Innovative Distribution Models for Uptake of Sustainable Fuels

Findings from the Pilot Stage

November 2016

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1. Introduction

Since July 2014, EcoZoom has been studying the market for pellet fuel in Kenya. We began this process in 2014 through a feasibility study looking at user responses to the gasifier stoves needed to cook with the pellet fuel. This was accompanied by a feasibility study on the availability of raw materials for pellet fuel production.

In May 2015, we were awarded a grant from The Global Alliance for Clean Cookstoves under their Pilot Innovation Fund (PIF). This grant allowed us to embark on a commercial pilot selling pellet fuel to households through 3 different distribution models. The aim of the pilot is to test innovative distribution and customer incentive schemes to increase the uptake of pellet stoves and fuels within households in Western Kenya. The pilot has tested three different fuel distribution channels using imported pellet fuel, static sales points, selling through community volunteer networks and neighbourhood deliveries to understand the revenue and distribution model needed to make household fuel sales viable. The PIF grant has also tested a customer loyalty scheme which has incentivised households to continually buy pellet fuels and allow more accurate tracking of fuel sales.

For the pilot, household were able to access a micro-gasifier stove sold by Philips, through a lease to own model. These are forced draft stoves capable of significantly reducing exposure to indoor emissions and reaching Tier 3 on indoor emissions under the IWA TC 285 performance tiers. This stove retails in Kenya at around 13,000 KES (128 USD), a price prohibitive for the majority of the targeted end users. In our lease model, households were able to make a down payment of 1,000 KES (9.8 USD) after which they were given the stove to start using. The households made subsequent quarterly payments of 1,000 KES for 12 months after which they had a chance to own the stove by making a final payment of 1,000 KES. The total amount that the household were to pay by the end of the lease period was 5,000 KES (49.5 USD).

Alongside these sales to households EcoZoom has continued to conduct market research into larger institutional and commercial customers with support from Gatsby Charitable Trust and ENEA consulting. Most notably we were able to build a business model for the establishment of a pellet production facility in Kenya with support from ENEA consulting in July 2014. These initial pilots and feasibility work have been completed to allow EcoZoom to decide whether to establish a pellet production facility in Kenya and the associated business models that would be needed.

This report presents the main finds from the commercial pilots with households in Western Kenya and shares lessons learnt on the initial uptake of the fuel and its reception in the market. It then goes on to assess the different distribution model tested, their influence on uptake and cost effectiveness. The report concludes by reviewing the larger business model for pellet production using what we have learnt from our pilots to determine the overall viability of pellet distribution as a business venture for EcoZoom.

The first sales of the branded “Pika Poa” pellets were made to households at the end of September 2015. This report uses data from these first sales up to the end of June 2016, approximately a 9

month period. Data was collected from customers through in person surveys which were conducted with 49 households across the 3 distribution model during May and June 2016. In addition we utilise sales information from our tracking systems and anecdotal accounts from household visit and focus groups held throughout the pilot phase. Though the data does not provide statistically significant results on the differences of pellet uptake of each model due to the small sample size, the data does provide valuable insights into the most cost effective distribution models and lessons learned about pellet uptake in Kenya.

2. Factors Effecting Uptake

2.1 Introduction to the Community Unit Approach

With pellet fuel being a completely new product in the market sensitization with the community is important for them to understand what the fuel is, how it works and the multiple benefits it can offer. For the initial stage of this project we worked closely with PATH, a non-profit organization focusing on healthcare innovations, to use the network of Community Health Volunteers (CHVs) as an entry point into the community. Organized into groups called Community Units (CUs) each one consists of around 20 – 40 Community Health Volunteers who are led by a Community Health Extension Worker (CHEW) an employee of the Ministry of Health. The CHVs themselves operate mainly on a volunteer basis although they receive stipends to participate in certain activities. PATH was particularly interested in helping the CHVs generate additional income through the sale of energy products.

The CHVs have between 50 -100 household that fall under their supervision whom they visit on a regular basis to promote health interventions and collect data on the same. As such they are ideally placed in the community to introduce new ideas to households and promote products that have a health benefit such as the pellet fuel and gasifier stove. The Community Units formed the entry point for us into the communities that we targeted through the 3 distribution models.

The first CU we targeted was Karapul in Siaya, consisting of 4,105 households and 40 CHVs, who were extensively involved in the design of the project participating in focus groups and group meetings around the structure and design of the program. It was this group that helped us to brand the pellet fuel as Pika Poa (meaning '*cook good*' in English). The Philips stove was also branded as the Supa Cooker. We engaged this group early on in the project planning in June 2015 and they received the first stoves at the end of September. With the group in Siaya we decided to pilot a reseller distribution model. With this model we would select static resellers such as local kiosk owners or vendors who would stock the pellet fuel and be selling points within the local community. The Karapul unit is based out of Siaya town which is a small town with a population of 41,174 people based in a mainly rural, agricultural county. The CHVs in the group are spread across the town and its rural surroundings. Most households targeted would be described as peri- urban with those outside the town being predominantly rural.

The second area we targeted was Nyalenda, based in an area of informal housing in Kisumu City. The CHVs in this location are organized into four sub-groups and we initially targeted one of these CUs consisting of around 18 CHVs covering 11,430 households, although we later extended the project to include other CUs. This group received the first products at the end of October 2015. Nyalenda is a low income urban area of Kisumu City consisting mainly of informal housing located within close proximity to each other. With this group we decided to test a model having CHVs sell the fuel to other members of the community.

The final group that we worked with under the project was based in the Mamboleo area located on the outskirts of Kisumu town (around 8km from central Kisumu). The local community units we worked here consist of 3,420 households and around 45 CHWs. This is predominantly a peri-urban location but many of the households further out from the market center are in a rural setting. This

group received their first products at the end of February 2016. With this group we decided to test a rider model whereby household could order pellets and they would be delivered via motorbike to their house.

2.2 Initial Product Marketing

Under the original project plan we marketed the products (the gasifier stove and fuel) to the CHVs for them to use in their own homes. The idea was, that after buying into the product and realizing the benefits of its use, they would become champions in the community, introducing the product to households under their supervision that would also sign up for the product. On introducing the product to the Community Units the CHVs demonstrated a lot of enthusiasm for them. However when it came to the sign up events (in which the users pay their lease fees, fill in the lease agreement and take the products to start using in their home) only a handful of the CHVs actually signed up. For example in Karapul which consists of 40 CHVs only 7 of them initially signed up for the product as the first users. In our Nyalenda group which consisted of around 18 CHVs we had 8 of them initially sign up.

As with any product that is new and untested in the market it is early adopters that are initially willing to buy the item and use it. Many people are unwilling to take the product until they have seen it working in other people's homes and heard the experience of other users. This is particular true where a significant investment is involved as is the case here. As such this limited the initial number of CHVs that signed up for the product themselves. We continued to work with the community groups to increase the number of CHV users having those that initially took the product share their experiences with other members of the group to convince them of the benefits of the product. However some of the first CHVs that took the product felt that it was more expensive than the fuels they were originally using which may have discouraged other members of the groups. This resulted in further CHV taking the products, with 32 of our final users being CHVs as per the distribution below;

Table 1: Numbers of CHV that signed up to use the pellet fuel

Project Location	Total Number of CHVs in all sub-units	Number of CHVs who signed up for the project
Siaya	40	10
Nyalenda	56	11
Mamboleo	45	11

Since the initial uptake from the CHVs for the product was lower than expected we subsequently opened up the opportunity to the rest of the community in our target areas that were able to access the fuel. To do this we worked through our existing customers and asked them to give us referrals of people that had seen them using the stove and had expressed an interest in also signing up. Initial this consisted of family members and neighbors of the existing users. After receiving only a few referrals initially, we incentivized customers by offering them 50 KES of airtime for every person they *successfully* referred – meaning the users must successfully pass through the trial period and go on to purchase fuel. Whilst this did provide incentive for a few individuals it had little effect on increasing the overall number of referrals we received. As a subsequent approach we ran a competition in Jan 2016, in which the user that referred the most new customers would win a

shopping voucher. Again whilst it provided motivation for some individuals it did not generate as many referrals as we had hoped.

Table 2: Number of referrals received before, during and after the shopping voucher promotion[1]

Referral time period	Number of referrals
5 weeks before the shopping voucher promotion	1
During the promotion (5 weeks)	9
5 weeks after the promotion	6

As *Table 2* shows the shopping voucher had little effect and the increase in referrals is more likely to be attributed to the increase in users and increase in general awareness of the produce with the increase in users.

Figure 1: Pika Poa customers and winner of the referral competition receiving her shopping voucher

Marketing considerations

The main fuel that Pika Poa is competing against is charcoal. In urban and peri urban areas charcoal is readily available and most households can access it within close proximity to their house. Our baseline data shows that 82% of households who took the stove were using charcoal either as their primary or secondary fuel. Out of these, 69% bought the fuel 1 km away or less from their home. For people to switch to using pellet fuel, making it equally easy to access will be an important factor. The ideal scenario is to have the majority of users situated in a 1 km radius from the point of resale. As such our marketing needs to be very focused in the areas we are targeting and traditional marketing channels that reach more general populations may not be as effective. Referrals

[1] The promotion ran for 5 weeks and the table compares this with the 5 weeks before and after.

between family and neighbors are a good way of promoting the products to people within a close proximity.

Additional criteria were used to vet the customers that we signed up as shown in *Text Box 1*. Since we were subsidizing the price of the stove technology the customer is agreeing to certain terms and conditions; for example they must pay quarterly lease fees and agree to be buying Pika Poa fuel on a regular basis. As such we wanted to ensure customers had this ability to pay, commitment to switch fuels and ability to be tracked throughout the program. For tracking purposes referrals are a good system as they provide an additional contact person to help follow up with the user. However the criteria below further reduced the pool of customers we were targeting in the program.

Checklist for Pika Poa Customers

1. You are a CHW in the required CU / you have been referred by a CHW or an existing customer
2. You live within the pilot location and are able to easily access the fuel sales point
3. You are willing to switch all of your cooking to pellet fuel
4. You are ready to pay the first installment today and are willing and able to pay the future installments
5. You understand the terms and conditions of the lease and that if after the trial period you do not buy Pika Poa fuel or pay your lease fees your lease is invalid and the stove will be taken back.

Text Box 1: Criteria for signing up new customer for Pika Poa

2.3 Additional Approaches

One of the challenges we experienced with signing up users through referrals is the ability to turn a potential customer's interest into a purchasing user. Once we had received a sufficient number of referrals we would arrange for a sign up event at which EcoZoom staff would invite all the referrals to participate. This event involved training on the use of the stove and fuel and how the lease works, after which they can sign up for the product, provide their baseline information and take home training and marketing material. We found that only a small number of the referrals would actually come to the event and sign up. This was mainly due to availability of funds; when a person was referred they had funds available but when we came to do the sign up event a week later they had already spent the money on other needs.

To overcome this we tested the idea of having an agent within the community who could sign up new households as and when they became interested and had the funds available to sign up. We tested this with our group in Siaya and trained our pellet reseller to also take new users through the stove training, lease agreement and baseline data. The agent receive a commission of 500 KES for every user they successfully signed up (meaning they went on to purchase a minimum quantity of fuel) to motivate them in this activity.

This method still did not produce high numbers of signs up with the agent signing up 5 new users over a period of 11 weeks. In this case it appeared our agent had a high standard of vetting for the users that she was willing to sign up. We also experienced challenges that the agent had not given the new users all the necessary information about the fuel and how the lease agreement works and in some cases had misled them on aspects of the program. However we still feel the use of community agents would be necessary in signing up new users to scale up the program but they would require close supervision and training to make sure they were communicating the right messages.

After the initial sign ups of CHVs we struggled to get new customers for the fuel in the following three months through referrals and the agent method we piloted. In February, we approached our third group in Mamboleo to pilot our final distribution model. Again we initially marketed the product to the CHVs and had 14 of them sign up after which we opened it to referrals. However in this case as well as individual referrals we were able to get referrals to women's groups in the area, where we received a lot of interest in the product which translated to actual sign ups. In the Mamboleo group we were able to sign up 32 users in the space of 2 months.

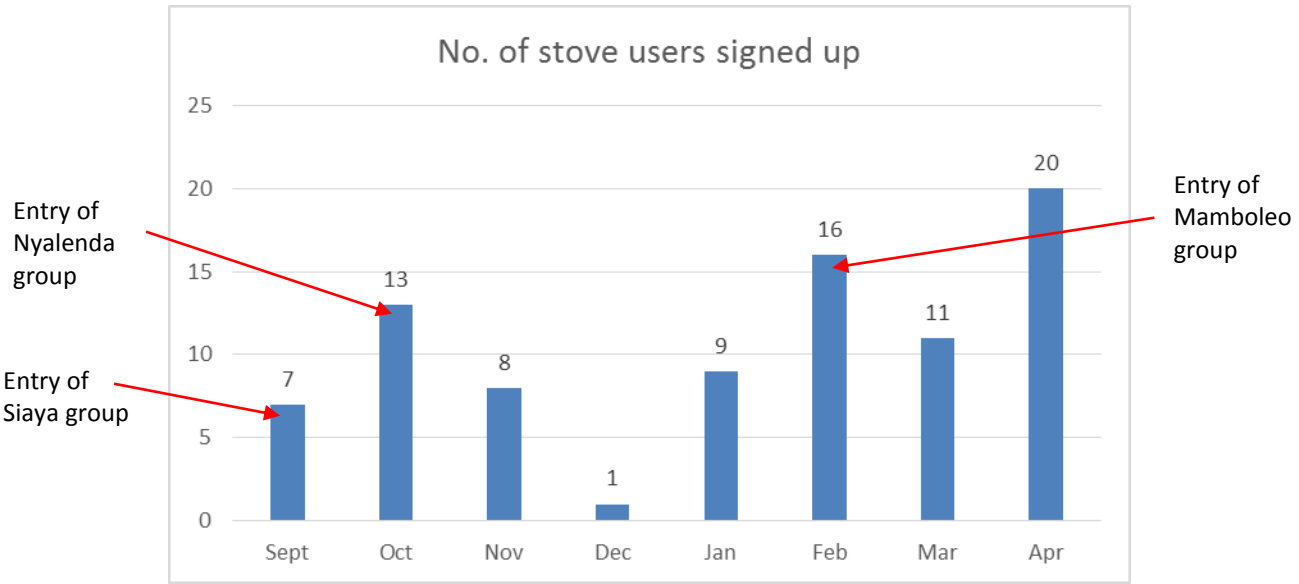


Figure 2: No of users we signed up each month

Figure 3: Summary of marketing approaches used and no. of user signed up through each approach

2.4 Lessons Learnt for Product Uptake

- Community Health Volunteers are a good way to make entry into a community and introduce new products and ideas. As members of the community themselves they understand well the needs and local dynamics and represented a trusted person who has easy access to households. In our pilot, 80% of users were either CHVs or referred by a CHV.

- However CHVs engage in many different activities and may have competing priorities. This can limit the availability and frequency in which they can engage in promotion. Providing incentives to users to engage in product promotion can increase this but any incentives provided need to be offset against the increase in uptake they produce.

- Not everyone is an early adopter and wants to try new technology. Many people want to see a product working first before they will decide to buy it, limiting the initial uptake of any new innovations. As such it can take time for a new product to gain traction within a community and this should be accounted for in initial pilots.

- The referral system was an effective way to get early users of the technology although the uptake of the product remained slow (potentially due to other factors as described here). In addition, the users we signed up developed in scattered pockets and building up a high density of households around a central sales point proved challenging.

- Having energy champions within the community is an effective way to promote a new product and gain new users. Out of 41 referrals, 19 came from just two individuals (46%). These energy champions often engage in promotion, not for financial rewards, but because they believe in your product and have a sense of shared commitment in bringing benefits to the community. Identifying and supporting these champions for your products is important and they can be further developed to take on formal roles as the business scales up.

- When using community volunteers or champions to promote a product or idea it is important to ensure they are communicating the right messages. This requires providing them with the right support, training and materials to do this.

- New customers need the ability to sign up and access products at their convenience and when they have the money available. They often need time to consider an investment in a product after initial seeing it advertised. Our target consumers have competing priorities for their limited income, if they are unable to access the products when they are ready it is likely funds will be diverted to other pressing needs.

- It is important to have adequate vetting of users of the technology when you are making a financial investment in that customer and expecting a return through fuel usage. It is important to learn through early users which types of customers generate the highest usage rates and refine your marketing approach to target them.

- Whilst our approach for marketing and sign up had an effect on how quickly we were able to get new users to sign up, finding the right type of people was just as important. Where customers were open to new innovations, had more disposable income and enthusiasm for environmental issues uptake appeared to be quicker.

2.5 Customer Loyalty Program

During the pilot phase of the project we ran a customer loyalty scheme in which users earned points on their pellet purchases that translated into rewards on reaching certain milestones. The aim of this reward program was twofold;

1. The program would provide an incentive for customers to be continually using pellet fuel to earn more points and hence gain rewards.
2. To earn the points household had to register each of their pellet purchases using the serial number on the pellet packaging. This registration provided us with a way to track household pellet purchases which allowed us to analyze household usage rates and monitor compliance with the stove lease agreement.

Award	Target No. of days	Points required
EcoZoom T-shirt	7	10
Free 2kg bag of pellets	50	50
Free 100 KES airtime	90	100
500 KES off a solar lantern	180	200

Table 3: Reward structure for the customer loyalty program

During the pilot phase of the project 50 customers accessed a reward through the customer loyalty program as shown in table 4 below:

Award	No of customer whom accessed	% of the total users
EcoZoom T-shirt	50	59%
Free 2kg bag of pellets	8	9%
Free 100 KES airtime	4	5%
500 KES off a solar lantern	0	n/a

Table 4

Table 4: Data on customers that access each reward

The original design of the customer loyalty program was done before we had started selling fuel to our first customers. At this time we had expected fuel usage rates of approx. 1-1.5 kg a day. However in reality the average usage rates across users was much less – approx. 0.35 kg/ day for our active users, and fuel uptake was generally lower than expected. As such this meant that during the pilot phase no users attained the fourth reward and very few users attained the third reward. This left some users feeling that the rewards were spaced too far apart and limited the motivational impact that they had.

During the end of pilot surveys customers were asked how much of an influence the customer loyalty program was in their purchasing habits (according to the defined statements below). The results are shown in

Statement	**No of people**	**% of respondents**
Earning points and getting rewards has motivated me to buy a lot more Pika Poa fuel	36	73%
Earning points and getting rewards is a nice idea and I sometimes think about it when buying Pika Poa fuel	7	14%
Earning points and getting rewards has had no effect on my decision to buy Pika Poa fuel	5	10%

Table 5. In addition we received anecdotal feedback from user on the customer loyalty scheme during focus group discussions as shown in *Text Box 2*.

Statement	**No of people**	**% of respondents**
Earning points and getting rewards has motivated me to buy a lot more Pika Poa fuel	36	73%
Earning points and getting rewards is a nice idea and I sometimes think about it when buying Pika Poa fuel	7	14%
Earning points and getting rewards has had no effect on my decision to buy Pika Poa fuel	5	10%

Table 5: Customers opinion on the motivational impact of the loyalty program

The results show that the majority of the users were aware of the rewards and how to earn them and they found it a motivational factor in their purchases. However the low number of customers

actually accessing the rewards shows that whilst it is a '*nice idea*' there are other stronger factors such as available funds and cooking habits that ultimately influence purchases.

Text Box 2 : Customer views on the customer loyalty program

Customer Quotes on the Impact of the Customer Loyalty Scheme

'When I got the [EcoZoom] T-shirt I was very happy and I felt very proud because now the people who doubted the program would think otherwise and also get motivated to use the stove more. It also forced some of the people to come and see the stove and I could explain how the stove was working.'

'I felt good getting a reward from Ecozoom and that made me want to get more rewards hence I need to buy and register more pellets because that is the only way to get the rewards'

'I felt proud of the gift and wanted to get other gifts and thus I wanted to buy more pellets and register them to get more points'

Whilst a rewards scheme can be a good way to motivate customers in their purchase and keep them engaged with the company it is important to consider the financial cost of any rewards and the payback from the increased uptake that they create. For example if we assume a 10 KES profit margin on each kg of pellets sold, when a user reaches 50 points we have made 500 KES of profit. However if we have given them a T-shirt worth 500 KES and a free bag of pellets worth 100 KES then we have actually made a loss. During the pilot, the rewards, particularly EcoZoom branded items, also provided an opportunity to promote the EcoZoom brand early on in the introduction of the product and provide further encouragement for users to adopt this new product. However in the longer term the pay back of the rewards would need to be considered carefully and may be restricted to low cost items such as airtime and fuel or rewards that are given out on a one of promotional basis.

Feedback from customers suggested that they would prefer reward items such as EcoZoom branded umbrellas, lesos (a material wrap used as a skirt) and caps. Several users also felt that presenting the rewards in group situations such as during community meetings would present further motivation to the user by adding an element of peer approval. They also suggested that they should be informed periodically on how many points they had accumulated and if the points were enough to redeem for a reward. Other users had difficulty registering the pellet serial numbers using their phone. They felt the process was long and they were prone to forgetting to register whenever they made a purchase. They recommended changing the system to an easier way of accumulating the points.

Figure 4: Pika Poa customers that have received T-shirts as rewards from the customer loyalty program

2.6 Product Packaging

The Pika Poa fuel was packaged into three different sizes 2kg, 7kg and 16kg. It was important to have a range of sizes on offer for customers particularly the smaller sizes which are more affordable. As predominantly charcoal users our target consumers are used to being able to buy fuel in values as small as 50 KES, which can be the only amount that a household has available for fuel on a given day. The table below shows the pricing of the different sized bags and how they made up the total volume of pellets sold during the pilot.

Table 6: Breakdown of different bag sizes sold during the pilot phase

Bag Size / kg	Retail Price / KES	% of total number of bags sold	% as a total of the volume sold
2	100	58%	22%
7	335	28%	37%
16	730	14%	41%

As can be seen from *Table 6* all of the different sizes of bags sold during the program suggesting that a range of sizes is needed to suit individual preferences. The smaller sized bags are important for consumers that do not have the financial capacity to buy the fuel in volume. However some users and particularly those that lived further away from the selling point preferred to take larger bags to reduce the time they had to spend on collection. We also observed that our customers with the highest usage rates tended to favor the larger bag sizes. On average, the 7kg and 16kg pellet

bags were a favorite for the top users accounting for 70% of their total pellet fuel purchases. For customers using the fuel everyday it appears they are willing to invest in bigger quantities to make sure it was readily available. Some users also noticed that it was cheaper purchasing the bigger capacity bags than buying the smaller capacity bags.

2.7 Cost Effectiveness

During the customer surveys respondents were asked whether they thought the price for Pika Poa was too high, too low or about right. The pricing for Pika Poa is as shown in *Table 6* and was structured so that it was similar to charcoal (or lower when charcoal is priced above 50 KES / kg) as well as being able to offer a margin for the reseller. The users' feeling on Pika Poa was nearly evenly split between those who thought the pricing was just right – 51% (25) and those who thought the pricing was too high-49% (24) as can be seen in the chart below. The top Pika Poa users were equally divided on their views on the pricing of the fuel 50% reported the price to be about right and also the pricing to be too high. The majority of medium users (56%) reported the Pika Poa pricing to be too high while the majority of low users reported the Pika Poa pricing to be about right.

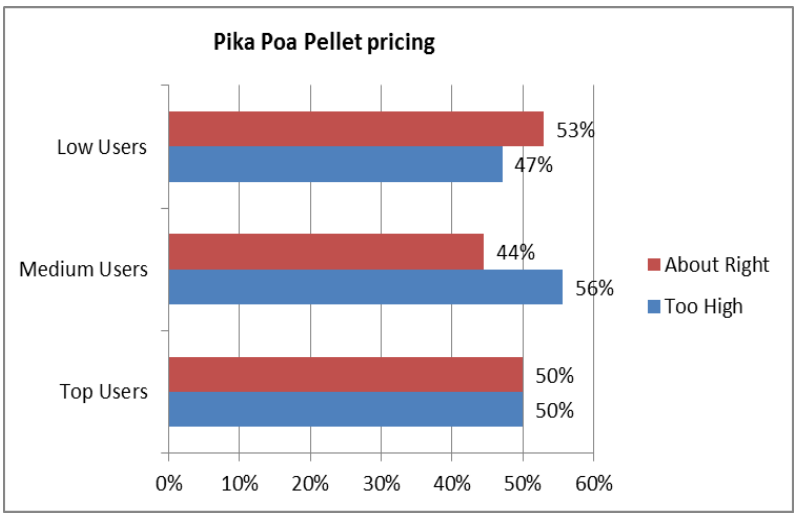


Figure 5: User views on the current pricing of Pika Poa

In the initial period of the pilot, we wanted to understand how the Pika Poa pellets and the gasifier stove compared against charcoal and the Kenya Ceramic Jiko (the common locally made charcoal stove) in terms of efficiency to cook and cost effectiveness. In this regard, we conducted cooking tests both in the lab and in the users' households. The Controlled Cooking Test (CCT) showed both time and fuel cost savings when using Pika Poa Pellets with the Philips cookstove. Average time savings were recorded to be up to 17% while fuel cost savings were up to 7% when compared with charcoal in the Kenyan Ceramic Jiko. However, the pellet stove consumed more fuel per gram of food cooked when compared with the charcoal stove. This could be due to the slow cooking foods (such as Githeri) that required low heat over a long period of time. The Pika Poa pellets have a high burning rate compared with charcoal which implies more pellets were burning per minute when compared with charcoal.

Table 7: Summary of Controlled Cooking Test results for different cooking task on both a KCJ using charcoal and with the Philips gasifier using pellets.

Cooking Task	Cooking Ugali		Boiling Githeri (Mix of Maize and Beans)		Cooking a meal (ugali, beef, vegetables)		Average		
Fuel	Pellets	Charcoal	Pellets	Charcoal	Pellets	Charcoal	Pellets	Charcoal	% Savings
Specific Fuel Consumption (g/l)	56	89	248	217	126	104	143	136	-5%
Time to cook (minutes)	23	43	131	144	73	88	75	91	17%
Cost of fuel that will complete the cooking task (KES)	12.8	20.88	56.35	64.56	37.95	29.52	35.7	38.32	7%

Table 8: Summary of Water Boiling Test Results for the KCJ using charcoal and with the Philips gasifier using pellets.

Parameter	Pellets	Charcoal	% difference
Specific Fuel Consumption (g/l)	43	40	-8%
Time to cook (minutes)	15	29	48%
High power thermal efficiency (%)	53%	35%	51%
Cost of fuel that will complete the cooking task (KES)	18.7	12.36	-51%

Water boiling tests conducted in the lab also showed the gasifier stove and pellets being 51% more efficient than charcoal in the Kenya Ceramic Jiko (KCJ) when completing a cooking task. A 5-liter water boiling test was conducted both with the Philips gasifier stove and the KCJ using pellets and charcoal respectively. Water boiling test protocol 4.2.3 was used to ensure reproducibility of the test results. *Table 8* shows a summary of the results obtained from the water boiling tests. The tests show that whilst pellets burn more efficiently than charcoal, marginally less charcoal was used compared with pellets, making it the cheaper option. However there were significant time savings of up to 48% when using pellets compared with charcoal.

Figure 6: A user participating in the Controlled Cooking Tests

During baseline data collection and the final household surveys we asked households to describe their monthly fuel expenditure across all fuels that they use in their homes. *Table 9* compares data from the nine households who were the most active pellet users. Across these users the average daily pellet usage was 0.51kg. As can be observed from the table for the customers that adopted the pellets and used them on a regular basis, there is a significant reduction in the monthly fuel expenditure with average monthly savings of 36%. One user who was running a small hotel and using charcoal and Pika Poa pellets to cook for customers reported average monthly savings on his fuel purchases of 55% (KES 18,532).

Table 9: *Comparison of monthly fuel expenditure before and after pellets were introduced for the top users*

Average Monthly fuel expenditure before Pika Poa	Average Monthly fuel expenditure using Pika Poa	Average monthly fuel expenditure savings	% average monthly savings
KES 2,017.14	KES 1,312.86	KES 704.29	36%

During the final households surveys users were directly asked whether they thought they were making any monetary savings from use of Pika Poa. The majority of them (55%) said they were saving on fuel expenditure from use of Pika Poa. 18% of the users said using Pika Poa actually increased their fuel expenditure, whereas for 27% it was not clear whether they were saving money or not. The main reasons people thought that Pika Poa was more expensive for them, included that some of these users were collecting firewood previously and weren't spending any money on fuel before but were now having to spend money on pellets. Whereas this was more expensive for them they valued other factors about the fuel such as the time saving and convenience of purchase.

Other users thought the pellets were expensive and burned very quickly. As our WBT tests showed pellets burn at a high heat and are more suited to high heat applications rather than low heat applications such as simmering food for a long period. In low heat applications it is likely that the user would use more pellets compared to charcoal which is why some users felt it was more expensive. This perception may also be worsened by people not operating the stove as efficiently as it can operate. Operating the stove to maximum efficiency requires controlling the amount of fuel you use and the speed of the fan, this can take some practice for users to get right.

For the 27% of users who said it wasn't clear to them whether they were saving on their fuel expenditure the main reason they gave was they hadn't been keeping a record of the costs. This was a common challenge during our monitoring of the fuel, that households did not have an accurate understanding of how much money they spent on fuel, due to multiple fuels being used and often different people using the fuel. One user commented that although she spends more on pellets, she preferred them as they are of consistent quality compared with charcoal which, although it is cheaper is sometimes of poor quality and cannot be used.

Table 10: Summary of user perception on whether pellet fuel saves them money

Statement	Percentage of users
I think using Pika Poa saves me money on my household fuel expenditure	55%
I think using Pika Poa increases my households fuel expenditure	18%
It's not clear to me if Pika Poa saves me money or not	27%

Findings from the pilot suggest that using pellet fuel can save households money but it is highly dependent on the way the pellets are used. Our in house testing showed that higher levels of fuel efficiency were experienced when using pellets for short, high heat cooking applications such as cooking tea or ugali, whereas for long, low heat applications, such as cooking maize or beans, pellets could be more expensive. It is also requires the user to tailor the way they use the stove to maximize the fuel efficiency for example only filling the stove with as much fuel as is needed and adding small amounts of pellet to lengthening cooking times in a controlled manner. This takes time for users to get right and is a point that many user never reached. As such there were mixed opinions from users whether they felt pellets were a cost effective fuel or not.

Some customers were previously highly reliant on firewood which they would collect for free hence switching to Pika Poa required them to start purchasing fuel instead. As such Pika Poa would be more expensive for them but many of them were willing to pay the price to upgrade to a more modern fuel that could save them significant time. However not everyone values time as much as they value money.

When asked about their ideal pricing for the stove, the majority of users interviewed (59%) preferred having the price of the stove remain at KES 5000. Paying for the stove in installments was certainly attractive to the majority of the users with 43% saying they would prefer paying for the stove in installments lasting a period of 12 months.

Table 11: Preferred price for the Philips gasifier

Recommended Philips Stove Price (KES)	% of users
2,000	2%
3,000	22%
3,500	2%
4,000	12%
4,500	2%
5,000	59%

Table 12: Preferred payment plan for the gasifier stove

Stove Payment Plan	% of Users
Upfront	10%
3 months	35%
6 months	4%
12 months	43%
Other	8%

2.8 Stove Repayment Rates

The majority of users whose 1st lease fee installment was due, successfully made the payment although it was noted that they didn't always pay on the actual day when the fees were due. The users had a choice of making small partial payments before the 3 month period was up but very few managed to do this preferring to wait until the quarter was up before making a full payment. 42% of the total users didn't pay their first lease fee installment despite repeated reminders. All the top users successfully cleared the first lease fee installment albeit 2 weeks late. The majority of users in each category paid the first lease fee installment despite the delays with 100% of top users, 63% of medium users and 51% of low users making the payment.

This shows that the top users realized the value of using the pellet fuel and as such were willing to continue paying for the stove. However overall the payment rates are low and represent a significant challenge in financing the cost of the stove without EcoZoom losing money. Whilst the lease agreement stated the stove would be repossessed if the lease fees were not paid, in reality this required significant follow up to achieve and many still remain with users.

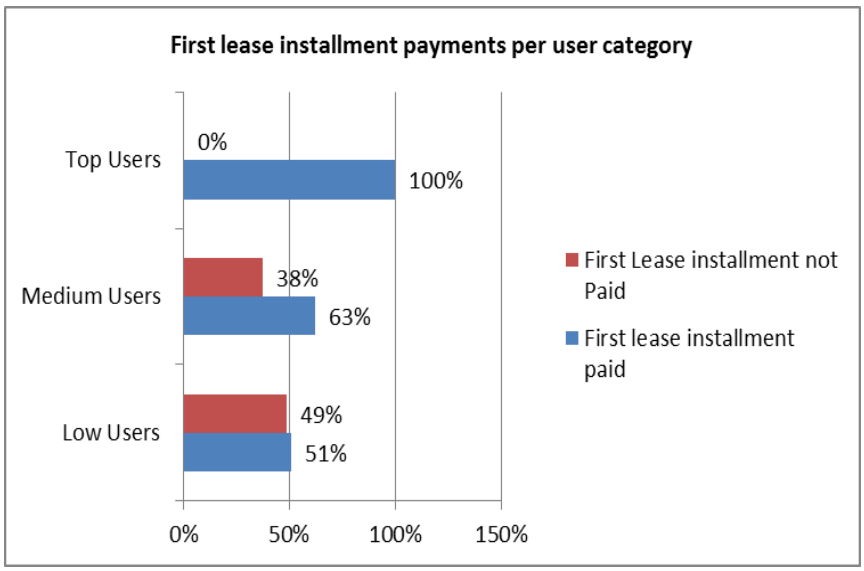


Figure 7: Summary of repayment rates for lease fee separated by usage category

2.9 Product Impacts

The majority of users (92%) interviewed in the final survey said they saved time when using Pika Poa. Only 8% felt using Pika Poa wasn't saving them any time. The majority of those who said they saved time spent the saved time on doing house chores and resting. Other activities that they did were tending to their farms and businesses, looking after their children, catching up on news and doing community work.

During the final household surveys, users were asked what their favorite things and least favorite things were about cooking with Pika Poa. The majority of users (61%) reported Pika Poa cooking fast as their favorite thing. On being asked their least favorite thing about cooking with Pika Poa,

the majority of users (41%) said they didn't have any dislikes about their cooking with Pika Poa. For those users who had a dislike for cooking with Pika Poa, the majority of them (16%) reported smoke and staining of saucepans as their least favorite thing when cooking with Pika Poa. The smoke appeared when lighting the stove and when reloading the stove with pellets during the cooking task. The tables below illustrate other points raised by the users.

Table 13: Users favorite things about cooking with Pika Poa

Users' favorite thing about cooking with Pika Poa N=49	**% of users**
It cooks fast	61%
It produce no dust/clean to handle	12%
It is economical/saves money/efficient	12%
It doesn't produce smoke/stain sufuria	8%
It lights quickly	2%
It is easy to pack	2%
It cooks food well	2%

Table 14: User least favorite thing about cooking with Pika Poa

Users' least favorite thing about cooking with Pika Poa N=49	**% of Users**
None	41%
It smokes a lot/stains saucepans	16%
It is difficult to control the fire	10%
Pellets are expensive	8%
Pellets burn too quickly	8%
The fire requires constant tending	6%
It is difficult to light	4%
The fire is too hot and burn holes in saucepans	2%
Pellet crumble easily	2%
It is not safe for children to use	2%

Users were surveyed on what they wanted to be improved on the stoves that would increase usage or make more people start using it. The majority of users (59%) were satisfied with how the stove looked and worked and didn't have any suggestions on the pellet stove improvements. For those who had suggestions, the majority (18%) wanted to be able to regulate the heat without the stove being too smoky. These users reported that at times they wanted to cook in low heat especially when simmering some foods but the fire got too smoky when they reduced the fan speed/heat. Other suggestions made by users are outlined in the table below.

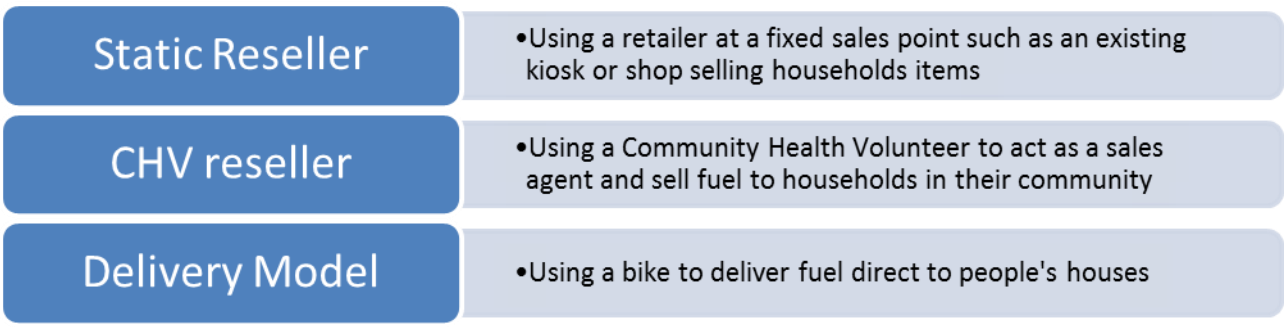
Table 15: Users recommendation on improvements that could be made to the stove

Improvements that could be made on the stove to increase uptake/usage N=49	**% of Users**
None	59%
Increase the size of the stove	10%
Be able to regulate heat without the stove being too smoky/improve fan speed to reduce smoke	22%
Improve the charging system to reduce breakages	6%
The base should be made of metal or a more durable material that wouldn't be damaged by falling hot embers	2%
Change pot rests as they damage the bottom of saucepans	2%

3. Comparison of distribution models

3.1 Introduction

One of the main aims of the pilot phase of the project was to assess the best methods for last mile distribution of pellet fuel to households considering factors such as access for the users, cost of distribution for EcoZoom and ability to scale. Setting up a cost effective supply chain and distribution network for a new fuel is challenging and often proves to be expensive for the household market, where you are dealing with a large number of low volume customers. During the pilot we tested three different distribution models as listed below;



3.2 Overview of delivery Models

Static resellers

This model utilizes static vendors in the neighborhoods where fuel users live to be retailers of the pellet fuel. These could include shops, kiosks or road side vendors and aims to replicate the way that many household currently buy goods such as vegetables and charcoal. We aimed to locate vendors that were accessible for our users in terms of location and opening hours, reliable and committed to the product. The static resellers buy the fuel from EcoZoom at a wholesale price before selling on to the households at a higher retail price which earns them a small margin.

We piloted this model with our users in Siaya town and were fortunate to find a vendor that was very committed to the new products, herself becoming one of our highest users of the fuel. Our vendor has two shops in the town; one a book stall located in our target neighborhood and another shop selling sodas located in the main town. This was ideal to give multiple locations where users could buy the fuel. Our vendor demonstrated good business acumen and was able to purchase pellets up front or with limited credit that was repaid promptly. Her belief in the product and use of the fuel herself was key as she took on the role of a champion within the community, helping to refer new users and provide advice on registering fuel and stove usage when customers bought from her shop.

On the downside it proved difficult to find a retail location that was accessible for all users. The idea was to build up a high density of users around a central sales point but in reality this proved difficult and users were more scattered. As a result, for some users they had to travel a significant distance to reach the sales point. To overcome this we looked at the option of having additional resellers

closer to other user, however for the business to offer enough income to the reseller they need to be able to service at least 15 households each and this was not possible.

Figure 8: Static Reseller with stock in Siaya

CHV Reseller

This model is similar to the static reseller above but in this case the reseller is a Community Health Volunteer who sells the fuel to households in their community. It is up to the CHV how households buy the fuel, either collecting from their house or the local health facility or with the CHV delivering the fuel as they conduct visits in the community. Again the CHV buys the fuel from EcoZoom at a wholesale price and sells at a higher retail price making some margin in the process.

We piloted this model with our users in Nyalenda. Whilst our reseller in this case was not as active in their own use of the Pika Poa fuel they were a well-known figure in the community who was able to easily interact with the users of the fuel. Since our reseller owned a bicycle and was mobile within the community in most cases he personally delivered fuel to customers' households. This proved convenient for them as again they were spread out across the area and some were a significant distance from the resellers' location. However our reseller soon came to find this arrangement time consuming on his part by which point many customers had come to expect this service from him. The income generating activity can also present opportunities for CHVs to engage in additional healthcare promotion and provide incentive for them to continue with these activities. For example our reseller commented that, 'my social work has improved by knowing and visiting new households who are Pika Poa customers [and as a result] I have gotten more clients on health matters'.

Our CHV reseller also had a job at a local hospital in addition to their CHV activities that meant he was only available at certain times during the day for people to order pellets. There were instances where users were left without fuel since the reseller was not available and we had to arrange for a direct delivery to supply customers.

Delivery Model

In this model EcoZoom directly took orders for fuel from the households and then organized with a local motorbike rider to deliver the fuel to their house. The households paid for the pellets direct to

EcoZoom via mobile money service M-Pesa and the fuel was delivered in most cases the same day. EcoZoom sold the pellet fuel direct to end users at the normal retail price.

This model had the advantage of offering a higher sales price to EcoZoom for the pellets since it cut out the margin for the reseller. It also meant that customers didn't have to travel any distance to collect their fuel with it being delivered to their doorstep. Several customers liked this model because it meant they were paying directly to EcoZoom for their fuel and this removed any chance for middleman to inflate the price or reduce the quality of the fuel (which often happens with charcoal).

However the model proved costly for EcoZoom (see section 3.3) since customers would order pellets at different times to suit their usage habits. This meant that we could send a motorbike to deliver 2 bags of 2kg pellets and the cost of the deliver would be greater than the cost of the fuel. In addition many customers found the process of calling EcoZoom to place the order and paying via mobile money cumbersome and an additional expense. This is especially true for households in more rural areas – whilst the delivery of the fuel is very convenient for them they would have to walk into the town to put money on their phone to be able to pay for the order. Having a large number of individual orders also required more time in processing and reconciliation on EcoZoom's part. In addition some customers preferred to have a place where they knew pellets would always be available so that they could collect them at their convenience.

To overcome some of these challenges we also arranged for pellets to be stored at the local health facility, if people preferred to collect them from there. During the pilot phase of the project 580 kg of pellets were collected from the facility compared to 169 kg which was delivered direct to households, hence even when direct delivery was offered for no extra cost most users preferred to collect the fuel in person. After 3 months of running the delivery model in an aim to reduce the cost of pellet delivery for groups that were further away from the facility, we requested them to all order together and have delivery on a set day each week.

Feedback from Customers

During the household surveys we asked households what they liked and disliked about the delivery models and their feedback echoed the observations given above. In Siaya, 83% (15/18) of households surveyed said that convenience and reliability were the things they liked the most, commenting that they knew there would always be pellets available at the resellers shop. Only 4 out of the 18 respondents had complaints, with 3 of these people saying the distance to the reseller was too far and 1 person saying that the pellet fuel was heavy to carry.

Again in Nyalenda where we worked with a CHV reseller the things people liked the most was the convenience of buying pellets, albeit only 60% of respondents, with several people specifically commenting that they liked the fact that the CHV delivered the fuel. One person also commented that the fuel was easy to carry. Three people had complaints that the distance to purchase was too far.

In Mamboleo where users could have their fuel delivered or alternatively collect from their local health facility 87% of respondents said they liked the fact it was convenient and easy to access the fuel because of the delivery option. However 6 out of the 16 respondents complained that the process of paying by M-pesa was cumbersome and 2 people thought access was a challenge.

Suggestions on improvements included the option to pay by cash and have local resellers to improve access further.

Another benefit of the fuel that came up in focus group discussions was the presentation and cleanliness of the fuel. Many people commented that they liked being able to buy the fuel from a shop that was clean and the packaging meant that they could carry the pellets with other shopping items without the fear of it getting dirty.

Table 16: Summary of Pros and Cons of the three delivery models piloted

Model	Pro's	Con's
Static Reseller	Similar to current buying habits User buy at their convenience Work with existing businesses Reseller can act as a champion of fuel in the community Create income generating opportunities in community Low effort for order processing and payment tracking Bulk delivery to reseller	Added cost for reseller margin Sales volumes do not support many resellers Relatively low margin available for resellers Some customers may have to travel a significant distance
CHV Reseller	CHV can act as a champion of fuel in the community CHV trusted and well known in the community Create income generating opportunities for CHV Provide new opportunities for CHV to do health promotion Low effort for order processing and payment tracking Bulk delivery to CHV	Added cost for reseller margin CHV may not have business acumen CHV may be busy with other activities limiting availability Some customers may have to travel significant distance to selling point May be cumbersome for CHV if customers expect them to deliver
Delivery Model	Higher profit margin for EcoZoom Direct payment cuts out risk of inflation by resellers Customers don't have to travel to collect fuel	High delivery cost Time consuming deliveries Mobile money payments can be difficult for customers Individual order processing time consuming Waiting for deliver can be inconvenient

3.3 Analysis of commercial viability of each model

Income Generating Opportunities

To build a network of distributors and agents for any product they need to be able to earn enough income from selling the product to make it attractive to them. *Table 17* below shows the margins that were available to resellers during the pilot phase for the pellet fuel. Resellers earn 5 KES per kg of pellets sold, which is in line with reported margins for the sale of charcoal fuel.

Table 17: Profit margins available to reseller selling Pika Poa fuel

Bag Size / kg	Retail Price / KES	Wholesale Price / KES	Retail margin / KES	Retail Margin / KES per kg
2	100	90	10	5
7	335	300	35	5
16	730	650	80	5

The text box shows an example order for a pellet reseller and the total profit margin that might be available. It shows that the profit available to the reseller is relatively small. This is particularly true since during the pilot we found the uptake of pellets to be lower than initially anticipated with resellers selling on average 124 kg of pellets per month. For example our static reseller sold 52,895 KES (518 USD) worth of pellets over the 9 months of the pilot period making a 5575 KES (55 USD) profit margin which equates to around 619 KES (6 USD) per month. If you compare this to her other lines of business that include selling sodas, in this business she can make a profit margin of up to 1620 KES (16 USD) per day from average monthly soda sales of 255,200 KES (2552 USD). This echoed feedback from the resellers who complained that the customers were too few and stock moved slowly.

Example order for a Pika Poa reseller

A reseller makes the below order;

16kg x 1 = 16kg = 650 KES
7kg x 5 = 35kg = 1500 KES
2kg x 20 = 40kg = 1800 KES

Total order weight = 91kg
Total cost of the order = 3950 KES

The reseller then sells the fuel on to customer at the below prices;

16kg x 1 = 16kg = 730 KES
7kg x 5 = 35kg = 1675 KES
2kg x 20 = 40kg = 2000 KES

Total sales price = 4405 KES
Profit from order = 455 KES

We required the resellers to make a down payment when initially buying Pika Poa stock but also offered them a small credit limit (4500 KES) to ensure that they could keep stocked up. With the few resellers we worked with during the pilot we experienced full repayment rates for stock albeit not always on time. It did not present a major challenge during the pilot phase but from experience in our other business lines it is something that would have to be closely managed if the number of resellers was scaled up.

Whilst the margins offered during the pilot did not offer a substantial income for resellers, they saw it as a business requiring low effort that could easily be added to existing products. Feedback also indicated that they wanted to sell the fuel not only for financial gains but also to help improve the wellbeing and carbon footprint of their community.

In the long term however the profit to resellers would have to be increased to make the business more attractive, either through an increase in customers or increase in selling price to successfully build a sustainable network of vendors.

It is also worth noting that in addition to the reseller our pilot phases provided income generation for 5 people involved in the delivery of pellet fuel in each of the pilot locations.

Figure 9: A rider delivering pellets to a reseller

EcoZoom cost of last mile distribution

For us to establish a fuel distribution model that can be sustainable in the long term we need to consider its cost in making fuel available to customers. This cost is incurred by EcoZoom and takes away from the potential profits that will be earned. *Table 18* below shows the average cost of each model in delivering 1 kg of pellets to the point at which it is collected by the customer. The table shows that on average the cost of delivery to a static sales point is between 3.6 – 5.1 KES per kg of fuel depending on the size of the order and the individual agreement with the rider in that area. For the third model we have compared both the cost of direct delivery to households and also the cost for us to deliver to a central collection point where households collect their orders from. The cost for delivering to a collection point is similar to the reseller models but doing direct deliveries to households is significantly higher at 40.2 KES per kg of fuel. This is mainly due to small volumes of pellets being delivered on each trip compared to the bulk deliveries to the vendors. It is obvious that these individual household deliveries are not a cost effective approach but we were prepared to do this during the pilot phase to get users to adopt this particular model and for us to get feedback on its influence on uptake.

Table 18: Cost to deliver 1kg of pellets for each delivery model

Delivery Model	Cost of delivery per kg of fuel / KES
Static Vendor	4.3
CHV Vendor	3.6
Delivery Model	
Collection from health facility	5.1
Direct household delivery	40.2

These costs give an indication of what to expect but are likely to be high during the pilot phase compared to what could be achieved longer term and when considering economies of scale. During our pilot we paid a higher price for the deliveries since it was a new concept to the riders for them and we were unable to guarantee consistent demand. If the business was at a larger scale it could look into purchasing its own motorbike with a dedicated rider or could negotiate favorable rates with service providers due to higher demand for the services. An investment in a motorbike capable of carrying the weight of fuel in rugged terrain could be around 200,000 - 300,000 KES (1960 – 2940 USD) with monthly running costs of around 20,000 KES (294 USD). During the pilot we averaged monthly sales of around 385 kg which, considering the motorbike running costs alone, would still represent a delivery cost of 52 KES per kg if we had our own bike. Hence delivery is not cost effective until large volumes are achieved. During the early stages of the business it is likely that the above costs are representative of what could be achieved and the use external delivery riders is the best option.

3.4 Influence of models on usage rates

As well as considering the feedback from users on the different distribution models and the associated costs, the pilot aimed to understand if the models had an impact on the uptake and usage of customers. The below analysis compares some of the statistics across each model to draw conclusions on this where possible.

Table 19: Summary of usage rates across the distribution models

	Static Reseller	CHV Reseller	Delivery Model
Total Users	30	23	32
Total Brought[2] / kg	941	484	487
Average daily usage rate during purchasing period[3] / kg per day	0.32	0.40	0.33
Av. daily usage rate of active customers during project period[4] / kg per day	0.19	0.14	0.17
Dropout rate	27%	17%	13%

[2] This is the total bought by all customers in the group across the pilot period

[3] This is the average daily usage rate based on purchases during the time customer were active

[4] This is the average daily usage rate based on purchases across the whole period the customer was in the pilot. It only considers customer that were active at the end of the period.

Table 19 shows that the static reseller group purchased the largest amount of pellet due to the fact that they have been purchasing pellets the longest. The average usage rates can be considered both in terms of the usage rate when the customer was active (the time between their first and last purchase) and also their usage rate over the whole period they were in possession of the stove. While customers are active they purchased between 0.32 – 0.40 kg a day with the CHV reseller group having a slightly higher usage rate. However, this can be misleading since some customers were only active for a short period which can result in high usage rates and skew the data. In addition we can consider the average usage rate for active customers across the whole period of the pilot. This rate is much lower at between 0.14 – 0.19 kg per day with the static reseller group having a slightly higher usage rate.

Figure 10 below goes on to show the average daily usage rates of customer against the number of days that the customers stayed active for the three distribution models. This graph considers only the customers that were active for more than 30 days hence eliminating customer for whom little data is available. Even considering these more active customers the vast majority fall below the 0.6 kg of pellets per day mark. It is difficult to determine any clear trends in how usage rates change over time, although customers in the delivery model do show some indication that usage drops off the longer they have been active. There are fewer customers that have been active over longer periods but still 5 of the longer users that have above 0.45 kg per day pellet usage. Whilst there are no clear trends linking usage rate to the different distribution model this graph highlights that usage rates across all the models are much lower than expected. Going into the pilot we predicted usage rates of between 1 -1.5 kg of pellets per day which in reality are closer to 0.3 kg / day with active users.

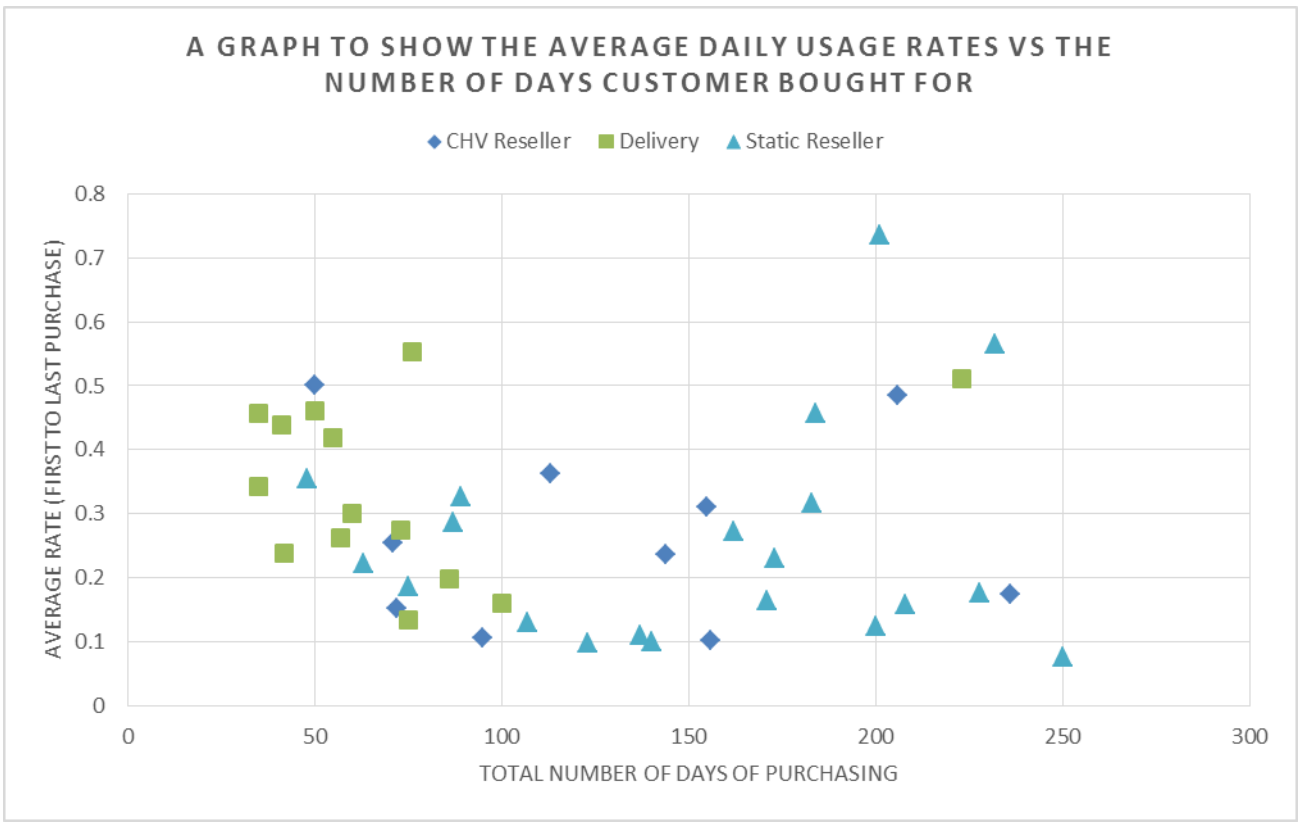


Figure 10: Graph showing the average daily usage rates of customer against the number of days that the customers stayed active for the three distribution models

To try and monitor customers' usage further we categorized them into 5 broad categories as below based on their usage and also their potential and interest in the project.

Table 20: Definition of usage categories

Category	Definition of category
High/Top	Households using an average of 0.4kg and more of Pika Poa daily
Medium	Households using an average of between 0.2kg and 0.39kg of Pika Poa daily
Low	Households using an average of 0.1kg or less of pellets per day
Inactive	Users that stopped using the stove with no interest to re-start
Returned	User that returned the stove during the trial period

Figure 12 to *Figure 13* below show how customers fall into these categories in each of the different distribution models at the end of the pilot phase. As can be seen the majority of users fall into the low category, with the delivery model having the highest percentage in this category (59% of customers). The top and medium users combined make up 26-30% of the user in each category with the static reseller having the highest percentage. However the static reseller model also had the highest number of inactive users, which may be due to this model having been running the longest allowing more time for users to drop out.

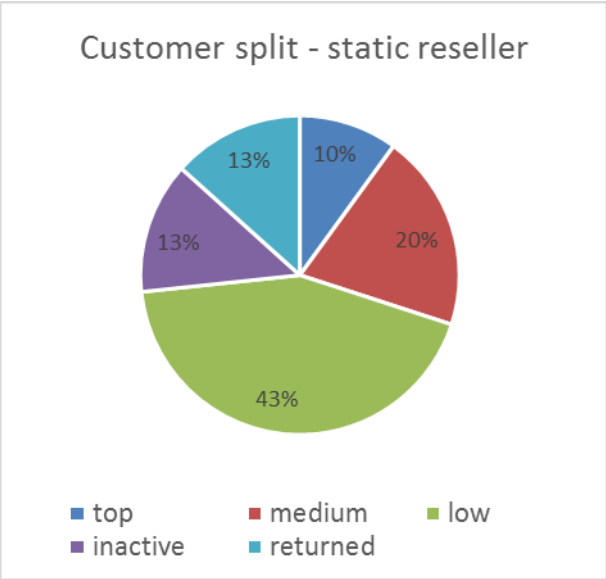


Figure 12: Customer usage categorization for the static reseller model

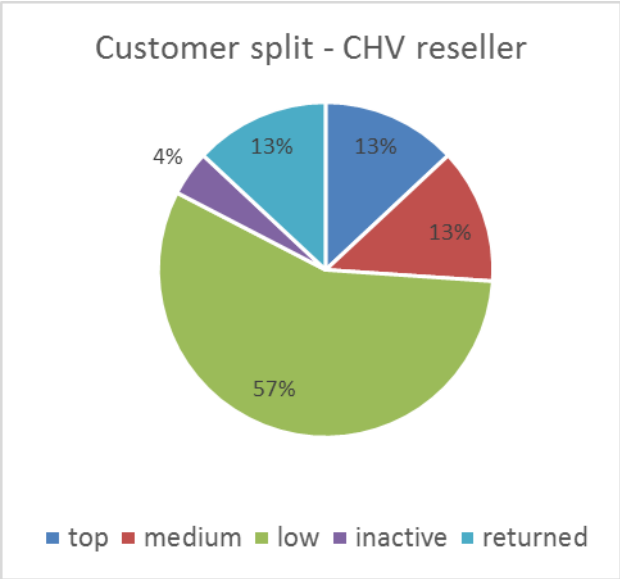


Figure 11: Customer usage categorization for the static reseller model

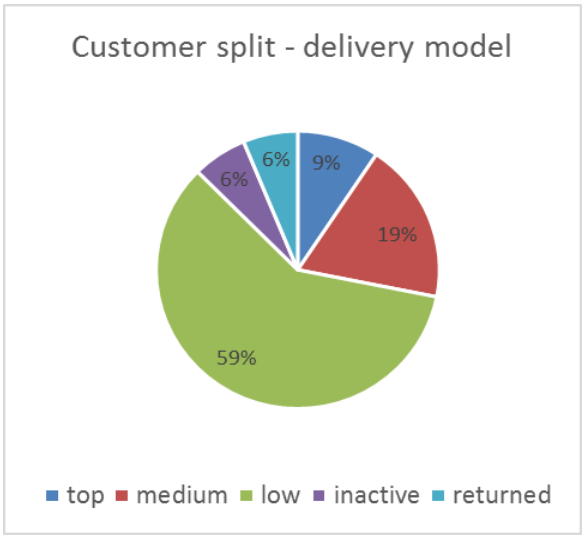


Figure 13: Customer usage categorization for the delivery model

The above categorizations are based on the pellet purchases that the customers register. We had around 85% registration rate during the pilot phase so some purchases are not represented in this analysis. During the customer surveys we asked users how they rated their usage of Pika Poa by getting them to pick which sentence best described them from the following;

1. I use Pika Poa for all of my cooking (with a few exceptions)
2. I don't use Pika Poa for all my cooking but I use it most days
3. I don't use Pika Poa every day I just use it when I have guests or for a special meal or occasion
4. I tried Pika Poa when I first took the stove but now I have stopped using it.

The graphs below show how customer rated themselves in the different distribution models[5].

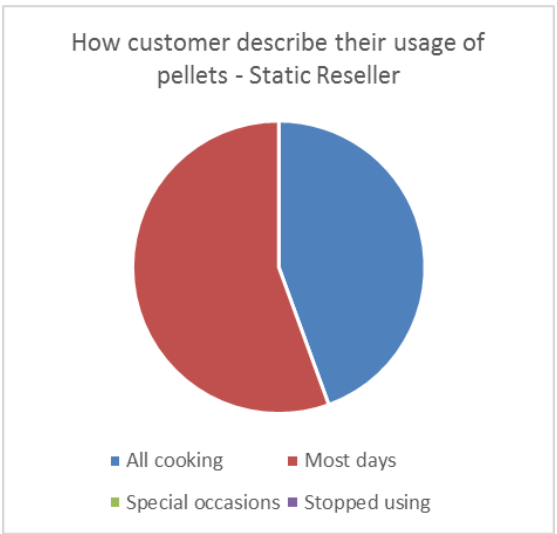


Figure 15: Customer opinion on their usage – Static reseller

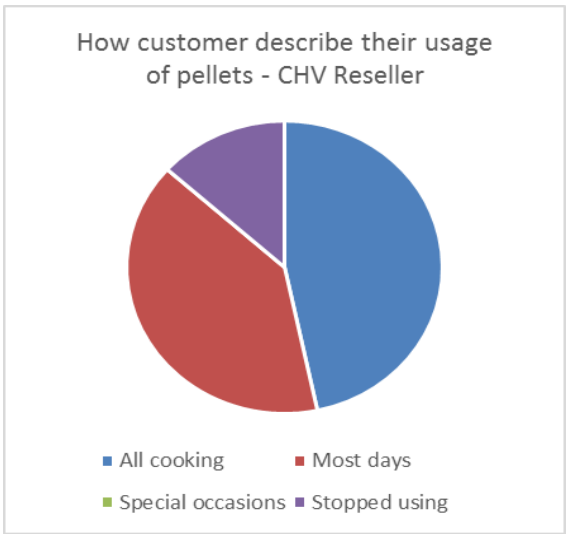


Figure 14: Customer opinion on their usage – CHV reseller

[5] note that the below graphs only cover the sample of users who took part in the final survey whereas the above graphs are for all of the users of the fuel

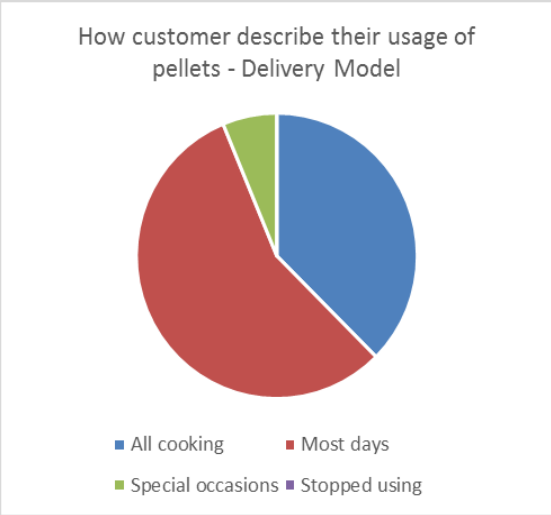


Figure 16: Customer opinion on their usage – Delivery model

As can be seen from the above graphs customers tend to rate their own usage as higher than the data from pellet registrations show. Under the customer lease agreement, if customer are not using Pika Poa regularly they have to return the stove, so this is likely to influence the customers into telling us their usage is higher than it might be. It was a challenge during the program to understand exactly why usage rates were not as high as expected due to the difference in customer perception of the fuel versus their actual usage rates from the registration data.

There is also a sense that customers use less pellets than we expected due to other factors as well. For example the stove is more efficient than we originally thought and customers are able to meet their cooking needs with fewer pellets. The reality of stove stacking also means that most household will use multiple stoves and fuels when this is possible. A significant proportion of household who buy the pellets were previously using multiple stoves (LPG, charcoal and firewood) and it is unrealistic to assume that households will exclusively use pellets. In addition many of our customers were out working most of the day or travelled as part of their work whilst others were single people without large families. As a result these customers were not consistently cooking in the household and hence had lower usage rates unrelated to their opinion on the pellet fuel.

Figure 17: Pellet burning in the Philips gasifier stove

3.5 Influence of Customer demographics on Usage Rates

In addition to the influence of the models on the uptake and usage of pellet fuel there may be other factors within the demographics of the customers that influence how likely they are to use pellets. In this section we will analyze some of these demographic factors and if there is any correlation on pellet usage rates.

Gender

It was noted that the average daily Pika Poa usage among the female users was higher than for the male users. It is important to note that we only considered users who were active at the end of the project period. Females made up 64% of active users while males represented 36% of active users. We also observed that for the male users, although it was a male who signed up for the stove, it was a female who used it once it got to the house. It would be advisable to include both partners (husband and wives) when rolling out similar project in order to get the perspectives of both individuals before buying the product. Females were on average using more Pika Poa daily (0.18kg/day) compared with their male counterparts (0.16kg/day) as can be seen in the chart below.

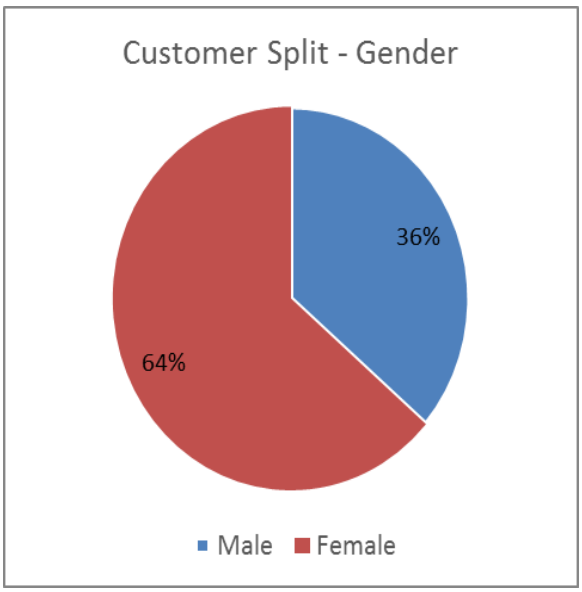


Figure 18: Customer distribution based on gender

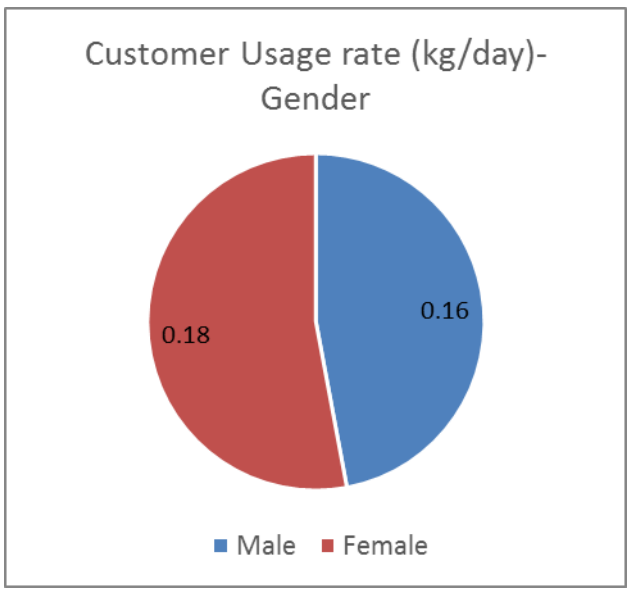
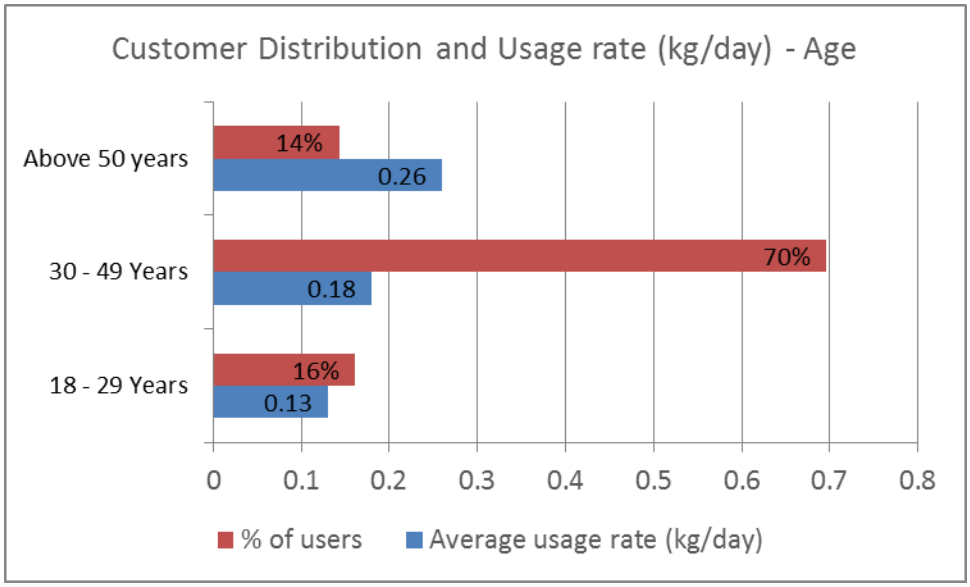


Figure 19: Pellet customer usage rate based on gender

Age

The majority of pellet users (70%) were aged between 30 and 49 years and had an average pellet usage rate of 0.18kg/day. However, the users with the highest average daily pellet use were those aged 50 years and above. These users made up 14% of the total active users and had a daily pellet usage rate of 0.26kg/day. These users were mainly women and they had expressed a commitment to use pellets with some of them transitioning to using only pellets for all their cooking. Two of the top Pika Poa users were in this age group.



Figures 20: Customer characterization based on Age and gender

Location – urban / peri urban/rural

Pika Poa customers were spread out in three locations broadly categorized into rural (Mamboleo), peri-urban (Siaya) and urban (Nyalenda). The majority of the users (41%) were based in the rural location. It was noted that these users also had the highest Pika Poa usage rate of 0.19kg/day followed closely by the peri-urban users with a usage rate of 0.18kg/day. This is illustrated in the charts below. It is important to point out that the rural users had been activated for the shortest amount of time and thus the high usage rates could be due to the novelty of the product having not worn off them yet and they were still excited about using the new fuel.

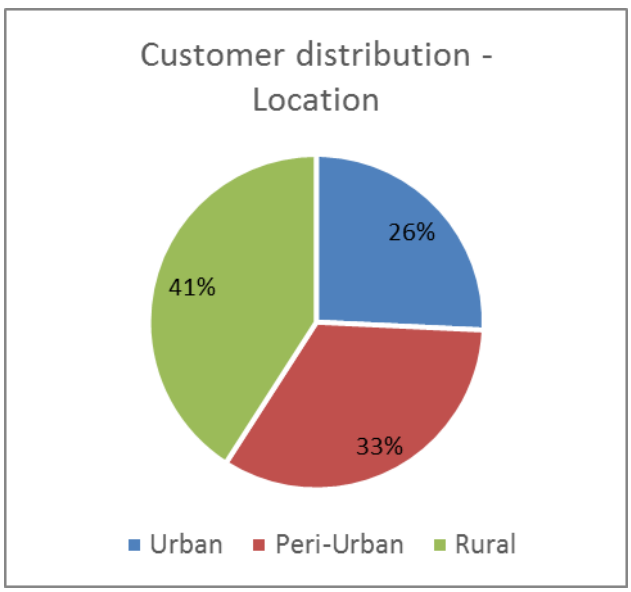


Figure 22: Customer distribution based on their location

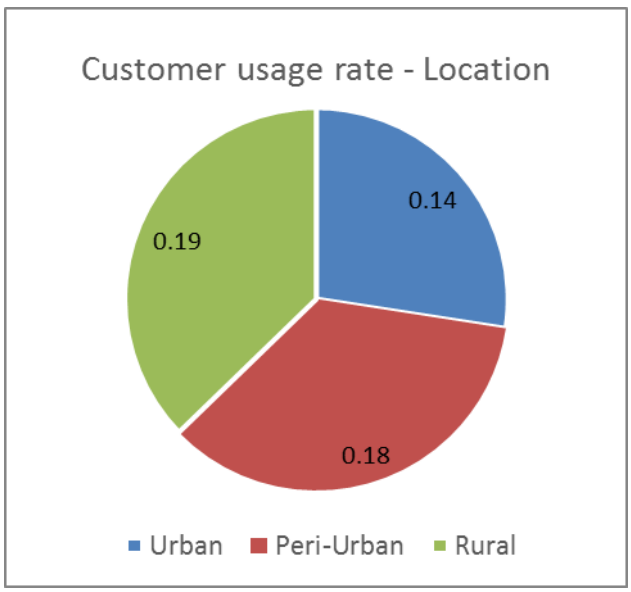


Figure 21: Customer average daily pellet usage rate (kg/day) based on location

6

Family Size

The majority of Pika Poa users (69%) had a family size of between 5 and 8 members. This group also had the highest average daily pellet usage rate at 0.20kg per day. Users with a family size of 4 or less members made up 25% of the total active pellet users and had an average usage rate of 0.14 kg/day as is illustrated in the figures below.

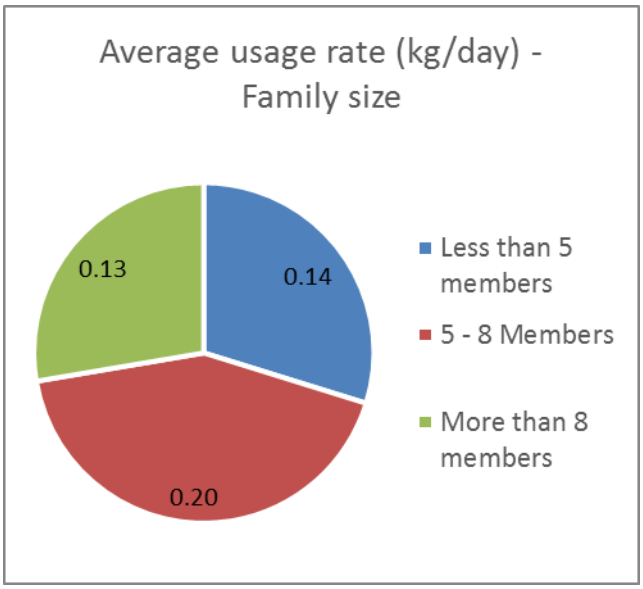


Figure 23: Average daily pellet usage rate based on family size

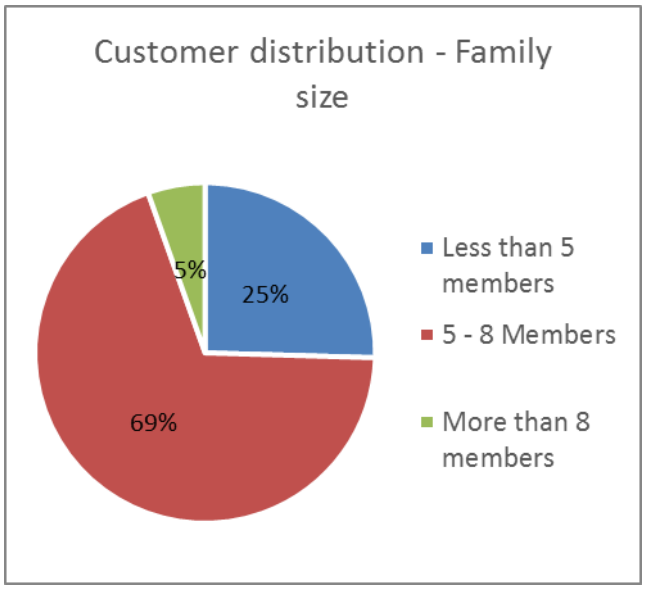


Figure 24: Distribution of Pika Poa customers based on family size

Fuels already being used

The majority of Pika Poa users (63%) were previously using charcoal as their primary fuel as is illustrated in the figures below. A smaller number (37%) were using firewood as their main fuel before signing up for Pika Poa. However, the firewood users had a higher average pellet usage rate (0.21kg/day) as compared to the charcoal users (0.19kg/day).

[6] Note that the above charts are based on data collected from customers who were active at the end of the project period

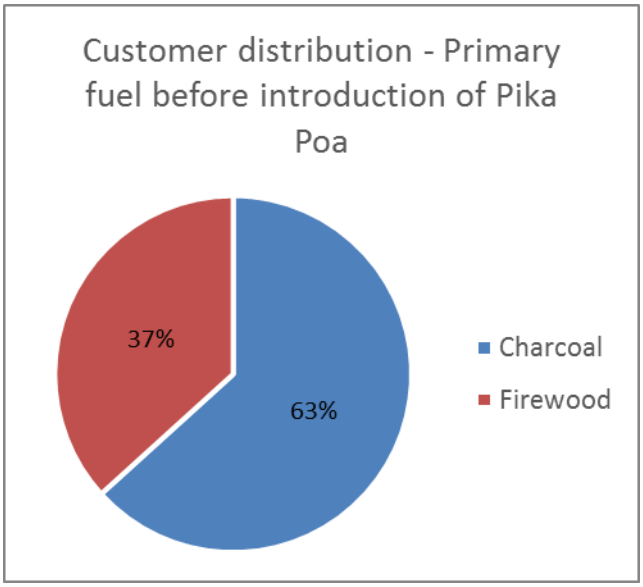


Figure 26: Distribution of customers based on primary fuel used before introduction of Pika Poa

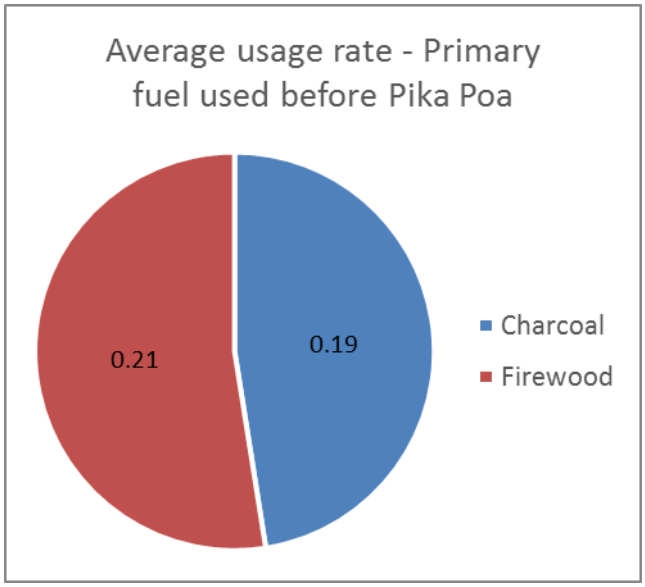


Figure 25: Average daily pellet usage rate kg/day - Primary fuel before introduction of Pika Poa

A similar trend was reported with users who had LPG stoves and those who didn't. Those who had LPG stoves were fewer (19%) and their pellet usage rates were equally low (0.17kg/day) compared to those without LPG stoves (81%) who had a marginally higher pellet usage rate (0.18kg/day). This could be explained by the fact that Pika Poa pellets and the Supa Cooker give the similar benefits as an LPG stove of fast, clean cooking. This could be the reason why more people who didn't have the LPG stove used Pika Poa more so as to enjoy these benefits compared to those who already had an LPG stove.

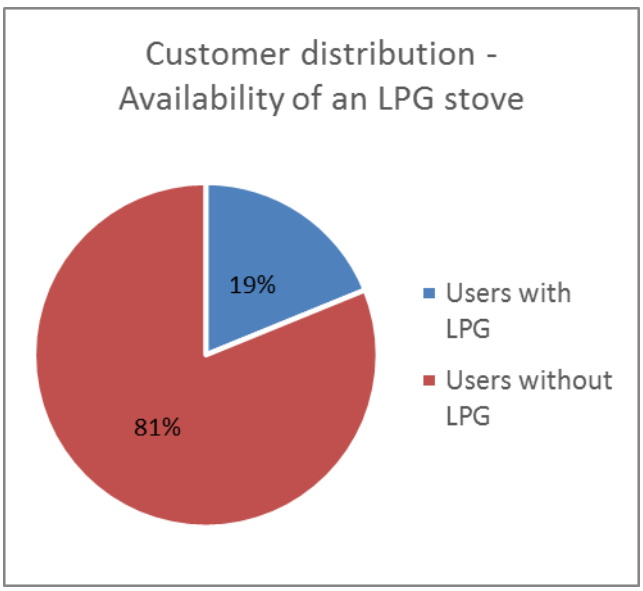


Figure 27: Customer distribution based on availability of an LPG stove in the household

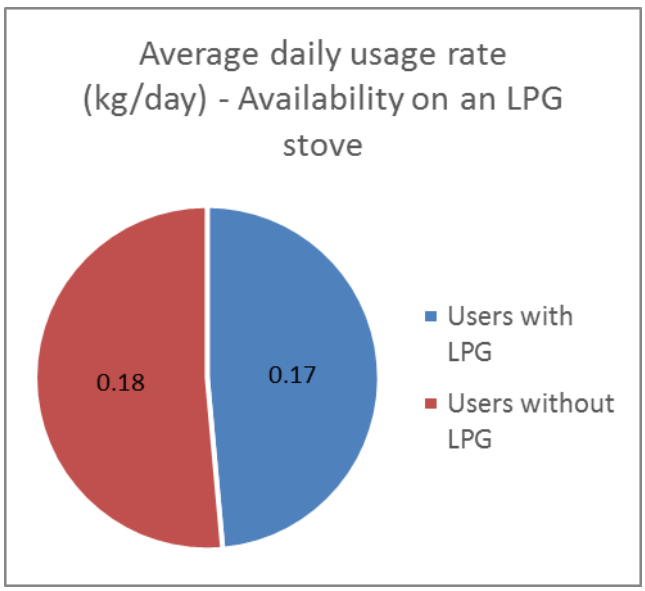


Figure 28: Average daily pellet usage rate based on availability of an LPG stove in the household

Household income

The majority of Pika Poa users (50%) were earning an average monthly income of between KES 5,000 and 15,000. This class of users also had the lowest average daily pellet usage rate at 0.16kg/day. The users who reported the highest daily Pika Poa usage rate (0.32kg/day) were those earning between KES 15,001 and 30,000 per month.

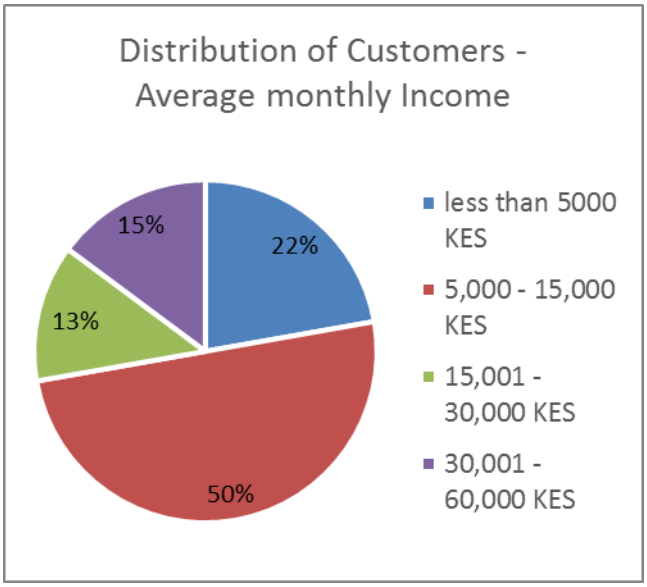


Figure 30: Customer distribution based on monthly household income

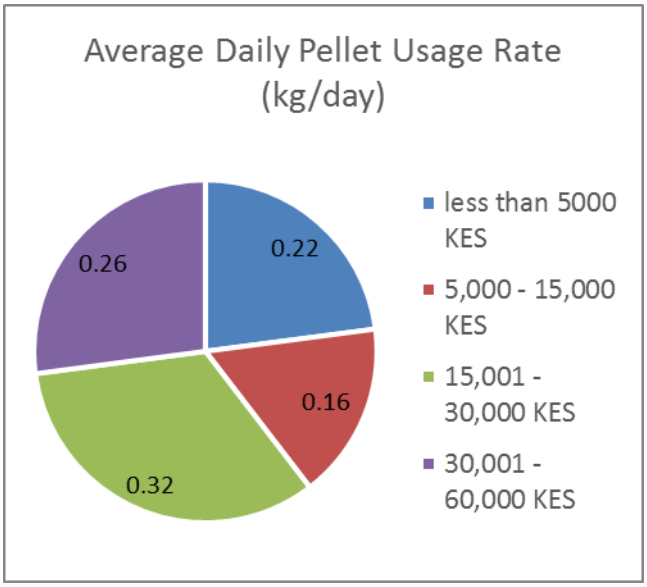


Figure 29: Average daily pellet usage rate based on customer monthly income in KES

Job / daily activities

The majority of Pika Poa users (45%) were business people with a fuel usage rate of 0.18kg/day. The Pika Poa users who had the highest usage rate were those with formal employment with a daily pellet usage rate of 0.25kg/day closely followed by farmers with a daily pellet usage rate of 0.24Kg/day.

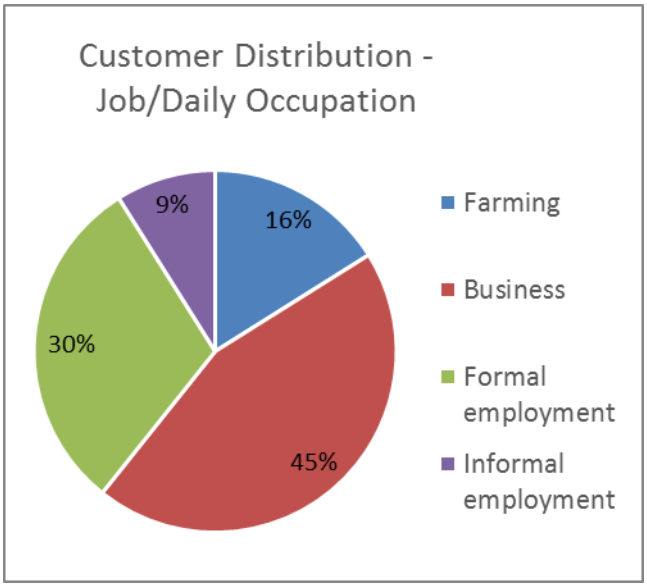


Figure 32: Customer distribution and average daily pellet usage rate based on jobs/daily activities

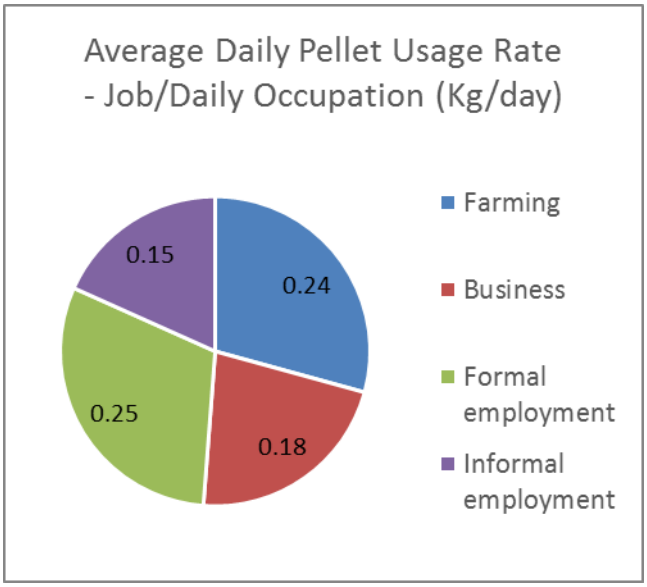


Figure 31: Average daily pellet usage rate in Kg/day based on customers' job/daily occupation

Customers were asked which their preferred size of pellet bag to purchase was and the responses are shown in
Figure 33. The graph shows that 2kg was the most popular bag size across all of the distribution models followed by 7 kg and 16 kg. For the delivery model when fuel can be delivered to the customer's doorstep no one favored the larger sizes. Hence it suggests that availability of funds is more of a factor in decided what size bag to purchase rather than logistics of transporting it. It also highlights why the cost of doing the deliveries was particularly high, since most users preferred the small bag sizes. All users that expressed a preference for the 16kg bag size fell under the top and medium usage category suggesting that if customers are willing to buy a large bag size they are committing to using the fuel.

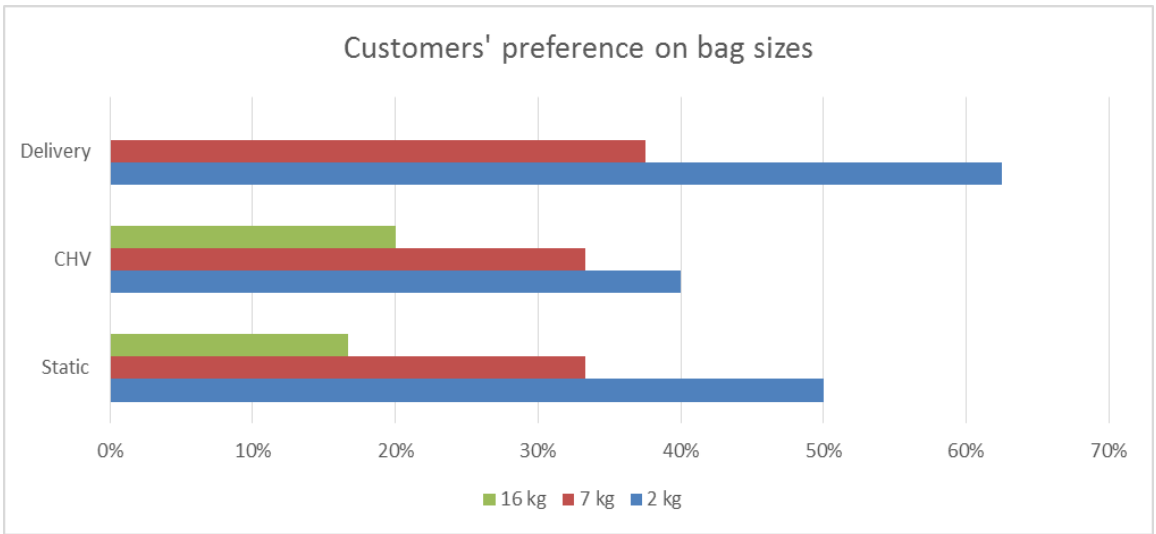


Figure 33: Graph showing customers preference for bag size across the different distribution models

3.6 Conclusions

Customers seemed to value convenience and reliability when giving feedback on the different deliver models. Knowing that the pellets were always there if they needed them was important. Convenience can also mean different things to different people; it could mean having the fuel delivered, having a sales point that can be accessed at any time or having an easy payment method. Results from this pilot show that having a fixed sales point seems to be the most preferred method for customers to access their pellets. The fixed sales point could take different forms it could be a local shop, health facility or home of a neighbor. Fixed sales points also had the lowest cost of last mile distribution to EcoZoom (around 3.6 KES/ kg), which could be further reduced at scale where larger volumes could be delivered and more favorable rates negotiated.

Getting the right person as your reseller is important. Ideally the individual should be committed to the project and can also act as a champion in the community and point of information on the product. However in our pilot we only tried one person with each model so it is difficult to draw strong conclusions when comparing each one. There is not a significant different between the way a CHV and non CHV reseller would operate, what is important is that the reseller is well connected and accepted in the community.

Ideally customers want to access a sales point that is close to their home. However in reality a critical number of customers is needed to support a decent profit for each reseller. Hence whilst customer numbers are low it is likely that not all will be located close to the sales point.

Whilst the delivery model can prove convenient for people who live far from the sales point it is expensive to operate and can only be cost effective when higher sales volumes are achieved. Having delivery as a backup can be useful to cover issues of unavailability at retail points. However it should be prioritized for larger bag sizes or run in a structured manner as to target several customers in each trip.

Current profit margins available to resellers from the sales of Pika Poa are low compared to other household items. To maintain an effective network of resellers and attract further resellers their profit margin would have to increase. This would have to come either from an increase in the sales price of the fuel or an increase in customers since the profit margin available to EcoZoom is already small. However any increase in sales price is likely to have an effect on uptake.

Our data shows that customers prefer a range of bag sizes. The 2kg bag was most popular amongst users since it allows them to access the fuel at a lower price point. However those customers that favored the larger bag sizes tend to be more active users of the fuel. The delivery model seemed to have little effect on the bag size bought; it is more dependent on availability of money and usage rates.

We cannot conclude any clear trends linking average customer usage to the different distribution models from the current data we have from the pilot. The pilot data is limited due to the relatively short time period and the limited number of consistent and active customers. However it shows that the majority of customers are low users and average usage rates of around 0.3 kg per day are what can be expected from active customers. This is much lower than expected and will have a significant impact on the viability of fuel sales to households.

In summary if EcoZoom was to scale the distribution network moving forward we should concentrate on building up a network of static resellers, locating them as close as possible to the highest density of customers. These reseller should be well recognized in the community and could also act as points of information on the stove and fuel products (potentially doubling as agents for signed up new households as well). However we would have to consider increasing the incentives to resellers since profit margins are currently low which would threaten the financial sustainability of the business. In more rural locations or where logistical challenges exist this could be supplemented with a delivery model. This delivery model would be most effective to deliver to customers organized in group setting having a weekly delivery data and allowing customers to order and pay together.

4. Commercial Viability of Pellet Distribution

During the pilot phase of this project, data was gathered on the ease of signing up customers, potential usage rates, cost of reaching those customers and factors that affect their usage. This data feeds into a larger question around the commercial viability of selling pellet fuel to households in Kenya. For the business to be sustainable in the long term, it needs to generate sufficient profit for EcoZoom to justify further investment and continued operations.

There is currently limited local production of pellet fuel in Kenya. For this pilot EcoZoom imported pellets from a supplier in Zambia which was an expensive option. In the long term, to lower the cost of the fuel EcoZoom would have to source pellets from Kenya or start their own production of pellet fuel in Kenya. The latter whilst giving the most control over the supply chain and highest profit margins required a significant investment in setting up a pellet production facility – especially one capable of producing high quality pellets at scale. Before making such as investment, this pilot allowed EcoZoom to get a better grasp of the potential market for the fuel and costs involved to make a more informed decision whether to scale pellet fuel supply and establish a local production facility.

To support this assessment EcoZoom received pro bono support from ENEA consulting in July 2014 to build a business model for the establishment of a pellet production facility in Kenya. This section discuss the recommendations from that model combined with the data collected form the pilot phase of fuel sales.

4.1. Cost to end user for distributing pellets

During the pilot EcoZoom used fuel that was imported into Kenya from Zambia. Due to the high costs of overland transportation and clearing charges the costs of the pellets landed in Kenya was approximately 60 KES/kg. To encourage users to switch to the fuel during the pilot and to also reflect costs that would be realistic for locally sourced pellets they were sold to retailers at approx. 40 KES per kg during the pilot. Hence the grant subsidized the cost of the pellets by approx. 20 KES per kg during the pilot.

Based on research of pellet and briquette manufacturers in Kenya and abroad, we estimate that if we were to source pellets from a local manufacturer in Kenya the lowest price we could get would be approx. 15 KES / kg. If we were to invest in our own production the cost of producing the pellet could be somewhere between 8-12 KES / kg depending on the scale and efficiency of the operation. These are however estimates and further testing and research would need to be done to get a more accurate cost.

In Scenario 1 below we assume that pellets would be purchased locally at a cost of 15 KES / kg. On top of this we have added on additional costs involved in getting the pellet to customers as based on what we incurred during the pilot phase of the project.

Table 21: Scenario 1 – Cost of pellet fuel to the customer assuming local purchase / production and based on pilot costs.

Cost	KES/kg
Cost of pellets	15
Storage cost	5.1
Transport supplier to warehouse	3
Transport warehouse to vendor	3.5
Packaging material	2.5
Packaging labour	1.75
Branding costs	4
Cost to customer	34.85
Selling price (before VAT)	34.48
VAT	5.5
Wholesale price	40
Profit Margin	**-0.37**

As you can see from *Table 21* considering all the additional costs on top of the actual cost of the pellet, when selling at 40 KES / kg it is less than the cost of reaching the customer, meaning that we would actually be losing money. The following should be noted about these costs as based on data from the pilot;

- Storage costs are high as we use a professional 3rd party logistics provider for handling our stock to offer the best security and management.
- Costs for packaging and branding material were high due to the small quantities and ad hoc purchasing during the pilot period. If purchases were made in larger quantities it would be possible to negotiate much more favorable rates and purchase direct from manufacturers.
- The issue of Value Added Tax (VAT) is somewhat of a grey area for sustainable fuels and many suppliers of fuels such as briquettes believe they are not subject to this tax. However during import of the pellet fuel into Kenya for this pilot, whilst it was zero rated for import duty, it was subjected to VAT by the government of Kenya hence in the above we are assuming VAT at 16% would be paid on the fuel to be on the side of caution. Paying these taxes is a big challenge for sustainable fuels that are competing against charcoal that is commonly traded informally, hence rarely subject to full taxes.

Whilst the costs incurred during the pilot give us a good indication of what could be achieved when starting the business and operating at a small scale it is felt that costs could be further streamlined if economies of scale were achieved. The below scenario shows the estimated cost in reaching the customer with further optimization of the value chain. In this scenario we assume that EcoZoom can produce the pellets for 12 KES per kg and storage would be on site hence reducing this cost. The branding costs only cover printing on the bag and doesn't include marketing costs. The packaging material costs could potentially be reduced based on bulk purchases. By increasing the volume of business we would be able to negotiate more favorable rates on delivery and packaging materials. The below scenario also assumes that discussions with the Government of Kenya would clarify that pellet fuel is in fact exempt from VAT (as is the case for other sustainable energy products such as solar and clean cookstoves).

Table 22: Scenario 2 – Cost of pellet fuel to the customer assuming local production and optimized costs in the value chain

Cost	KES/kg
Cost of pellets	12
Storage cost	2
Transport supplier to local storage	3
Transport warehouse to vendor	2.5
Packaging material	2.5
Packaging labour	1.75
Branding costs	2
Total Costs	25.75
Selling price	40
Profit Margin	**14.25**

In this optimized scenario where the costs are streamlined and VAT excluded the potential profit margin raises to 14 KES/ kg making the business much more viable and attractive. However feedback from the pilot showed that either the sales price would need to decrease or the selling price increase to give more margins to reseller to scale up the distribution network. Any increase in retail price would be challenging at this stage when the product is new in the market and hence it is likely the selling price may need to drop slightly.

This analysis shows that there are many cost variables that affect the profit margin when distributing and selling pellet fuel to households and each one would have to be optimized to make the business viable. However these optimized costs are still assumptions and further testing at scale would have to be done to understand what could realistically be achieved. It should also be noted that reaching this scale would take considerable time and investment as highlighted by our pilot. This analysis does not consider the investment that would be needed to gain a market but just shows the potential profits once that market was gained.

During ENEA's assignment they compared the two scenarios of local production versus importing pellets based on initial program assumptions[7]. During their analysis they used the Levelized Cost of Energy (LCOE[8]) as a parameter to compare the total cost of producing one tonne of pellets. This analysis showed that the LCEO for one tonne of pellets produced locally was 287 USD/ tonne compared to 467 USD / tonne for one tonne of pellets imported into Kenya, making local production the most economical option in the long term even when considering the upfront investment cost. For local production, the main costs involved are labor and upfront facility investment, whereas for pellet imports the major costs are the cost of the pellets themselves and shipping. However if EcoZoom was to move ahead with local pellet production it is likely that it would have to continue using pellet imports to sustain the market whilst a production facility became operational.

[7] Refer to final ENEA report for more detailed analysis and list of assumptions

[8] The LCOE (Levelized Cost of Energy) is the total cost of producing pellets including both discounted CAPEX and OPEX. All steps from the raw material to the final reseller are then considered within this indicator.

4.2 Cost of Stove Technology

The cost of the gasifier stove for burning pellet fuel should also be considered during the initial stages of building a household market. The cost to EcoZoom for purchasing the Philips gasifier stoves used in this pilot was approximately 100 USD. The amount paid by the end user for the stoves over a 12 month period was approximately 50 USD, with the idea that the lease agreement tied the end user into buying the pellets, allowing the subsidy to be repaid through profits on sales.

If we consider a scenario where a profit margin of 10 KES was available on every 1 kg of pellets, a customer must use 500 kg of pellets before this subsidy is made back. During our pilot an average daily usage rate of 0.35 kg/day was achieved amongst active users when purchasing on a regular basis. Using this usage rate it would take almost 4 years before a customer paid back the subsidy on the stove and EcoZoom began to make a profit on fuel sales.

To overcome this challenge the following factors would need to be considered;

1. Usage rates would have to significantly increase – this would require additional investment and testing of strategies to understand how to achieve this.
2. Users would have to purchase the gasifier stove at full price – this would require an end user financing component to allow the cost to be spread out over several months to make the stove affordable. EcoZoom does not have the capacity and cannot take on the risk of direct end user financing so this would require a scheme through a third party financial provider.

There are cheaper gasifier stoves available on the market, for example natural draft versions that sell for 40-50 USD, however they would not offer the same health benefits of the forced draft gasifier stove, which is an important factor in promoting the switch to pellet fuel.

4.3 Potential from other markets

Institutional markets

Whilst this study has focused on the household market there is a high potential from other markets such as institutions and industrial customers for purchasing pellet fuel. Institutions can use pellet fuel for cooking in a specially designed large-scale gasifier stove. Institutions can cook for large numbers of people every day and as such have a high demand for cooking fuel. We approximate that an institution could use up to 12,000 kg of fuel per year (however this has not been tested and would likely be lower as we found out with our household estimates). Institutions would also be able to order fuel in bulk reducing transportation costs and would require large bags reducing the packaging costs. These factors would reduce the cost to the customer and increase the profit margin available – although it is likely that the institutional market would also purchase at a lower price compared to households. Pellet producers in other countries such as ECS in Zambia and Abellon Energy in Ghana have had more success in these markets compared to the household market.

A potential challenge with the institutional market is the cost savings that they might incur from switching to pellets. Where an institution is using and buying charcoal they are likely to have a high

cost for their fuel and a switch to pellet fuel can offer them significant financial savings – as is the case in many parts of Zambia where ECS operate. However in Kenya the majority of institutions are either using LPG (over which pellet fuel would not offer a clear advantage) or they are using firewood for cooking tasks such as boiling. In the case of firewood their energy bills are much lower compared to charcoal – in addition many institutions such as schools in Kenya already have energy saving wood stoves. Some schools also have a policy whereby pupils and parents donate firewood to the school, often partially in lieu of school fees. Out of 7 schools we surveyed in Nakuru, all were using firewood with an average spend of KES 9,500 per month. If we are assuming an average usage of 500 -1,000 kg of pellet per month for an institution, at a wholesale price of 40 KES/kg, this would cost them between 20,000 – 40,000 KES per month. This is significantly more than they currently pay for their fuel and hence limits the financial incentive for them to switch to pellets.

Figure 34: An institutional stove burning pellet fuel supplied by ECS in Zambia

The cost of an institutional stove capable of burning pellets should also be considered. During this pilot we planned to import a sample of these stoves into Kenya for testing – since none were available in the country. Whilst the stoves themselves cost approx. 500 USD from the manufacturer once you consider shipping and import duties the landed cost in Kenya would be around 875 USD. Whilst this is comparable with the cost of a large institutional wood saving stove it is still a significant investment for an institution. To get the costs down it is likely that a locally sourced stove solution would have to be found. During this pilot we were unable to test out any institutional stoves due to shipping delays and time constraints. However further commercial testing needs to be done with institutions in Kenya to understand potential usage and uptake further.

Industrial Markets

There is a large fuel demand from industrial customers in Kenya for operating boilers and other heat powered equipment. Large industrial users of fuel include tea factories, cement factories and

other agricultural processing industries. Many of these industries, such as tea factories, are still reliant on firewood, which is often harvested in an unsustainable manner. As such these industries are facing large fuel shortages. Other industries that rely on furnace oil are looking for alternatives that could save them money. Demand for wood fuel in Kenya (firewood and charcoal) is projected to reach 40 million m^3 by the year 2020 against a supply of 27 million m^3 – resulting into a large deficit of about 13 million m^3 [9].

As such there is a large potential and significant interest from these industries to switch to alternative fuels. However there is still a lack of knowledge with potential suppliers and customers as to the cost-benefit analysis of such a fuel switch and there is a need for more information to answer questions such as the following;

- Would pellet fuel require a switch in boiler technology and how much would this cost?
- How many pellets would an industrial customer need to meet their energy needs?
- What would be the cost saving in switching to using pellet fuel?
- What is the benefit of using a biomass pellet over a briquette?

The few large scale briquette producers that exist in Kenya already have industrial customers as their main markets, showing that these industries are willing to make a switch. However the challenge with these markets is that for a customer to commit to switching to pellet fuel it needs a suppliers that can guarantee a quality supply of pellets in large quantities. Anecdotal findings suggest that a large industrial customer could require up to 5 tons of fuel a day. To secure these customers it requires a large scale facility and significant investment in establishing it.

4.4 Analysis on Commercial Viability of Production

During their assignment ENEA built a business model to assess the viability of setting up a pellet production facility in Kenya. This work was completed before we had collected usage data from our household pilots and hence made the following assumptions on the market for fuel sales from such a facility;

- The company would grow household customers from 1000 hhs in year 1 to 2000 hhs in year 3. Average household consumption would be 500 kg per year per household.
- The company would have 20 institutional customers each with an average fuel consumption of 18,000 kg per year.
- The company would secure 1 large commercial customer with an average usage of 60,000 kg of pellets per year.

In addition we built into the model an approximation of the investment cost to set up a medium size production facility, capable of producing around 5 tons of pellets a day, using high quality equipment imported from Europe and including the purchase of vehicles for fuel transportation. The total investment costs for the facility came to approx. 640,000 USD. The model then considered the costs for operating the facility on a yearly basis.

[9] *Unique, Kenya Commercial Forestry Sector Programme Development, Markets, value chains & timber trade options, Draft Report, Sept 2014.*

Based on the sales assumptions above, the model showed that the business could breakeven in the fourth year and make a profit of approximately 350,000 USD per year thereafter. Such analysis shows that there is high commercial potential for such a venture although initially based on many assumptions that would need further verification.

However if we keep all assumptions the same and consider the household usage rates at the level we experienced in our model of 0.35kg / day this would give a yearly consumption of only 128kg / year, much lower than we had initially assumed. With this consumption it would take 8 years to pay back the initial investment in a facility with a profit of approximately 86,000 USD per year, therefore a much less lucrative business. If you take out the institutional and commercial customers and consider only households at a usage rate of 128 kg / year the business would not be profitable at the investment cost we estimated. To sustain the business on the household market alone would require a high usage rate and a large number of household, both things which we were unable to achieve in our pilot project. For example in the ENEA model the business would become profitable at approx. 1600 HHs when the average usage rate of the household was 400kg per year.

Whilst this business model was built on many assumptions that would need to be further verified and may have used a high cost for equipment and initial production setup, it indicates a couple of key things;

- Customer usage rates have a significant impact on the profitability of a pellet business
- It is difficult to sustain the business of sales to households alone; the business would also require bulk orders in the form of institutional and industrial customers.
- If the business was to consider households alone it would require a large number of households (>1500) and for those households to have high usage rates (>1.1kg/day).
- Both of these things are difficult to achieve and would require significant investment in sales, marketing and awareness.

4.5 Conclusion on Commercial Viability

Our project, piloting the commercial sales of pellet fuel in Western Kenya, has shown that pellets have the potential to save households money and provide a fast and clean cooking alternative through an environmentally sustainable fuel. However the distribution and sale of pellet fuel is faced with significant challenges in establishing itself as a viable and hence commercially sustainable business opportunity;

1. Importing pellet fuel is not commercially viable (as well as having a high carbon footprint). Hence anyone wanting to sell pellet fuel would have to set up a local production facility for any chance of making a profit on fuel sales.
2. Achieving high usage rates is critical for making the household market commercially viable. Observations from our pilot have shown that this is difficult to achieve and a high touch approach would be necessary to push user's usage rates up, requiring significant investment in awareness creation and staff resources.
3. The viability of the household market also requires a large number of households to commit to switching to pellet fuel for all their cooking needs. This again would take significant investment and time to achieve with pellet fuel being relatively new in the market.

4. The stove technology required for burning pellet fuel efficiently and cleanly is currently too expensive for the majority of household to afford. Financing mechanisms need to be established in order for people to afford the stove. Offering any subsidy on the stove to be repaid through fuel sales is risky and only possible where high usage rates can be achieved.
5. In addition to the high price current stove technology for burning pellet is often unsuited to everyday cooking needs (such as long low heat cooking tasks) and forced draft technologies require high levels of after sales support and maintenance.
6. To make a pellet production facility more viable a company would need to secure institutional and industrial customers in addition to households. However there remain gaps in knowledge to understand the technology requirements and cost benefit analysis for these market segments.
7. To secure such customers requires a producer to be able to guarantee a large volume supply of high quality pellets from the start – presenting the dilemma of 'go big or nothing' in terms of a pellet production facility, hence requiring a significant investment cost.

Based on the above, at this stage, EcoZoom is not intending to scale up its sales and distribution of pellet fuel and does not intend to invest in a pellet production facility in Kenya. There is still a high potentially for alternative fuels such as pellets but it requires significant investment to build the market to a stage where it could be viable. As a pre-profit social enterprise EcoZoom is currently not in a position to make this investment without additional financial support or partnership.

The following recommendations, which The Global Alliance for Clean Cookstoves may consider supporting, could help to further increase the viability of alternative fuel businesses in Kenya;

- Support to further test business models and approaches to increase the uptake and usage rates of alternative fuels.
- Support to stove manufacturers to further improve usability and reliability aspects of gasifier stove technology as well as opportunities to reduce costs.
- Further assessment of the institutional and industrial fuel markets to understand the technical requirements of fuel switches and the cost benefit of fuel switching.