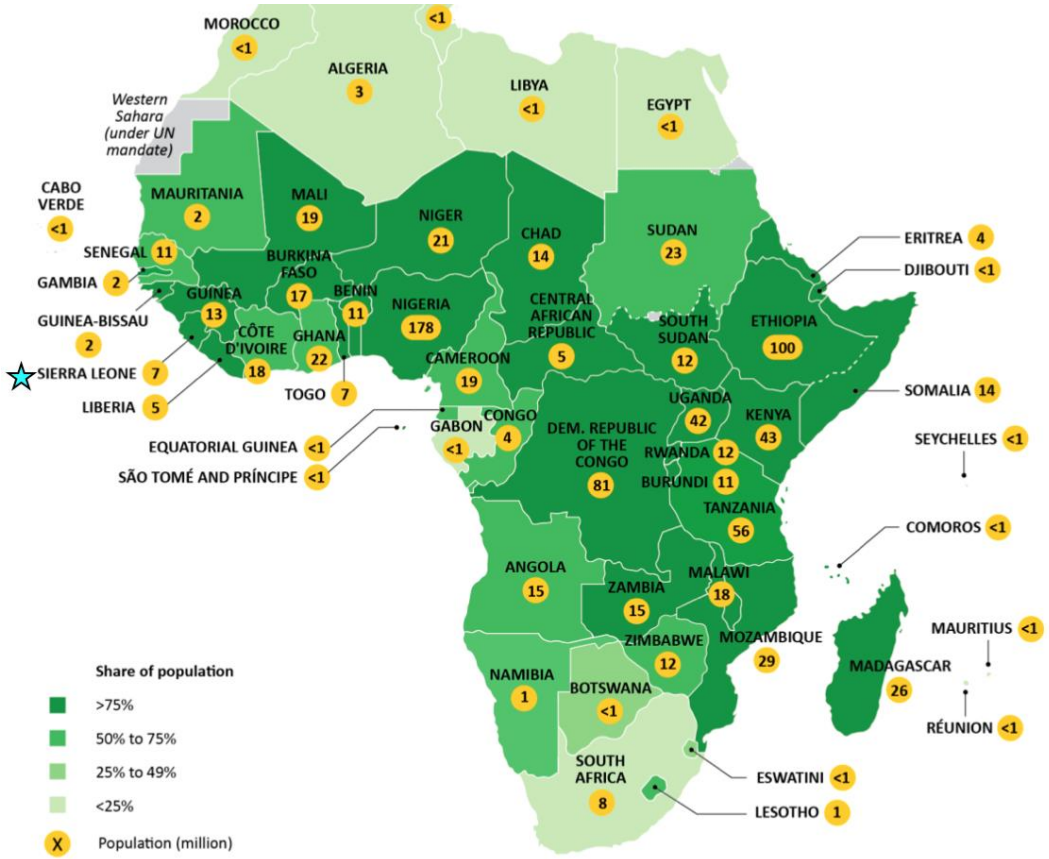
Susan's Bay (Sierra Leone) and PayGas Customer in Cape Town (South Africa)

7. Description of Products and Services

7.1. Problem to address

According to IEA, nearly half of Africans (600 million people) did not have access to electricity in 2018, while around 80% of sub-Saharan African companies suffered frequent electricity disruptions leading to economic losses. In addition, more than 70% of the population, around 900 million people, lack access to clean cooking. The resulting household air pollution from traditional uses of biomass is causing 500 000 premature deaths a year. It also contributes to forest depletion resulting from unsustainable harvesting of fuelwood, as well as imposing a considerable burden and loss of productive time, mostly on women.

Furthermore in 32 African countries, more than 75% of the population is without access to clean cooking, including Sierra Leone.



In 32 African countries, more than 75% of the population is without access to clean cooking (IEA Africa Energy Outlook 2018)

Access to modern energy is a central pillar of efforts to reduce poverty and support economic growth in sub-Saharan Africa.

Modern household energy services have two components:

- first, access to clean cooking facilities, where progress remains slow, with around 900 million people without access today;
- second, access to electricity, where there has been strong progress in several countries over the past decade, but almost 600 million people in sub-Saharan

Beyond households, gaining access to modern energy services is also essential for businesses, farmers and community buildings. One of the most effective solutions to address this problem is the use of LPG as it can be up to five times more efficient (high calorific value) than traditional cooking fuels, produces less air pollutants than kerosene, wood or coal, and emits about 20% less CO_2 than heating oil and 50% less than coal.[18]

7.2. LPG KEY CHARACTERISTICS

Liquefied petroleum gas (LPG), known in some countries as propane, butane, bottled gas, or cooking gas is a clean-burning and efficient cooking fuel used by almost three billion people worldwide.

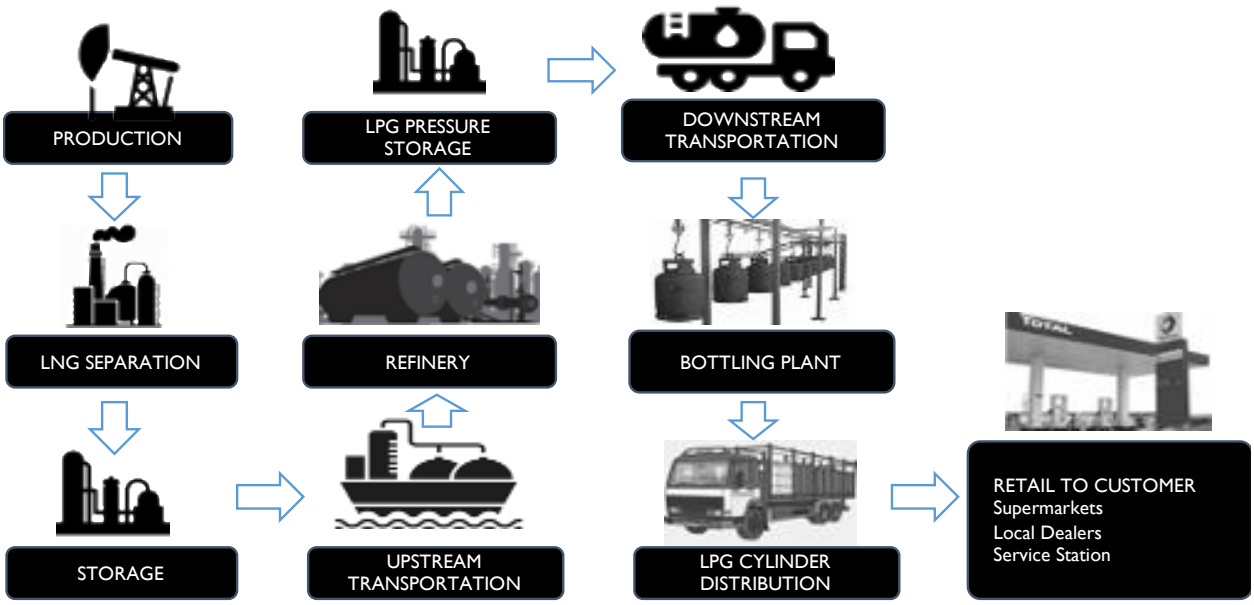
7.2.1. MAIN CHARACTERISTICS OF LPG:

- Produced from the petroleum extractive industry dominated by North America and the Middle East
- By-product of oil and natural gas production and petroleum refining, produced in a highly purified state with two main ingredients being propane (C_3H_8) and butane (C_4H_{10})
- Portable with convenience
- Clean burning nature and non-toxic, colorless and odorless; characteristic smell being from an odorant added to aid detection of leaks
- In comparison to biomass, causes minimal household pollution and negative health impacts (energy access tier 4 solution)

7.2.2. THE LPG INDUSTRY AND VALUE CHAIN

The LPG value chain is made up of a number of different steps starting from production in a raw form to bottled form for the final consumer.

[18] https://www.homeideas.co.za/13-facts-you-might-not-know-about-lpg-gas/



LPG Industry value chain

7.2.3. LPG MAIN BENEFITS

Increased uptake of LPG could:

- Reduce poverty, in particular for women and girls, who are mainly involved in cooking and fuel collection
- Being a private sector-driven industry, have significant potential for job creation and entrepreneurship
- Reduce the amount of time women spent on cooking because of its high energy and calorific value
- Have a positive health effect
- Replace biomass fuels and therefore reduce pressure on forest reserves
- Contribute to reducing net GHG emissions through more efficient combustion and cooking than biomass, leading to lower emissions of CO2 and black carbon per unit of heated food

7.2.4. MAIN BARRIERS TO THE UPTAKE OF LPG[19]

Given the benefits, for LPG to be rapidly deployed in Sub-Saharan African countries, an enabling environment for the sector must be in place to overcome the barriers.

[19] more detail provided in Section 7.2.5

This enabling environment includes:

- Affordability:
    - Transitioning from traditional fuels to LPG requires an initial investment in equipment as well as cash payments for fuel over the lifetime of the equipment.
    - Barriers to affordability can be addressed at several levels by financing the initial investment and operating costs and providing subsidies, consumer financing and adapted business models
    - As LPG use requires the initial purchase of a stove, cost is a significant barrier to adoption and/or repurchase. These affordability issues can be addressed through government or market economies of scale to reduce the price of stoves, or through stove subsidies.

- Accessibility
    - Value chain must be in place and functional, and a distribution system to enable feasible access for the customers
    - Make available spare parts or complete LPG stoves at a single point of sale

- More social development
    - Value chain must involve the local population by creating entrepreneurships and jobs opportunities
    - Promote women entrepreneurship by favouring the women integration in the whole value chain
    - As LPG business will compete with informal charcoal traders and informal LPG sellers, these stakeholders should be integrated in value chain. For example, they can become a franchisee to operate the station, or as a delivery service or marketing agents.

- Regulation
    - Public & private sector and policy makers must support in making the sector commercially viable by financing pilots of disruptive business models as well as allocating entrepreneurship subsidies to the operators and finally set finance solutions to help customers to pay cylinder deposit
    - Regulator must support innovative business model allowing consumers to afford LPG by enabling the “fractional dispensing”
    - Enforcement mechanisms: Enforcement of standards to ensure LPG safety

- Awareness & Education

    - Knowledge and awareness to LPG as a safe and clean alternative must be developed
    - Culinary habits and food taste are also important for LPG uptake and can be addressed through a combination of gas sales and cooking demonstrations (PayGas has hired a chef and partnered with a grocery shop to host "Soup Kitchen" events)
    - Modes of demand creation include general awareness raising of the benefits of LPG (e.g. through media campaigns) and personal contacts through women's organisations or business representatives.
    - Support user training in the safe use of LPG to reduce the fear of explosions.

7.2.5. FOCUS ON SAFETY ISSUES

Many misconceptions of LPG as dangerous is a particular barrier to uptake and making awareness building among key users is a key issue. LPG is a non-toxic but highly flammable fuel that needs to be handled according to good safety practices. All LPG appliances throughout the supply and distribution chain (e.g. storage tanks, trucks, cylinders etc.) are designed specifically for accepting only this fuel, providing an additional level of safety and control (Bizzo et al. 2004).

LPG for household use is generally stored in cylinders made of steel or, increasingly in some wealthier countries, of mixed materials.

To be fully safe and compliant, cylinders require:

- A specific training for the operators to manipulate the cylinders properly
- Regular inspection to maintain, requalify and scrap if in poor condition
- Respect life span of the revalidation date engraved on the cylinder
- Proper cylinder and stove positioning, adequate ventilation and regular inspections of the cylinder and piping system
- LPG cylinders must be sold only by legitimate marketers (licensed LPG companies like Afrigas and NP) and filled to the correct level
- Cylinders must be owned by the gas supplier who will be responsible for maintaining it and ensuring its compliance

7.2.6. FOCUS ON HEALTH IMPACTS

With regard to health issues, there is strong evidence of the benefits of switching from solid biomass fuels to LPG. Almost 3.1 billion people, or just over half (53%) of the population in Low and Middle Income Countries and 43% of the global population cook with polluting fuels.

According to a recent review article by Goldemberg et al. (2018) the current state of scientific understanding indicates that the health impact resulting from direct exposure to smoke from biomass cooking leads to about 2.2–3.8 million excess deaths per year, accounting for about 3.9%–6.4% of global mortality.

As indoor, traditional cooking is the main cause of HAP (household air pollution), shifting to cleaner fuels like LPG can have paramount effects. The latest understanding of the air-pollution-exposure–risk relationship suggests that emissions from cookstoves have to be reduced significantly in order to adequately protect human health.

A 2016 joint study by the World Bank and the Institute for Health Metrics and Evaluation (IHME) sought to estimate the costs of 5.5 million premature deaths from air pollution in 2013. In this study, the cause of death is attributed to both HAPs and ambient particulate matter (PM2.5), with HAPs accounting for 2.9 million.

LPG (and paraffin) cookers are by far the cleanest technologies, with the lowest PM (particulate matter) concentration values compared to other types of cookers (biomass and coal), and even better than the most advanced improved biomass cookers (advanced wood-fired fan-assisted cookers).

For comparison, the PM (particulate matter) emissions from the daily use of a single traditional wood stove are similar to those of a dirty heavy-duty diesel truck driving 20 km (Subramanian et al. 2009).

7.2.7. EMISSION LEVELS FROM USE OF LPG

The combustion of petroleum-based fuels - but also of solid biomass fuels - emits carbon dioxide into the atmosphere. Solid biomass fuels are generally considered renewable, implying no or low net GHG emissions. However, in recent years there has been a growing awareness that domestic combustion of biomass is in fact a significant source of GHG emissions, due to unsustainable logging and management of biomass resources.

Although it is a fossil fuel, the actual emissions from the use of LPG for cooking are very low (LPG emits 20 % less Co2 than heating oil and 50% less than coal).

As LPG has lower greenhouse gas emissions than the alternatives with which it is natural to compare it, it can be assumed that the transition from the use of biomass for cooking to the use of LPG has a potential to mitigate these GHG emissions.

Greenhouse gas emissions from LPG combustion can be estimated with some accuracy because of the extensive information on fuel production and the relatively uniform thermal efficiency of LPG use for cooking.

A report by WLPGA (2018) models the potential for mitigating GHG emissions by substitution of fuelwood with LPG. The model uses standardized values for efficiency and finds that annual per capita cooking requires 43 kg LPG instead of 400 kg of wood. The model further considers forest regrowth time, stove efficiency, soil carbon, and time horizon. On this basis, the potential for carbon reduction from switching from wood to LPG rages between 60 and 70 % in this scenario. If residential LPG becomes an important element in 'energy access' scenarios for poor populations globally, modelling studies find that increasing energy access can have a net cooling impact on the climate by 2100 (Bruce et al. 2017).

Burning wood is dramatically less carbon-efficient than burning LPG. Wood consists of 50% fuel. The rest is molecularly-bound oxygen plus left-over moisture. Neither of these burns, and vaporising the moisture wastes energy. LPG, by contrast, is all fuel. Per unit of delivered cooking heat, burning wood generates about five times the carbon of LPG.

Switching from wood to LPG can reduce cooking's carbon emissions significantly. In the tropics, where much traditional cooking happens, switching cuts net-CO2 output to the atmosphere by 60%.

If, as the International Energy Agency projects, the 800 million to two billion people switching from wood instead used LPG , this would create to a net annual atmospheric reduction of 170-415 million t of carbon dioxide. That lower figure is about equal to the annual emissions of Pakistan or the Netherlands; the larger is about that of South Africa or the United Kingdom.

If, as the International Energy Agency projects, the 800 million to two billion people switching from wood instead used LPG, the annual savings per person are 211 kg CO2, or 1.055 tonnes for an average developing-world household of five people. This latter figure is equal to the emissions of an average, new European car being driven for some 8,000 km.

Source: (SUBSTITUTING LPG FOR WOOD: CARBON AND DEFORESTATION IMPACTS, World LPG Association, July 2018, page 03)

7.2.8. POTENTIAL FOR CONTRIBUTION TO REDUCED DEFORESTATION

According to IEA, bioenergy accounts for about 10% of global primary energy use. Of this, the majority is solid biomass fuel burned for household cooking and heating in the global South (IEA, 2010). This is an important contributor to degradation of forests and deforestation.

According to a recent report by UN Food Agency (UNFA, 2020), while the rate of deforestation globally declined in the decade from 2010 to 2020, Africa was the only continent where deforestation rate continues to increase.

Studies of domestic energy use suggest that socio-economic status is positively correlated not only with the quantity of fuels used, but also the quality of the energy.

Given the properties of LPG, switching from charcoal to LPG is clearly beneficial because for 250,000 tons of charcoal, only 80,556 tons of LPG are needed.

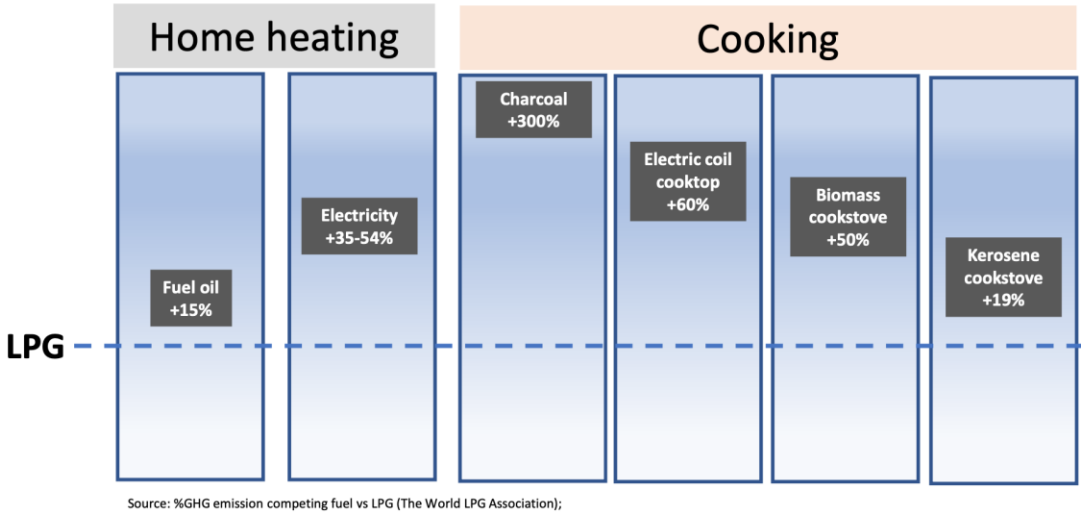
For the wood substitution, the benefits are very clear.

Fuel	Carbon intensity kg CO_2/GJ (LHV)	Thermal efficiency Fuel LHV to cooking heat delivered	Product/residue split	Fuel required kg/GJ delivered heat
Wood	105.4[5] (Johnson and Tschudi, 2012)	15% (World Bank, 2006, p 39) (International Energy Agency, 2017, p 124)	100% product, 0% residue	400 (World Bank, 2006, p 39)
LPG	8.0 well-to-stove (UK Dept of Business Energy & Industrial Strategy, 2016, p 13) plus 64.0 stove-to-stack, i.e. combustion (DECC and DEFRA, 2010) equals 72.0 well-to-stack	50% (International Energy Agency, 2017, p 124)	100% product, 0% residue	42.9 (World Bank, 2006, p 39) (DECC and DEFRA, 2010) (IEA, 2017)

Source: SUBSTITUTING LPG FOR WOOD: CARBON AND DEFORESTATION IMPACTS, the World LPG Association, JULY 2018

Regardless of the application, switching to LPG will help reduce CO_2 emissions compared to competing fuel.

Competing fuels' footprints vs LPG's:



Source: %GHG emission competing fuel vs LPG (The World LPG Association);

7.2.9. TAKEAWAYS FOR FURTHER CONSIDERATION OF LPG AS A CLEAN SOLUTION FOR COOKING

LPG has the potential to substitute charcoal and woodfuels for a substantial part of household energy and could contribute positively toward several of the SDGs, including Access to Energy, Climate Change, Health, and Gender/Equality (SDG nos. 7, 13, 3, and 5).

LPG is 'clean' and sustainable - although it is non-renewable - (at least in the medium term) and can represent substantial positive impact on several important sustainability factors, such as creating jobs and reducing deforestation, GHG emissions, and the number of deaths that each year are caused by indoor pollution.

With only 1% of the population using LPG, Sierra Leone has a significant and untapped potential among urban households as well as the growing demographic spheres referred to as 'peri-urban areas'. This market could be reached with targeted policies and support measures.

7.3. LPG REGULATION IN SIERRA LEONE: PETROLEUM REGULATORY AGENCY (PRA)

PayGas met with Samura Ansumana Tunti, Head of Gas Business Regulation at the Petroleum Regulatory Agency (PRA). The Petroleum Regulatory Agency (PRA) is the regulatory agency that licenses, regulates and enforces the following downstream petroleum activities, including LPG:

- Importation
- Refining
- Storage
- Transportation
- Bunkering

- Retail & Distribution

The PRA ensures regular supply at reasonable standard prices and is a member of the African Refiners and Distributors Association (ARDA) and the World Petroleum Council (WPC).

As PayGas will only be a technology partner (license) for Afrigas and not an LPG distribution company, PayGas doesn't need to fulfil among these regulatory requirements which are for LPG companies.

7.3.1. How is the LPG price fixed?

The price of LPG sold to the end customer is not regulated today, like it is in South Africa. The LPG company can sell at the price they want. On the week of the feasibility study the price was 20 000 SLL per kg. The government wants to regulate it from May 2022. The PRA will meet with Ghana authorities (bilateral relations) to decide how to regulate the price and how to define the formula. The government already implemented tax incentive to promote the import of LPG. Since the Incentive government act 2020, the import duties are null for LPG.

PayGas is used to operate in a regulated price of LPG to the end user environment (fixed margin). In South Africa the Ministry of Energy/ NERSA is fixing the Maximum Retail Price for LPG (MRP) every month like petrol, to protect the customers from too high selling prices from LPG companies. So, whatever the price of LPG will be regulated or stay non regulated, the PayGas business model is not really affected. We are used to operate our business model in both pricing environment: regulated price in South Africa and (completely) unregulated price in Nigeria.

7.3.2. Are there any incentives to prevent shortages?

There is no shortage of gas. The government is facilitating the supply of LPG. Sierra Leone even exports 50% of its imported LPG to Guinea. Exports of LPG to neighboring countries is motivated by the enclosure of those countries (Guinea) with and the high demand of LPG in Guinea. The LPG bullet storage capacity of 50 tons at the import terminal (jetty + one filling plant for each gas company (Afrigas/NP)).

Increase of LPG imports over the last 3 years:

- 2019: 3 800 tons
- 2020: 4 200 tons
- 2021: 4 600 tons

7.3.3. What are the building standards for a refilling plant?

Boundary walls and restrict movements; build a big fire wall around the refilling site. Space required about 25m^2. City council might have space close to Susan's Bay. PayGas identified a potential site at the fishing jetty in Susan's Bay.

7.3.4. IS THERE A SPECIFIC LICENSE REQUIRED TO DISTRIBUTE LPG AS A RESELLERS/DISTRIBUTOR?

Dealers and distributors of legitimate marketers (Afrigas, NP) don't need a license for swap.

7.3.5. HOW DOES THE LPG DISTRIBUTION CHAIN ORGANIZE UNTIL THE END USER?

The LPG distribution chain in Sierra Leone is as follow:

1. The LPG is imported to the LPG terminal (Kissy, Eastern Freetown) with shipping vessels
2. The LPG is transferred into the LPG bullets storage at the LPG terminal where the filling plants of Afrigas and NP are located.
3. The cylinders are refilled at the respective filling plants

There are around 650 000 cylinders in circulation in Sierra Leone. Some of them might have crossed the border with Guinea and Liberia

- 400 000 cylinders owned by Afrigas for 150 000 returning cylinders/clients (working stock)
- 250 000 cylinders owned by NP

7.3.6. WHAT IS THE COST TO PURCHASE LPG (MARCH 2022) AS END USER?

- 6kg = 120 000 SLL to refill and it lasts for 30 days for a low-income family of 6 people = 1,71 USD/ kg
- 12kg = 240 000to refill, combo $40 (deposit + burner+ full cylinder) = last for 60 days for a low-income family of 6 people

NB: in South Africa a low-income family of 4 people is using 7kg of LPG for 30 days, from PayGas data (60 000 buying transaction)

7.4. PAYGAS'S SOLUTION

In 2018, the founder of PayGas, Philippe Hoeblich and Natalia Guida Giampietri decided to tackle the problem of access to clean energy for cooking by creating a start-up which has disrupted traditional household cooking, by dispensing the quantity of gas (LPG) delivered at a patented refilling station, to the amount that customers can afford.

With PayGas, customers can easily walk to the closest gas station in their neighborhood and use their cashless payment or airtime vouchers to buy as much as they can afford. Customers can buy cooking gas with as little as $0.5.

PayGas gas station in Delf township, Cape Town (South Africa)

7.4.1. PAYGAS'S BUSINESS MODEL

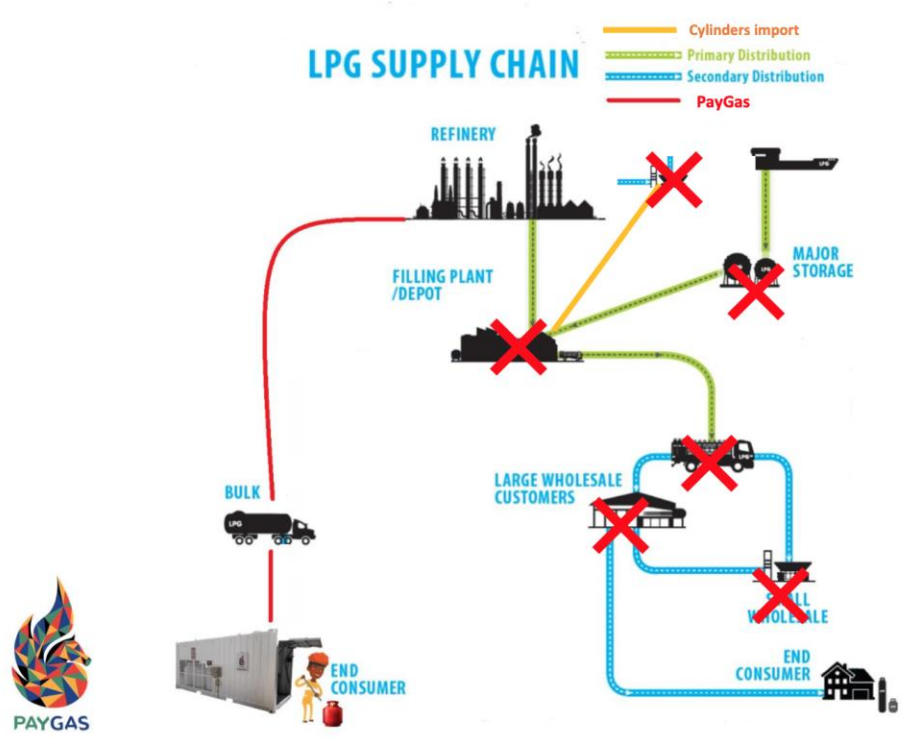
The business model of the PayGas solution relies on 5 pillars:

- **AFFORDABILITY** by breaking the minimum cooking consumption barrier (vs Full cylinder) through a cashless fractional innovative dispensing of gas (minimum $0.50)
- **SAFETY** by protecting customers from hazardous cooking fuels like kerosene, charcoal

- **ACCESSIBILITY** with Hyperlocal refilling station inside low-income communities
- **TECHNOLOGY & IP (TRL 8-9)** by digitizing the customer journey via patented PayGas system
- **ECONOMIC INCLUSION**, each station is operated by a local micro woman franchisee with a profit sharing model
-

7.4.2. PAYGAS'S VALUE CHAIN

PayGas positions itself at the end of the value by buying gas in bulk from the gas supplier directly from the refinery plant. This position has huge benefits for the gas supplier, the end-customers and the community, as it is reducing the gas supplier distribution costs by 40% compared with a cylinder swapping distribution. In the PayGas model the gas suppliers doesn't need to invest in major bottling filling plants, neither in large fleet of trucks transporting full and empties cylinders or wholesalers' depots and cylinders storage.



LPG industry supply chain

7.4.3. FROM PILOT TO COMMERCIAL DEPLOYMENT

Following its first pilot in Delft (Cape Town, South Africa), PayGas launched a pilot in partnership with the 2nd largest retail chain in South Africa – Pick N Pay. The objective was to implement a gas station on the "food path" to accommodate the customers. On one single place, customers can purchase food and gas. The outcome of this pilot was so huge that the gas station reached the breakeven after only 30 days of operation and Pick N Pay decided to continue the partnership by implementing 75 new PayGas stations by 2023.

8. PayGas pilot project plan at Susan's Bay

8.1. The appropriate business model based on Sierra Leone and Susan's Bay context

Despite the situation of extreme despair affecting the housing and energy access of the Susan's Bay population, in particular for the cooking, the survey revealed that the business model of PayGas can meet the demand of LPG in Sierra Leone if:

- prices per transaction remain affordable
- population is properly educated on the safe use of LPG
- burners are made available by the gas supplier (Afrigas)
- payment of cylinder deposit can be adapted to budget if needed (Micro loans via MFI (like Ecobank Microfinance) or Orange Money SL)

PayGas is dispensing the quantity of gas (LPG) delivered at a patented cashless micro refilling station, to the amount that customers can afford: PAY AS YOU GAS™. With PayGas, customers can easily walk to the closest Pay as you Gas™ station in their neighbourhood and refill their cylinder with as little as ($0.50/ 5 000 SLL) of cooking gas with cashless payment.

Considering that a family of 04 members are using 7 KG of LPG to cook for the full month, it represents ((7 kg x 20 000)/30 days) 4 666 SLL per day (PayGas datas based on 62 000 customers buying transactions for a total of 400 tons of LPG in South Africa). So 5 000 SLL will sustained for a entire day (2 meals + boiling bath water).

In the last 12 months, PayGas deployed 10 stations all over South Africa, from Cape Town to Johannesburg. Over the same period PayGas:

- ✓ sold more than 850 tons of LPG to low-income households
- ✓ acquired over 22,000 active households per month
- ✓ registered 165,000+ customer buying transaction, including 70% of partial refilling transactions, representing customers that were excluded from cooking with gas before PayGas.

- ✓ PayGas is busy deploying 75 PayGas stations with Pick N Pay Group and Shoprite located inside South African townships, over the next 3 years.

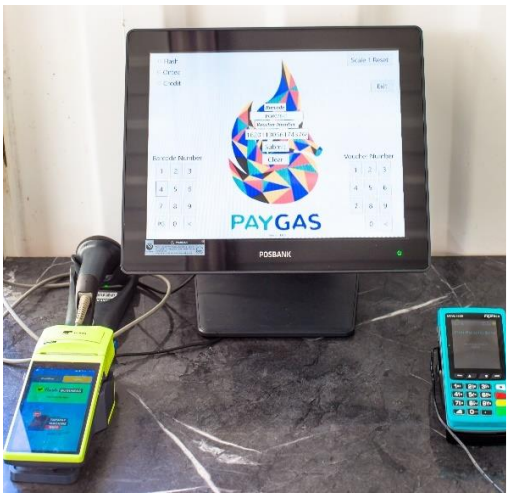
Therefore, PayGas is first a software company who fragments gas with digital payment (enabling access to the consumption of LPG to the lower income) and also supporting local LPG/cylinders suppliers on the capex per client reduction due to the fact that the PayGas model only uses 1 cylinder per client, instead of the usual 4 cylinders per client.

Each of the PayGas client receive a unique barcode on its LPG cylinder and every time this client needs more gas, she/he just brings this same barcoded cylinder to the nearest PayGas station to top up her/his gas.

Each PayGas station is exclusive to the gas supplier which financed it, to avoid any cross-filling. If PayGas ends up working with Afrigas and NP in Sierra Leone, the customers will only be able to use their barcoded cylinders at the closest PayGas station. If the customer would like to purchase their gas at a PayGas station of the competitor, the PayGas operators will change their cylinder for the one of the competitors. As the purchase of gas is normally at walking distance (heavy carry) they are very few chances that this situation occur as the different PayGas stations are strategically located at certain distance the ones from the others.

On the convention industry, however, the refill of cylinders happens on a swap mode by which the client gives his empty cylinder in exchange for a pre-filled one. This traditional model makes that for each client the LPG company needs to invest at least 4 cylinders ($100/client) against the innovative PayGas model, which keeps 1 cylinder/client ($25/client).

The PayGas software was created to track each client's transaction and consumption history as well as each PayGas station's performance including the stock management. By client's history we understand how many times this client came to each PayGas station, how much gas has she/he refilled, and if she/he has any credit in his PayGas account.



PayGas terminal to register the sales

PayGas scale

Differently to the swap model, if the clients come to the PayGas station and refill their cylinders the PayGas software will weigh this cylinder and calculate if there are any LPG residual inside. In case there is (which normally represents 4 to 12% of the weight of the cylinder full) the PayGas software will give this credit back to the client so next time he comes he can refill his cylinder with only his credit, not having to spend any further amount from his pocket.

The PayGas's software station's performance comprises the profitability of each station and also the stock management. It enables the Station's operator to know exactly when he should order gas or cylinders based on the stock on site and the sales for that period.

PayGas is presently deploying in South Africa, Nigeria, Zambia, India, and Brazil, representing a total of 923 cashless refilling stations to offer clean cooking LPG to 4,5 millions of low-income households over the next 5 years.

Empowering People with the freedom to Pay As You Gas™

The PayGas has designed a specific business model for Susan's Bay considering the challenges of this community in terms of safety.

The pilot will consist in launching a pilot PayGas station inside the Susan's Bay community serving clean cooking gas to about 5 000 households/ 20 000 low-income beneficiaries.

The PayGas station will serve 5 000 families, creating about 11 jobs, with a possible extension of the benefits to the 2 neighbouring communities (about 23,000 people): Mabella and Magazine.

Resources needed to run the pilot:

1. Operations manager: The PayGas operations manager will be in charge of training the local operators in sales, safety and on the PayGas system
2. PayGas Marketing manager: The PayGas Marketing manager will train the local marketers on the PayGas awareness/marketing campaign.
3. LPG installer: The PayGas LPG installer will oversee doing the LPG installation on the PayGas container after this station is on site. He will also train the local team on safety to operate the PayGas container.
4. Master electrician: The PayGas Master electrician will be in charge of connecting the PayGas station on site regarding all the PayGas safety standards procedures

For the pilot to run adequately, there are a few steps PayGas needs to put in place:

8.1.1.1. FIND A SUITABLE SITE

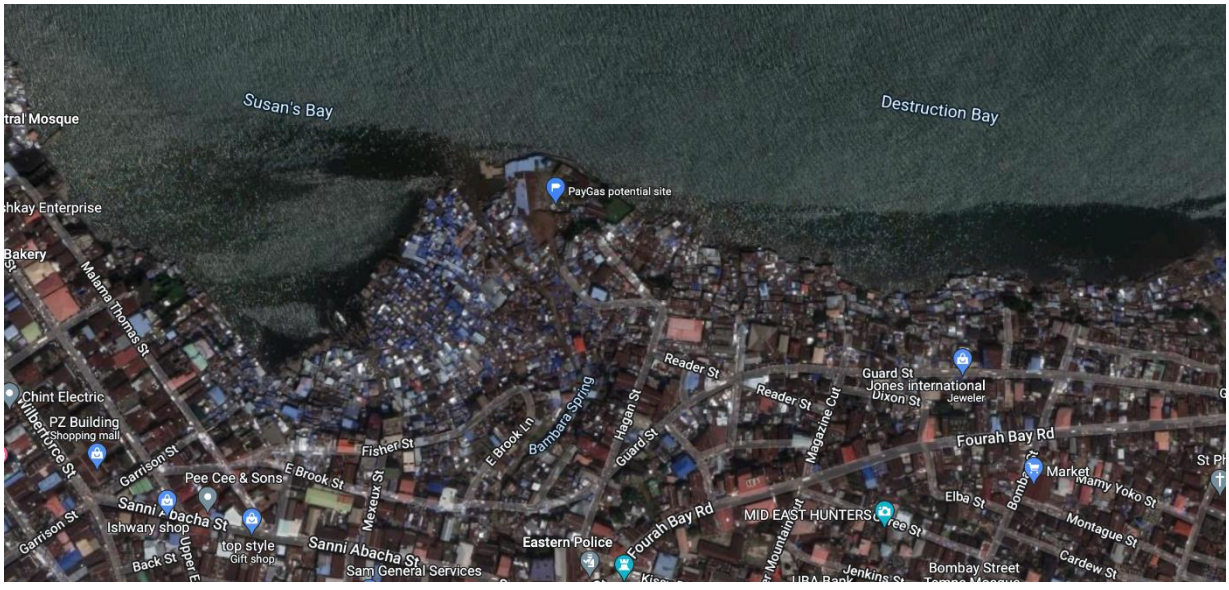
According to the local regulations, the site hosting the PayGas station, needs to be an empty space, easily accessible by the roads to enable the LPG and cylinders delivery and also emergency fire intervention in case an accident happens.

During the sites visit at Susan's Bay, PayGas located 02 possible sites to install the pilot:

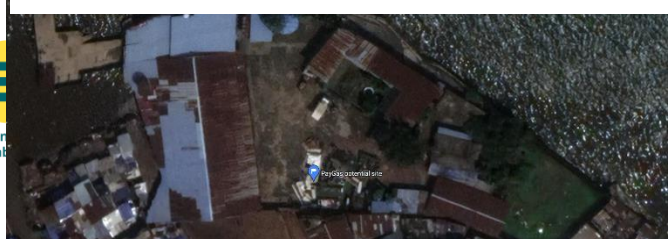
- the frontier between the Susan's Bay and Mabella communities:
- The fisherman's cooperative (1) behind the soccer field (2) (coordinates: 8.4914401, -13.2268517):

- **Fisherman's cooperative:**

This is the safer option as it stands inside an empty and private plot, no high traffic of people and big enough to ensure all the safety and security distances. This site is located at 150 meters from Susan's Bay Community Hall.



Fishermann's Coperative google map views



Fishermann's Coperative google map views. "PayGas potential site" is where we are planning to deploy the pilot station for Susan's Bay community. The red rectangle is accurately indicating the location of the PayGas station on the site (inside the boundary wall)

An option regarding the civil works to the pilot is to create a separate entrance to the PayGas clients, ensuring the cooperative is not disturbed by the high volume of people entering on their site boundaries, and in the same time that the PayGas clients have easy access to gas usage.

- **The corner of the soccer field:**

An alternative space could be the other side of the cooperative wall, which is also an empty space, but serves as a bench to the local soccer supporters:

corner of the soccer field

This space is a bit more congested by the foot traffic of people as it surrounds a soccer field. A big firewall would be mandatory to prevent any vehicles or any sources of ignition to get close to the station. However, from the commercial point of view the site is more visible to the community passing by. PayGas will only require 40m^2 on side of the soccer field. PayGas will asked the FCC to advise regarding the 02 optional sites.

Potential PayGas site

Both sites are compliant from the regulation point of view and very well located in terms of access to the community (short distances from their homes).
PayGas and Afrigas/NP will require a lease agreement with the landlord for the Fisherman's cooperative as soon as ENACT will confirm the output of the feasibility study and pilot implementation plan.

8.1.1.2. GET A SITE CERTIFICATE (REGULATION)

The local LPG company (Afrigas/NP) partnering with PayGas will engage with the local authorities to get a site's compliant certificate to start operations.

It is important that this is an initiative from the local partner as this site will be operated on the daily basis by him, so the certificate needs to be on his name.

The LPG partner will have to submit plans to the Freetown City Council containing the PayGas station and all the safety distances required to operate an LPG refilling site with a stock of

molecules superior to 1 ton. From local partner it doesn't seem to be more than 02 to 04 weeks to get the plans approved

As the PayGas station design is patterned, PayGas will work closely together with the LPG partner to ensure that our safety standards are also respected, and that the container can be deployed safely.

8.1.1.3. CONTAINER MANUFACTURE AND SHIP FROM SA:

The PayGas technology consists of a mix of hardware and software, which enables the fragmenting gas with digital payment. So, for the pilot project PayGas will ship its patterned container including all the hardware required to enable the technology to work locally and safely. That includes a container containing:

- 02 pump/scale.
- The complete LPG installation with a spare of the material in case the station needs maintenance in the next 6 months.
- Electrical connections and earthing pre-settled (connection will be done locally);
- Internet access points (connection will be done locally).
- 04 Fire extinguishers

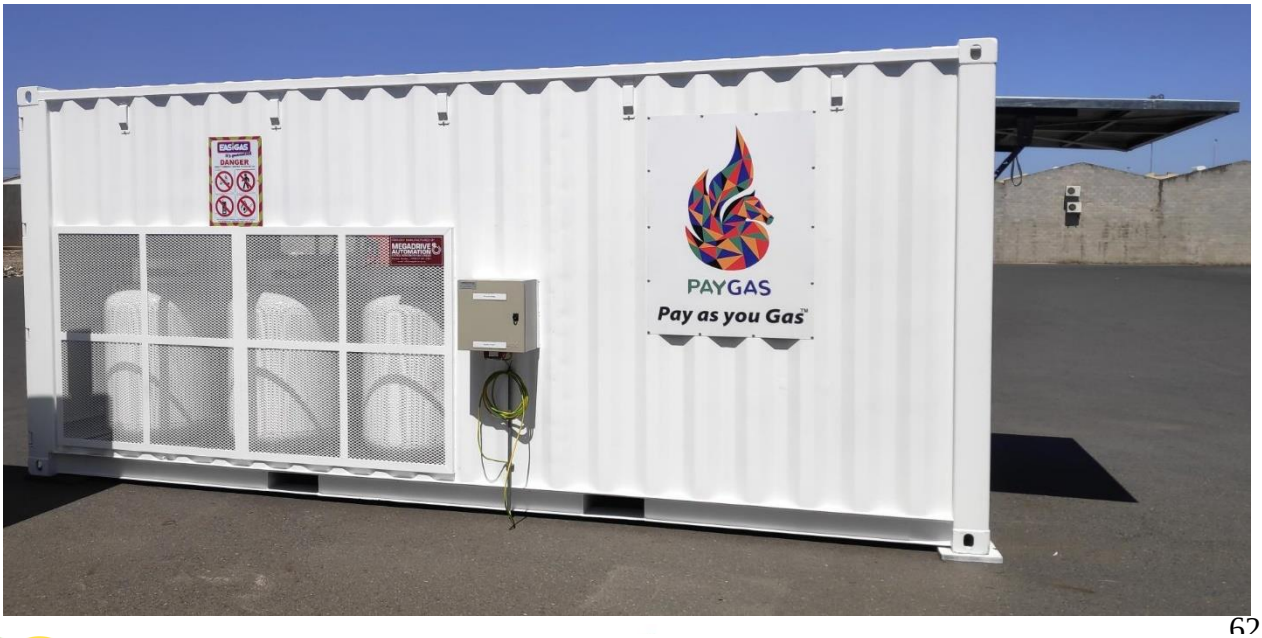
8.1.1.4. CONTRACT WITH A LOCAL GAS AND CYLINDERS SUPPLIER: PARTNERSHIP CONTRACT/INVESTMENT AND RESPONSIBILITIES

As mentioned on the business model, PayGas wishes to deploy inside the community of Susan's Bay a co-responsibility model (site AB), by which PayGas will bring the technology (software + hardware) and the local LPG partner will operate and co-maintain the asset, perceiving its revenue discounted from the PayGas royalties (15%).

The below projection are based on the average performances of the 10 PayGas stations in presently in operation:

	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23
Tons of LPG Sold	2	4	6	6	7	5,5	4	6	5,6	7,4	6,6	7	8,4
Estimated revenue	$3 006	$4 831	$7 732	$7 630	$8 933	$7 539	$6 607	$9 447	$9 368	$12 918	$11 333	$12 152	$14 771
PayGas Royalties 15%	$ 451	$ 725	$1 160	$1 144	$1 340	$1 131	$ 991	$1 417	$1 405	$ 1 938	$ 1 700	$ 1 823	$ 2 216
LPG partner revenue	$2 645	$4 252	$6 804	$6 714	$7 861	$6 634	$5 814	$8 313	$8 244	$11 368	$ 9 973	$10 694	$12 999

For that, PayGas will sign a contract with the LPG supplier (AFRIGAS/NP) engaging each one's responsibility as well as a minimum supply of LPG and cylinders available for the PayGas pilot.



PayGas container

CAPEX per PayGas station		USD
fire equipment	Equipment	200.00
insurance	Equipment	300.00
Certification/Alvara	Equipment	500.00
Containerised station	Equipment	30,000.00
customs taxes	Taxes	6,000.00
Shipping	Service	6,000.00
LPG Site Construction (100sqm)	Equipment	5,000.00
LPG installation (CoC)	Equipment	7,000.00
02 LPG pumps modified (PAYGAS)	Service	15,000.00
Plumbing and Electricity (CoC)	Service	1,000.00
Public Opening/Education	Marketing	3,000.00
Orange Money integration	Service	5,000.00
Training/Consulting/Safety	Service	8,000.00
project management		10,000.00
travel & hotel		5,000.00
Contingency		10,200.00
Total CAPEX		**112,200.00**

The above estimated budget is non-binding and may be revised according to revisions beyond PayGas' control such as currency fluctuations.

8.1.2. THE TIMELINE TO FORECAST A POTENTIAL DEPLOYMENT

Comitology & RACI of the project to be agreed between all the parties		
KPIs		**Requirements**
- number of transactions		- ENACT agreement signature
- number of customers		- Afrigas/NP agreement signature
- number of beneficiaries		- Creation of PayGas Sierra Leone
- volume of gas sold		- Orange Money agreement signature
- number of women hired		- PayGas / Afrigas/NP plans approval
		- Employee's training

	week 4	week 1	week 2	week 1	week 2	week 1	week 2	week 3	week 4	week 5	week 6	week 7	week 8	week 9	week 10	week 11
	02-May	09-May	16-May	23-May	30-May	06-Jun	13-Jun	20-Jun	27-Jun	04-Jul	11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug
Pilot agreement between ENACT & PayGas																
Payment by ENACT of 50%																
Project framing																
Commercial agreement between PayGas and Afrigas																
PayGas container manufacturing																
PayGas container shipping																
Site visit with the Afrigas team (site compliance)																
Site plans draft and submission to the local authorities prior to construction																
PayGas / Afrigas Site plans approval																
Site construction (Slab/firewall/electrical connections)																
Container installation (electrical works, internet access)																
Payment by ENACT of 30%																
PayGas training: - System's operations - Sales - Safety - Marketing Campaign																
Station's official opening																
Payment by ENACT of 20%																

The estimated planning is non-binding and comitology & RACI of the project to be agreed between all the parties.

8.1.3. MAIN RISKS AND MITIGATIONS

		Risk detail			Actions for risk mitigation
Category	Project phase	Risk description	Root cause	Consequences	Description
1.1.1. Country Risk	Operations	Crime: potential degradation of the station due to criminal acts	Location of the stations in the slums	Station shutdown and loss of revenue	Have the station operated by a local community member selected as a PayGas expert Installer des caméras de sécurité
1.1.3. Economic environment	Operations	Economic recession: decline in sales	Downturn in the local economy	Decline in revenue	Competitive advantages of fractional selling
1.1.4 Volumes	Operations	Gas shortage	Embargo, economic recession, ...	Falling sales	Negotiate stocks with gas companies and authorities
1.1.5. Investors relations	Operations	Growth targets not met	Poor governance	Failure to meet growth targets and postponement of the breakeven	Relocate the station in another customer area
1.1.7. Competitors	Operations	Copy cat	New player on the market	Slower growth	Technology of PayGas protected by IP.
1.3.4. Marketing adequacy	Operations	No adoption of the solution	Culinary culture and fear of gas	Stagnation of sales	Adoption study, events, sponsorships, partnerships with women's groups, advertising

8.1.3.1. ASSUMPTION OF AVOIDED DEFORESTATION BASED ON WLPGA MODEL

Assumption of avoided deforestation based on WLPGA model	Quantity
Average household size, Susan's Bay (according to survey based on 49 respondents)	4.90
Households using biomass fuels, global	5,000.00
t LPG to replace product/byproduct wood per household	0.21
ha forest saved for 1 t LPG	0.01
ha forest saved for 5000 households	46.20

Switching 100 households from consuming 200 tonnes of harvested wood a year to consume instead 21.5 tonnes of LPG would save one hectare of forest each year. Each household would save about 100 square metres of forest. A typical 13 kg cylinder of LPG would avert deforestation of a 6 m2 forest area. Source: (SUBSTITUTING LPG FOR WOOD: CARBON AND DEFORESTATION IMPACTS, World LPG Association, July 2018, page 03)

9. RECOMMENDATIONS

Based on the information presented in this feasibility study, it is recommended that ENACT choses a model based on model 'AB' between PayGas and Afrigas/NP:

PayGas will install at the Fishing Jetty a complete PayGas station financed by ENACT and operated by Afrigas. This PayGas station will contain:

i. A refilling part: 01 Pump, 01 scale and the PayGas technology – "Pay-as-you-Gas™"
ii. The LPG storage inside the station will be equipped with 20x 55 Kg cylinders from Afrigas/NP
iii. A cylinder's cage with about 200 cylinders in stock

Tasks and responsibility sharing between PayGas and Afrigas/NP at the Susan's Bay station

Afrigas/NP role		**PayGas role**
Staff to recruit to operate the station (opex)	**Sites AB 7 years contract**	PayGas station manufacturing
		PayGas IP/software
LPG purchase		Cashless payment integration
Cylinders purchase		Safety monitoring/training expertise
LPG installation co-maintenance		LPG installation and co-maintenance
Site Rental/site certificate issuing		LPG compliance co-responsibility
Local Marketing and education		PayGas broad marketing and education
Overheads: electricity, internet, security		Signage and branding
Cylinders capex savings		15% revenue-based royalties

* 7 years renewable license contract, based on performances and volumes sold.

To meet the particular conditions of the families living in Susan's Bay (extreme poverty and lack of access to a clean cooking) PayGas is proposing this station AB to set-up/run the pilot and eventually scale up the business, in partnership with Afrigas/NP.

This option would enable 11 direct jobs creation inside Susan's Bay, such as:

- Three (3) Salesperson
- Two (2) Technical LPG refillers
- (3) Marketing and community education
- (2) Cylinders delivery
- (1) technical maintenance

These operators will be under the responsibility and managed by Afrigas/NP, the operating partner of the PayGas Susan's Bay station.
These are the stakeholder's tasks and responsibilities regarding the PayGas Susan's Bay pilot.

PAYGAS

PHASE 2: PAYGAS – AFRIGAS PARTNERSHIP SUSAN'S BAY

Salient terms	
CAPEX - Financing 01 PayGas station	ENACT
TECHNOLOGY/ Branding - Manufacturing, transporting, setting -up, launch the PayGas station - Provide its Pay -as-you-Gas™ system - Set-up the site/ civil work (concrete slab + fire walls+ cage) - Training of AFRIGAS operators (Susan's Bay) - Commercial/marketing/Operations - Revenue sharing (15 %)	PAYGAS
OPERATIONAL/Supply: - Provide the LPG storage tanks (50 kg * 20) - Deliver LPG to the stations (50 kg cylinders) - Risk assessment for the site - Site/Plans/Construction overview - Operate the station/ serve the clients - Maintenance of the PayGas station - Access to client and production data	AFRIGAS/NP
Key considerations	• Additional benefit: by starting the PayGas Susan's Bay pilot , the 02 gas suppliers in SL might be interested to deploy 1 to 5 PayGas Pilots (01 Afrigas+04 NP) for a total investment of $600 000 (TBC) and an estimated impact of 100 000 very low -income beneficiaries in Freetown, SIERRA LEONE .

PAYGAS Pitch deck – February 2021 – Confidential

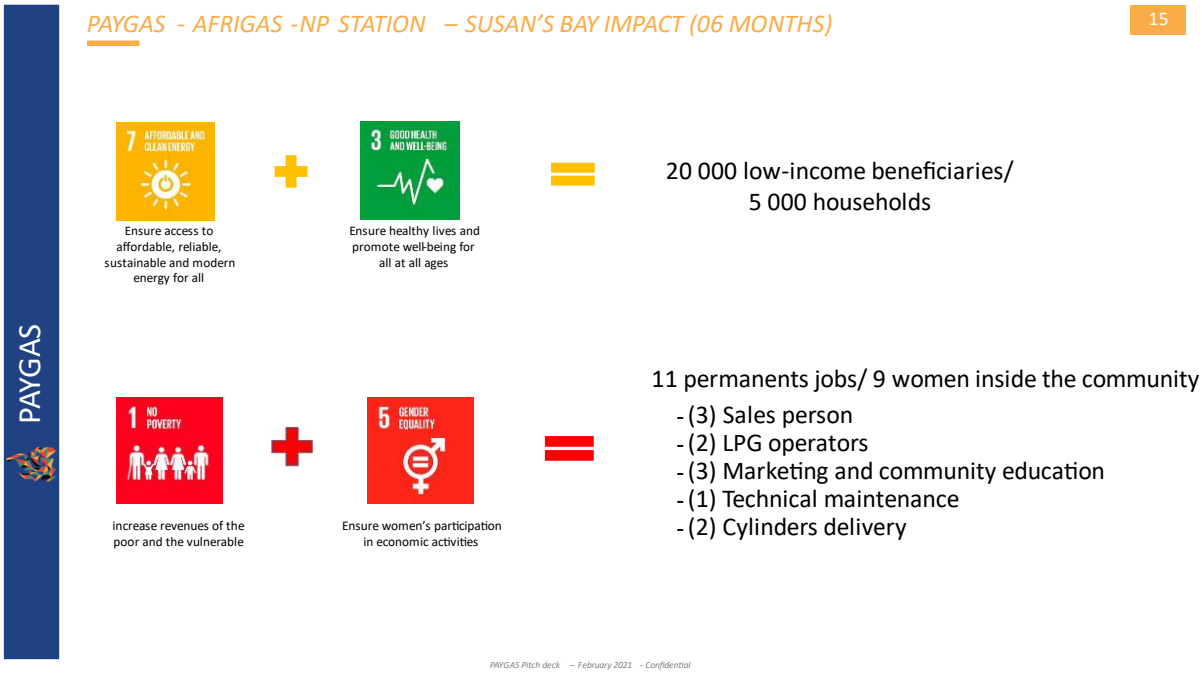
By choosing this model PayGas/Afrigas/NP would actively participate on the training and education of the Susan's Bay community, creating awareness about its product and preventing accidents by ensuring the site's compliance and safety. In term of local job creation, a specific focus will be done on reconverting the charcoal and fuelwood producers into cylinders delivery and marketing and communication education inside Susan's Bay.

Compared to traditional fuels such as kerosene, wood or coal, LPG is five times more efficient, produces less air pollutants, and emits approximately 20% less CO2 than heating oil and 50% less than coal.

By investing 112 200 USD in a "Pay-as-you-Gas™" cashless refilling station in Susan's Bay provided by PayGas and operated by Afrigas that will be deployed in 03 months, ENACT will be able to provide an affordable clean cooking and economically viable solution to the community of 27 000 low- income people in Susan's Bay.

The community of Susan's Bay will easily walk to the *Pay as you Gas™* station at the Fisherman jetty and use their cash to buy an Orange Money voucher provided by the PayGas/Afrigas/NP operator to purchase the quantity of cooking gas (LPG) with as much as they can afford. The customers will be able to buy their cooking gas with as little as 5 000 SLL.

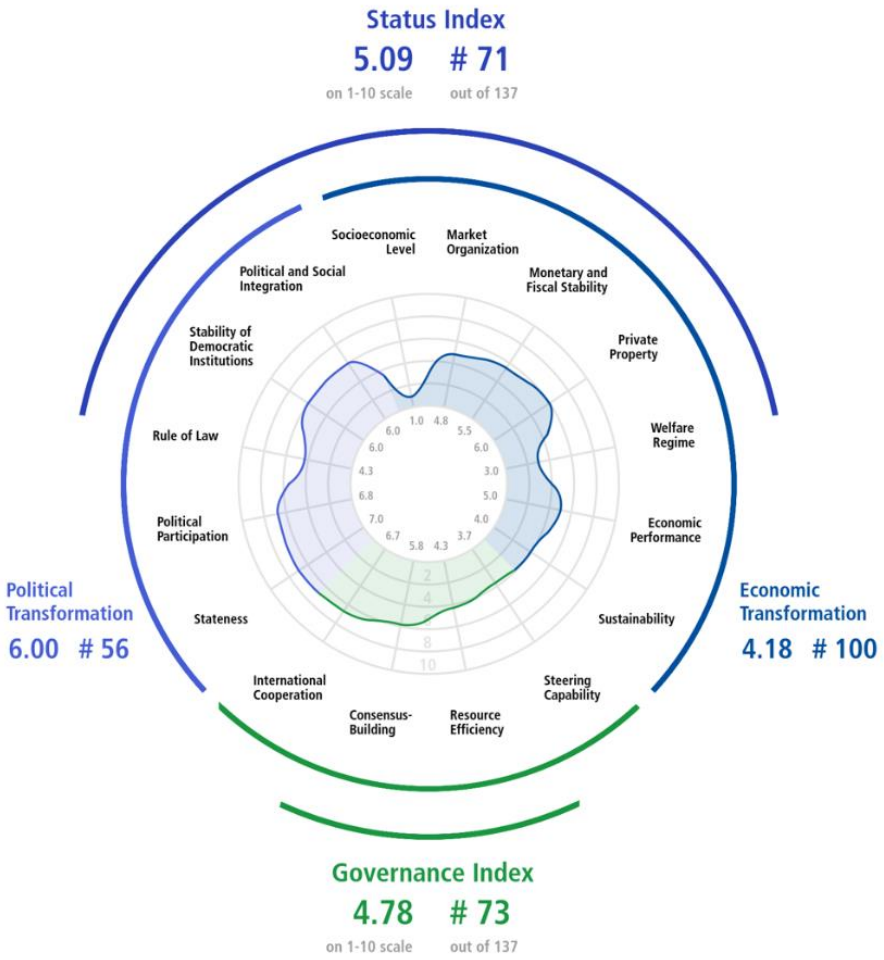
The SDG impacts that are targeted by the PayGas Susan's Bay station operated by Afrigas/NP over a period of 6 months are the following:



PayGas provides access to affordable clean cooking.
Cleaner cooking fuel equals better health.
PayGas participates in the creation of small businesses, including those led by women, and supports access to financial services and integration into value chains and markets.

10. APPENDICES AND LIBRARY

10.1. MORE DETAIL ABOUT SIERRA LEONE



10.1.1. ADMINISTRATION

Basic administrative functions of the state remain highly insufficient, delivery of public services is inadequate, and the majority of the population lives in poverty with only very limited socioeconomic perspectives.
Mismanagement, corruption, clientelism and the lack of human, as well as material resources curtail the functioning of state institutions on all administrative levels.

10.1.2. EMPLOYMENT

Most people in Sierra Leone make a living working in the informal sector and/or rely on subsistence farming. The institutional framework for market-based competition is inadequate. Free and fair competition, unrestricted participation in the market and a level playing field for all market participants do not exist. The majority of people lack the resources to enter the market – due to low education levels, lack of capital and insufficient framework conditions.

10.1.3. BANKING SYSTEM

The banking sector remains deficient. Flaws in directives and management, a weak policy and legal environment as well as inadequate bank coordination continue to hamper its performance. A shortage of skilled professionals, insufficient technological resources, a deficient interbank market, the absence of credit-risk information, inadequate short-term financial markets, an absence of long-term finance and foreign currency lending combine to pose significant challenges to the banking system. For example, in the World Bank's Doing Business "getting credit" category for 2020, Sierra Leone's banking system was found to perform well below the regional average. Credit information is difficult to obtain, and the rights of lenders and borrowers are not effectively protected.

10.1.4. ENVIRONMENTAL POLICY

Environmental concerns are subordinated to growth efforts. Whereas a legal framework for environmental regulation does exist and the government under President Bio rhetorically embraces environmental sustainability just as its predecessor did, enforcement of environmental laws is weak, and a comprehensive environmental policy is not implemented.
Laws such as the Environmental Protection Act 2000, institutions (Environment Protection Board) and strategies (Convention on Biological Diversity membership since 1995) did not result in policy formulation and implementation that take into account criteria for sustainability. Deforestation, erosion, environmental damage caused by mineral and sand mining, overfishing and unplanned urban development endanger the livelihoods of future generations.

10.1.5. EDUCATION

The government launched the Free Education Quality Program in August 2018 and declared human capital development one of its main objectives. Construction of additional schools and recruitment and training of additional teachers was announced, school fees were scrapped, the purchase of learning materials subsidized, and public schools promised subsidies for furniture, basic amenities and the expansion of their infrastructure. The education system as a whole remains deficient, but before the COVID-19 pandemic, some positive trends materialized. According to UNESCO, the pre-primary education gross enrolment ratio was 19% in 2019, up from 14% the year before. School enrolment figures provided by UNESCO for primary education also show a positive trend (up to 144% in 2019 from 113% in 2018), but for secondary schools the total gross enrolment ratio was 41% in 2017, and no data is provided for subsequent years. Likewise, UNESSCO did not provide data for tertiary education, which points to the fact that only a very small, privileged minority of students attends university.

10.2. LIBRARY

https://www.coface.com/Economic-Studies-and-Country-Risks/Sierra-Leone
https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=SLE
https://www.advanceconsulting.nl/projects/liberia-lpg-bulk-storage-and-distribution/
https://www.worldbank.org/en/country/sierraleone/overview#1
https://bti-project.org/en/reports/country-dashboard/SLE
https://www.theguardian.com/global-development/gallery/2021/may/27/after-the-inferno-sierra-leones-poorest-struggle-to-recover-from-slum-fire-in-pictures
https://www.unicef.org/media/115056/file/Sierra-Leone-HAC-Situation-Report-2021.pdf
https://en.wikipedia.org/wiki/Sierra_Leone
https://data.worldbank.org/indicator/SP.POP.TOTL?locations=SL
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4256045/
https://iea.blob.core.windows.net/assets/2f7b6170-d616-4dd7-a7ca-a65a3a332fc1/Africa_Energy_Outlook_2019.pdf
https://www.mindat.org/feature-2403670.html
https://www.slurc.org/uploads/1/0/9/7/109761391/slum_mapping_report_2014_final.pdf
https://www.ucl.ac.uk/bartlett/development/sites/bartlett/files/group_2_fires.pdf
https://www.un.org/sites/un2.un.org/files/energy_compact_for_sierra_leone_.pdf
https://rise.esmap.org/data/files/library/sierra-leone/Energy%20Efficiency/EE%201.2.pdf
https://pd.gov.sl/assets/regulations/PEPA-2011-07.pdf
http://www.energy.gov.sl/NATIONAL%20ENERGY%20POLICY.pdf

https://iopscience.iop.org/article/10.1088/1748-9326/aaa49d/pdf
https://openknowledge.worldbank.org/handle/10986/25013
https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_542024.pdf
https://ilostat.ilo.org/topics/wages/
https://awokonewspaper.sl/sierra-leone-news-only-10-of-the-11300-roads-are-paved-pres-bio/
https://sdinet.org/wp-content/uploads/2015/04/State_of_11_Coastal_Slum_in_Freetown_Sierra_Leone.pdf
https://www.slurc.org/uploads/1/0/9/7/109761391/slurc_urban_livelihoods_report_web_quality.pdf

10.3. QUESTIONNAIRE

Questionnaire n.	Gender	age	Profession	From which place of Susan's bay are you coming from?	Family	How many Adults in your household?	How many Children in your household?	How old is the youngest family member?	How old is the oldest family member?
1	F	27	Trader	45 Susan's Bay	Sesay Family	4	4	5	47
2	F	75	Trader	28 Susn's Bay		9	3	4	75
3	F	63	Trader	49 Susan's Bay	Maariama	6	3	2	63
4	F	56	Trader	25 Main street	Kamara family	7	10	3	56
5	F	45	Trader	33 Main street	Sesay family	2	3	4	45
6	F	54	Trader	35 Susan's By	Koroma family	9	10	0.58	54
7	F	30	Trader	43 Susan's Bay	Kamara family	7	5	2	30
8	M	56	Trader	27B Susan's Bay	Mohammed Koroma	3	4	4	56
9	F	32	Trader	43 Susn's Bay	Kamara family	5	3	9	40
10	M	55	Trader	33 Hagam st	Kamara family	4	3	6	55
11	F	38	Trader	30 Susan's Bay	Barrie Family	3	3	9	38
12	M	65	Trader	20/15 group Lane	Koroma fmily	2	3	6	65
13	M	42	Security	33 Hagam st	Kamara family	3	5	3	85
14	M	27	Sport	21 Fisher st	Sesay family	3	4	3	50
15	F	50	Trader	43 Susn's Bay		4	2	6	50
16	F	52	Trader	42 Susn's Bay		9	4	0.5	52
17	F	60	Trader	43 Susan's Bay	Kamara family	1	2	3	60
18	F	25	None	45 Susan's Bay		9	4	1.5	25
19	F	40	Trader	45 Susan's Bay		7	3	7	40
20	F	45	Trader	43 Susan's Bay		4	2	2	45
21	F	20		46 Susan's By		2	1	1	29
22	F	35		45 Susan's Bay	Kamara family	4	3	2	45
23	F	19	Trader	no address		6	1	7	35
24	F	25	Trader	45 Susan's Bay		2	1	7	32
25	F	36	Trader	no address		5	2	13	36
26	M	46	Trader	Community Center	Kiadiatu Turay Family	10	8	2	78
27	F	40	None	Susan's Bay community hall	Isata Bamgula	4	6	2	52
28	M	62	business	Mill st community	Osman Kamara	3	2	1	62
29	M	25	none	Mill st community	PA Alimany	6	3	1	49
30	F	42	None	Mill st community	Yebu Kamara	7	6	1	69
31	F	38	Trader	Susan's Bay community hall	Aminatha Kargbo	1	1	1	38
32	F	36	business	Mabaya community	Mabiniy Kargbo	7	2	3	47
33	F	64	Trader	Susan's Bay community hall	Yanoh Kamara	9	6	3	64
34	F	32	none	Mill st community	Intmatz	8	10	2	55
35	F	45	business	Mabaya community	Zanabu Turay	4	4	2	48
36	F	27	business	Mill st community	Sally Sannoh	8	4	4	29
37	M	30	driver	Mill st community	Santigie Kamara	2	4	3	30
38	F	55	business	Mill st community	Hawancta Kamara	2	2	0	55
39	F	39	business	Mill st community	Mbaly Sesay	5	4	4	39
40	F	59	business	Susan's Bay community	Mariatu Sesay	11	6	3	59
41	M	51	driver	Susan's Bay community	Alimamy Kamara	1	4	2	55
42	M	56	driver	Mill st community	Obai Tsangura	4	3	2	56
43	M	54	None	Mill st community	Ibrahim Bangura	4	10	2	65
44	F	46	business	Robot st	Marie Cecil	6	5	1	46
45	F	45	business	Biquaw	Kesila	5	6	5	45
46	F	don't know			Isatu Kabia	8	7	7	20
47	F	35	business	47 Susan's Bay	Abibatu Kmara	2	4	1	39
48	F	37	business	97 Hogan st		6	4	5	37
49	M	43	Sea Ferry	Magazine community	Osman Kamara	1	3	10	43

Who usually goes to collect the main fuel for the cookstove your household uses most of the time?	Who usually goes to collect the main fuel for the cookstove your household uses most of the time? (gender)	On a single trip, how long does it take for this person to go to collect the fuel, get the fuel, and come back? (min)	In the past month (the last 30 days), how many times has this person collected this fuel for household cooking?
Aminatha	Female	2	2
Hawa	Female	1 min	60
Maariama	Female	2 min	60
Child	Child	1 min	60
Wife	Female	30 min	60
Hawabangura	Female	1 min	4
Emma Kamara	Female	4 min	60
	don't know		0
Wife	Female	2 min	60
Wife	Female	30 min	60
Umar Barrie	Male	2 min	30
don't know	don't know	don't know	60
Wife	Female	30 min	30
	Don't know		1
Wife	Female	1h	60
wife	Female	1 min	60
Fatmata	Female	3 min	30
Wife	Female	2 min	30
Wife	Female	2 min	60
Wife	Female	3 min	60
Wife	Female	1 min	120
Fatma	Female	2 min	90
wife	Female	4 min	150
don't know	don't know	don't know	1
Wife	Female	2 min	60
Husband	Male	1,5h	90
Husband	Male	1h	60
Uncle	Male	2h	60
son	Male	1h	60
uncle	Male	1h	90
son	Male	2h	120
Wife	Female	2h	60
Father	Male	1h	30
Wife	Female	3h	150
Son	Male	2h	60
Wife	Female	1h	60
husband	Male	1h	60
Uncle	Male	2h	30
Wife	Female	1h	60
don't know	don't know	don't know	1
uncle	Male	2h	30
Wife	Female	2h	90
Husband	Male	1h	120
Wife	Female	1h	60
Wife	Female	10 min	30
Wife	Female	1h	90
Wife	Female	20 min	20
Wife	Female	10 min	8
father	Male	10 min	4

How often do you cook per day?	How long do you cook per day? Min	What is your most important meal?	What meal do you cook most?	What does this household use for cooking most of the time, including cooking food, making tea/coffee, boiling drinking water?	Is any food or drink consumed by household members cooked or prepared at the household dwelling using a cookstove, fire or other cooking device?	How many stoves (including open fires) are used for these activities?	Yesterday, how much time was this cookstove used for cooking food, making tea/coffee, and boiling drinking water?
2	90	rice	rice	Coal pot	no	2	2
1	60	rice	rice	Coal pot	yes	1	1
2	60	rice	rice	Coal pot	no	2	
2	60	rice	rice	Coal pot	no	3	3
3	300	rice	rice and couscous	Coal pot	no	2	3
1	90		don't know	Coal pot	no	1	1
1	60	rice	rice	Coal pot	no	1	1
1	60	rice	rice	Coal pot	no	1	1
2	60		don't know	Coal pot	no	3	2
2	90		don't know	Coal pot	no	3	2
1	90	rice	rice	Coal pot	yes	2	1
2	60		don't know	Coal pot and wood	no	2	2
1	90	rice	Cassava/potatoes	3 stones stove and open fire	yes	2	1
1	60		don't know	Movable fire pan	no	3	2
2	90		don't know	Coal pot	no	2	2
2	60	rice	cassava leafs	Coal pot	no	2	
1	60	rice	soup	Coal pot	no	2	1
1	60	rice	rice	Coal pot	no	1	1
2	300	rice	soup	Coal pot	no	1	1
2	240	rice	soup	Coal pot	no	1	1
1	60	rice	soup	Coal pot	no	2	1
3	60	rice	Soup and Cassava leafs	Coal pot	no	2	3
1	60	rice	soup	Coal pot	no	2	1
3	180	rice	Cassava leafs	Coal pot	no	2	3
1	60	rice	soup	Coal pot	no	2	1
3	240	Evening meal	rice	Coal pot	yes	3	3
2	180	rice	rice	Coal pot	yes	4	2
2	120	rice	rice	Coal pot	yes	2	2
1	60	rice	rice	Coal pot	yes	4	2
3	360	rice	rice	Coal pot	yes	3	3
1	120	Evening meal	rice	Coal pot	yes	1	4
2	180	don't know	don't know	Coal pot	yes	2	2
2	180	rice	rice	Coal pot	yes	2	1
2	240	rice	rice	Coal pot	yes	2	5
2	180	rice	rice	Coal pot	yes	3	4
2	180	Evening meal	rice	Coal pot	yes	2	2
1	60	Evening meal	rice	Coal pot	yes	2	3
1	180	rice	rice	Coal pot	yes	2	1
5	180	rice	rice	Coal pot	yes	2	4
2	120	Evening meal	don't know	Coal pot	yes	3	2
3	120	rice	don't know	Coal pot	yes	2	1
1	60	Evening meal	don't know	Coal pot	yes	2	3
2	240	rice	rice	Coal pot	yes	4	4
2	180	soup and rice	cassava soup	Coal pot	yes	1	5
2	240	rice and fish	soup	Coal pot	yes	2	2
2	120	rice	soup	Coal pot	yes	3	2
3	180	Evening meal	soup	Coal pot	yes	2	3
2	240	Evening meal	soup	Coal pot	yes	2	4
2	180	rice	rice	Coal pot	yes	2	2

How much did this household pay for this fuel or energy source last month for cooking (the last 30 days)?	In the past 12 months, how often was this fuel or energy source unavailable in the quantity you desired?	What other fuels and energy sources does this household use in this cookstove or device for cooking food, making tea/coffee, boiling drinking water and/or starting the fire?	Yesterday, how much time was this cookstove used for cooking food, making tea/coffee, and boiling drinking water?	How often did you use the cookstove or cooking device over the last week (last 7 days) for these activities?	Is the cooking usually done in the house, in a separate building, or outdoors?
don't know	Sometimes	Kerosene	2h	14	outdoor
SLL 300,000.00	Sometimes	Kerosene	Number of hours	7	outdoor
SLL 500,000.00	Sometimes	Kerosene	Number of hours	Several times during the day	Varanda
SLL 500,000.00	Sometimes	Charcoal unprocessed	Number of hours	Several times during the day	Varanda
SLL 500,000.00	Sometimes	Kerosene	Number of hours	Several times during the day	Varanda
SLL 400,000.00	Sometimes	Charcoal unprocessed	Number of hours	Once this week	outdoor
SLL 500,000.00	Sometimes	Charcoal unprocessed	Number of hours	Several times during the day	outdoor
SLL 500,000.00	Sometimes	Charcoal unprocessed	Number of hours	Several times during the day	outdoor
don't know	Sometimes	Kerosene	Number of hours	Several times during the day	Main house
SLL 500,000.00	Sometimes	Kerosene	don't know	Several times during the day	Separate room
SLL 500,000.00	Sometimes	Charcoal unprocessed	Number of hours	Once a day	Varanda
don't know	Sometimes	Charcoal unprocessed	Number of hours	Several times during the day	Separate room
SLL 70,000.00	Rarely	Charcoal unprocessed	Number of hours	Few times this week	Main house
SLL 150,000.00	Often	Kerosene	don't know	Several times during the day	outdoor
SLL 500,000.00	Sometimes	Kerosene	don't know	Several times during the day	outdoor
SLL 800,000.00	Sometimes	Kerosene	don't know	Several times during the day	outdoor
SLL 500,000.00	Sometimes	Kerosene	Number of minutes	Several times during the day	outdoor
SLL 400,000.00	Often	Kerosene	Number of minutes	Once this week	outdoor
SLL 900,000.00	Often	Charcoal unprocessed	Number of hours	Several times during the day	outdoor
don't know	Sometimes	Charcoal unprocessed	Number of hours	Several times during the day	outdoor
don't know	Sometimes	Kerosene	Number of hours	Once a day	outdoor
don't know	Sometimes	Kerosene	Number of hours	Several times during the day	outdoor
don't know	Sometimes	Charcoal unprocessed	Number of hours	Several times during the day	outdoor
SLL 1,500,000.00	Sometimes	Kerosene	Number of hours	Several times during the day	outdoor
don't know	Sometimes	Kerosene	Number of hours	Several times during the day	outdoor
SLL 500,000.00	Rarely	Charcoal unprocessed	3h	Several times during the day	outdoor
SLL 250,000.00	Rarely	charcoal briquettes	1h	a few times this week	outdoor
SLL 700,000.00	does not know	Charcoal unprocessed	1h	Several times during the day	outdoor
SLL 130,000.00	Rarely	charcoal briquettes	2h	Once a day	outdoor
SLL 200,000.00	Sometimes	woodchips	3h	Several times during the day	outdoor
SLL 600,000.00	Sometimes	Charcoal unprocessed	3h	Once a day	outdoor
SLL 250,000.00	never	Charcoal unprocessed	3h	Once a day	outdoor
SLL 100,000.00	Rarely	charcoal briquettes	1h	Once a day	outdoor
SLL 200,000.00	Sometimes	wood	1h	Once a day	outdoor
SLL 150,000.00	Sometimes	charcoal briquettes	3h	Several times during the day	outdoor
SLL 300,000.00	never	Charcoal unprocessed	2h	Several times during the day	inside the house
SLL 300,000.00	Rarely	Charcoal unprocessed	2h	Once a day	outdoor
SLL 80,000.00	Sometimes	other	3h	Once a day	outdoor
SLL 500,000.00	Rarely	Charcoal unprocessed	3h	Few times this week	outdoor
SLL 350,000.00	Rarely	charcoal briquettes	2h	Few times this week	Varanda
SLL 400,000.00	Sometimes	charcoal briquettes	3h	Once a day	outdoor
SLL 280,000.00	Sometimes	charcoal briquettes	2h	Few times this week	outdoor
SLL 120,000.00	Rarely	wood	1h	Once a day	outdoor
SLL 300,000.00	never	wood	4h	twice a day	outdoor
SLL 300,000.00	never	Charcoal unprocessed	2,5h	Several times during the day	outdoor
SLL 750,000.00	never	wood	4h	Several times during the day	outdoor
SLL 120,000.00	never	wood	don't know	don't know	outdoor
SLL 400,000.00	Sometimes	wood	4h	Several times during the day	outdoor
SLL 120,000.00	never	wood	3h	2 times every day	outdoor

Does the cookstove have a chimney or hood?	In the past 12 months, did any harm or injury happen from using this cookstove, device or fuel?	What is your average monthly spend/budget for fuel?	What is your average monthly spend/budget for food?	Do you borrow money for cooking spend?	Do you think you can afford for paying the cylinder deposit?	How do you intend to pay for the cylinder deposit?
no	Fire in the house	don't know	Don't know	yes	yes	yes
no	Fire in the house	don't know	Don't know	yes	yes	After
no	Person burned	don't know	Don't know	yes	yes	After
no	Fire in the house	don't know	Don't know	yes	yes	After
no	Person burned	SLL 100,000.00	SLL 500,000.00	yes	yes	yes
no	Fire in the house	don't know	Don't know	yes	yes	After used
no	Fire in the house	don't know	Don't know	yes	yes	After used
yes	Fire in the house	don't know	Don't know	yes	yes	After used
yes	Person burned	don't know	Don't know	yes	yes	After used
yes	Person burned	SLL 100,000.00	SLL 500,000.00	yes	yes	After used
yes	Person burned	don't know	Don't know	yes	yes	yes
no	don't know	don't know	Don't know	yes	yes	yes
yes	none	SLL 450,000.00	SLL 1,200,000.00	yes	yes	yes
no	Person burned	SLL 150,000.00	SLL 500,000.00	no	yes	yes
no	Fire in the house	don't know	Don't know	yes	yes	By seing it :)
no	Fire in the house	don't know	Don't know	yes	yes	when I have the money
no	Fire in the house	don't know	Don't know	yes	yes	After used
don't know	Fire in the house	SLL 400,000.00	SLL 500,000.00	yes	yes	little by little
don't know	Fire in the house	SLL 900,000.00		yes	yes	By seing it :)
don't know	Fire in the house	don't know	Don't know	yes	yes	After used
don't know	Fire in the house	don't know	Don't know	yes	yes	By seing it :)
don't know	Fire in the house	SLL 2,000,000.00		yes	yes	By seing it :)
don't know	Fire in the house	don't know	Don't know	yes	yes	By seing it :)
no	Person burned	SLL 1,500,000.00	Don't know	no	yes	After used
don't know	Person burned	don't know	Don't know	yes	yes	By seing it :)
no	Person burned	SLL 500,000.00	SLL 1,800,000.00	Sometimes	yes	By installment
yes	none	SLL 400,000.00	SLL 250,000.00	yes	yes	credit
no	Person burned	SLL 500,000.00	SLL 700,000.00	yes	yes	installment
no	Fire in the house	don't know	Don't know	yes	yes	credit
no	Fire in the house	SLL 1,500,000.00	Don't know	don't know	don't know	don't know
yes	none	SLL 600,000.00	SLL 1,000,000.00	yes	yes	credit
yes	Person burned	SLL 230,000.00	SLL 1,250,000.00	no	yes	installment
yes	none	SLL 350,000.00	SLL 1,300,000.00	yes	yes	credit
no	Person burned	SLL 540,000.00	SLL 200,000.00	yes	yes	credit
no	none	SLL 40,000.00	SLL 175,000.00	no	don't know	don't know
no	Person burned	SLL 300,000.00	SLL 1,500,000.00	yes	yes	installment
no	Person burned	SLL 300,000.00	SLL 1,300,000.00	no	yes	installment
no	Person burned	SLL 80,000.00	Don't know	yes	yes	credit
no	none	SLL 500,000.00	SLL 1,500,000.00	yes	yes	installment
no	none	SLL 350,000.00	SLL 5,000,000.00	no	yes	credit
no	Fire in the house	SLL 300,000.00	SLL 2,000,000.00	yes	yes	installment
no	Person burned	SLL 200,000.00	SLL 500,000.00	yes	yes	credit
no	Fire in the house	SLL 200,000.00	SLL 1,200,000.00	no	yes	credit
no	Person burned	SLL 300,000.00	SLL 1,500,000.00	yes	yes	installment
no	Person burned	SLL 300,000.00	SLL 1,500,000.00	yes	yes	don't know
no	Smoke	SLL 750,000.00	SLL 300,000.00	yes	yes	don't know
no	person burned/smoke	SLL 120,000.00	SLL 160,000.00	yes	yes	cash
no	person burned/Smoke	SLL 400,000.00	SLL 3,000,000.00	Sometimes	yes	installment
no	Person burned	SLL 120,000.00	SLL 60,000.00	Sometimes	yes	installment

Do you think you can afford for paying the burner?	How do you intend to pay for the burner?	Did you already try LPG for cooking?	If yes, does the use of LPG change the taste of your food?	Have you already heard about PayGas solution?	Would like to test PayGas solution ?
yes	After	yes	yes	yes	yes
yes	After	yes	yes	yes	yes
yes	After	yes	yes	yes	yes
yes	After	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	Laybuy	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	yes	yes	yes	yes
yes	don't know	yes	yes	yes	yes
yes	After used	yes	Maybe	yes	yes
yes	After used	yes	yes	yes	yes
yes	After used	no	don''t know	yes	yes
yes	By cooking with it	no	don''t know	yes	yes
yes	After used	no	don''t know	yes	yes
yes	After used	no	don''t know	yes	yes
yes	After used	no	don''t know	yes	yes
yes	After used	no	don''t know	yes	yes
yes	Deffer payment	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	yes	yes
don't know	don't know	no	don''t know	no	yes
yes	installment	no	don''t know	no	yes
yes	yes	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
don't know	don't know	no	don''t know	no	yes
yes	installment	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	credit	no	don''t know	no	yes
yes	installment	no	don''t know	no	yes
yes	don't know	no	don''t know	no	yes
yes	don't know	no	don''t know	no	yes
yes	cash	no	don''t know	no	yes
yes	installment	no	don''t know	no	yes
yes	installment	yes	yes. Positively	no	yes