KTEMBO

AN INSULATED, FILTERING KETTLE FOR OFF-GRID KENYA

External Business Plan

EXECUTIVE SUMMARY

KTEMBO is a social enterprise aiming to balance social impact and profit.

We have identified the need for boiling water for drinking and cooking as well as the benefits it can have in killing harmful bacteria found in contaminated water.

2.2 billion people lack access to safe drinking water with 1000 children dying every day from diarrhoea alone [7]. Treating household water would help solve this problem.

Many of the areas around the world which suffer from poor access to clean water also suffer from poor access to electricity. The region with lowest rates of access is Sub-Saharan Africa; growth in this sector is occurring, with localised regions such as Kenya seeing huge growth in electrification. **In 2020, 80% of off-grid solar appliance sales in East Africa, were in Kenya** making it an ideal location to market a DC electrical appliance [1].

Our solution to provide a suitable method of boiling water to Kenya, is a DC vacuum insulated kettle with an integrated filter. The insulation minimises heat loss meaning the water will retain its heat for many hours and the kettle will not have to be re-boiled. This saves the user both time, and cost associated with energy use. The activated carbon and alumina filter removes contaminants that cannot be removed via boiling.

Over six weeks our kettle is less expensive than firewood, the cheapest fuel in Kenya [2]. This is pertinent with the most common method of boiling water, being over an open fire.

With an **initial investment of £300,000** we can start development and manufacturing of our kettle. A design team will be based in the UK, focusing on product development. The product will be manufactured in Kenya which will also provide jobs to the local economy.

We are **seeking grant funding** of £200,000 from Efficiency for Access, who have an R&D fund for solar-powered appliance technology projects [3]. The remaining will be covered by a business loan.

The kettle is to be sold to customers in Kenya at an equivalent of £20. Kettles sold in developed countries, such as the United Kingdom, to ethically conscious consumers will help subsidise some of the cost to our end user in Kenya.

We will also generate revenue from issuing and selling carbon credits by measuring the yearly difference between KTEMBO and typical water boiling emissions.

KTEMBO will **breakeven by Y3 Q2**, generate a peak of £4 million yearly sales revenue and £1 million in carbon credits issuing, in the 10 year forecast.

KTEMBO TEAM

“Quite simply, water is a matter of life and death.”

ANTÓNIO GUTERRES

SECRETARY-GENERAL OF THE UNITED NATIONS

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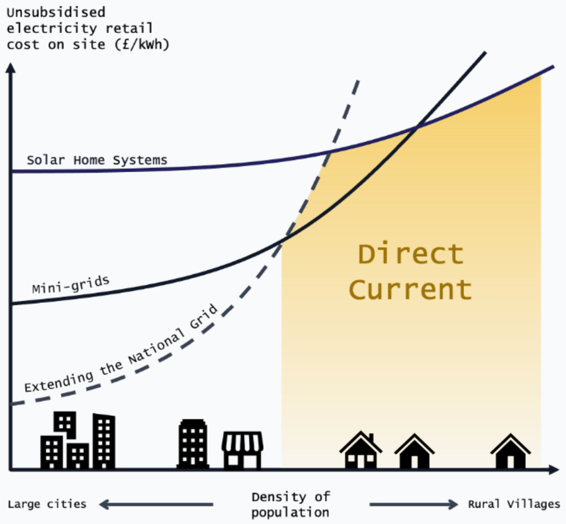
CONTEXT



The UN Sustainable Development Goal (SDG) 7 identifies access to reliable, affordable, and modern energy as a critical step in eliminating poverty around the world. Access to energy is an enabler and central to achieving many of the other SDGs [4].

The most economical way of achieving electrification in remote and peri-urban settings is through direct current (DC) mini-grids[1] and solar home systems. With the turn of the decade, access to energy in developing regions is growing. The International Energy Agency (IEA) forecasts more than 600 million people in Sub-Saharan Africa need to be served by an off-grid renewable solution by 2030 to meet SDG 7 [5].

Conventional, inefficient appliances use far too much energy to be used affordably with off-grid solar home systems or mini-grids. The burden of inefficient appliances can overload these small systems causing load shedding and outages.

Around the world, 2.2 billion people lack safe drinking water[2]; nearly 1000 children die daily from water sanitation-related diarrheal diseases [6]. In Sub-Saharan Africa, household water treatment is the recommended means to reduce diarrhoea, but only 22% of households currently do this [7]. Boiling water is the simplest method which the WHO recommend but is also energy intensive.

By supplying a better means to boil water, clean water becomes more accessible.

Providing an efficient, affordable and sustainable way of boiling water has potential to be a driver of social change.

[1] Mini-grids are small scale off-grid electricity generation and distribution networks, typically less than 10kW but can be up to 10MW. They often supply a localised group of customers in a small town or village.
[2] 320 million people in Sub-Saharan Africa [30]

WHAT

PROBLEM

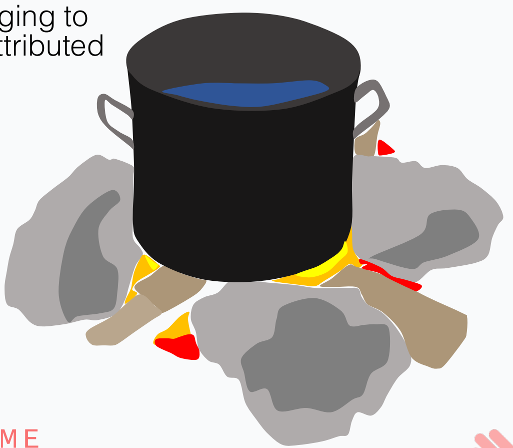
Boiling water is a universal problem that many face, whether it’s for making tea and coffee or to kill the harmful bacteria in a contaminated water supply. A common method for those who have limited access to electricity would be to boil water using a simple three stone fire.

DETRIMENTAL TO HEALTH

It is not uncommon to have indoor three stone fires, where inhalation of fumes can be damaging to respiratory health, attributed to 4 million deaths a year worldwide.

EXPENSIVE

The hidden cost of firewood and coal adds up over time.



Simple three stone fire for cooking and boiling water

SAFETY

Open flames and exposed boiling water can lead to fire and burns.

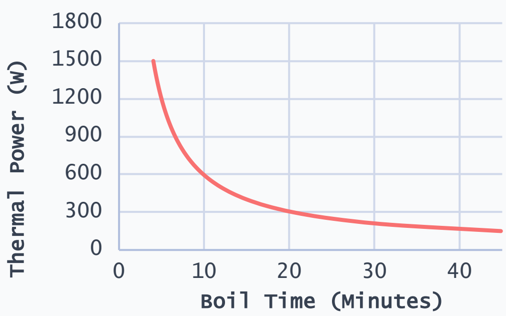
LONG BOIL TIME

Heating water to a boil takes a long time, especially after you factor in collecting firewood, starting, tending, and putting out a fire.

OTHER CONTAMINANTS

Boiling water only kills bacteria and viruses, leaving heavy metals and other unwanted particulates in the water.

For people who have access to an AC national grid, efficiency is not normally considered when buying a kettle. However, for people around the world who live in less developed areas, where energy is more scarce, it can have a larger impact than you may think.



There are DC electric kettles available, however these often have:

SMALL CAPACITY

Current solutions are typically 500mL, only enough for 2 cups of water.

LONG BOIL TIME

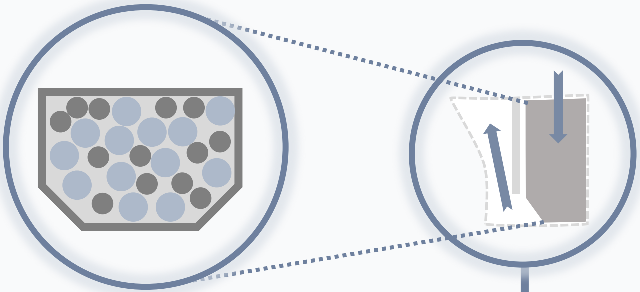
Despite the small capacity, they still suffer from long boil times due to their inefficiency.

The small capacity also limits the usefulness of the kettle and restricts the use to primarily making hot beverages.

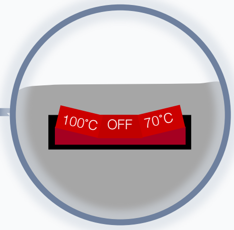
Current solutions do not provide a single process for boiling and cleaning water that is affordable and suitable for domestic use.

SOLUTION

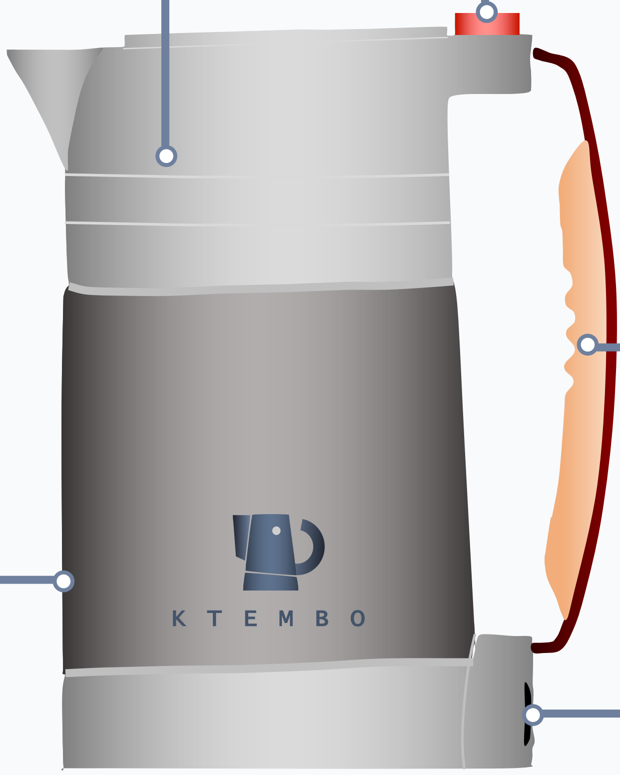
Our solution is an insulated kettle with an integrated filter. Our kettle has been carefully designed to best meet our user's needs.

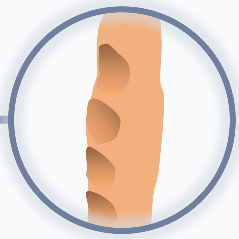


Integrated Filter – Activated Carbon and Alumina filtering removes small particles and heavy metals



Multi-mode Operation – Two operation modes mean water can be heated to 100°C or 70°C

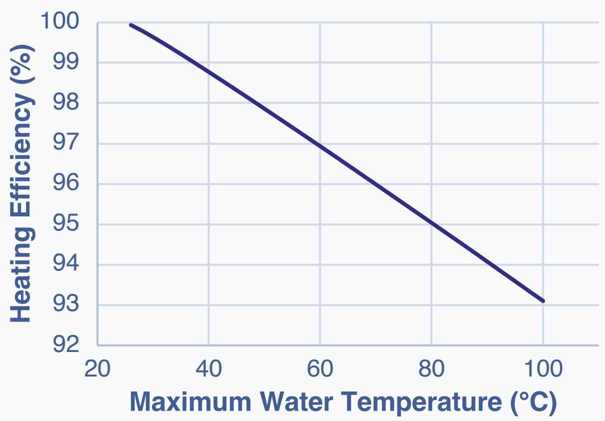




Ergonomic Design – For example, shaped cork grip for easy one-handed use

Insulation – Double-walled vacuum insulation minimises heat loss from the kettle

Interchangeable Power Connectors – Can be fitted with different power connectors such as crocodile clips and automobile auxiliary power outlet for operation with various power sources



INSULATION

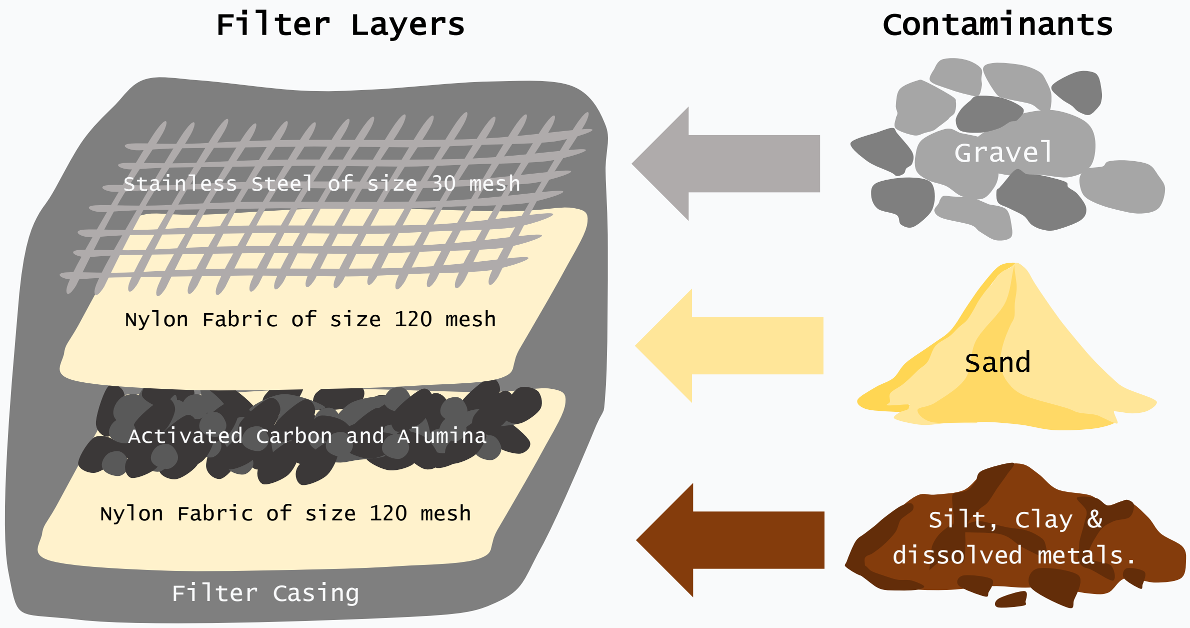
Insulation increases efficiency twofold, both in the actual boiling of the water and also in reducing frequency of use. The most efficient way to boil water is by not boiling at all; keeping water hot from previous uses is far more valuable than the minor efficiency gain while heating.

FILTER

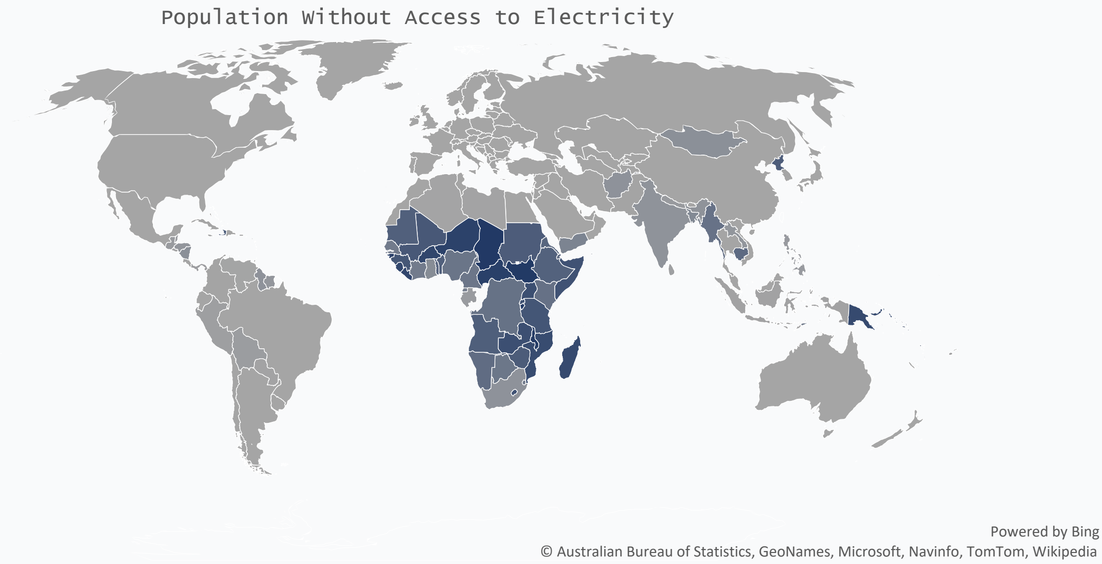
Naturally sourced water in Kenya is highly turbid [8]. Each layer of the filter removes contaminants of decreasing size, from larger contaminants such as gravel and insects, to finer contaminants such as silt and clay. Dissolved metals such as iron and fluoride are chemically removed with activated carbon and alumina that become deactivated after 1 month of use and will need replacing. Each layer provides a vital role in meeting the acceptable standards for potable water.

Filter failure is the other key risk that needs to be managed. Due to the effect that it has on the product operation, it is a critical area. The risk of the water failing to pass through the filter will be mitigated through additional development and testing of the filter module.

The full technical risk register can be found in Appendix A.

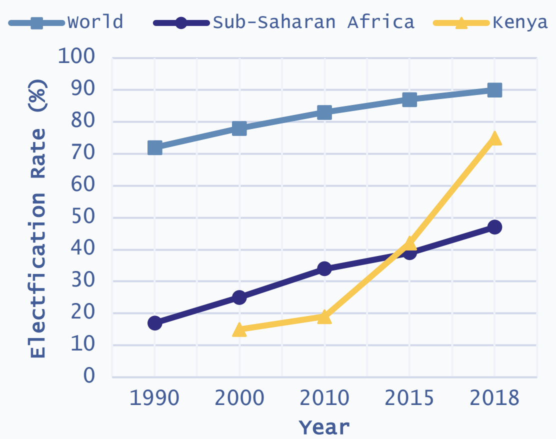


WHY



Sub-Saharan Africa currently suffers from the lowest rates of energy access. Of the global population without access to electricity, 75% live in Sub-Saharan Africa [5].

However, access to energy is improving. The UN aims to ensure universal access to electricity by 2030 [4]. With the enormous efforts to reach that target, localised regions like Kenya are seeing huge growth in electrification. Large proportions of the population have new access to energy, and therefore there is a growing opportunity and market for electrical appliances. The IEA forecasts 60% of those gaining access to electricity will do so through DC power [9].



Annual growth rate of solar photovoltaic systems has consistently been around 10 to 15% percent since 1990s, stemming from residential solar home system demand [10].

The electrical appliance market and more specifically the electric kettle market is highly fragmented with many brands supplying a homogenous product.
To increase chance of success in a fragmented market, an initial focus on a restricted geographic area of Kenya has been chosen.

The water purifier market in Africa is estimated to reach

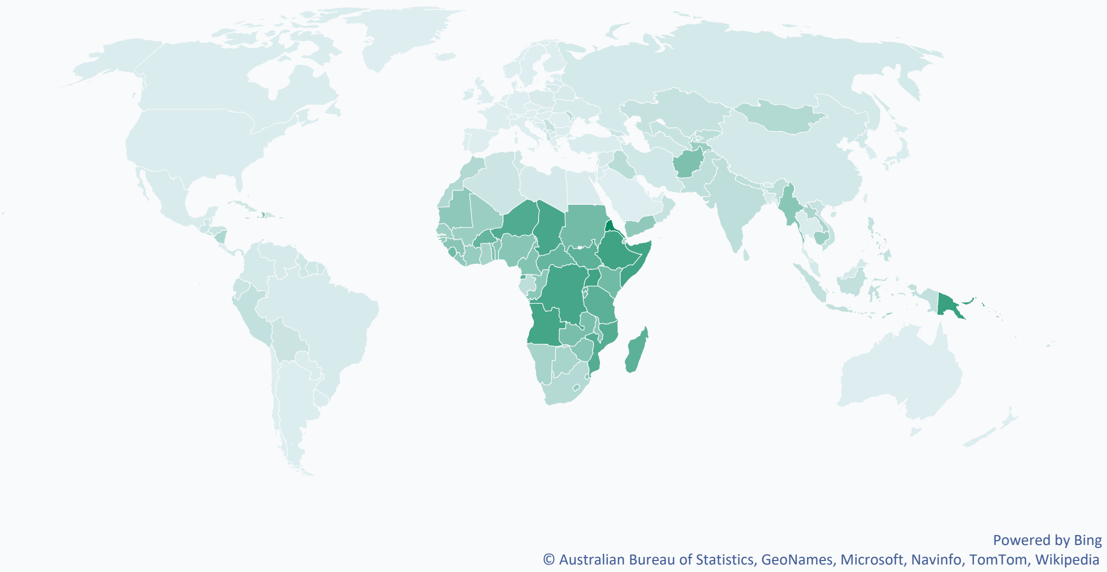
$617.7

million by 2027

The rise of ethically conscious consumers also has seen a surge of companies who have corporate social responsibility, ethical values and customers' interests at their core. B-Corps, a kind of business that balances purpose and profit, are growing with 3,720 companies spanning 150 industries in 74 countries [11].

WHY KENYA?

Population Without Access to Basic Drinking Water



There were three main metrics used when selecting a suitable location to sell our kettle:

Lack of access to clean water
We want to target countries who would benefit greatest from a domestic water filter.

Access to DC electricity
Our product only works on DC power, so want to maximise the addressable market.

Affordability
The population must be able to afford the product.

Sub-Saharan Africa has the lowest proportion of the people who have access to basic drinking water services. Within Sub-Saharan Africa, half of East Africa is still without clean water [12].

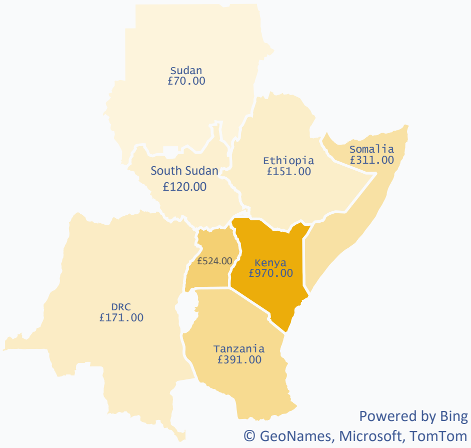
Of these countries, Kenya is representative of poor clean water access, but also has large investment into national electrification.

Between January and June 2020, the total recorded number of off grid solar appliance sales in East Africa reached 164,000 units and between January and June 2020, the total recorded number of off-grid solar appliance sales in Kenya were 131,000 units [1].

Kenya's average monthly income is also the highest of East Africa, further highlighting Kenya's suitability as a candidate in which to launch our kettle [13].

In 2020, 80% of off-grid solar appliance sales in East Africa, were in Kenya.

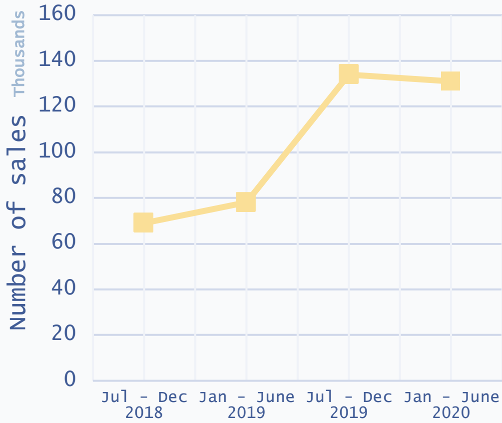
Average Monthly Incomes 2021



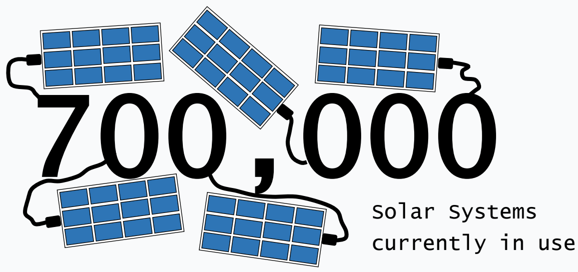
As well as the three mentioned metrics, on which Kenya scores highly, government investment into infrastructure and commitment to development was crucial in choosing this region.

Kenya joined the Sustainable Energy for All initiative in 2016, targeting universal electrification by 2022 [14]. Off-grid appliances sales have almost doubled in 2 years because of this.

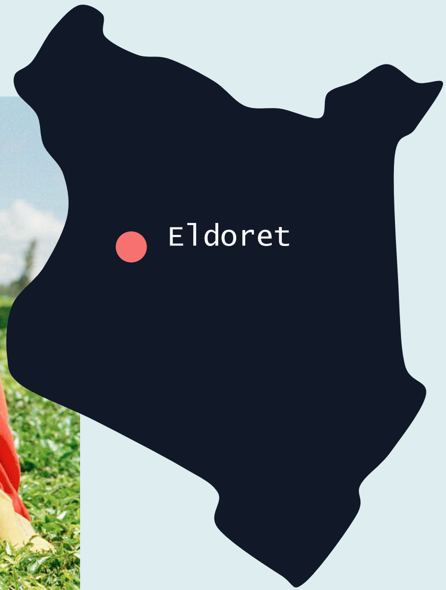
Off-grid Appliance Sales in Kenya



The Kenya Power and Lighting Company owns and operates most of the electricity transmission and distribution system in Kenya.



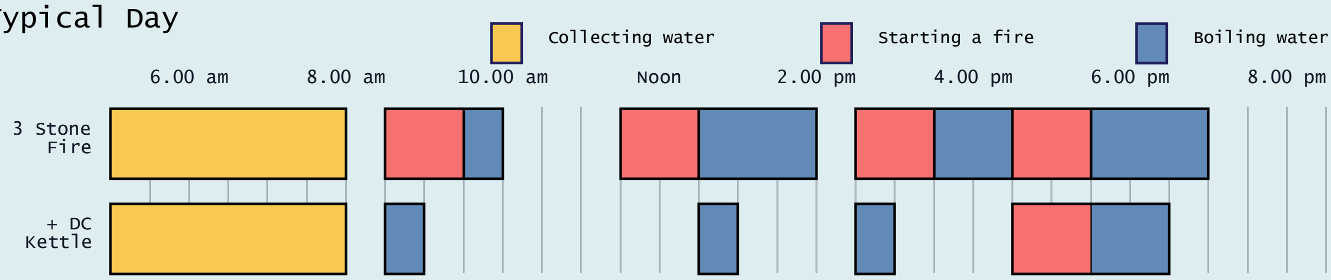
They have served 700,000 solar home systems to customers, with the potential to implement 1.96 million more to households [15].



Layla & Samuel

Layla, a representative of our target user, is a 29-year-old Kenyan mother of 3. She is married to Samuel, they live in a small township outside the city of Eldoret, where he works.

Typical Day

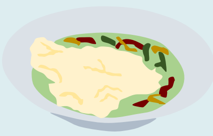


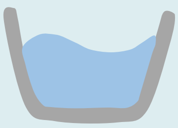
A kettle is far quicker at boiling water for hot beverages like ginger tea

A kettle alone can be used to cook dishes like Ugali, cornmeal porridge, a Kenyan favorite

Sterile water for cleaning and washing can be boiled faster in a kettle

Kenyan cuisine involves lots of pulses, beans and grains that need boiling. Cooking doesn't begin till close to boiling, starting from hot water reduces overall cooking time





Like most Kenyan women, she spends at least 4 hours a day on unpaid domestic work, on top of weekly tasks such as collecting firewood. A kettle cannot eliminate all of this, like collecting water each day, but it can reduce overall domestic burden.

More free time leads to more opportunity to spend time in education, looking after children, other productive use, or leisure.

CUSTOMER PROFILE

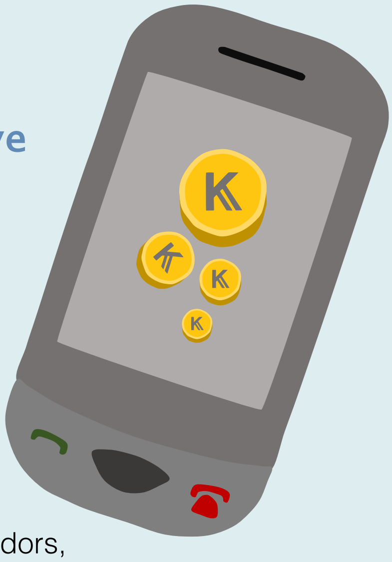
Although the customer and user may be the same person, in many Kenyan agricultural households it is the husband that dictates spending decisions [16].

Samuel has recently purchased a solar home system which provides DC electricity to their home. This is used for lighting so his children can study at night and mobile phone charging.

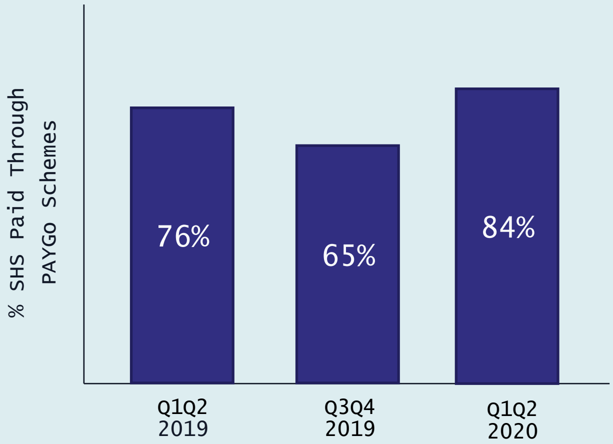
Their household income is 88,400 KES (£590) a typical monthly salary in agriculture [2].

A 2016 survey of 387 rural Kenyan households, states 12% of reported monthly cash income is spent on coping costs of unclean water. This includes money paid to water vendors, capital costs of storing and collecting rainwater, costs of treating diarrhoea cases, and expenditures on drinking water treatment [17].

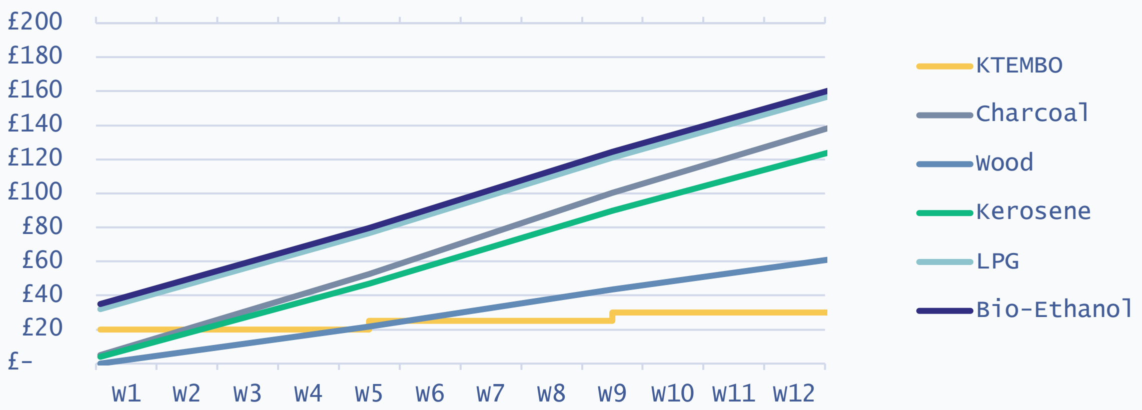
In Kenya, 72% of people have a mobile money account [68].



Customers are familiar with mobile purchasing, with this likely increasing due to increasing reach of technology.



COMPETITION



There are many different combinations of appliances or systems customers may have to boil water. Most people will boil water in a pot, however the fuel source for this is variable. Unsustainable fuel sources have a high hidden running cost compared to solar powered DC; our solution is designed to be a cost-effective method of boiling water.

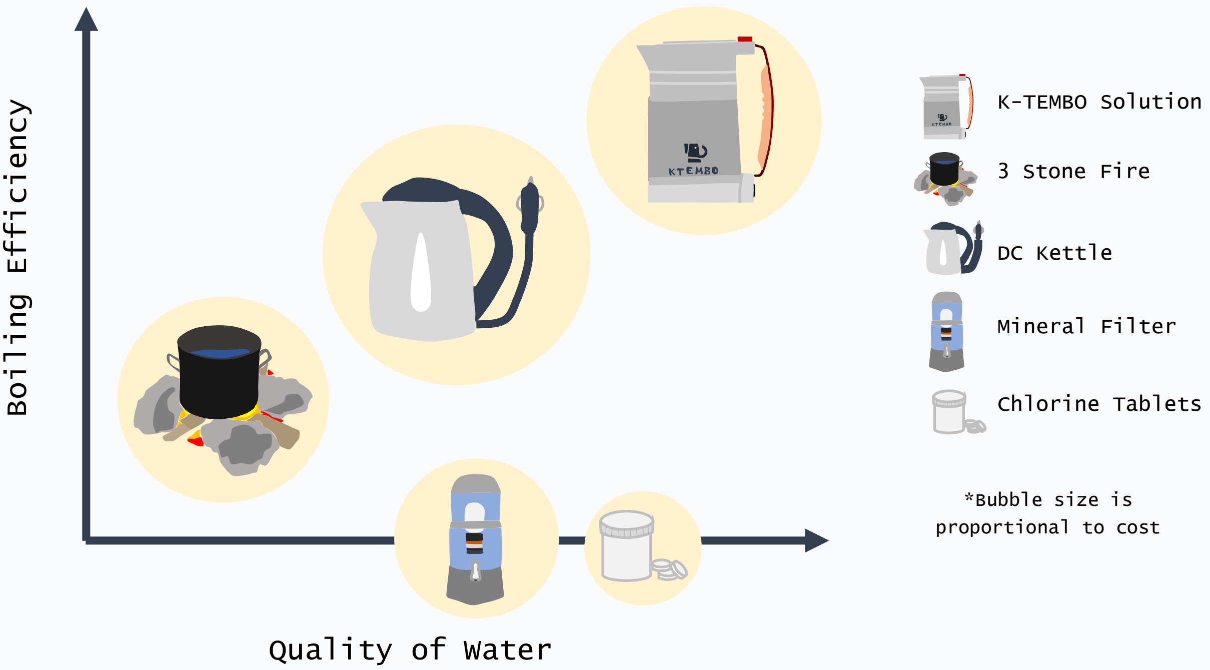
In addition to this, we have an integrated filter. This added feature, means we also directly compete with water purification systems. Although chemical methods like WaterGuard are much cheaper, our purified water comes at no additional cost when using the kettle to boil water.

Our kettle is more affordable than the cheapest unsustainable fuel source of wood over as little as 6 weeks, including replacement filter costs [2].

Those who already have other electronic cooking capabilities can use the kettle in their ‘stack’ to reduce overall cooking times.

The kettle is also a good first appliance due to its cost compared to an electronic pressure cooker for example.

Other existing DC kettles are very inefficient and have slow boil times as well as not integrating filtering.



HOW

VISION

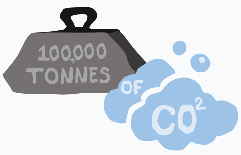
The intensions of KTEMBO are to build a profitable, sustainable, scalable, and resilient business. The core values of the company should ensure that impact and social change are a key part of our operations and not a by-product.

IMPACT AND GOALS

Profit is an important metric to measure success by, but as a social enterprise, we strive to do better and measure our success by the impact on quality of life for people in developing countries. With a product that provides hot, clean water, and through investing in local industry, we want to epitomise a brand that helps.

500 employees by 2030

With roles in manufacturing, distribution, sales, and administration, we will provide jobs to local people, aiming for 50% female workforce with wage parity.



100 thousand tonnes of CO_2 avoided by 2025

Through the efficient use of DC electricity rather than kerosene or wood to heat water, the carbon emissions of a household can be dramatically reduced.

1800 hours saved per household per year

By using our super-efficient kettle, families can save time cooking that can be used for enrichment through education or relaxation.

10 billion L of water boiled by 2030

The use of the KTEMBO kettle will improve water quality, reducing the likelihood of health problems.

PRODUCT ROADMAP

DEVELOPMENT

PERSONNEL

A three-person design team based in the UK will develop the initial pilot product. The team will consist of a mechanical engineer, an electronic and electrical engineer, and a manufacturing engineer. The mechanical engineer will be responsible for the mechanical and thermal design parts of the kettle, the electrical engineer will be focused on the control system and the manufacturing engineer will help both in designing for mass, cheap manufacture.

COMPANY STRUCTURE

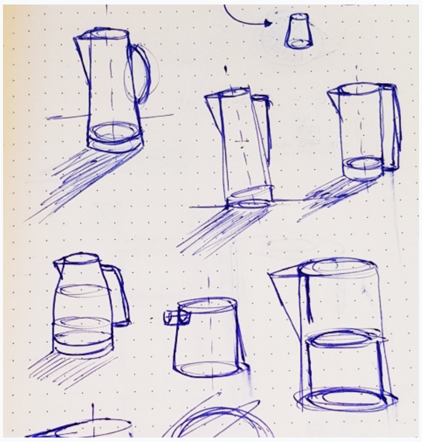
The design team is separate from operations and based in the UK. The reasons for this are primarily due to access to a large talent pool, familiarity and expertise in the area, infrastructure, and for its intellectual property laws.

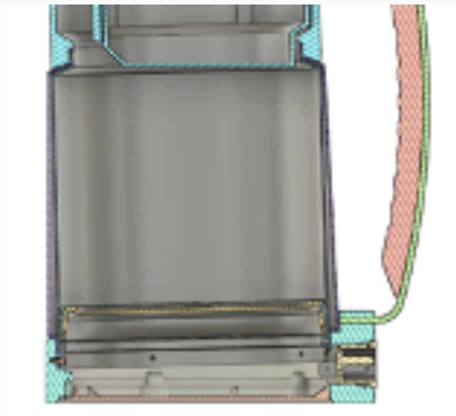
OUTCOME

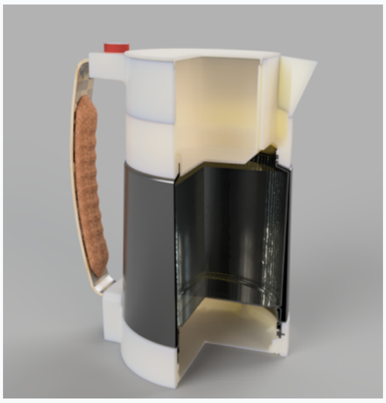
The intended outcome of this phase of work is a viable product for use in a small to medium scale pilot program.

COST AND TIME

Using typical hourly rates, this will cost £45,000 with an expected time frame of 24 weeks.







MANUFACTURING

PERSONNEL

In addition to factory workers who will operate assembly machinery we will also require a foreman to oversee production and ensure inventory is adequately stocked and the production time is as low as possible.

RESOURCES

With initial capital of £300,000, we will purchase machines and tools to complete orders of up to 100,000 units per year. In our 5th year of production, when this threshold is surpassed, specialist production equipment will be purchased and set-up in a larger warehouse; the cost of which will be covered by company cash, therefore no further investment will be required.

COSTS

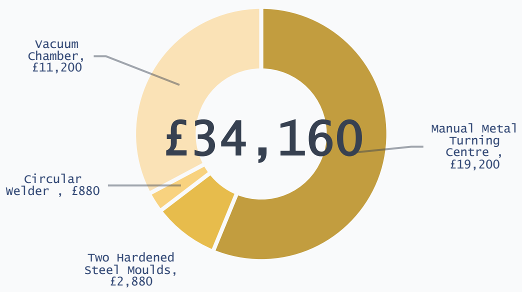
The manufacturing overheads for small-scale and large-scale operations are shown below, highlighting the additional costs associated with higher output. These do not include the site rent costs. Warehouses in Kenya charge a monthly average of £3.21 per m^2. This works out to be £3210 per month for small scale manufacturing and £14445 per month for large scale manufacturing [18].

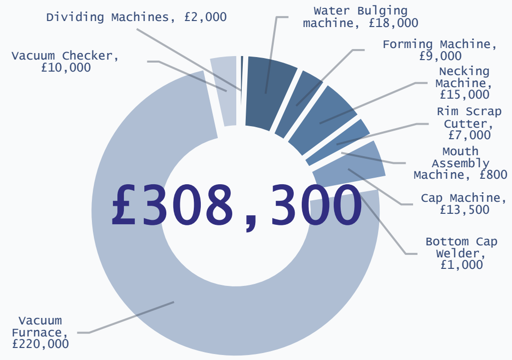
LOCATION

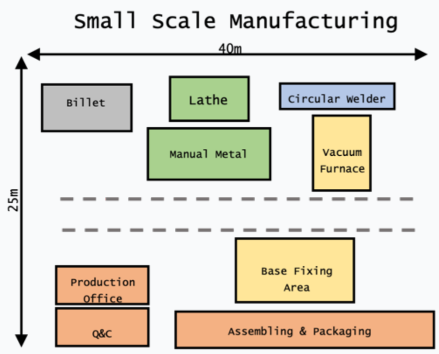
Manufacturing will be in Kenya to contribute to a circular economy, keep production close to customers, employ residents. As demand increases manufacturing facilities will expand in-situ until logistics and distribution costs outweigh facility costs at which point new facilities will be assembled in other operating countries.

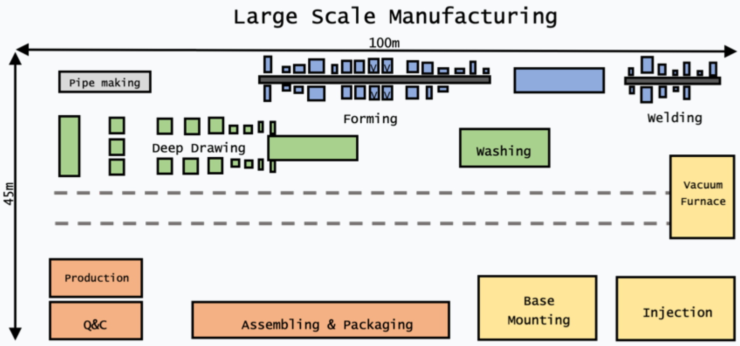
PRODUCTION PLAN

For the small-scale production facility working at maximum capacity, the









machine utilisation will be 40 hours a week for all five machines.

If unforeseen circumstances incur an increase in production requirements the lead time to source additional materials from suppliers is one month and should further machinery be required, a predicted three months will be needed for small-scale machinery and six months for specialist large-scale machinery.

Of the causes of failure that pose the greatest risk to the project, most are as a result of manufacturing issues. As well as additional quality assurance checks, random line checks and product tests will be introduced. The most critical potential failure is the vacuum failing, especially if there is direct contact between the inner and outer layers, as this may cause harm to the user.

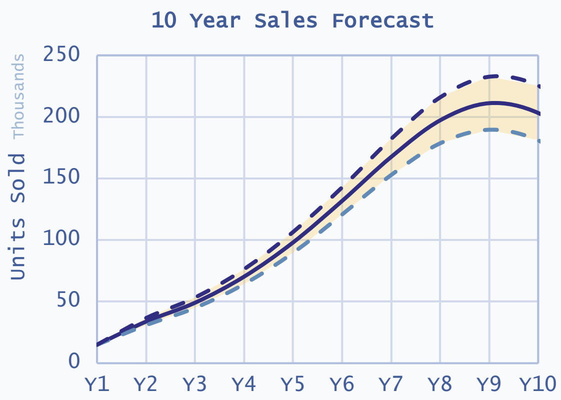
RISKS

To understand the possible technical risks associated with the product, an FMEA was produced, highlighting the highest risk items by calculating the Risk Priority Number. Using this, we could introduce additional measures into the design and manufacturing processes with the aim of mitigating the potential risks. The chart below shows the potential causes of product failure, demonstrating the different RPN between the original and managed risks.

OPERATIONS

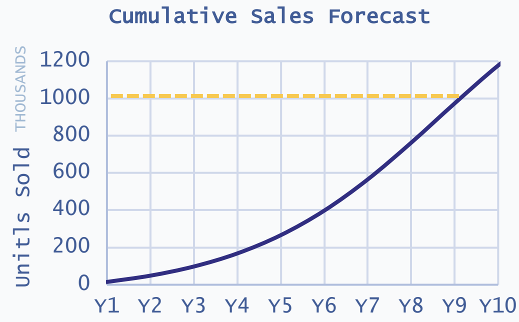
SALES

Sales figures for the kettle are based on sales from other companies who have launched similar off-grid solar products in Kenya. Where this information was not available, a Bass diffusion model was used. Year 1 sales are slightly lower than the general trend suggests because we will be operating an initial pilot programme with a reduced quantity of units. This is to allow for small redesigns after initial user and customer feedback.



The rate of sales reduces after Year 8 since we have only considered the sale of one line of products in this analysis. This is approaching market saturation; in practice more development and sales into other products such as e-cook stoves, thermal flasks or larger community-use boilers will contribute to the total units sold.

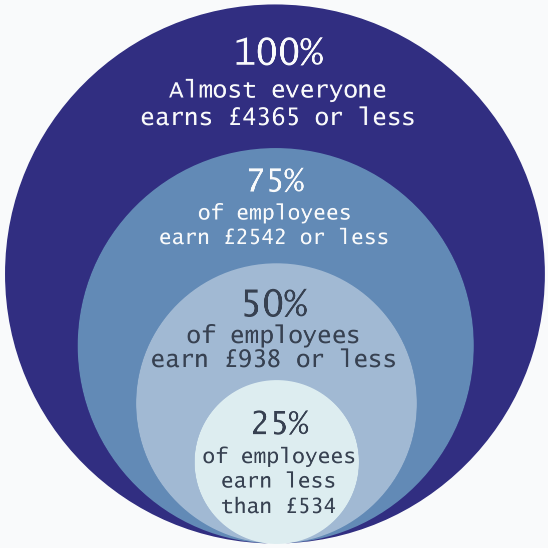
220,000/year
Units sold at peak



Looking at the cumulative sales forecast for the 10-year period, the goal of a million customers will be reached by Year 9. This is similar to M-KOPA who reached this milestone 8 years after operations began.

PRICING

The kettle will be sold to customers in Kenya at £20, providing a gross profit of £16 per unit. The cost of distribution has been accounted for in this price. The product has been priced to allow a small profit to be made per unit sold, whilst remining affordable for a large proportion of people in Kenya [19].

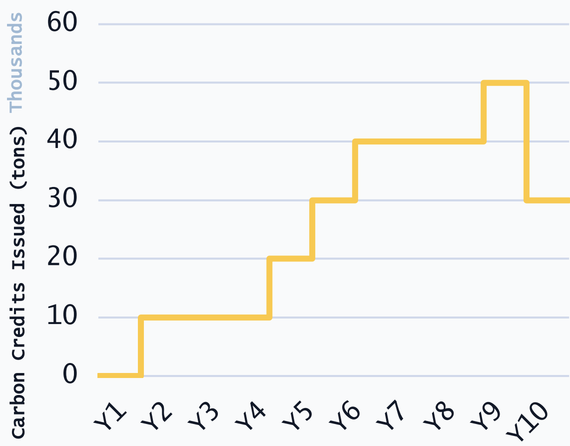


To increase the revenue from the kettles, the units sold to developed countries such as the U.K. and in Europe will be sold at a higher price. The target group would be ethically aware people who enjoy the outside lifestyle or do lots of travelling. Instead of being sold at £20, the kettle would be sold at £60, producing a higher profit. The price is similar to the Vektra kettle, which is our main competitor for this market. This figure also accounts for higher transport and import costs. This allows for greater income, without compromising on the company's social and ethical values. Wonderbag, a company who produce thermally insulated cooking bags, employ a similar strategy. To purchase a small Wonderbag in South Africa costs around £10, yet in the U.K., it is £40 [20]. Even accounting for import fees, this price is greatly inflated .

OTHER REVENUE

Carbon credits are permits that allow companies to emit a certain amount of CO_2 and other harmful greenhouse gases. Companies get issued a certain quota and are free to trade them with each other like any other commodity. There is a finite number of credits issued which reduce periodically over time. This is to limit supply and increase price, incentivising companies to reduce their carbon footprint.

We will measure the yearly difference between typical water boiling emissions and KTEMBO boiling emissions, to use this as a basis for the amount of carbon offset by out kettle. This will be verified by a third party who will ensure that our offsets are accurate and properly measured. This will allow us to sell the offset carbon and give us another revenue stream other than sales. This business model was pioneered by Wonderbag who have sold 318,000 tons of carbon in 4 years to companies such as Microsoft [21].



We have modelled our carbon credit program after Wonderbag's and our estimated sales. We assumed that we would sell credits in blocks of 10,000 metric tons at the beginning of the year, at the average current market price of £23.45 per ton. In reality, the price is likely to fluctuate but there will be a long-term upwards trend due to decreasing supply.

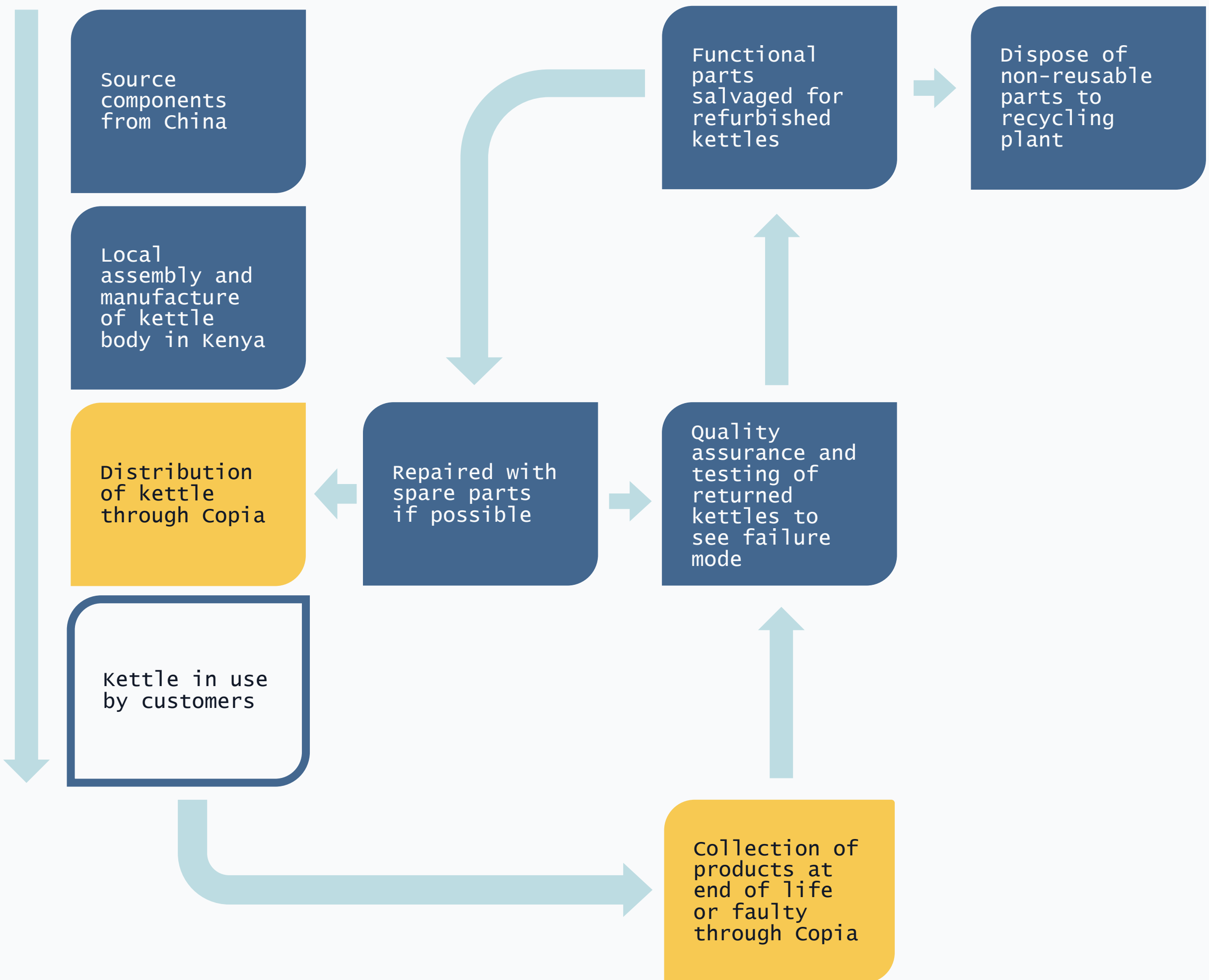
We also see opportunity for a revenue stream from filter replacements. We recommend they are replaced every 4 weeks and we intend to sell them for £5 a filter.

LOGISTICS

To distribute the product to customers, we will use Copia, an internet and mobile commerce platform for rural Kenya. Customers will purchase the product through their services, which will be delivered by Copia's couriers. They take a 10% cut of the sale as payment, similar to that taken by Amazon or eBay. The advantage of using an indirect sales approach reduces overheads and management requirements as Copia control the last mile business operations.

When expansion into neighbouring regions is deemed suitable, we will find other distributing partners who operate in those regions. This provides an added benefit of creating competition for the delivery contracts, creating an opportunity to drive down costs.

In the long term, the distribution strategy is likely to change. We will set up a subsidiary of the company that delivers our products to customers. This will save money as we will not have to pay a fee for every item sold, reducing our cost of sales.



INSURANCE

We will invest in product, public, and employer liability insurance to protect the company against lawsuits in the case of harm or injury caused by the product, to an employee, or anyone visiting the manufacturing site or office.

MARKETING

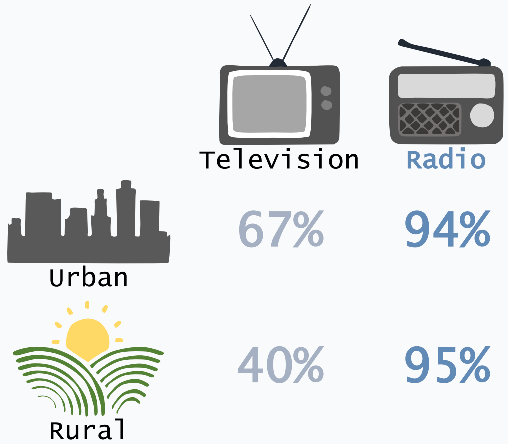
BRANDING

For the customers in Kenya and Sub-Saharan Africa, the product is a means of boiling water. However, for those in developed countries, the kettle provides a means of helping those less fortunate than them and supporting the fight against climate change. The product branding is targeted towards to the latter, where social media and public opinion is more influential. The name KTEMBO stems from the Swahili word for elephant, an animal indigenous to Kenya, which is reflected in the company logo. Providing a strong connection to Kenya will enhance the perception of helping those in less developed regions. Despite the branding being focussed on this group, highlighting that the product is made in Kenya will provide a useful marketing tool for promotion in Kenya.

The recyclability and sustainability of the product, alongside the social benefits, are the key selling points of the kettle for those buying in developed countries. Creating an identifiable brand that is synonymous with these values is imperative. Companies such as Patagonia have built a customer base around the sustainable clothing culture, making themselves a household name for ethically sourced and environmentally friendly products. We want a similar reputation for KTEMBO.

ADVERTISING

Product demonstrations are a major promotion technique in Sub-Saharan Africa. A customer is 35% more likely to purchase a product if they are clearly able to see the benefit to them, with 65% of people choosing to purchase the product at a sampling event [22]. The product promotion would focus on the quality of the product, as this is particularly influential factor when making purchasing decisions in Kenya [23]. Radio advertising would form a major part of the product awareness campaign, with 95% number of people having a radio compared to 40% that have access to a television [24]. This also has a cost benefit as radio advertisements are cheaper than purchasing television airtime.



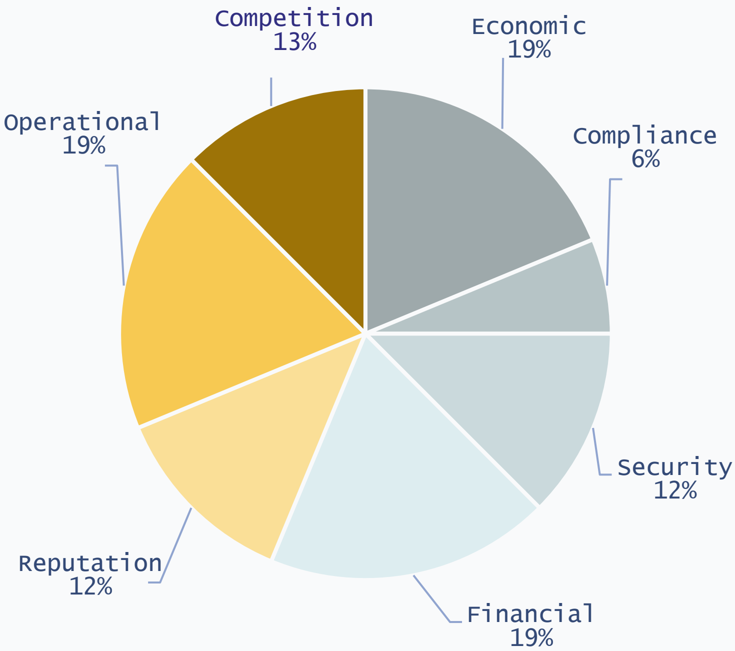
A key feature of the marketing will be targeting the correct demographic. Traditionally, women would be the main user of many households' products, being the family members that stayed at home, with the initial purchase being made by men, who typically had greater purchasing power. Although this is still the case, particularly in rural communities, men and women are approaching parity regarding spending money. Women are still the main product users.

CUSTOMER FEEDBACK

As well as providing distribution services, Copia will also provide a platform on which customers can give feedback about the product. This will allow us to gain a better understanding of the users' needs, providing information regarding how to improve the existing product, and ideas for new ones.

RISKS

Operational risks were highlighted to determine the possible threats the everyday running the business which could lead to reduced revenue. Product recall is a key commercial risk that would threaten the reputation of the company, this can be mitigated by ensuring the product quality is at a maximum. This would also reduce the likelihood of customer dissatisfaction or being undercut by a similar product.



Building and contents insurance would protect some of the assets in the case of flood or fire damage to the manufacturing site. However, we could lose operation time which would result in lost orders. To mitigate the risk of a COVID-19 resurgence, reserve capital would be set aside to accommodate any additional expenses or pay bills during a period of lower revenue. A full commercial risk register can be found in Appendix B.

FUTURE PLANS

DEVELOPMENT CYCLE

As part of our vision of having a meaningful impact on our customers, we aim to follow a framework to iterate on our design to best fit our customers. After the initial pilot program with the prototype kettle design, we will go back to a development phase that will run in parallel to our other activities; likewise, when bringing new products to market.

Development

Utilise feedback from customers; personnel operation in Kenya will setup customer relations and communication channels to relay usage information that will help dictate future design decisions.

Growth

Increase number of retailers stocking the product. Invest in large scale manufacturing machinery that requires less manual labour when sales cannot be met with the initial facilities

Maturity

Market saturation may eventually be reached in Kenya once everyone who wants our kettle has purchased one. Design other DC appliances for our pre-existing customers who already have solar home systems.

Decline

Carbon credits can provide an alternative revenue stream as well as relying on the instalments of pre-existing customers to get through periods of declining sales until development of the company's approach is implemented

EXPANSION

Following the product launch in Kenya, expansion into neighbouring regions will be considered. To determine the suitability of different countries, and the general feasibility of an expansion plan, various metrics will be used. These will prove whether deploying the kettle in a specific country is viable from a commercial, logistical, and cultural perspective.

For example, Ethiopia leads Africa in coffee production and consumption, it is the world's seventh largest producer of coffee; a kettle could be suited to their requirements [25]. Ethiopia also has a national electrification programme that aims to provide 100% of its population with electricity access by 2025, with 35% of households having an off-grid supply [26]. More detailed design work would be needed to adapt the proposed design to best suit a new target market.

To cope with the increased demand, the sales region expansion will coincide with the upgrade of the manufacturing facility. We will also adopt a new distribution method. We will form our own courier service that will be a subsidiary of the business. They will handle the last-mile distribution from the factory to the final customer. For such large volumes, this is far more cost effective than an online retailer taking a percentage of each sale. It will also allow us to expand our network across the region, enabling us to employ more people, improving their livelihoods.

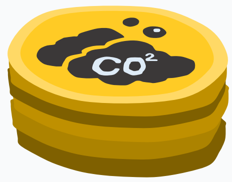
FINANCES

AT A GLANCE

£300,000
initial investment required

Breakeven by
Y3 Q2

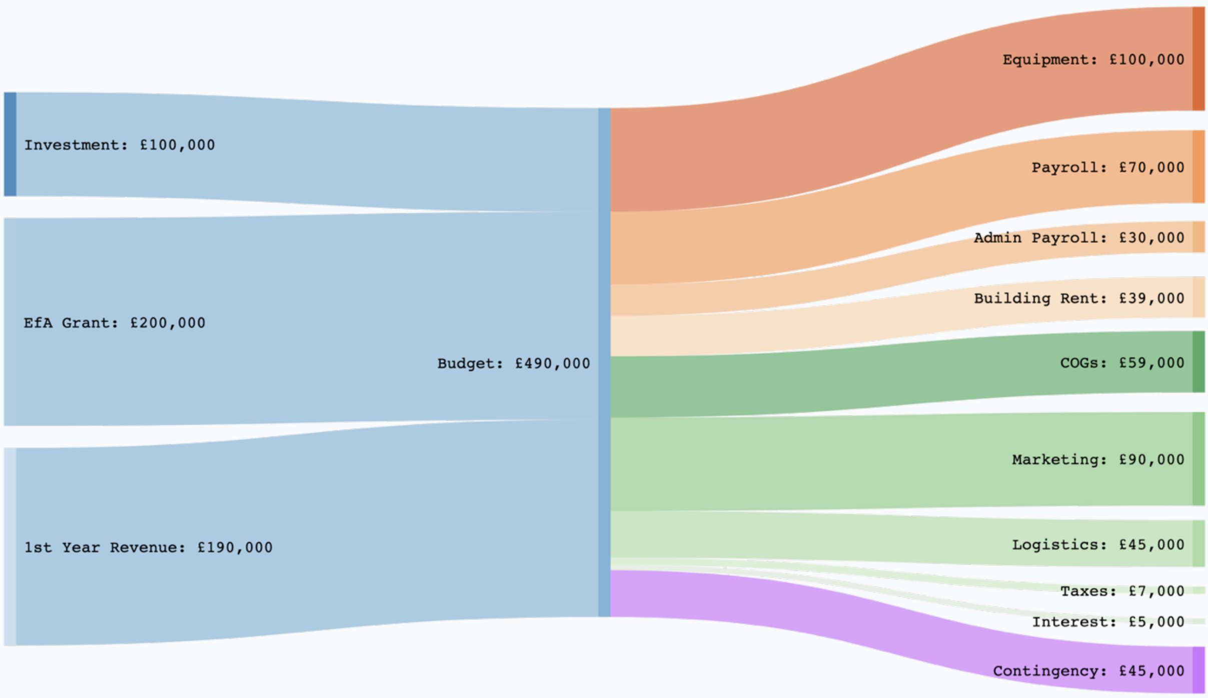
£4m
yearly revenue by 9th year of operation



£1m
in carbon credits sales in 9th year

The financial accounts start with the capital investment for manufacturing facilities until the end of 2031, when all expansion plans have been completed and the initial product's potential market has been saturated.

YEAR 1 CASH FLOW



FUNDING

The Efficiency for Access R&D Fund has given £2.9 million in grants to 20 organisations for innovative, solar-powered appliance technology projects. SureChill, a UK based off-grid solar refrigeration company, received £196,781 from this fund; AgSol received £166,060 to develop a solar mill prototype for Kenya. Since these two companies, among the others who have received funding, are at a similar maturity and working in very similar markets, we are confident we will be able to secure grant funding of £200,000 for the initial development of our product. The additional £100,000 will come from a business loan.

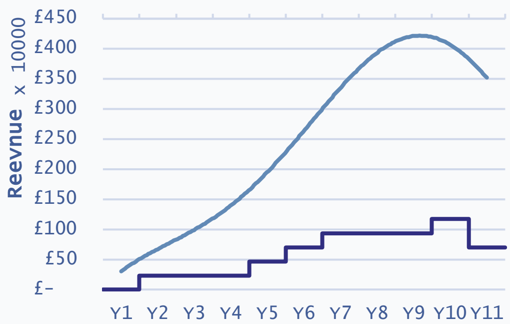
KEY FINANCIAL ASSUMPTIONS

Sales figures were analogically estimated using data provided by M-KOPA who operate in the same space as KTEMBO, however, historical data was limited so a mathematical model was used to estimate the variation in sales rates compared to a typical newly released product. Where analogical data was not available parametric estimations were used where applicable, though it is important to note that any predictions calculated with all available data will still be subject to unpredictable external circumstances, and volatile markets/purchasing behaviours that will likely alter the forecast results in reality. The financial model would be adjusted accordingly after operation commences.

Assumption	Reason	Effect On Estimate
Normalisation and converting currencies	Figures were converted from their respective currencies to GBP and assuming 2% inflation year on year.	2/5
Business was set up as a residential company in Kenya and therefore paying a 30% **corporation tax**. [27]	KTEMBO will manufacture, operate, and sell in Kenya and therefore should be classified as a Kenyan company. However, this could be subject to change if the Kenyan government does not allow any foreign counterparts to the business and corporation tax would rise to 37.5%.	2/5
Grant from Efficiency for Access.	Efficiency for Access provide the necessary investment funds for R&D projects that aim to improve efficiency of low energy appliances in developing countries.	3/5
Equipment is **purchased in full**	To avoid incurring any interest charges on repayments. This will not affect overall estimates greatly but has contributed to spikes in cashflow.	1/5

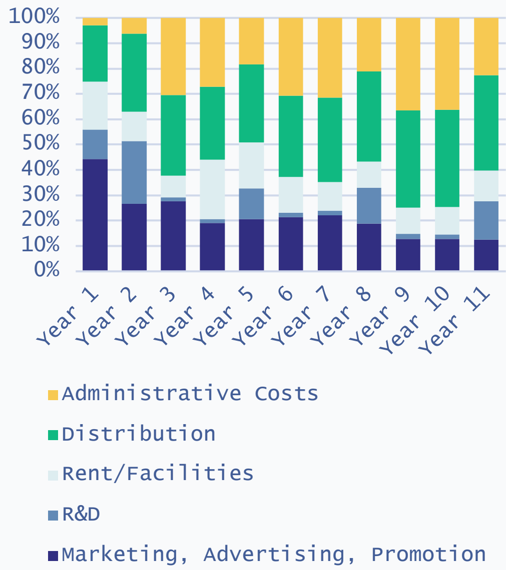
REVENUE

Revenue is generated as soon as the product is released to market. Sales revenue may be slower within the first year because of the initial pilot program and the product's success in Sub-Saharan Africa is dependent on word-of-mouth marketing, which takes time.



The revenue graph shows the smooth revenue from sales and the stepped revenue from selling carbon credits over a 10-year period.

PROJECTED COSTS



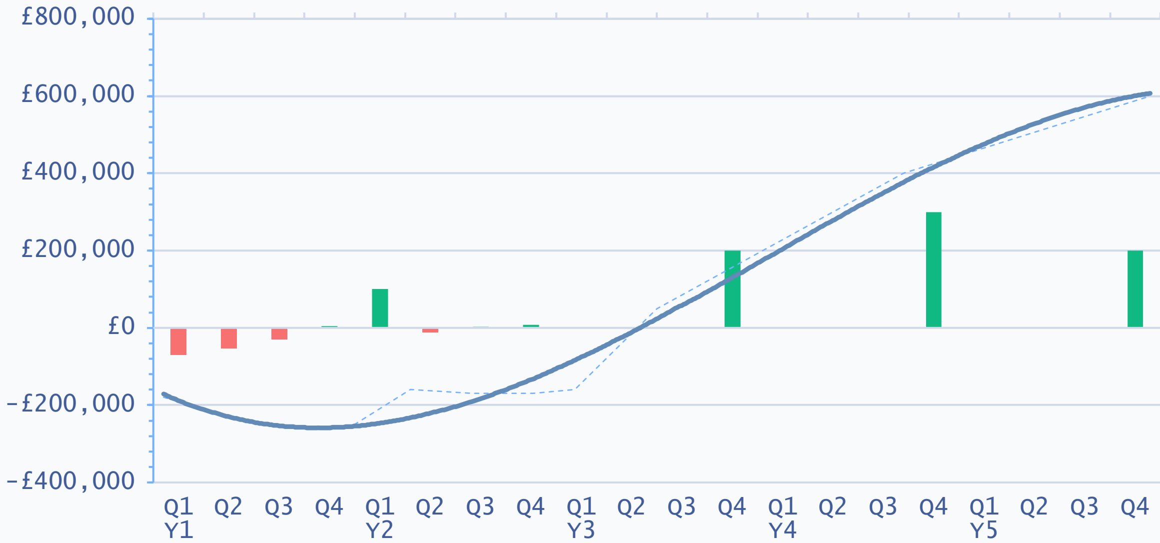
R&D higher in second year after the pilot program when the design iteration and changes are made to the initial prototype product. There are further design iterations and new products driving R&D spending in years 5, 8 and 11.

INCOME STATEMENT

	Y1	Y2	Y3	Y4	Y5
Revenue	£ 300,000	£ 680,000	£ 980,000	£ 1,400,000	£ 2,000,000
Cost of Sales	(59,000)	(130,000)	(190,000)	(270,000)	(380,000)
Gross Profit	241,000	550,000	790,000	1,130,000	1,620,000
Other Income	-	230,000	230,000	230,000	470,000
Depreciation	(16,000)	(31,000)	(46,000)	(46,000)	(110,000)
SG & A	(204,000)	(327,000)	(469,000)	(730,000)	(950,000)
Operating Profit	21,000	422,000	505,000	584,000	1,030,000
Income Taxes	(6,400)	(130,000)	(150,000)	(170,000)	(300,000)
Net Income	14,600	292,000	355,000	414,000	730,000

CASHFLOW

With the parameters set as they are currently, the project is set to make a loss for the first two years before breaking even in Q2 of year 3. Our cashflow performance is largely determined by the proposed monthly payment instalments, which are set in place as many of our customers do not have sufficient disposable income to purchase the kettle in full. This means that though many units may be sold within the first year, not all the purchases are paid in full by the end of the period, so revenue will carry over to the following year; hence the sharp dip and subsequent growth around Q4 of year 1. To minimise risk of customer not paying for the kettle, the instalments are sufficiently low and manageable.



The cashflow summary shows the net flow of cash for the first 3 years with the first-year split into quarters. The full accounts can be found in Appendix D – H. The positive green spike in the sparklines in Q1 Y2 is from the initial sale of carbon credits.

	Y1 Q1	Y1 Q2	Y1 Q3	Y1 Q4	Y2	Y3
Expected Sales (Units)	1,350	2250	4500	6900	34,000	49,000
Operating Activities						
Cash Inflow	£ 9,000	£ 27,500	£ 55,000	£ 99,000	£ 880,000	£ 1,200,000
Payroll	(17,400)	(17,400)	(17,400)	(17,400)	(90,000)	(150,000)
Admin	(7,500)	(7,500)	(7,500)	(7,500)	(100,000)	(150,000)
Equipment	(110,000)	0	0	0	(100,000)	(100,000)
Building Rent	(9,600)	(9,600)	(9,600)	(9,600)	(39,000)	(39,000)
Manufacturing	(5,400)	(8,700)	(17,600)	(27,000)	(130,000)	(190,000)
Marketing	(34,000)	(29,900)	(17,100)	(9,900)	(88,000)	(130,000)
Logistics	(4,200)	(6,800)	(13,600)	(20,700)	(82,000)	(120,000)
Taxes	(1,620)	(1,620)	(1,620)	(1,620)	(130,000)	(150,000)
Total Cash Outflow	79,000	81,000	85,000	94,000	760,000	1,000,000
Cash Flow Forecast	(180,000)	(230,000)	(260,000)	(260,000)	(140,000)	50,000

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APPENDIX

APPENDIX A – TECHNICAL RISKS

Process	Component	Function	Potential Failure Mode	Potential Effect of Failure	Potential Cause of Failure	Current Controls	Existing Conditions: Occurrence (O)	Existing Conditions: Severity (S)	Existing Conditions: Detectability (D)	Existing Conditions: RPN = O x S x D	Recommended Action	New Controls	Action Results: Occurrence (O)	Action Results: Severity (S)	Action Results: Detectability (D)	Action Results: RPN = O x S x D
Manufacture	Vacuum Casing	Heat Retention	Vacuum not formed correctly	Reduced efficiency	Incorrect manufcature	QA Check	3	3	4	36	Perform visual inspection of PCB	Additional checks	3	3	3	27
	Circuit Board	Electronic Processing	Short Circuiting	Electrical damage to kettle	Excess solder used	QA check	3	3	3	27	Perform visual inspection of PCB	Additional checks	2	3	2	12
			Poor electrical connection	Reduced/ No function	Dry joint	QA check	3	2	3	18	Perform visual inspection of PCB	Additional checks	2	3	2	12
Assembly	Operation Switches	Initiating heating	Maloperation	Incorrect operation mode selected	Heat and boil switches connected to the incorrect microcontroller pin	QA check	3	3	4	36	Use coloured wires to differentiate	Poka-yoke	2	3	2	12
	Circuit Board	Electronic Processing	Components being dislodged	Reduced/ No function	PCB incorrectly mounted	QA check	2	3	3	18	Rattle check	Additional checks	2	3	2	12
	Filter	Removing solid particles	Damage to filter	Reduced/ No function	Incorrectly mounted	QA check	3	4	3	36	Seated fit	Poka-yoke	2	4	2	16
Transport	Vacuum Casing	Heat Retention	Impact Damage	Visual Discrepancies	Incorrectly packaged	QA check	3	2	2	12	Tighter packaging	Stricter controls	3	2	1	6
	Plastic Casing	Filter Containment	Impact Damage	Visual Discrepancies	Incorrectly packaged	QA check	3	2	2	12	Tighter packaging	Stricter controls	3	2	1	6
			Impact Damage	Filter Damage	Incorrectly packaged	QA check	2	3	2	12	Tighter packaging	Stricter controls	2	3	1	6
Filtration	Filter	Removing solid particles	Carbon or Alumina particles leak into boiling chamber	Contaminated water	Faulty filter mesh	QA check	3	5	4	60	Perform mesh checks for every batch	Additional checks	2	5	2	20
			Filter blocked by sediment	Water remains in filter system	Filter mesh too fine	Component test	2	3	1	6	Confirm filter time	Additional testing	2	3	1	6
					Excessive use	Lifecycle test	3	3	1	9	Confirm filter lifetime	Additional checks	2	3	1	6
Heating	Heating Element	Heating water	Scale forms on heating plate	Reduced heating efficiency	Hard water	Heating plate testing	3	2	2	12	Perform water tests	Additional testing	2	2	2	8
			Water gets under base plate	Electronic damage	Tolerance error	CAD checks	3	5	3	45	Additional tolerance check	Tolerance check	2	5	3	30
					Manufacturing error	QA check	3	5	3	45	Stricter controls	QA check	2	5	3	30
	Vacuum Casing	Heat Retention	Outer casing becomes hot	Harm to user and reduced efficiency	Vacuum seal is broken	QA check	3	4	5	60	Stricter controls	Additional checks	2	4	4	32
					Inner and outer layers contact due to mismanufacture	QA check	2	4	4	32	Stricter controls	Additional checks	2	4	3	24
	Plastic Casing	Filter Containment	Plastic degrades or melts	Harm to user and product failure	Low thermal resisatnce of plastic	Material Testing	2	5	5	50	Reperform plastic tests to confirm suitability	Additional checks	2	5	3	30

APPENDIX B – COMMERCIAL RISKS

Commercial Risk	Description	Likelihood	Severity	Mitigation
Economic	Recession leads to smaller market size	3	7	Explore alternate markets
	Higher taxation	3	5	Keep reserve capital
	Increased manufacturing costs	3	6	Explore alternate manufacturing locations/methods
Compliance	Fail to meet environmental or health and safety regulations, resulting in a fine	1	7	Remain informed on new and changing regulations
Security	Data breach	1	7	Maintain high security
	Company IP stolen	1	6	Get intellectual property rights for product designs
Financial	Supplier or customer goes bust leaving unpaid debts	3	8	Investigate back-up suppliers and distributors
	Interest or exchange rate fluctuations result in smaller margins	3	4	Follow financial markets
	Carbon trading is banned	2	4	Keep reserve capital
Reputation	Customer dissatisfaction	2	4	Retain product quality
	Lawsuit filed against company	2	8	Retain product quality
Operational	Re-emergence of COVID-19 virus halts production	2	6	Keep reserve capital
	Fire/water damage to manufacturing facility	1	5	Business insurance
	Product recall	1	4	Retain product quality
Competition	Kettle price undercut by similar product	3	4	Constant product development
	Superior product launched	3	4	Constant product development

APPENDIX C – MONTHLY BOILING METHOD COST

	KTEMBO	Wood	Charcoal	Kerosene	LPG	Bio-Ethanol
Stove Retail Price	20	0	5	4	32	35
Cost / Month	5	21.80	47.61	42.83	44.55	44.74
Month 1	£ 20	£ -	£ 5	£ 4	£ 32	£ 35
Month 2	£ 25	£ 22	£ 53	£ 47	£ 77	£ 80
Month 3	£ 30	£ 44	£ 100	£ 90	£ 121	£ 124
Month 4	£ 35	£ 65	£ 148	£ 132	£ 166	£ 169
Month 5	£ 40	£ 87	£ 195	£ 175	£ 210	£ 214
Month 6	£ 45	£ 109	£ 243	£ 218	£ 255	£ 259

APPENDIX D – SALES FORECAST

Monte Carlo simulation of Bass diffusion model

	Avg	Rounded	Cumulative	Std Dev	Std Error	Min	Max
Y1	15000	15000	15000	0	0	15000	15000
Y2	33801	34000	48801	12890	2882	30919	36683
Y3	49128	49000	97929	18801	4204	44924	53332
Y4	70288	70000	168218	27102	6060	64228	76349
Y5	98088	98000	266306	37783	8449	89640	106537
Y6	131780	132000	398086	49298	11023	120757	142803
Y7	167485	167000	565571	65530	14653	152832	182138
Y8	197256	197000	762828	83411	18651	178605	215908
Y9	211162	211000	973990	96301	21534	189629	232696
Y10	203228	203000	1177218	99378	22222	181006	225450
Y11	176201	176000	1353419	93834	20982	155219	197183

APPENDIX E – CARBON CREDITS ISSUED

Year	Estimated Sales	Min	Avg	Max	Rounded Down	Remainder	Revenue
2021	15000	1754	3215	4238	0	3215	£ -
2022	34000	3975	7288	9607	10000	503	£ 234,500
2023	49000	5729	10503	13845	10000	1007	£ 234,500
2024	70000	8184	15005	19779	10000	6011	£ 234,500
2025	98000	11458	21007	27690	20000	7018	£ 469,000
2026	132000	15433	28295	37297	30000	5312	£ 703,500
2027	167000	19526	35797	47187	40000	1109	£ 938,000
2028	197000	23033	42227	55663	40000	3336	£ 938,000
2029	211000	24670	45228	59619	40000	8565	£ 938,000
2030	203000	23735	43514	57359	50000	2078	£ 1,172,500
2031	176000	20578	37726	49730	30000	9804	£ 703,500

APPENDIX F – MANUFACTURING COSTS

Vacuum Insulated Wall		
Machine	Estimated Cost	Product Sources Used for Average
Cost Per Turning Centre	1200	
Manual Metal Turning Centre	£19,200	[83, 84, 85, 86, 87]
Two Hardened Steel Moulds (Billet + estimated lathe work cost)**	£2,880	[88, 89, 90, 91]
Circular welder	£880	[92, 93, 94, 95]
Vacuum chamber + heater	£11,200	[96]
Factory/workshop rental	Location Dependant	
Total:	£34,160	

Filtration	
PVC pipe	
Activated carbon	£0.14
Activated alumina	£0.12
Mesh and Stainless Steel Filter	£1.50

Plastic injection moulding for component housing		
Number of Unique Moulds Required	3	
Cost per Mould	£2,000	
Moulds/Year	£90,000	Good for 3 separate 1000 units
Outsource to injection moulding company		

Labour in Kenya	
Average Monthly Wage for a Machinist Worker	£260
Proposed Monthly Wage	£550
Production Time Per Unit (minutes)	1
Number of workers required	48
Average weekly working hours	52

Total capital investment	£124,160	
Production Rate after 1 Year (Units/Year)	15000	
Total COGs per month	£26,402.15	£3.91
Sale Price For Each Unit	£20	
Number of Monthly Payment instalments (Min: 12 months, Max: 24 months)	6	

Vacuum Insulated Wall Production Cost per Unit	
Raw Material	
Aluminium Discs	£0.12
Welding	£0.09
Labour cost	£1.95
Electricity	

Large Scale Vacuum Insulated Wall	
Stainless steel coil passes through pipe forming machines to form separate inner and outer bodies.	£12,000
Metal pipe cutting through dividing machine	£1,000
Water bulging machine to form shape	£18,000
Metal pipe cutting through dividing machine	£1,000
Forming machine	£9,000
Necking machine	£15,000
Rim scrap cutting	£7,000
Mouth assembling machine	£800
Cap making	£13,500
Bottom cap welding	£1,000
Vacuum Furnace	£220,000
Vacuum Checker	£10,000
Total	£308,300

APPENDIX G – INCOME STATEMENT

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Revenue	300,000	680,000	980,000	1,400,000	2,000,000	2,600,000	3,300,000	3,900,000	4,200,000	4,100,000	3,500,000
Cost of goods sold	59,000	130,000	190,000	270,000	380,000	520,000	650,000	770,000	830,000	790,000	690,000
Gross Profit	240,000	550,000	790,000	1,100,000	1,600,000	2,100,000	2,700,000	3,200,000	3,400,000	3,300,000	2,800,000
Marketing, Advertising, Promotion	90,000	88,000	130,000	140,000	200,000	260,000	330,000	320,000	210,000	200,000	180,000
Administrative Costs	30,000	100,000	150,000	210,000	290,000	400,000	500,000	590,000	630,000	610,000	530,000
Rent/Facilities	39,000	39,000	39,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000
Distribution	45,000	100,000	150,000	210,000	290,000	400,000	500,000	590,000	630,000	610,000	530,000
Carbon Credits		230,000	230,000	230,000	470,000	700,000	940,000	940,000	940,000	1,200,000	700,000
EBITDA	38,000	450,000	560,000	630,000	1,100,000	1,600,000	2,100,000	2,400,000	2,700,000	2,800,000	2,100,000
Depreciation and Amortisation	16,000	31,000	46,000	46,000	110,000	190,000	220,000	120,000	550,000	45,000	350,000
EBIT	21,000	420,000	520,000	580,000	980,000	1,400,000	1,900,000	2,300,000	2,100,000	2,800,000	1,800,000
Interest	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Current Taxes	6,400	130,000	150,000	170,000	300,000	420,000	570,000	700,000	640,000	840,000	540,000
Net Earnings (Bottom Line)	15,000	290,000	360,000	410,000	690,000	990,000	1,300,000	1,600,000	1,500,000	2,000,000	1,200,000

APPENDIX H – CASH FLOW

Cashflow	Beginning	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Expected Sales (Units)		450	450	450	600	750	900	1050	1650	1800	2100	2325	2475
Operating Activities													
Cash Inflow		£1,500	£3,000	£4,500	£6,500	£9,000	£12,000	£14,000	£18,000	£22,500	£27,500	£32,750	£38,000
Payroll		£5,833	£5,833	£5,833	£5,833	£5,833	£5,833	£5,833	£5,833	£5,833	£5,833	£5,833	£5,833
Payroll Admin		£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500
Equipment	£109,200	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Building Rent		£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210
Manufacturing		£1,760	£1,760	£1,760	£2,347	£2,933	£3,520	£4,107	£6,453	£7,040	£8,213	£9,093	£9,680
Marketing		£11,700	£10,800	£10,800	£10,800	£9,900	£9,000	£7,200	£5,400	£4,500	£3,600	£3,600	£2,700
Logistics		£1,350	£1,350	£1,350	£1,800	£2,250	£2,700	£3,150	£4,950	£5,400	£6,300	£6,975	£7,425
Taxes		£536	£536	£536	£536	£536	£536	£536	£536	£536	£536	£536	£536
Total Cash Outflow	£109,200	£26,889	£25,989	£25,989	£27,026	£27,163	£27,299	£26,536	£28,883	£29,019	£30,193	£31,748	£31,884
Cash Flow Forecast	-£109,200	-£134,589	-£157,578	-£179,068	-£199,593	-£217,756	-£233,055	-£245,591	-£256,473	-£262,993	-£265,685	-£264,683	-£258,567

Cashflow	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24
Expected Sales (Units)	2550	2550	2890	2890	2890	2890	2890	2890	2890	2890	2890	2890
Operating Activities												
Cash Inflow	£277,500	£46,000	£49,633	£52,267	£54,150	£55,533	£56,667	£57,800	£57,800	£57,800	£57,800	£57,800
Payroll	£7,500	£7,500	£7,500	£7,500	£7,500	£7,500	£7,500	£7,500	£7,500	£7,500	£7,500	£7,500
Payroll Admin	£8,500	£8,500	£8,500	£8,500	£8,500	£8,500	£8,500	£8,500	£8,500	£8,500	£8,500	£8,500
Equipment	£100,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Building Rent	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210	£3,210
Manufacturing	£9,973	£9,973	£11,303	£11,303	£11,303	£11,303	£11,303	£11,303	£11,303	£11,303	£11,303	£11,303
Marketing	£10,608	£8,840	£8,840	£8,840	£7,072	£7,072	£7,072	£7,072	£6,188	£6,188	£5,304	£5,304
Logistics	£7,650	£7,650	£8,670	£8,670	£8,670	£8,670	£8,670	£8,670	£8,670	£8,670	£8,670	£8,670
Taxes	£10,481	£10,481	£10,481	£10,481	£10,481	£10,481	£10,481	£10,481	£10,481	£10,481	£10,481	£10,481
Total Cash Outflow	£157,922	£56,154	£58,504	£58,504	£56,736	£56,736	£56,736	£56,736	£55,852	£55,852	£54,968	£54,968
Cash Flow Forecast	-£138,989	-£149,143	-£158,013	-£164,250	-£166,836	-£168,038	-£168,107	-£167,043	-£165,094	-£163,146	-£160,314	-£157,481

Cashflow	Year 1	Year 2	Year 3	Year 4	Year 5
Expected Sales (Units)	15000	34000	49000	70000	98000
Operating Activities					
Cash Inflow	£189,250	£880,750	£1,214,500	£1,634,500	£2,429,000
Payroll	£70,000	£90,000	£150,000	£150,000	£150,000
Payroll Admin	£30,000	£102,000	£147,000	£210,000	£294,000
Equipment	£109,200	£100,000	£100,000	£0	£500,000
Building Rent	£38,520	£38,520	£38,520	£173,340	£173,340
Manufacturing	£58,667	£132,978	£191,645	£273,778	£383,289
Marketing	£90,000	£88,400	£127,400	£140,000	£196,000
Logistics	£45,000	£81,600	£117,600	£168,000	£235,200
Taxes	£6,430	£125,767	£154,967	£174,301	£295,011
Total Cash Outflow	£447,817	£759,265	£1,027,131	£1,289,419	£2,226,841
Cash Flow Forecast	-£258,567	-£137,081	£50,287	£395,369	£597,528