Project Summary for Research, Development & Commercialisation Team

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Project:	**Fuel Sustainability**		

Executive Summary

Following the inception of Fuel Sustainability in July 2018, our main goals for the month were to conduct a number of offer and currency tests to begin developing prototypes from the top two to three solutions. This involved determining whether individuals had a problem with their current method of cooking and if they would be interested in a solution to the problem(s).

Our first two weeks in country were heavily centered around empathising and offer testing with local populations in the regions of Dili/Dili Farms, Hera and Dare. After reaching our target of 70 offer tests, we had achieved Green Light to proceed onto currency testing. As the majority of individuals identified smoke or cost of fuel to be the main problem with their current cooking method, we proceeded with solution ideation, determining the best three possible solutions as a rocket stove similar to Fiji's model, a wooden briquette press and biomass briquettes.

Currency testing was conducted within the final two weeks of project, and within that time the 70 household target was reached, with a 34% success rate achieving another green light. The currency tests involved selling one of three educational brochures, each one describing a different solution. The option to place a deposit was also included, however without a product to demonstrate not many were interested in this option. It was found the rocket stove solution was the most popular due to the familiarity of the design. While these tests were being conducted, the wooden briquette press and various briquettes were constructed for price testing.

We have commenced price testing with the prototypes created, however this will need to be concluded by the January team. Some contacts have been made towards possible manufacturers and suppliers, however these contacts will need to be strengthened and expanded. The prototypes created also require testing to ensure they perform as expected and will be suitable for our customers.

Background

The business aims of Fuel Sustainability is to address the UN sustainable development goals, specifically:

- Goal 7: Affordable and clean energy
- Goal 12: Ensure sustainable consumption and production patterns
- Goal 13: Take urgent action to combat climate change and its impacts.

The Fuel Sustainability team are interested in reducing the production of greenhouse gases, increasing the efficiency of fuel used for cooking and heating, and reducing the negative impact on the health of those who depend on unsustainable and inefficient fuels used in Timor-Lesté.

The Problem

The specific problems our product aims to resolve in Timor-Lesté are listed below:

Emissions and Smoke inhalation

Alongside the Fiji Rocket Stove project, one of our overriding goals aligns with the Sustainable Development Goal to improve worldwide health and wellbeing. Approximately 3 billion people worldwide use biomass open fire cooking and heating (WHO, 2016). Inefficient burning contributes to carbon emissions and releases excessive quantities of smoke containing particulate matter(soot) and carbon monoxide, which is a toxic, colourless, tasteless and odorless gas (WHO, 2016). Other pollutants including plastic are regularly used as a fire accelerant in Timor Leste. It is estimated that there is an annual premature death of 4 million people from illness associated with household air pollution (WHO, 2016).

Our team has gathered survey data during the offer testing phase that indicates the vast majority of individuals in all of the targeted regions use a traditional method of cooking with a three stone fire using firewood. As a result, just over half of our documented responses have outlined problems such as too much smoke leading to headaches and respiratory issues. Whilst there is insufficient quantitative evidence to conclude most communities are educated on the risks associated with cooking with wood, there is a general consensus from individuals across each of the regions that these problems are unavoidable due to their economic status or lack of alternatives available in the area(s). Moreover, when asked during offer testing about what they like about their current cooking method(s), individuals responded they enjoy the ‘smokey flavour’ from wood and would be interested in using a cleaner cooking method if it produced a similar taste.

High cost of Fuel

A common issue for individuals offer tested was the cost of their current cooking method’s fuel being too expensive. Whether this for was firewood, oil, kerosene or electricity, there was concern surrounding affordability, particularly in relation to quality and durability of the method.

As many of the individuals in the specified regions are of low income status, with a high demographic being farmers, store owners and larger families, much of their deciding factor as to whether they were interested in an alternative solution was contingent on their financial status. Whilst many people in the areas of Hera and Dare gather their own firewood, they also mentioned in interviews that the effort taken to collect would was a factor in relation to cost. A number of people in Dili, however, were content with paying a higher price provided that the product would exhibit the value and quality associated with the cost.

No other alternatives and Lack of resource availability

A frequent response during interviews with communities in Hera and Dare was individuals are using cooking methods including wood because it was the most readily available material in the area. This problem was also heavily related to individual socioeconomic status and presence of businesses, suppliers and retailers in the area. Hera and Dare are largely comprised of low income families, with many being unemployed, so accessibility plays a significant role in their ability to potentially use solutions that are distributed in Dili. This is particularly important as there are a limited number of stores and businesses in these areas and if they don't have or can't afford transport. This issue, although not as common a response from communities in Dili, was still evident amongst the suburbs further away from the main municipality.

Durability and Reliability

When empathising with communities in the specified areas, many individuals brought up the issue of a lack of reliability and/or durability of their current method. The most common mentioned were wood during the rainy season, previous stoves (either oil or clay) breaking down and electricity going out during the week, which was most common in Hera where the electricity is provided by the government. The lack of reliability from aforementioned methods is detrimental for the larger families in more regional areas as they will be unable to cook or prepare food for prolonged time periods.

Proposed Solution(s)

The products we have begun developing are an alternative to cooking on open fires with firewood, kerosene/oil stoves, gas burners and ricecookers.

Current Solution

Based on our survey data gathered from Dili, Hera and Dare, the most common current solution in households is wood. 80.4% of households in Timor-Leste use wood as their main material to cook with and 65.2% using electricity. Out of those that use wood, 79.5% rely on a three stone fire as their primary cooking method and a limited number of people use stoves other than oil or kerosene (roughly 6.3%).

Individuals in Hera and Dare were the most common areas that collected firewood and the majority of those in Dili would purchase wood either weekly (12.9%) or daily (11.8%). The target market is currently using methods that do not adequately solve the issues and provide further problems. An example of this is solving the difficulty of starting fires by using plastic, however this produces more harmful smoke and emissions.

Possible Solutions

1) *Rocket Stove for Household use*
   Based on the number of brochure sales from weeks 3-4 (21 Rocket Stove, 2 Biomass Briquettes and 5 for Briquette Press), the Rocket Stove solution has the highest appeal factor to the customer. The rocket stove is also the most researched out of all the solutions. Many individuals in the more regional areas/suburbs expressed interest with the stove due to their familiarity with how it works and how to use it. Much of the intrigue from potential customers for the product was also the fact that it still uses firewood and thus may be viable for areas such as Hera and Dare. The stove is also similar in appearance and design to the model from Fiji and uses less firewood.

2) *Wooden Briquette Press*
   Empirical research gathered from NGO testing confirms that the Wooden Briquette Press model is an environmentally friendly solution applicable for use in developing countries such as Timor-Leste. The design is made up of wood, which can be sourced locally for manufacturing and allows for individual families to create and press their own briquettes in a mould from materials available. The press will allow for briquettes to be made from a number of sizes in a rectangular shape that will be left to dry before use.

3) *Biomass Briquettes*
   Our team have devised three possible recipes for biomass briquettes made up of materials including sawdust as well as fresh and carbonised coffee husks. The biomass ingredients in the briquettes allow for more complete combustion and therefore produce little to no smoke when used (tests comparing each biomass recipe are yet to be conducted). Each of these can be moulded through a briquette press, water bottle or caulking gun. Based on our current tests and reviews, the Wooden Briquette Press has produced the most stable moulds that have held their shape significantly better than the other methods.

Most Promising Solutions

Rocket Stove for Household use

Progress

We have been using the Fiji Rocket Stove prototype as a guide to design and develop our own version for Timor-Leste. One of our key monthly goals was to have two prototypes developed and use the existing stove for future demonstration workshops and to take on empathising sessions. From our survey data gathered this month and sales for the Rocket Stove, we have determined that the stove we manufacture must be durable, affordable and produce less smoke than the wood and oil current solutions.

Implementation of the rocket stove solution will require the completion of:

1) *Price Testing*
   This can be achieved through further empathising sessions involving education about the product through brochures and training workshops. Running tests with communities will also allow us to gather feedback and further potential customers.

2) *Pre-sale Contracts and Brochure Sales*
   Taking brochures of the solution(s) that sell for $1 USD and contracts for a prepayment of $10 USD to each of the price testing sessions. If individuals are interested in paying for the Rocket Stove solution, they will be able to secure a $2 USD discount on the final price of the product and in signing the pre-sale contract, will have access to the product before others. This secures customers' expressions of interest and provides an opportunity to find early adopters.

3) *Suppliers and Manufacturers*
   Contacting local businesses and manufacturing companies is essential to begin production of the solution to the interested customers. Branching out to contacting trades and technical colleges like Dom Bosco and CNEFP for eventual larger scale production.

4) *Distribution*
   The final step involves defining and setting up a distribution pathway to the targeted customer segment. Following this, conducting cooking tests on the stove with customers post-distribution to collect data for improving the product design and functioning.

Alternative Solution(s)/Competitive Analysis

Biomass pellets are manufactured in a very similar way to briquettes, however, require resources that are able to produce higher density. This was an issue as the facilities to produce the required density were not currently available in Timor Leste. Facilities for manufacturing briquettes however were able to be reasonably easy to source and samples were able to be produced and tested. Therefore this accessibility made briquettes a more viable solution than biomass pellets.

The only manufacturer and distributor in Timor Leste (to our knowledge) of briquettes is Bamboo Institute. This is a public institute bought by the government and working on the briquette project

since 2015. The bamboo briquettes sell for 20c per kilogram. From empathising, locals of Timor-Leste had not heard of briquettes before and showed limited interest in the briquette brochures. Bamboo Institute is still in early stages of commercialisation and is lacking the marketing skills to currently infiltrate the rural and urban areas.

Regarding the stove, there is a presence already in Timor Leste including locals, charities and other social enterprises. A local manufacturer located on a mountain outside Dili on the way to Hera had a stove that was made out of clay with a fairly simple combustion chamber. Other stoves were either purchased directly from the distributors or from local markets around the Dili area. One organisation who also developing clay stoves (Mercy Corps) also advertised on television.

Another competitor is Startech enterprises, who sell metal stoves with a combustion chamber engineered in Canada, manufactured in China and shipped to Timor Leste. The small stoves sell for $10-$15 USD, medium $25 USD and depending on size up to $50 USD. Supported by Mercy Corps (charity), the combustion chamber in Startech's stoves, according to Kim, were the best found yet to reduce smoke emissions and reduce wood use. Despite the Startech stove significantly reducing smoke emissions, the importation as part of the cost made the stoves almost entirely unaffordable to most Timorese communities.

Nazareth Foundation is a NGO social enterprise started up by two local Timorese in 2014 that collaborated with an Australian couple and sponsored by Mercy Corps. One of the skills they are trained in is manufacturing cookstoves which are sold in shop and at local markets. The stoves sell for $20 USD and Mercy Corps have provided locals in rural communities with free stoves or subsidies.

Backing Data

Primary Data

The primary data was collected through empathising within various suburbs around Dili, Dili farms, Hera and Dare. Two different scripts were performed - the offer test, which was conducted earlier in the month to gauge interest in a solution, and the currency test, which was to gauge the number of people who were interested enough to pay money towards a potential solution. All of the information gathered, along with July's data, was converted to a 'Bible' for easy viewing, which is discussed further within **Other Useful Documents**.

Offer testing had a green light at the end of week 2. There was a large interest for a solution that will produce less smoke, will perform with more reliability then electricity and will make cooking both easier and faster. Many people however expressed concern in the potential cost of the solution, suggesting they would only be interested in purchasing the solution if it is cheaper or the same price as their current cooking methods.

There were three common themes amongst the people not interested in a solution. The first was limited knowledge on the harmful nature of smoke. This occurred primarily within low-income households. Many people were unaware of the issue, however would mention factors such as watery eyes and coughing when smoke is brought up. Those that did not were content with their cooking method, and therefore uninterested in a solution. For higher income households, cooking with materials such as oil and gas was much more common. It was found those not frightened by using these materials were not interested in changing their cooking method. Finally, it was found across all income levels many people enjoy using firewood on a three stone fire due to traditional values. Cooking is a skill passed down from generation to generation, therefore these types of people do not wish to alter their current methods.

Currency testing was performed in the final two weeks. The currency tests were performed in the same manner as the offer tests, however at the end three brochures were offered to be purchased for $1, which provided information on a potential solution each as well as some information on the harmful nature of smoke. The brochure can be exchanged for the final product for a $2 discount, or can be refunded if they are not interested in the chosen solution. This procedure not only allowed us to determine if people were willing to exchange our victory currency for the solution, but also showed us which solution people were most interested in based on brochure sales. Currency testing achieved statistical significance at the end of the final week, green lighting the project.

After the conclusion of the currency tests, the solution with the most interest proved to be the Rocket Stove, as 82% of brochure sales were for this solution. This seemed to be due to familiarity with the appliance, as well as the visual appeal of the stove in comparison to the briquettes. Furthermore, 38% of briquette-related brochures were bought in unison with the rocket stove brochure from higher income households. Due to these factors, it is evident the most popular solution is the Rocket Stove. An important consideration here is that there is a wider understanding of stoves in general in Timor, whereas briquettes are far less commonplace. The impact this had on the results was not able to be quantified.

The most common reason for someone not to purchase a brochure was due to the lack of a prototype. Many people did not feel comfortable committing without viewing the quality of the solution. Other common reasons for not purchasing a brochure include limited funds (particularly in low income households), and unsuccessful offer tests.

Secondary Data

Research was conducted into multiple possible solutions, and three were determined to be most feasible; selling premade briquettes, a briquette press for in-home pressing and a rocket stove. Through the currency test, it is evident there is more interest in a rocket stove, however this was due to familiarity with the solution in comparison to briquettes. It was therefore determined

prototypes of all three solutions should be created so they can be demonstrated to potential customers.

The effectiveness of a briquette is heavily dependant on the materials used to construct it. An instruction manual on briquette construction was found within Cambodia's documents on the drive. Materials used within a briquette however heavily depend on what is available, therefore it was imperative to determine what could be used within Timor. Possible materials included coffee husks, wood chips, paper and biomass waste. Further information can be found within the Briquette Ideation document.

Extensive designs were found to exist for briquette presses, in particular designs by Engineers Without Borders. One of these, the Micro Lever Briquette Press (Hite L, 2017), was constructed and used to build briquettes. Smaller presses, such as the can press and roller press were also researched. Further information can be found within the Briquette Press Ideation document. All together, briquette presses that were not motorised were found to be strenuous and messy to use, however could provide useful for households with a large amount of waste, as they will be capable of selling excess briquettes.

Research on the rocket stove revealed that they are safer to use, are more efficient at heating, can produce less smoke and are portable. Several possible rocket stove shapes exist and were evaluated in the Rocket Stove Ideation document. Scaled prototype design drawings were completed by the Fiji July 2018 team (Buka stove 5.0), and will be used for further prototyping.

Critical Future Actions

The next logical and achievable steps are to determine which solution is most viable. This should be done by determining costings for each of the three solutions including supply and manufacturing of each. Hence, price testing of these options in the community, which will include demonstrations as mentioned within **Proposed Solution(s)**. Throughout this process iterate each of the solutions to better them specifically to reduce costs, make them easier to produce and use, and make them more sustainable. This is especially true in regards to briquette production, currently the recipe that works the best uses store bought bags of cornstarch that is a significant cost in the long run, and so alternatives should also be considered. Currently there are multiple briquettes made (recipes can be found on the drive). These will need to be tested according to the future briquette testing procedure document (https://docs.google.com/document/d/1D6QlaqtnWP6ImlK2EO7ar8yTF3yEHV_7rIqlkS4dxo0/edit) and briquette comparative testing document (https://docs.google.com/spreadsheets/d/1AITZgO55j6fVYb0TttaNwXwm_5sxiQHC68EYiqv-CNY/edit#gid=0).

A rocket stove based off Fiji's design should also be manufactured here if possible to determine if that design is suitable for Timor-Leste or if any changes need to be made. It may be necessary to contact competitor briquette producers, specifically Bamboo Institute, about their pressing machines and labour to produce briquettes. Education and channels need to be considered as there are competitors that sell briquettes and stoves and where cost is not a factor, access is. Where people have either not heard of alternative solutions or have no way to access them, community-wide group demonstrations may be a viable pathway.

Most of next step will need to be undertaken in country. In Australia contact can be made with manufacturers and suppliers over the phone and using email, however it is expected that some face to face meetings will be required. The team must be aware of quality of resources, efficiency of staff/workers and quality of products in order to maintain a consistent supply chain. Secondary research is valuable which can easily be completed in Australia as opposed to in country. This may include planning for new areas, sorting distribution channels or brainstorming new solutions. While this research will be useful, putting the research into action will be the most important process and this will have to be done in country.

Similar to last month, useful resources to achieve these steps could potentially be forming relationships and/or collaborations with a charity or another local business that already has a manufacturing and distributing system (e.g Nazareth) in place in order to mitigate the manufacturing cost issue in regards to the cookstove. There is also a list of suppliers and manufacturers, and some of the prices, on the drive detailing whom have been contacted. A coffee supplier called Chaitanya (information available on hubspot) was also visited. He provided us with coffee husks at no cost, was very supportive and has a relative who is the largest briquette supplier in India. Forming a stronger relationship with Bamboo Institute will also be beneficial for the production of the briquettes due to the resources and facilities the institute possess. Chris Birzer, a professor at Adelaide University, was very involved and crucial for the development of the stove in Fiji and has helped the team in Timor Leste this July. His knowledge and passion for the project is a valuable resource. The interns at UNTL over the course of the month were extremely valuable and passionate to help and were critical in the development of the project both for communication barriers, engineering knowledge and understanding of Timor Leste.

Key Risks

Determining the key risks relating to development, testing, supply and manufacture and implementation of the solution(s) is integral to establishing a successful business model for the product. The outlined goals for the next team are:

1. Price Testing
2. Manufacturer and Supplier Sourcing
3. Prototype Development and Testing

Based on these objectives, the areas of risk can be categorised into social, commercial, economical and environmental.

Risks associated with conducting price tests are similar to those mentioned in July 2018's summary, including but not limited to, the potential for injury and miscommunication due to language barriers. Approaching local communities with care and empathy is critical to gaining further potential customers and the overall success of the project in country. Teams going out must be mindful they are acting as representatives of the project as there is also the likelihood for risks to reputation to arise. These can occur from miscommunication of the product and project goals in addition to making duplicitous and/or unrealistic pitches of the product. Moreover, this results in inaccurate data, which will have an impact on the resources used in country such as transport. In order to avoid losing potential customers, it is integral for individuals conducting price tests to accurately document the necessary details from interviewees, primarily recording their contact details and providing them with the relevant PEV contact details.

For manufacturer and supplier sourcing, the same social risks apply as price testing, mainly the possibility for miscommunication due to language barriers. Mitigations to this involve contacting and designating an intern when deemed necessary, e.g. a potential manufacturer having limited English proficiency. Researching and gathering relevant knowledge on potential companies' manufacturing process, materials available, conditions of work etc. is important to preventing commercial risks in making products with defects or poor quality.

Prototype development and testing will encompass social, economic and environmental risks, specifically those relating to individual safety. Depending on the designated materials for the design, the team is required to minimise the potential for injury through risk assessments, assembling the prototype and for when conducting tests both at headquarters and with interested local communities. The prototype itself must be user-friendly and properly tested with a range of different individuals to minimise the above risks to safety and responsibility for the project. It is important for the team to also consider the environmental risks associated with testing, particularly with the stove, so as to minimise harsh emissions. Delegating a definite number of tests at headquarters and with locals will help to avoid this and the potential for exceeding time spent on testing.

Next Teams Goals

Cost Analysis for all three defined solutions. Price Testing this to then determine viability of each solution. Chose a specific solution.
https://projecteverest.crowdicity.com/post/789450

Manufacturer and Supplier Sourcing as a part of Cost Analysis.
https://projecteverest.crowdicity.com/post/789450

Prototype Development - specifically briquette recipes and the press design/manufacture. For the stove, the team can use Fiji Buka 5.1 for testing or as a base design framework.
https://projecteverest.crowdicity.com/post/783980

Other Useful Documents

Post Empathy SOP:
https://docs.google.com/document/d/1UanHAlfpD1M8sBE_93pVYNjvgcHduKyaV_w7Yw9RYs8/edit
A list of tasks required after empathising. Links to corresponding documents are included within the checklist and below. The link for the second point is to December's Goal Spreadsheet, this link will need to be changed to January's Goal Spreadsheet, or removed if the January team does not have a notice board and/or a teams out spreadsheet.

Survey:
https://docs.google.com/forms/d/1rJBKKbNM8zBaSgV8FXMJsYuldrFdCHnQDzCN7WtrO5s/edit#responses
Used to quantify the data obtained through empathising. All results are added to the bible within the sheet 'Form Responses 1'. You can edit, add or rearrange the order of questions, but do not delete them as this will change the bible. Any new questions will be added to the last column of 'Form Responses 1' despite where it was placed in the survey.

To delete a response, you must both delete the individual response in the survey and the entire row within 'Form Responses 1'. You can only edit a response within 'Form Responses 1', therefore due to this the survey summary within Google Forms is inaccurate and should not be used.

Bible:
https://docs.google.com/spreadsheets/d/1T37bBlWaT30fUvgPa_Ka55ckBcWlHtSrIuz5lEFVKro/edit#gid=1917597
This is the potential customer database. It contains all the data from July empathy up to the end of December Currency Testing. There are also preliminary price data points in there. It is automatically updated as a survey is completed except for the Household ID Number which must be added manually. Instructions on usage are on the first sheet, with the key points being to be careful and do not edit or sort the data.

Household Identification Database:
https://www.google.com/maps/d/edit?hl=en&mid=13FZpGfqYXyeGrLRemxgZfXBF2znqU9Vy&ll=-8.551907969778314%2C125.59288130131938&z=16
Each house visited must be added to the Household Identification Database. Each region is colour coded as described within the Post Empathy SOP. The points are added to the correct

layer based on the responses. If both offer and currency test are performed, the point is added only to the layer based on the currency test. There is also a layer for possible locations to visit and microlet routes to help with route planning.