Design Scope for Solar Mill Product

SCOPE OF WORKS

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For
IUK
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EXECUTIVE SUMMARY

The overall objective of the Scope Of Works is to outline the requirements of bidders to provide a multi-attachment DC powered solar agro-processing machine, with associated mechanical, electrical and software engineering requirements.

The machine shall follow the concept as shown below:

Whereby the mill shall operate from a solar PV system, the motor shall be DC voltage powered, the machine shall run from either a battery or directly from a solar PV array and the machine shall have supporting software to operate a telemetry system and Pay-As-You-Go meter for easy financing of the product. All components shall be modular depending on end-user requirements.
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GLOSSARY OF TERMS AND ABBREVIATIONS

The following glossary of terms and abbreviations are specific to this report.

**ABC**  
Food waste that could be avoided in the first place through improved efficiency and planning to reduce spillages, spoilage and unnecessary disposal.

**AC**  
Alternating Current

**BLDC**  
Brushless DC motor

**DC**  
Direct Current

**HH**  
Households

**IUK**  
Innovate United Kingdom(UK)

**PAYG**  
Pay As You Go

**VIA**  
Village Infrastructure Angels
1 PROJECT INTRODUCTION

1.1 BACKGROUND

Starting in September 2019, Innovate UK has agreed to support the innovative work on the UK-based company Village Infrastructure Angels Ltd via the Energy Catalyst program, with a common focus on bringing better energy and infrastructure to low income villages in emerging markets, particularly those that live offgrid and may not have access to reliable electricity, with a focus on using solar energy for improved food chain services. The partnership will be at minimum 3 years in length, with an initial 18 month period focused on the first development iteration of new products including field trials, and the second 18 month period focused on refinement of the first products based on field trial feedback. The two main areas of focus for this Solarizing Food project are to improve 1st generation solar powered mills that VIA developed with its partner Project Support Services (www.psspng.com) in earlier years, and to also develop a 1st generation electric solar cooking product.

1.2 PROJECT PARTNERS

1.2.1 INNOVATE UK

Innovate UK (part of UK Research and Innovation), the Engineering and Physical Sciences Research Council (EPSRC) and the Department for International Development (DFID) is investing in innovation projects as part of the Global Challenges Research Fund (GCRF) and Transforming Energy Access (TEA) programme. The aim is to support highly innovative, market-focused energy solutions in any technology or sector. Projects must encourage the development of products and services that help countries in sub-Saharan Africa, South Asia or both regions access secure, low cost and low carbon energy. They must be targeted at people, public services and local enterprises who are unable to afford or access existing solutions, or who lack the time or expertise to successfully use those solutions. Three elements of the energy ‘trilemma’ must be addressed - cost, emissions and the security of energy supply or access to energy. This project is focused on mid-stage for industrial research, and has been accepted to the 5th round of Energy Catalyst.

1.2.2 VILLAGE INFRASTRUCTURE ANGELS

Village Infrastructure Angels (VIA) is a group of concerned individuals and organizations that is helping rural villages in developing countries to access the infrastructure they need to reduce poverty and improve living standards. This includes helping 1 billion people gain access to electricity for the first time, agricultural machinery to reduce manual labour when processing crops by hand, and water pumps for irrigation and drinking water. Further details are available on www.villageinfrastructure.org.
1.3 PROJECT RATIONALE

Solar power is one of several renewable energy sources that can be used to replace these fossil fuel, and while the use of white LEDs for lighting has been rapidly accepted as a viable market transformation opportunity, little attention has so far been paid to daytime uses of energy for the poor, which are often related to farm productivity, such as agro-processing, refrigeration and communication for improved market access. In many villages in the Pacific, manual labour still dominates agro-processing, and reducing the time of mostly women spent on these laborious manual tasks could open up opportunities for increased productivity and income-generating opportunities. Globally, if 1 billion people or 250 million households (and women) could free up this productive hour, it would be equivalent to the workhours of the entire workforce of the UK, France or Italy.

Significant challenges exist in transforming the offgrid fossil fuel markets towards a commercially viable renewable energy market, including highly dispersed small populations, relatively high transportation costs, and susceptibility to natural disasters. To assist in overcoming these barriers, Innovate UK is providing VIA with funding to develop innovative products aimed at targeting diesel powered mills with clean, safe, solar powered alternatives, as well as helping those who have no access to mills to reduce their hours spent processing crops by hand. This report seeks to describe technical options for using renewable energy for agro-processing, as this is a very new system technology, although the components used to make up the system will be used are mostly mature technologies.

Rural electrification and “access to electricity” is not defined by any organization as the provision of lighting and phone-charging only, but must also include productive end uses of electricity such as agro-processing. As long as men, women and children continue to beat crops by hand with sticks and stones, the United Nations’ goal of attaining Energy for All by 2030 cannot be attained. Such investments in rural villages may have longer payback periods than lighting and phone-charging, and thus may be harder to mobilize investment for, but with rapidly decreasing costs for solar power, longer-lasting batteries and smart monitoring technologies, this project aims to demonstrate such hurdles are not insurmountable.

The leading staple foods of the global poor are rice, maize and cassava, all of which must be processed before consumption, and this is also true in the target geography of this Innovate UK project - with additional foods also targeted as a by product of the research. The vast majority of households undertake food processing in one of two ways - manually, using human effort, or by paying for services from a local mill, which is powered from central grid (or large minigrid) electricity or, in off-grid situations, almost always by diesel engines.

There are some exceptions - in the Himalayas, most agro-processing happens from centuries-old water mills called ghattas/gharats, or from modern microhydro mills. But in most offgrid villages, agro-processing is either manual or via a local mill that is belt-driven by a diesel engine (and no electricity is produced). These are generally of 5-15 kW capacity and can process a 30-50 kg bag
of crop in 10 minutes, or at a rate of about 200 kg/hour. Households often spend as much on transport to and from agro-processing mills as what is paid for processing the bag of crop itself, so decentralizing large mills to one smaller (1-3 kW) mill per village can also help save transport costs.

**Figure 1: Typical diesel belt-driven maize mill and rice mill**

Manual processing is laborious, and often requires one hour per day or more for the various processes required to prepare crops into food ready for cooking. The process for maize involves shelling (removing kernels from the sun-dried corn cob), grinding (usually between two stones) and winnowing (removal of the lighter kernel husk pieces from the heavier/denser corn meal pieces by tossing in the air so the wind blows the husk away). Similar for rice, the grains must be removed from the stalk (threshing), then the husk from the rice (hulling) and sometimes this is followed by polishing of the rice and/or separating the bran. Cassava is cleaned, cut into chunks and then pounded into a very coarse flour.

These processes are shown in Figure 2. Hand-operated corn shellers and flour grinders often cost $30 and last only 6 months if used daily, meaning an average of $1/week is spent on such tools, similar to expense on kerosene lighting.
1.4 PROJECT DESCRIPTION

In recent years, the price of solar power has dropped dramatically, making it more competitive with diesel than ever before, and even affordable for those who have used manual methods, as these households state that time saved could be used to expand their garden and grow more crops, or have more time to make handicrafts or to do weaving and thus generate more income. At $1/watt and 1500 hours of productive power per year, the cost of energy from solar over 10 years is approximately $0.07/kWh, or $0.14/kWh over 5 years. Diesel, at $1/litre and 3 kWh/litre efficiency has a cost of $0.33/kWh. Even with higher installed costs per watt, the payback period of solar displacing diesel is attractive.

Agro-processing is a daytime activity, and can often be done on a flexible schedule, so the potential of having little to no battery storage by directly driving motors from solar panels is appealing (DC motors if inverters are not used, AC motors if they are). This "direct drive" approach has been used for solar water pumps, which pump water only while the sun is shining. Such systems have successfully displaced a large number of diesel generators that were previously used for this task. One example of solar milling can be found at www.solarmilling.com, and a 1kW version is shown in Figure 3 below. However, a preliminary investigation indicates that a) grinding is not the only process required, and b) various costs and designs may lead to

Figure 2: Manual processes for maize and rice. Cassava is also beaten with poles.
more optimal solutions. Given other uses of energy, and fluctuations in solar energy during the day or week, it is not necessarily optimum to have a battery-free design.

Figure 3 - A 1kW battery-free "direct drive" solar milling system

In this project VIA will investigate the opportunities for agro-processing using renewable energy, with a primary focus on solar power, to reduce manual labour of women and children and dependency on small diesel generators. Experience to date suggests 200W - 2000W solutions are possible for $500-$5000, which would produce 20-200 kg/hour. A typical tariff for processing is often around $0.03/kg, so a mill utilizing an average of around 2.5 hours/day of solar power could process 50-500 kg/day, generating $1.50-15.00/day of revenue, or $500-5000/year, allowing 1-5 year payback periods that are commercially viable.

A small handful of staple crops make up the majority of the food eaten by the poor in developing countries. Corn/maize, rice and wheat (and other grains/cereals) top this list, each of which need processing before eating. Our focus is mostly on staple diets to have maximum impact for households, and the more varied market of cash crops has not been investigated deeply, though more processing opportunities will exist for those crops as well, particularly for coffee. Given this focus on staple foods, the following list of agricultural processes were found to be the most common in the target geography of emerging markets (sub-Saharan Africa, south-east Asia, the Pacific Islands and Central/South America). The top level summary of crop processing that is covered by the product scope of works is:

<table>
<thead>
<tr>
<th>Rice hulter</th>
<th>Corn shellers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice (and other) winnowing</td>
<td>Vegetable graters</td>
</tr>
<tr>
<td>Rice polisher</td>
<td>Meat and kava mincing</td>
</tr>
<tr>
<td>Flour grinders</td>
<td>Oil expellers</td>
</tr>
</tbody>
</table>

Table 1 - Set of crops to be processed by project outcome
1.5 PROJECT OUTCOMES

1.5.1 HARDWARE

The project is to provide the industrial, mechanical & electrical engineering and manufacturing design for a set of multi-functional hardware equipment which within the one package will cover the agro-processing outlined in Section 1.4 Table 1. This package includes the mechanical and electrical design of all associated equipment where such equipment is not available “off shelf” (off shelf may refer to a DC motor component, bearings etc but not complete products that suit the project brief).

The package shall use a common DC motor platform, with various attachable heads to carry out the functions of Table 1.

The package shall provide a DC solar package suitable to operate the package by both direct solar PV power and via lithium battery back up system.

The package shall consider the hardware necessary for PAYG (Pay-As-You-Go) whether this be RFID readers, keypads, IC card readers etc.

1.5.2 SOFTWARE

The project is to provide any software required for the operation of the hardware in section 1.5.1.

In addition, the project is to provide a “PAYG” (Pay-As-You-Go) platform to allow the operation of the hardware on either time based, weight based, energy based or flow based payment method - the most appropriate to be determined by the Client based on design discussion with the engaged firm.

The software provided shall also allow for remote monitoring of the hardware platform via a LoRA or other long range wireless/cellular communication system.

The software provided shall provide an online cloud portal for PAYG code management and reporting on and performance-monitoring of a portfolio of PAYG-enabled mills. Any Android phone app that may accompany such a package that allows agents to sell PAYG codes for cookers would also be of interest, but is not a compulsory component. An example of using such an app is at http://www.bopinc.org/updates/getting-rid-of-cash-digitizing-last-mile-distribution-of-payg-solar.

1.6 PROJECT BUDGET

The project will be a fixed cost contract and the budget has no fixed minimum or maximum value, but should be reflective of the limited time period available to develop the product. The
Bidder shall break their proposal down into the following costing table for the Client to assess competing bids like for like. The Bidder may include additional sub-line items but tasks 1-8 should be provided as cost totals of any sub-task items. The bidder shall include their own detailed Gantt chart with key milestones in their project proposal. The project schedule is outlined in section 5.

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Total Man Days</th>
<th>Total Cost</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Technology Options Analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Technology Options Selection (inc. BOM cost estimates)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Conceptual designs for Client selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Mechanical design of Alpha Hardware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Electrical/software design for Alpha Hardware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Prototype of complete Alpha Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Prototype testing &amp; results of Alpha Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Preparation of Manufacturing Documentation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VIA will accept bids from bidders who have the expertise for delivering only part of the Scope of Works (eg. only the Hardware and not the Software, or vice versa), but bids must clearly state which sections of the SOW the bidder can or cannot offer services for broken into three parts:

1. Mechanical Design
2. Electrical Design
3. Software Design

Bidders may not submit partial bids on the above three items (such as electrical design but without prototype samples). All 8 tasks listed above must be included for a full valid bid.
2 SCOPE OF WORKS

The overall scope of works of the project is to provide a multi-functional DC solar powered agro-processing tool for farmers in remote areas of emerging market countries, generally with no access to AC power connections. This local solar mill will allow farmers to move from manual hand labour post-harvest processing of crops to solar PV powered processing of crops, or to reduce reliance on diesel mills or traveling to distant grid-connected mills. Given the low income of the target market and lack of access to servicing locations, lowest cost & robust design with simplicity is preferred. The product is not to be designed with inherent redundancy - long life and durability should be foremost, as financing periods of 3-6 years will likely be required.

In addition to the hardware aspect, electronics for driving the hardware is included in the Scope of Works and should be designed with simplicity where possible, durability with lowest cost available to achieve the expected long service life of 5-10 years. While the solar PV system is not included in the design, a solar controller which can accept either direct PV drive of the motor as well as an option to accept a battery for ‘rainy/cloudy days’ service.

Further to the mechanical and electrical design, the SOW includes the requirement for remote monitoring of the system (both energy usage of the motor and the energy input of the solar PV system) with some form of long range wireless communication (such as LoRA, GSM or other). The electronics should also provide the possibility to operate the mechanical / electrical hardware as a financial service ie. Pay-As-You-Go, similar to that as commonly found in the solar home system market.

An overall conceptual layout of the product is shown in Figure 3 (right).

The table below outlines the expected capacity of requirements of the multiple head attachments.
**Item** | **Product Type** | **Description of Use** | **HH Daily Consumption (kg)** | **Machine Daily Capacity Req. (kg)** | **Min. Machine Processing Req. (kg/hr)**
--- | --- | --- | --- | --- | ---

a) | Rice hullers | (to yield brown rice) | 2-3 | 300 | 50

b) | Rice winnowers | (to separate hulls from brown rice) | 4-6 | 500 | 100

c) | Rice polishers | (to separate bran from brown rice to yield white rice) | 2-3 | 300 | 50

d) | Flour grinder | (for dried corn, cereals) | 1-2 | 150 | 30

e) | Corn sheller | (to remove corn kernel from corn cobs) | 2-4 | 500 | 150

f) | Cassava/vegetable/coconut grater | (for cooking purposes) | 0.5 | 100 | 25

g) | Meat/kava grinder | (for cooking purposes) | 0.1 | 20 | 5

h) | Oil expeller | (for both cooking and cosmetic purposes) | 0.1 | 10 | 2

The winning bidder shall be provided with either a prototype or similar products of each item in the list to establish baseline designs. The key task of the project will be to merge these multiple products into a single multi-attachment product. Similar products for each crop processing function which will be provided are shown in the Figure below.

- a) Rice huller
- b) rice winnower
- c) rice polisher
- d) flour grinder
- e) corn sheller
- f) vegetable grater
- g) meat grinder
- h) oil expeller
2.1 MECHANICAL DESIGN

The overall design concept of the solar agro-processing mill is a multi-functional attachment system to a DC motor hub, as shown conceptually previously in Figure 3. The key aspect is that the product should save upfront cost by avoiding multiple motors on multiple mills, while increasing functionality of a single motor to allow several crops to be processed and thus increasing utilization (hours of operation) of the asset. Further documentation on Design Technology Review undertaken by VIA can be provided on request.

2.1.1 MOTOR

The designer firm shall offer cost analysis of both brushed DC motor and brushless DC motor options, including both upfront cost and life-cycle costs (including any related control equipment). Some potential suppliers and technologies have been identified by VIA but are not definitive, just indicative of potential options. The winning design firm shall provide no less than 3 supplier options and pricing per technology during the design process.

Ideally, a single phase AC motor (of any type) could replace the DC motor with minimal adaption to the housing to allow product application to conventional AC grids and minigrids, however it is not a key task of the project scope and not a deliverable.

The motor selected shall have suitable control equipment recommended to operate with the motor (eg. brushless DC motor including variable speed controller). There should be consideration of the controllers’ operation with the PAYG and remote metering system.

Consideration of the RPM and power requirement expectations of the DC motor are shown in the table below.

<table>
<thead>
<tr>
<th>Item</th>
<th>rpm Range</th>
<th>Estimated rpm</th>
<th>Power Range (W)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour Mill (Hammer)</td>
<td>5,000 - 10,000</td>
<td>9000</td>
<td>750 - 2,200</td>
<td>Dependent on tip speed</td>
</tr>
<tr>
<td>Rice Huller</td>
<td>3,200 - 3,900</td>
<td>3500</td>
<td>200 - 500</td>
<td>Impeller type</td>
</tr>
<tr>
<td>Rice Huller</td>
<td>2,400 - 2,800</td>
<td>2800</td>
<td>500 - 1,200</td>
<td>Roller type</td>
</tr>
<tr>
<td>Corn Sheller</td>
<td>2,100 - 2,400</td>
<td>2200</td>
<td>500 - 1,200</td>
<td>Spindle type</td>
</tr>
<tr>
<td>Rice Polisher</td>
<td>1,400 - 1,600</td>
<td>1500</td>
<td>750 - 2,200</td>
<td>Screw type</td>
</tr>
<tr>
<td>Rice Winnower</td>
<td>1,300 - 1,500</td>
<td>1500</td>
<td>100 - 250</td>
<td>Fan type</td>
</tr>
<tr>
<td>Flour Mill (Grinder)</td>
<td>1,300 - 1,500</td>
<td>1500</td>
<td>750 - 2,200</td>
<td>Stone or plate type</td>
</tr>
<tr>
<td>Coconut Grater</td>
<td>1,300 - 1,500</td>
<td>1500</td>
<td>250 - 750</td>
<td>Ball scraper type</td>
</tr>
<tr>
<td>Cassava grater</td>
<td>1,300 - 1,500</td>
<td>1500</td>
<td>250 - 750</td>
<td>Cylinder type</td>
</tr>
<tr>
<td>Meat Grinder</td>
<td>190 - 210</td>
<td>200</td>
<td>250 - 750</td>
<td>Screw type</td>
</tr>
<tr>
<td>Oil Expeller</td>
<td>80 - 100</td>
<td>100</td>
<td>250 - 750</td>
<td>Screw type</td>
</tr>
</tbody>
</table>
Due to the product being solar PV powered, great emphasis shall be placed on the efficiency of both the motor and the motor transmission type across the various Power and RPM requirements of each item. The table of RPM figures suggests that 1500rpm might be most suitable, but a cost analysis shall be undertaken of RPM + gearing at various RPMs due to the increase in cost of motors as RPM reduces. The analysis of RPM shall include the total system cost including the solar PV system, based on the varying levels of efficiency, not only the motor+gearing cost (ie. shall include the cost of extra energy for less efficient options).

The design firm shall also investigate the efficiency trade offs in simply reducing RPM (where available motor power is sufficient) for the specific application - eg. the rice winnower could possibly be a variable motor speed design based on the low power requirement of the winnower compared to higher RPM/power rice huller.

Packaging consideration is not considered priority. In fact, a larger heavier motor package is considered advantageous for consumer perception of “heavy duty”. Overall packaging should remain with in a single person being able to move the package easily (particularly for women), therefore the motor should ideally be less than 5kg.

2.1.2 GEARING

Given the wide range of RPM requirements, mechanical design shall extend to gearing where variable motor speed control is not able to sufficiently drive the mill attachment, and where the reduction/increase in motor speed to motor efficiency is less than the total loss of potential gearing system losses, or where the loss of power/torque makes variable speed control non-viable.

Two initial transmissions type are to be considered in the design phase, both high efficiency pulley types (eg. serpentine or cogged belt) or gear box type transmission.

- Belt drive shall be integrated without the need for the user to remove and replace transmission systems when replacing heads (eg. not remove a pulley belt to replace to another belt).

- Alternatively a gear drive may be used, with consideration given to noise levels of the gearing selected. Gearing shall not be user dependent for selection of correct gear ratio for gear head - it shall be automatically selected. In the same way, any variable speed requirement shall be automatically selected by the connection of the mill attachment, and not via user selection.

- Preference is given to a gear box system to minimise ongoing maintenance.

- Any gearing system shall be housed in a protective enclosure with rating of IP5X or better, to prevent the ingress of dust from the mill attachments and light water protection. If a lubricated system is used, the housing shall be sealed IP68 or higher.
• Provision shall be made for simple maintenance of the gearing system (either for belt tension or oil level check).

• The design firm may consider other transmissions types provided they are not of greater expense than pulleys or spur/helical gears - eg. CVT or other, but the efficiency shall be greater or justified why any further loss of efficiency benefits the product as a whole.

### 2.1.3 MULTI-HEAD ATTACHMENTS

As described, the motor platform shall attach to multiple head attachments as shown in the concept drawing below:

#### 2.1.3.1 RICE HULLER ATTACHMENT

The rice huller is a device which removes the husk from the rice to leave a brown rice.

The rice huller attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power ($W_e$)</th>
<th>Min. Machine Processing Req. (kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rice hullers</td>
<td>(to yield brown rice)</td>
<td>300</td>
<td>50</td>
</tr>
</tbody>
</table>

The design principle to follow for the design of the rice huller is what is termed an impeller type huller. The impeller type huller principle is to use centrifugal force to throw the rice from a spinning disc consisting of an impeller lattice, exiting the impeller at high velocity along a cylindrical rubber impact pad. As the rice tumbles over the rubber impact pad, the weak rice
husk gets removed and blown out one exit and the brown rice is exited from another exit. The principle is demonstrated in the figure below:

- The design of the impeller should be of metal construction, some impellers use a plastic blade which experience has shown to wear too quickly.
- The rubber liner should be of silicone construction, but should be easily replaced with a rudimentary cut up bicycle tyre should the replacement silicone liner not be available.
- Rubber roller type huller may be considered if greater performance can be demonstrated, however it is VIA’s experience that the power consumption of impeller type is much lower and that rubber rollers are difficult to source locally and find replacements for as they frequently wear out and are expensive to replace.
- Variable speed will be required for obtaining the correct output quality.
- The output shall separate the husk waste from the brown rice without further processing to achieve a 95+% greater level of separation (by 100-grain count, not by weight).
- The output brown rice shall achieve a 95+% rate of unbroken rice output (by 100-grain count, not by weight).
- The hopper should have a means for electronically regulating the rate of feed into the rice huller that is linked to the motor controller to regulate based on motor current draw.

### 2.1.3.2 RICE WINNOWER ATTACHMENT

The rice winnower is a device which removes loose husk from the harvested palay/rice.

The rice winnower attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power (W_e)</th>
<th>Min. Machine Processing Req. (kg/hr)</th>
</tr>
</thead>
</table>

Design Scope of Works for Solar Mill Product
The design principle to follow for the design of the rice winnower is a simple fan type. The current design principle currently investigate is shown in the image below, however multiple options may be considered as the product is essentially only a fan.

- The winnower should not require the user to simply throw rice in front of a fan - it shall have a hopper and operate without the user input once set up/tuning is complete.
- The hopper shall accept up to 25 kg (half a standard rice sack) volume size.
- The output of the waste shall have the option to attach a cyclone or other to concentrate the waste to a container, not just blow to atmosphere.
- The performance of separation shall be 95% or greater (by count, not weight).

### 2.1.3.3 RICE POLISHER ATTACHMENT

The rice polisher is a device which removes bran from hulled brown rice. The rice polisher attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power (W)</th>
<th>Min. Machine Processing Req. (kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c)</td>
<td>Rice polisher</td>
<td>(to separate bran from brown rice to yield white rice)</td>
<td>750</td>
<td>50</td>
</tr>
</tbody>
</table>

The design principle to follow for the design of the rice winnower is screw + cage type polishing, whereby the brown rice is fed into the perforated cage of the machine and then forced through the length of the cage via a tapered screw which causes friction between the cage/rice/screw, wearing off the bran from the brown rice. The bran falls through the perforated cage and the polished white rice exits out a spring loaded cap on the end of the cage.
- The rice polisher shall use a steel cage and steel screw rather than stone type, to allow longer life from the system prior to requiring replacement parts.

- The rice polisher shall separate the bran to a different exit point to that of the white rice, so that further processing/separation is not required and that the bran may be collected separately.

- The polisher shall have an adjustable setting to determine the level of the whiteness of the white from the processing.

- The rate of breakage of the rice from the polisher shall be no greater than 10% of broken rice to whole rice, measured by count not weight.

- The hopper should have a means for electronically regulating the rate of feed into the rice polisher, that is linked to the motor controller, regulated on motor current draw.

2.1.3.4 FLOUR GRINDER ATTACHMENT

The flour grinder is a device which takes whole grain cereals and grinds them to a fine flour. The flour grinder attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power (W)</th>
<th>Min. Machine Processing Req. (kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>d)</td>
<td>Flour grinder</td>
<td>(for milling dried corn and cereals)</td>
<td>750</td>
<td>30</td>
</tr>
</tbody>
</table>

The design principle to follow for the design of the flour grinder is the ‘hammer’ mill principle which is defined by high velocity impact of particles by a high velocity spinning armature. The impacted particles are then forced out through a screen/filter once they have been impacted to small enough particles to pass through the screen/filter.
• The flour grinder shall be able to mill at various particle sizes, from 0.8mm screen size up to 7mm screen size (designated by the largest gap possible anywhere within the screen).

• The flour grinder should have a tip speed of the hammer heads of velocity no less than 70m/s.

• The screen/filter should be easily replaceable and low cost/simple to manufacture as a consumable item, ideally locally manufactured with simple tools (drill, metal grinder etc).

• The hopper shall have no less than 30L of volume.

• The hopper should have a means for electronically regulating the rate of feed into the flour mill, that is linked to motor controller to regulate based on motor current draw.

### 2.1.3.5 CORN SHELLER ATTACHMENT

The corn sheller is a device which takes whole dried corn cobs that separates the corn shells from the corn cob. The corn sheller attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power (W_e)</th>
<th>Min. Machine Processing Req. (kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>e)</td>
<td>Corn sheller</td>
<td>(to remove corn kernel from corn cobs)</td>
<td>500</td>
<td>150</td>
</tr>
</tbody>
</table>

The design principle to follow for the design of the corn sheller is to be determined by the design firm between the choice of roller type shelling (of which the VIA team has experience) or that of disc type shelling (of which the VIA team has not experience, but believe it shows promise).
The corn sheller shall have some from of adjustment to the tension applied to the corn as it is being shelled, as to allow for adjustment for different sized corn cobs.

- The corn sheller should avoid wearable components that would be considered consumable components throughout the considered life of the product.
- The sheller shall have safe operation whereby the user does not have to place the corn cob directly into the moving parts (i.e., shall have hopper or chute).
- The sheller should have consideration placed on portability, due to the attachment generally transported to location of use, unlike other crops where bags of crop are brought to the mill. This is due to the low bulk density of corn cobs.

### 2.1.3.6 VEGETABLE GRATER ATTACHMENT

The vegetable grater attachment is for the purpose of grating, slicing and grinding vegetable matters (in particular emphasis on coconut and cassava processing).

The vegetable grater attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power (W_e)</th>
<th>Min. Machine Processing Req. (\text{kg/hr})</th>
</tr>
</thead>
<tbody>
<tr>
<td>f)</td>
<td>Vegetable grater</td>
<td>(to process vegetables for cooking purposes)</td>
<td>300</td>
<td>30</td>
</tr>
</tbody>
</table>

The design principle to follow for the design of the vegetable grater is not fixed, however the grater should have multiple replacement cutting blades for various cutting shapes.
The vegetable grater shall have no less than 4 separate blade attachments consisting of 1) typical ‘cheese’ grater spike profile for grating, 2) perforation holes for shredding, 3) straight blade profile for slicing and 4) an S blade for chopping. A dicing blade and whisk attachment are also ideal additions.

The vegetable grater should be considered as ‘commercial’ grade, not ‘consumer’ grade and therefore should be made from heavy duty materials.

The vegetable grater should be considered as ‘food grade’ and therefore appropriate materials selected.

An input funnel with separate pusher to insert the vegetable into the cutting area without the need to push with fingers shall be considered for safety reasons. The funnel should be as wide mouth as possible, sufficient to fit a whole normal sized potato or apple or half a root of cassava. The funnel will also have a spring loaded entry cover to prevent flyback of processed material exiting the machine and hitting the user, which has been found to occur if putting dried coconut chunks (copra) into such a machine.

### 2.1.3.7 MEAT GRINDER ATTACHMENT

The meat grinder attachment is for the purpose of grinding meat, in addition to grinding kava (a Fijian root plant).

The meat grinder attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power (W)</th>
<th>Min. Machine Processing Req. (kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>g)</td>
<td>Meat grinder</td>
<td>(to convert whole meat to ground meat)</td>
<td>750</td>
<td>10</td>
</tr>
</tbody>
</table>
The design principle that the meat grinder attachment shall take is that of a screw & tube type meat grinder with a screen at the end of the screw & tube where the pressurized meat is pressed through to convert unprocessed meat into a mince or ground meat.

- The meat grinder shall have no less than 4 separate screen attachments consisting of 1) 2.6mm hole lattice, 2) 3.2mm hole lattice, 3) 5.0mm hole lattice, 4) 8.0mm hole lattice, 5) attachment for making sausages.
- The meat grinder should have a blade attachment on the end of the screw shaft and prior to the screen to assist with detachment of the meat and prevent blockages.
- The meat grinder shall have it's own hopper for storing the meat prior to inputting to the machine.
- The hopper of the meat grinder shall have a plunger of some description for the user to press the meat down into the grinder tube.
- The materials exposed to the meat shall all be of food grade certified materials.

### 2.1.3.8 OIL EXPELLER ATTACHMENT

The oil expeller attachment is for the purpose of producing vegetable oils from seeds or meat of nuts of various plants (in particular coconut).

The meat grinder attachment shall meet the following minimum performance criteria:

<table>
<thead>
<tr>
<th>Item</th>
<th>Product Type</th>
<th>Description of Use</th>
<th>Maximum Power (W)</th>
<th>Min. Machine Processing Req. (kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h)</td>
<td>Oil expeller</td>
<td>(to produce vegetable oils)</td>
<td>500</td>
<td>2 of oil</td>
</tr>
</tbody>
</table>
The design principle that the oil expeller attachment shall take is that of a screw (auger) & tube type, not dissimilar in principle to the meat grinder attachment. The operating principle is that the screw pressurises the input seeds, nuts or meal into a screw chamber and compresses it to a high pressure so that the oil is expelled from the input feed through one outlet, and the left over dry feed (cake) is expelled from another output - using a rotational screw type and not a linear stroke type press.

- The oil press shall be screw type and not linear piston type.
- The oils press shall be cold press type and not require heating element.
- The materials exposed to the input meal shall all be of food grade certified materials.
- The oil press shall have it’s own hopper for collecting the input meal materials.
- The oil press should have a pressure adjustment of some form.
- The oil press should be firstly optimised for coconut and secondly other materials.

### 2.2 ELECTRICAL DESIGN

The electrical design of the system shall consist of a motor controller, solar controller, PAYG system and telemetry system which all communicate with one another to form an overall electrical control system to maintain the system as a whole within the limits of the motor & battery system’s safe operating limits, as well as limiting use through a PAYG system, and remote data collection from the system (and simple control) via the telemetry system.

#### 2.2.1 MOTOR CONTROLLER

The purpose of the motor controller is to ensure the continuous operation of the motor within it’s rated speed and power to prevent the motor from overload and over heating to ensure greater longevity of the motor.
- The motor controller shall be as simple in design as possible with minimal components. The controller design shall be rated minimum 1.3x the rated continuous current of the motor rating.

- The controller shall have a user selectable reverse option, for the purpose of unclogging blocked attachments. Reverse selection shall only be operated by momentary button selection.

- Where variable speed is used for lower RPM attachments, the variable speed shall be selected by adding the attachment to automatically select the speed - not via a user input to the machine, as a safety mechanism against accidentally running a 150rpm attachment at 9000rpm etc.

- The motor controller shall have electronic over-current protection, which shall not permit the motor to provide greater current to the motor than it’s rated current.

- In addition, the electrical control system shall have a mechanically operated circuit breaker as fail safe.

- In the case of brushless motor, the controller shall have an option for sensor or sensorless motors.

- The motor controller should disconnect the motor power when the detected voltage is determined to be over discharging the battery being used.

- The motor controller circuit board shall be completely encapsulated to protect against water ingress with an IP rating of IP68.

### 2.2.2 SOLAR CONTROLLER

The purpose of the solar controller is to convert the variable voltage solar DC current coming from the solar PV modules into a steady voltage suited to the battery voltage and to keep the
batteries operating within their safe and optimal range. In addition, it shall operate the motor without the requirement of batteries.

- The solar charge controller shall be modular, so that the product can be sold as a simple DC powered product without this controller to who already own solar home systems that have a controller. As such, it is expected that the solar controller used for this cooker product will be an “off the shelf” component rather than having customized design, minimizing design effort.
- The solar charge controller shall be MPPT (Maximum Power Point Tracker) type charge algorithm.
- The solar charge controller shall be rated 1.3x the maximum design current required for either battery charging or direct motor powering.
- The solar charge controller shall operate the battery(s) within their safe operating levels by both current, voltage and temperature.
- The solar charge controller shall operate the motor within it’s safe operating levels by both current, voltage and temperature.
- The solar charger should allow battery charging regardless of the status of the PAYG system (eg. if the PAYG system registers the machine load should not be accessible, the solar controller will still maintain power to the batteries).
- Shall operate with the remote telemetry to monitor energy production and consumption as well as remote control of the solar system and/or motor controller.
• Shall have charge status indicators via LED or LCD screen, with a minimum requirement of showing charging, low charge, battery disconnected and load disconnected status.

### 2.2.3 PAYG CONTROLLER

The PAYG (Pay-As-You-Go) controller shall control the operation of the machine by either a kWh based consumable token or a time based consumable token or a weight based consumable token to connect or disconnect the motor based on the user available credit of either consumable token. The open source hardware and software from EnAccess Foundation partners are highly recommended to be reviewed for consideration: https://enaccess.org/projects

Consortium partnerships that combine expertise in both PAYG and non-PAYG aspects of this project are encouraged. Bids for only the PAYG component development are welcome, and if of interest, introductions can be made by VIA between potential consortium partners before final bids are submitted.

• The PAYG controller shall be modular, so that the unit may be sold as either a DC motor product with/without solar charge controller (for when added to an existing solar home system) and likewise with/without PAYG controller (for when the product is sold for cash and no financing or slow repayment is required).

• The PAYG controller should utilise either RFID or IC card or keypad to input the digital reload token.
- The units of re-load token shall be either kWh, time (default of 30 days usage) or weight.
- When the PAYG controller reaches a level of zero value remaining user credit, then the controller shall disconnect the motor power but shall leave the solar charge (if applicable) available.
- The PAYG controller shall have a screen to indicate the current level of user credit remaining, either by a series of LEDs or a small LCD screen with single warning LED for low value remaining (<10% of the last topup).
- The PAYG controller will be capable of passing credits usage data to the telemetry systems and thus back to the system software, but if no PAYG controller is included, the solar controller and telemetry system would still convey energy usage.
- The PAYG controller shall keep a local store of the cumulative lifetime hours of use and kWh and weight (if applicable).

### 2.2.4 TELEMETRY

The telemetry system shall allow the device to communicate remotely to a central web server the current and historical status of the product, monitoring critical operating system parameters.

- The telemetry controller shall use either WiFi, GSM or LoRA communication protocol and hardware. The possibility of using more than one method is a welcome optional extra.
- The telemetry system shall send status report in minimum data package type at programmable time intervals.
• The telemetry system shall monitor and send data reports (generally daily) with programmable time intervals on the following, including timestamps:
  ■ Solar PV maximum and average power generation (watts) as well as energy generation (watt-hour)
  ■ Heating element maximum and average power usage (watts) as well as energy usage (watt-hours)
  ■ Battery state of charge (voltage & watt-hours capacity remaining)
  ■ Heating element time spent operating at any power level (hours)
  ■ PAYG controller credits used and remaining (kWh or days)
• The telemetry system shall enable the motor controller to be disabled remotely via the cloud software platform.
• The telemetry controller shall be modular and removeable, whereby the system can operate without the telemetry hardware may operate without the telemetry hardware installed (eg. when selling the mill for cash).
• The telemetry controller shall have an external antenna option.
• The telemetry system shall come with recommended gateway hardware if required.

2.3 SOFTWARE DESIGN

The hardware shall be complimented with a cloud based software system and optionally a PAYG smartphone Android ‘app’. The Android ‘app’ is currently optional and preference given to bidders that provide in their scope - but creation of PAYG tokens from the cloud platform only will also be considered and bids offering this only will be considered valid.

The purpose of the cloud based platform shall be to display and tabulate the data that was collected and transmitted by the telemetry system outlined in 2.2.4. Should the telemetry system not be installed in the system hardware, then the cloud based platform shall display only data collected by the PAYG smartphone app.

The cloud based software is defined as the software only, as operated by a management team to manage the ongoing operation of the hardware package. VIA has access to an Amazon AWS server and a Microsoft Azure server that may be useful if required. In addition, the cloud platform shall serve the function to allow the management team to manage payment reconciliation from end users and vending agents - vending agents being intermediaries between VIA and end customers that sell credits tokens to end customers operating the PAYG device. The relationship between the three components and end user outlined in this section is shown in the following diagram for the PAYG platform.
In addition to this, where the hardware has been fitted with the telemetry system, then the software platform shall also collect data as outlined in section 2.2.4 directly to the cloud server.

### 2.3.1 MINIMUM REQUIREMENTS

Operations acceptable in either online and offline mode of the Android PAYG app:

a. Transfer of all Android app data to the cloud based software, including but not limited to:
   i. All end user personal and payment transaction data;
   ii. All agent personal and payment transaction data;
   iii. All hardware status and location data;

b. Setting/resetting of PAYG app credit limit and credit availability, as well as in the case of time-based monthly codes which codes are active and can be downloaded by vending agents, and which cannot (token availability control)

c. Registration of end users;

d. Activation of hardware and assignment to end users;

e. Unlocking of the PAYG device once full payment has been made
Minimum operations required in offline mode (that may also function online):

a. Creation of the prepaid digital token/token code for the end user;

b. Transfer of the prepaid digital token/token code to the hardware PAYG prepayment controller;

c. Viewing end-user contact information and hardware system status.

The software deployment of the full system (Android vending/PAYG app and cloud based software) should adhere to the following minimum general requirements:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compatibility</td>
<td>the cloud based software platform should be compatible with a centrally managed PC running the compatibility Vending Management Software</td>
</tr>
<tr>
<td>Security</td>
<td>the software for both cloud based platform and Android app should be password protected in the event of theft.</td>
</tr>
<tr>
<td>Credit Limits</td>
<td>the Android app shall have limits to the value of the prepayment credit (days or kWh) for the Android app user that are set by the cloud based platform. Credit limits shall only be reset once cloud based software has reconciled payments from the Android app user.</td>
</tr>
<tr>
<td>Payment Reconciliation</td>
<td>The cloud based platform must have payment reconciliation features in which once the Android app user data is uploaded into the cloud based software, end user transactions can be easily summarized and when Android app user payment is inserted into the cloud based software, and a balance can be obtained to determine easily and quickly if the reconciled amount received matches that expected as collected.</td>
</tr>
<tr>
<td>Dashboard</td>
<td>The cloud based software and Android app software should present information in a summarised way so that information can be captured ‘at a glance’ such as amount of moneys overdue, status of users/machines etc., and then be easily filtered by criteria such as date/users/status/locations and others. The dashboard shall also present telemetry data summaries, if available.</td>
</tr>
<tr>
<td>User</td>
<td>The cloud based software must be able to control and edit all</td>
</tr>
<tr>
<td>Management</td>
<td>aspects of user management including assigning roles to users as well editing user details. The Android app must be only able to update end user information such as Name, Phone Number, Address etc and not manage roles.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Hardware Management</td>
<td>The cloud based platform and Android app must be able to control and edit all aspects of hardware management including assigning status of location, deployment status, serial number database and user assignment.</td>
</tr>
<tr>
<td>Defaulting Users</td>
<td>The cloud based software should enable a dashboard views of total number of end users whom are 30/60/90+ days since last payment. Access to the users data contained within these views should be easily accessible and exportable including total paid, date of last payment, name and contact details including address/GPS co-ordinate.</td>
</tr>
<tr>
<td>Data Access</td>
<td>Global data of both cloud based software and Android app software should be exportable to CSV or other file type importable to MS Excel - minimum data to be exported should be all MC data, all vending transaction data and all hardware asset data.</td>
</tr>
<tr>
<td>Software Updates</td>
<td>The Supplier must commit to providing ongoing support of the software platform for the life of the Product, with fees and other arrangements to be negotiated with VIA separately to the cost of this product development project.</td>
</tr>
</tbody>
</table>
3 TASKS AND DELIVERABLES

The following section will outline the tasks and deliverables to be undertaken to deliver the project in a timely manner in accordance with the Task Schedule.

TASK 1 - TECHNOLOGY OPTIONS ANALYSIS

The supplier shall be responsible for providing a list of technology options for the following minimum requirements to develop the hardware with recommendations for the final selected technology.

i. Motor options including voltage, power, type and cost estimate
ii. Motor control options including voltage, current, type and cost estimate
iii. Gearing options including ratios, type and cost estimate
iv. Attachment types including operating principles, power requirement, gearing if required and cost estimate
v. Telemetry types and hardware cost estimate
vi. Software platform types and ongoing cost estimate (monthly hosting fees etc)

TASK 2 - TECHNOLOGY OPTIONS SELECTION

The technology options selection task shall take the results of Task 1 in co-ordination with VIA to determine the final technology path to take for the product design. The final technology selection shall include an estimated BOM (bill of materials) for each technology and final assembled product options.

TASK 3 - CONCEPTUAL DESIGNS

The supplier shall provide VIA with conceptual industrial design of the product of no less than 3 overall industrial design directions to select from, as well as conceptual designs of the gearing and motor system attachments for the hardware.

The supplier shall provide VIA with conceptual wireframe design of the software and app including dashboard mockups for selection of design direction of the software.

TASK 4 - MECHANICAL DESIGN

The supplier shall provide complete mechanical design of the solar agro processing hardware to accommodate all component items including motor, PCBs, gearing and other in a single packaged design which acts as a multi-head attachment machine as outlined in section 2.1 - Mechanical Design.
The task shall require the creation of all 3D CAD and manufacturing drawings/files for the production of alpha prototype products.

**TASK 5 - ELECTRICAL/SOFTWARE DESIGN**

The supplier shall provide complete electrical design and software design of the solar agro processing electronics system and software platform in a modular format whereby various components such as solar/PAYG/telemetry can be added or removed based on customer requirements.

The task shall require the creation of all PCB design and manufacturing drawings/files and firmware coding required for production of the alpha prototype products as well as the software platform to operate and manage them.

**TASK 6 - PROTOTYPE ALPHA PRODUCTS**

The supplier shall provide complete working prototype hardware of the mechanical and electrical components as outlined in this document, as well as the prototype software platform.

The prototype products shall be delivered to VIA by air freight for their own assessment.

**TASK 7 - PROTOTYPE TESTING & RESULTS**

The supplier shall provide VIA with complete testing results of the prototype design hardware and software, including key metrics as developed with VIA throughout the project. Particular focus shall be on the output efficiency of each mill attachment to the energy input of the electrical system.

Minimum targets on the testing results shall be developed in conjunction with VIA as the progress progresses, but shall not be less than the minimum outlined in this document - however consideration will be undertaken where performance results are limited by mechanical/electrical or other constraints.

**TASK 8 - PREPARATION OF MANUFACTURING DOCUMENTATION**

The supplier shall undertake final preparation and handover of all documentation and hardware prototypes at the completion of the project to undertake small batch manufacturing by VIA’s manufacturers. The supplier shall commit to ongoing support during the production phase of the Alpha design products and undertake adjustment of engineering drawings for the purpose of manufacture throughout the alpha production period. Design changes (rather than design modifications to allow manufacture to be carried out) shall be undertaken on a case by case between the supplier and VIA.
4 PROJECT SCHEDULE

The following section outlines the project schedule that the supplier shall adhere to, to ensure the timely delivery of designs for manufacture to avoid delay of field trials of the final produced product.

4.1 CONTRACT AWARD

The following timetable exists for the Notice of Award and Contract signing.

I. The SOW will be advertised on the VIA website and identified potential bidding parties will be notified directly.

II. A virtual prebid meeting will be undertaken with any potential bidders at their request to make clarifications to the SOW if required.

III. Submission of bids shall be met by the specified deadline, or bids will not be considered.

IV. Following the deadline of all submissions to bid, VIA will undertake a 2 week bid evaluation period of all bids.

V. The successful bidder of the evaluation process will be provided with a Notification Of Award and unsuccessful bidders will also be notified of their unsuccessful bid (winning bidder will remain confidential)

VI. When the winning bidder as met all VIA administrative requirements within the time period available, then contract signing will take place. Notice of Award does not constitute a supplier contract.

<table>
<thead>
<tr>
<th>Item</th>
<th>Activity</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sending of Invitation to Bid</td>
<td>1st May 2020</td>
</tr>
<tr>
<td>2</td>
<td>Deadline for requesting any bid clarifications</td>
<td>15th May 2020</td>
</tr>
<tr>
<td>3</td>
<td>Deadline for the Submission of Bids</td>
<td>24th May 2020</td>
</tr>
<tr>
<td>4</td>
<td>Bid Evaluation</td>
<td>Duration 1 week</td>
</tr>
<tr>
<td>5</td>
<td>Notification of Award to the successful bidder</td>
<td>31st May 2020</td>
</tr>
<tr>
<td>6</td>
<td>Contract Signing</td>
<td>15th June 2020</td>
</tr>
</tbody>
</table>
4.2 TASK SCHEDULE

The following task schedule is to be included in the contract awarded to the winning bidder. Should any delays in the bidding process take place, then the length of the delay shall be added to each task deliverable date.

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Jun</td>
</tr>
<tr>
<td>1</td>
<td>Technology Options Analysis</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Technology Options Selection (inc. BOM cost estimates)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Conceptual designs for Client selection</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Mechanical design of Alpha Hardware</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Electrical/software design for Alpha Hardware</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Prototype of complete Alpha Design</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Prototype testing &amp; results of Alpha Design</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Preparation of Manufacturing Documentation</td>
<td></td>
</tr>
</tbody>
</table>

Following this development project, VIA intends to manufacture 50 alpha products during December 2020 to April 2021 and field testing these in various markets during June - August 2021. A second development project would then start to refine this alpha product into a beta design, that will be part of a separate project scope, but is likely to offer the opportunity of ongoing development work during September 2021 - June 2022 to the winning bidder.
5 PROJECT MANAGEMENT

5.1 VIA MANAGEMENT

VIA shall have a dedicated technical Engineering Project Manager available 4 days per month to assist and manage the winning bidder’s project schedule. The Project Manager will have technical experience in the product brief to assist in technical direction of the product development.

5.2 BIDDER MANAGEMENT

The winning bidder is expected to have one full time Project Manager assigned to the project who will be responsible for oversight of the project and communications with the VIA Project Manager.

In addition, the bidder must provide the CVs of the following key staff:

- Project Manager
- Lead Industrial Designer
- Lead Mechanical Engineer
- Lead Electrical Engineer
- Lead Software Engineer
6 SUCCESS CRITERIA & SIGN OFF

The project will be deemed successful each task is signed off as completed by VIA and the following total project payments will be made as a percentage of the total bid value.

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Payment Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Technology Options Analysis</td>
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<tr>
<td>2</td>
<td>Technology Options Selection</td>
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<tr>
<td>3</td>
<td>Conceptual designs for Client selection</td>
<td>15%</td>
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<tr>
<td>4</td>
<td>Mechanical design of Alpha Hardware</td>
<td>25%</td>
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<tr>
<td>5</td>
<td>Electrical/software design for Alpha Hardware</td>
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<td>6</td>
<td>Prototype of complete Alpha Design</td>
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<tr>
<td>7</td>
<td>Prototype testing &amp; results of Alpha Design</td>
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<tr>
<td>8</td>
<td>Preparation of Manufacturing Documentation</td>
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