Team 16

Team Design Task 3: Design Portfolio

http://www.nowpublic.com/world/chulha-indian-village

Team 16 Members:
Keenan Boon, Sam Groves, Andrew Hunt, Daniel Modica and Chris Wembridge
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Introduction:

The challenge was put forth by EWB to help an underprivileged area in India, this area in the Pitchandikulam forests situates a small community called Devikulam where there is an opportunity for a radical improvement on the people’s health and wellbeing through projects governed by Engineers without Borders (EWB). Our team decided to choose the project of designing an alternative cooking system.

Devikulam is situated in the forests of Pitchandikulam and is located on the south east coast of India, the type of living conditions the local community face is hot weather through dry season and monsoon conditions during wet season. The community is surrounded by rainforests and is a good source of income.

The current cooking system the people of Devikulam rely on is basic rocket stoves that use fuels such as wood or kerosene to light fires, these type of cooking systems produce a large amount of smoke and is extremely bad for long term health and also results in a large amount of deaths due to the mothers having there babies close to them while they are cooking.

Mission Statement

Our product will be a cost effective alternative cooking system that is durable/reliable that can be mass produced and easy to use. It will allow a high quality of living through innovative features that will reduce smoke emissions and cut down on excessive fuel consumption.
**Vision Statement**

This system will be the primary source for cooking meals for the people of Devikulam and last at least 5 years before a new product becomes available on the market. It will provide a better quality of living through the innovative features that will increase hygiene and health.

**Goals**

**Business Goals:**

- An inexpensive system that coincides with features that will enhance quality of living.
- Compatible with the local knowledge allowing the community to still use the system without supervision.
- Serve as a main form of alternative cooking for the Devikulam people.
- Reliable with minimal maintenance
- Sustainable in remote area

**Social Goals:**

- Increase the morale of the community
- Create a sense of pride from the cooking systems they own
- Reduce environmental impact
- Reduce death from smoke inhalation
- Better quality of living for everyone
Target Markets

Primary Market:

• Devikulam people

Secondary Market:

• Third world countries in need of a reliable cooking system.
• New class leader of robust and efficient cooking system

Stakeholders

• Team 16
• Engineers without borders (EWB)
• Deakin University
• Prakti
• Lectures and tutors
Background:

Devikulam is situated on the south east coast of India.

Devikulam is considered one of the poorest communities in India with families typically making less than $1 per day. The main form of work is agricultural farming but this is infrequent and a rare occurrence. The main food that the average family will eat is rice and is a vital staple for their diet. Rice contains a large amount of carbohydrates and also a vital amount of protein for their diet. On the rare occasion an egg is given to the primary school children and this is usually take home and given to the family to share.
In this small community there are 86 families, with the size of individual families ranging from 4 to 6 people. The main form of fuel for cooking purposes is the use of firewood chopped down from the surrounding rainforests this logging takes a massive toll on the wildlife causing some local species to become endangered. The use of poor cooking practises and use of toxic igniters releases a large amount of pollutant gases into the atmosphere such as carbon dioxide and monoxide, sulphur dioxide and soot etc.

Address of the village:
Devikulam village, Nadukkapam Panjayat, Marakkanam block, Tindivanam Taluk, Viluppuram District, Tamil Nadu, India
Assumptions:

• The community of Devikulam would have a low education due to the wealth of the area; education is a privilege for them and is a valuable resource. From this fact we assumed that the system would have to be extremely user friendly and not be complicated. A simple insert of fuel and ignition system would be needed and a viable option.

• The system would have to be robust and withstand a vast amount of weather conditions such as extreme heat and condensation. Therefore a system with a complex circuit board or fragile parts would have to be taken out of the design as the use of the system would need to be for many years.

• The type of energy used would either have to be something readily available such as wood or stalks from rice crops this was due to the cost factor. Anything that used renewable energy source would solve fuel problems but also increase the overall price of the system.

• If the system wasn’t appealing or felt needed by the community they would not use it and would prefer to use the older system even if it is worse for their health and hygiene. Therefore the system would have to be suitable for their cooking customs and be something the community prided themselves for having.
## Customer Needs:

<table>
<thead>
<tr>
<th>Number</th>
<th>Need</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The cooker must be able to produce enough food to feed a family.</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>The cooker must be able to cook a variety of food.</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>The cooker must be easily maintainable.</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>The cooker must be robust.</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>The cooker must be able to reach a high enough temperature to cook the required food.</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>The cooker must be able to be used by people of a young age.</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>The cooker must be energy efficient.</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>The cooker must not be too large.</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>The cooker must be cost effective.</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>The cooker must be environmentally friendly.</td>
<td>5</td>
</tr>
</tbody>
</table>
Metrics:

<table>
<thead>
<tr>
<th>Metric No.</th>
<th>Need Number</th>
<th>Metrics</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>How many people can the cooker feed</td>
<td>Number of People</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>What can the cooker produce</td>
<td>Number of Foods</td>
</tr>
<tr>
<td>3</td>
<td>4,5</td>
<td>How long does it take to clean</td>
<td>Time</td>
</tr>
<tr>
<td>4</td>
<td>5, 7</td>
<td>Can the cooker work in the rain</td>
<td>Yes/no</td>
</tr>
<tr>
<td>5</td>
<td>1, 6</td>
<td>What temperature does the cooker reach</td>
<td>Degrees</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>Minimum age of user</td>
<td>Years</td>
</tr>
<tr>
<td>7</td>
<td>8, 12</td>
<td>Energy Consumption</td>
<td>Kwh</td>
</tr>
<tr>
<td>8</td>
<td>7, 9</td>
<td>How large is the cooker</td>
<td>M^3</td>
</tr>
<tr>
<td>9</td>
<td>4, 5, 10</td>
<td>How much does the cooker cost</td>
<td>AUD ($)</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>How long does the cooker last</td>
<td>Years</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>Level of impact on Environment</td>
<td>Kg/h (CO2)</td>
</tr>
<tr>
<td>12</td>
<td>12, 13</td>
<td>Does it use renewable energy?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>13</td>
<td>14</td>
<td>Can it be maintained by the villagers</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Needs</td>
<td>Metrics Matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooker must be environmentally friendly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooker must be cost effective</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cooker must not be too large</td>
<td>•</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cooker must be energy efficient</td>
<td>•</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>The cooker must be accessible to all ages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cooker must reach a high temperature</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>The cooker must be robust</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cooker must be easily maintainable</td>
<td>•</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cooker should cook a variety of food</td>
<td>•</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>The cooker must be able to feed a family</td>
<td>•</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>The cooker must be able to cook rice</td>
<td>•</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many people can the cooker feed</th>
<th>What can the cooker produce</th>
<th>How long does it take to clean</th>
<th>Can the cooker work in the rain</th>
<th>What temp. does the cooker reach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SED102: Introduction to Design and AutoCAD
<table>
<thead>
<tr>
<th>Needs</th>
<th>Metrics Matrix cont.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooker must be environmentally friendly</td>
<td>•</td>
</tr>
<tr>
<td>Cooker must be cost effective</td>
<td>• • •</td>
</tr>
<tr>
<td>The cooker must not be too large</td>
<td>•</td>
</tr>
<tr>
<td>The cooker must be energy efficient</td>
<td>•</td>
</tr>
<tr>
<td>The cooker must be accessible to all ages</td>
<td>•</td>
</tr>
<tr>
<td>The cooker must reach a high temperature</td>
<td></td>
</tr>
<tr>
<td>The cooker must be robust</td>
<td>• •</td>
</tr>
<tr>
<td>The cooker must be easily maintainable</td>
<td></td>
</tr>
<tr>
<td>The cooker should cook a variety of food</td>
<td></td>
</tr>
<tr>
<td>The cooker must be able to feed a family</td>
<td></td>
</tr>
<tr>
<td>The cooker must be able to cook rice</td>
<td></td>
</tr>
<tr>
<td>Minimum age of user</td>
<td>Energy Consumption</td>
</tr>
<tr>
<td>Biomass stove</td>
<td>Dependant on pot size</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Zhenghong oven</td>
<td>1 cup</td>
</tr>
<tr>
<td>Solar cooker</td>
<td>Dependant on pot size</td>
</tr>
<tr>
<td>Induction cooker</td>
<td>Dependant on size</td>
</tr>
<tr>
<td>Rocket stove</td>
<td>Dependant on pot size</td>
</tr>
<tr>
<td>Units</td>
<td>Cups of rice</td>
</tr>
<tr>
<td>Importance</td>
<td>5</td>
</tr>
<tr>
<td>Metrics</td>
<td>How much rice can the cooker produce</td>
</tr>
</tbody>
</table>

SED102: Introduction to Design and AutoCAD
<table>
<thead>
<tr>
<th>Biomass stove</th>
<th>200</th>
<th>12</th>
<th>3.3</th>
<th>1</th>
<th>Varies about 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhenghong oven</td>
<td>150</td>
<td>12</td>
<td>2.3</td>
<td>0.4</td>
<td>1500</td>
</tr>
<tr>
<td>Solar cooker</td>
<td>150</td>
<td>12</td>
<td>2</td>
<td>0.6</td>
<td>100</td>
</tr>
<tr>
<td>Induction cooker</td>
<td>Dependant on what is being cooked</td>
<td>8</td>
<td>1.8</td>
<td>1</td>
<td>Varies about 500</td>
</tr>
<tr>
<td>Rocket stove</td>
<td>649</td>
<td>12</td>
<td>4</td>
<td>1.5</td>
<td>125</td>
</tr>
</tbody>
</table>

### Importance

<table>
<thead>
<tr>
<th>Units</th>
<th>Degree (Celsius)</th>
<th>Minimum age of user</th>
<th>Energy consumption</th>
<th>How large is the cooker</th>
<th>How much does the cooker cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Biomass stove**

- **Importance**: 3
- **Minimum age of user**: 2
- **Energy consumption**: 3
- **How large is the cooker**: 2
- **How much does the cooker cost**: 4

**Zhenghong oven**

- **Importance**: 2
- **Minimum age of user**: 2
- **Energy consumption**: 2.3
- **How large is the cooker**: 0.4
- **How much does the cooker cost**: 1500

**Solar cooker**

- **Importance**: 3
- **Minimum age of user**: 12
- **Energy consumption**: 2
- **How large is the cooker**: 0.6
- **How much does the cooker cost**: 100

**Induction cooker**

- **Importance**: 2
- **Minimum age of user**: 8
- **Energy consumption**: 1.8
- **How large is the cooker**: 1
- **How much does the cooker cost**: Varies about 500

**Rocket stove**

- **Importance**: 3
- **Minimum age of user**: 12
- **Energy consumption**: 4
- **How large is the cooker**: 1.5
- **How much does the cooker cost**: 125
<table>
<thead>
<tr>
<th>Metrics</th>
<th>Importance</th>
<th>Units</th>
<th>Rocket stove</th>
<th>Induction cooker</th>
<th>Solar cooker</th>
<th>Zhenghong oven</th>
<th>Biomass stove</th>
</tr>
</thead>
<tbody>
<tr>
<td>How long does the cooker last</td>
<td>4</td>
<td>Years</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Level of impact on the enviroment</td>
<td>5</td>
<td>Co2 per KWH</td>
<td>0.11</td>
<td>0.45</td>
<td>0</td>
<td>0.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Class leader**      **Competitive**      **Standard**
Cooking systems that have been benchmarked:

- Zhenghong oven
- Biomass stove
- Solar cooker
- Induction cooker
- Rocket stove
## Targets:

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Marginal Value</th>
<th>Ideal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much rice can the cooker produce</td>
<td>3 cups</td>
<td>5 cups</td>
</tr>
<tr>
<td>How many people can the cooker feed</td>
<td>5 people</td>
<td>8 people</td>
</tr>
<tr>
<td>What can the cooker produce</td>
<td>Rice and staples</td>
<td>Meat, rice, vegetables</td>
</tr>
<tr>
<td>How long does it take to clean</td>
<td>2-3 minutes</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Can the cooker work in the rain</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>What temperature does the cooker reach</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Minimum age of user</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>How large is the cooker</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>How much does the cooker cost</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>How long does the cooker last</td>
<td>3-4</td>
<td>8-10</td>
</tr>
<tr>
<td>Level of impact on Environment</td>
<td>.98</td>
<td>.4</td>
</tr>
<tr>
<td>Does it use renewable energy?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can it be maintained by the villagers</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Concept Generation/Selection Process:

Divide the cooker into its 3 main components.

Brainstorm on the individual components of the system.

Concept screening for each subsystem.

Generation of initial concepts.

Concept scoring.

Final Concept

Divide the cooker into its 3 systems the cooker the burner and the cooking plate.

Brainstorm the type of materials and different type of subsystems that can be used.

Rate the different subsystems according to the benchmarked system.

From the previous screening a generation of initial of concepts is produced.

From these concepts a scoring system is used to determine the best concept to use.

Finally a final concept is found.
Functional Decomposition:

Fuel

Ignition

Radiant Energy

Spark or igniter

Heat Energy

Thermal energy

Used spark or igniter

Heat

Unusable biproduct
User Based Decomposition:

Insert Burner into Cooker
Load with fuel
Light fuel
Add Cooking Plate

User
Cook food
Clean up

Burning Materials
Prepare Food
Dispose of used fuel

Insert into Burner
Light with match
Store inside
**Brainstorming:**

Brainstorming was used to come up with multiple ideas for the different forms of the 3 subsystems in which we have; the burner, cooker and cooking plate. These helped us give our initial concepts and the backbone to concept screening process.

<table>
<thead>
<tr>
<th>Burner</th>
<th>Cooking Plate</th>
<th>Type of Cooker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>Ceramic</td>
<td>Rocket Stove</td>
</tr>
<tr>
<td>Aliminum</td>
<td>Iron</td>
<td>Methane cooker</td>
</tr>
<tr>
<td>Steel</td>
<td>Aliminum</td>
<td>Biomass Stove</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Gravity system</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Solar Battery</td>
</tr>
</tbody>
</table>
**Concept Screening:**

Concept screening - Cooker

<table>
<thead>
<tr>
<th></th>
<th>Rocket Stove (Benchmark)</th>
<th>Methane Gas</th>
<th>Biomass Stove</th>
<th>Gravity System</th>
<th>Solar Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many people can the cooker feed</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>What can the cooker produce</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>How long does it take to clean</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Can the cooker work in the rain</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>What temperature does the cooker reach</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Minimum age of user</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>How large is the cooker</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>How much does the cooker cost</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Does it use renewable energy?</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Can it be maintained by the villagers</td>
<td>0</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Σ</strong></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>2</td>
</tr>
</tbody>
</table>

The concept screening showed that the biomass stove and solar battery were the two concepts that would move onto the concept scoring.
## Concept Screening Continued:

**Concept Scoring - Burner**

<table>
<thead>
<tr>
<th></th>
<th>Ceramic</th>
<th>Iron</th>
<th>Aluminium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Weight</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Maintenance</td>
<td>-</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strength</td>
<td>-</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>$\Sigma$</td>
<td>-1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Concept Screening Continued:

Concept Screening – Cooking Plate

<table>
<thead>
<tr>
<th>Material</th>
<th>Ceramic</th>
<th>Iron</th>
<th>Aluminium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Resistance</td>
<td>-</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Cost</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Maintenance</td>
<td>-</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Weight</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>∑</td>
<td>-1</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

As there was an outright winner for cooking plate the concept scoring did not continue for the cooking plate subsystem.
Initial Concept 1: Gravity/Solar cooker

The gravity solar cooker harnesses energy using both a gravity system and solar energy. This means that it can be used if there isn’t enough sunlight for the solar panels, by using gravity system. Both these two concepts will be explained in greater detail further down in the initial concepts.
Initial Concept 2: Methane Gas

The methane gas system would be used in conjunction with another teams work in sanitary systems, exploiting the methane gas that is released from composting faeces it would help drive generators and have an electricity source for the community to use for their alternative cooking system.
Initial Concept 3: Biomass stove

Biomass stove uses any forms of fuel such as leaves, wood, unused crops etc. to burn in a chamber, warming up a cooking plate so that it can cook varying pot sizes of foods. This system is good because the fuel can be diverse and only necessary for the type of need that it is going to be used for.
Initial Concept 4: Gravity system

The gravity system relies on man power during the day to solve energy usage. During the day water is pumped up into a tank from a man-made lake then is released overnight or when needed to power a generator using a hydroelectric system. This water can be reused and would be separate from the water systems they have now such as rivers and lakes.
Initial Concept 5: Solar Battery

The solar battery would be separate from the cooker and would be 86 panels or more connected to a battery during the day these would be laid out and absorb the heat from the sun. Then during the night the batteries can be disconnected and used to power stoves and other sources needing electrical consumption to run.
# Concept scoring table: Cooker

*Relating to our screening matrix (‐ = 0, 0 = 3 and + = 5) for the ratings*

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight</th>
<th>Biomass Stove</th>
<th>Solar Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rating</td>
<td>Weighted Score</td>
<td>Rating</td>
</tr>
<tr>
<td>How many people can the cooker feed</td>
<td>.05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>What can the cooker produce</td>
<td>.05</td>
<td>5</td>
<td>.25</td>
</tr>
<tr>
<td>How long does it take to clean</td>
<td>.10</td>
<td>5</td>
<td>.50</td>
</tr>
<tr>
<td>Can the cooker work in the rain</td>
<td>.10</td>
<td>5</td>
<td>.50</td>
</tr>
<tr>
<td>What temperature does the cooker reach</td>
<td>.10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Minimum age of user</td>
<td>.05</td>
<td>3</td>
<td>.15</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>.10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>How large is cooker</td>
<td>.05</td>
<td>5</td>
<td>.25</td>
</tr>
<tr>
<td>How much does the cooker cost</td>
<td>.15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Does it use renewable energy?</td>
<td>.15</td>
<td>5</td>
<td>.75</td>
</tr>
<tr>
<td>Can it be maintained by the villagers</td>
<td>.10</td>
<td>5</td>
<td>.50</td>
</tr>
<tr>
<td><strong>TOTAL WEIGHTED SCORE</strong></td>
<td>1</td>
<td>2.9</td>
<td>2.8</td>
</tr>
</tbody>
</table>
# Concept scoring table: Burner

<table>
<thead>
<tr>
<th>Concept</th>
<th>Weighting %</th>
<th>Iron</th>
<th>Subtotal</th>
<th>Aluminium</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>.3</td>
<td>3</td>
<td>.9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weight</td>
<td>.1</td>
<td>3</td>
<td>.3</td>
<td>5</td>
<td>.5</td>
</tr>
<tr>
<td>Maintenance</td>
<td>.3</td>
<td>3</td>
<td>.9</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>.1</td>
<td>3</td>
<td>.3</td>
<td>3</td>
<td>.3</td>
</tr>
<tr>
<td>Strength</td>
<td>.2</td>
<td>3</td>
<td>.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Σ</strong></td>
<td><strong>1</strong></td>
<td><strong>3.0</strong></td>
<td><strong>2.3</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Iron being the winner and choice as Burner material
Final Design Specifications:
The concept we chose was the biomass stove concept no. 3
Below is a CAD drawings to show the system as a whole.
Final design relates to user needs:

Need 1:
The cooker must be able to produce enough food to feed a family. The cooker has a large cooking plate allowing for a large pot to be placed on it therefore a quantity of rice to feed a family can be made.

Need 2:
The cooker must be able to cook a variety of food. The cooker is able to cook anything that rests on a cooking plate, such as food that goes in pots, in saucepans, in woks etc.

Need 3:
The cooker must be easily maintainable. Because of the three parts system of the biomass stove it is easily pulled apart and each individual part can be cleaned monthly, whereas the cooking pans and other cooking utensils just have to be washed regularly.

Need 4:
The cooker must be robust. The cooking system is made from iron and is a strong metal allowing it to withstand the elements, due to the cooker being inside the house it didn’t need any galvanising to stop the corrosion of metal reducing the costs.

Need 5:
The cooker must be able to reach a high enough temperature to cook the food. The cooker will burn at the same temperature or greater to a log fire with sufficient heat to cook the food on the cooking plate.
**Final design relates to user needs continued:**

Need 6:
The cooker must be able to be used by people of young age. Due to the simplicity of the system, inserting fuel and igniting the fuel it is simplistic for people to use.

Need 7:
The cooker must be energy efficient. The cooker uses the unused parts of crops and dead leaves, using renewable source of fuel.

Need 8:
The cooker must not be too large. The cooker is streamlined to fit in a corner of a room or up against a wall so does not take up a large amount of area.

Need 9:
The cooker must be cost effective. The cooker is in comparison to other stoves on the market quite cost effective and is competitive in the market place.

Need 10:
The cooker must be environmentally friendly. The cooker uses excess and leftover products for fuel making it environmentally friendly and also does not have toxic chemicals within its system.
Features:

Use of fuel:
The use of fuel is one of the leading features of the biomass stove, it uses an excess vegetation and crops for the fuelling system, as this part of India is heavily agricultural any unused crop parts can be used as fuel. A main crop grown in India is rice, only the top of the stalk of rice crops is used for food, the rest of the stalk is discarded, this stalk is a prime source of fuel for the biomass.

Robustness:
The shape and use of materials makes the biomass stove system very robust it allows for it to still work if knocked over and because it does not have any complicated parts inside it can be easily fixed and maintained by the community through simple instructions, all is needed is regular clean outs and maintenance.

Versatility in weather conditions:
This cooking system does not rely on weather conditions for it to work, during harvest season for rice, rice stalks can be used for biomass stove making the system carbon neutral and during the offseason, lying bark, grass and other forms of vegetation can be used instead of having to cut down rainforest.
## Concept compared to initial targets:

This table is used to show how our final concept relates to our initial targets, a good final concept will have majority of the final specifications in the pre-planned ideal values.

<table>
<thead>
<tr>
<th>Metric Number</th>
<th>Need Number</th>
<th>Metrics</th>
<th>Importance</th>
<th>Marginal Value</th>
<th>Ideal Value</th>
<th>Final value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>How many people can the cooker feed</td>
<td>4</td>
<td>5 people</td>
<td>8 people</td>
<td>5 people</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>What can the cooker produce</td>
<td>2</td>
<td>Rice and staples</td>
<td>Meat, rice, vegetables</td>
<td>Meat, rice, vegetables and others</td>
</tr>
<tr>
<td>3</td>
<td>4, 5</td>
<td>How long does it take to clean</td>
<td>5</td>
<td>2-3 minutes</td>
<td>30 seconds</td>
<td>30 seconds</td>
</tr>
<tr>
<td>4</td>
<td>5, 7</td>
<td>Can the cooker work in the rain</td>
<td>5</td>
<td>No</td>
<td>Yes</td>
<td>limited</td>
</tr>
<tr>
<td>5</td>
<td>1, 6</td>
<td>What temperature does the cooker reach</td>
<td>3</td>
<td>200</td>
<td>300</td>
<td>250</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>Minimum age of user</td>
<td>2</td>
<td>12</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>8, 12</td>
<td>Energy Consumption</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>7, 9</td>
<td>How large is the cooker</td>
<td>2</td>
<td>1.5</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>9</td>
<td>4, 5, 10</td>
<td>How much does the cooker cost</td>
<td>4</td>
<td>30</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>How long does the cooker last</td>
<td>4</td>
<td>3-4</td>
<td>8-10</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>Level of impact on Environment</td>
<td>5</td>
<td>.98</td>
<td>-.4</td>
<td>.2</td>
</tr>
<tr>
<td>12</td>
<td>12, 13</td>
<td>Does it use renewable energy?</td>
<td>5</td>
<td>No</td>
<td>Yes</td>
<td>yes</td>
</tr>
<tr>
<td>13</td>
<td>14</td>
<td>Can it be maintained by the villagers</td>
<td>5</td>
<td>No</td>
<td>Yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
Cost:

Both biomass stove systems already implemented in India

The biomass stoves have been equated to cost $20 each, with help from EWB for funding and a slight amount of the communities income the biomass stoves can be paid back quite quickly and improve the health and wellbeing of many lives.
CAD drawings of the biomass stove concept:
**CAD drawings of the biomass stove concept continued:**

*The holes inside the burner are 7cm and 3cm wide. This view does not depict that as the holes curvature is unseen.*
CAD drawings of the biomass stove concept continued:
3D representation models of the biomass stove parts:
3D representation models of the biomass stove parts:

Cooking plate
**Protoype:**

A program was used called minecraft it is a basic program designed for RPG interaction with an environment, we used this program to show the use of a stove that was also created on the same software. There are 3 pictures one of the stove stationary, one of fuel being inserted into the stove and one with it lit.
Protoype continued:

Fuel being added

Burner being lit
This Gantt chart shows the progress in which our team took to complete tasks on a weekly basis, as you can see tasks were grouped together around the same weeks, this was due to presentations being due. They also finish around the same time as we’d make sure all the work was done during meetings or done the night straight after the meeting to make sure we were on top of tasks.
Team Meeting:

Log Week 1
Date: 22\textsuperscript{nd} of March
Attendees: Everyone

Topics discussed:
The EWB design challenge and what it is asking us to complete, a quick brainstorm of ideas we could have for the system.

Work items to complete:
Mission statement that is due next practical

Next meeting:
28\textsuperscript{th} of March

Team Meeting:

Log Week 2
Date: 28\textsuperscript{th} of March
Attendees: Everyone

Topics discussed:
What is exactly needed to complete the first presentation and who wants to be allocated certain roles to complete

Work items to complete:
Everyone has their own slides that needed to be completed and expected back by next team meeting.

Next meeting:
5\textsuperscript{th} of April
Team Meeting:
Log Week 3

Date: 5th of April
Attendees: Everyone

Topics discussed:
How did everyone go completing their individual tasks, looking over what was taught in the practical to see if any adjustments need to be made to our presentation.

Work items to complete:
Putting together of the presentation in ready for the first assignment.

Next meeting:
14th of April

Team Meeting:
Log Week 4

Date: 14th of April
Attendees: Everyone

Topics discussed:
A rest week, a short look over what is expected in the weeks to come for the next presentation and a chat about ideas

Work items to complete:
No work items to complete this week.

Next meeting:
10th of May
**Team Meeting:**

**Log Week 5**

Date: 10\(^{th}\) of May  
Attendees: Everyone

Topics discussed:  
A brainstorm session, looking at the decomposition of the problem and the different types of variations that could enhance the product.

Work items to complete:  
User based decomposition and functional decomposition diagrams

Next meeting:  
16\(^{th}\) of May

---

**Team Meeting:**

**Log Week 6**

Date: 16\(^{th}\) of May  
Attendees: Everyone

Topics discussed:  
What type of screening we would want for the objects we have brainstormed

Work items to complete:  
Concept screening pages and Daniel will finish the concept scoring so it is ready to put into the presentation

Next meeting:  
24\(^{th}\) of May
Team Meeting:
Log Week 7

Date: 24th of May
Attendees: Everyone

Topics discussed:
Everyone is getting ready for the final presentation, discussion about how the prototype will be done and who will correlate all the jobs.

Work items to complete:
The final touches on the presentation so that it is ready for when Dan brings in his video camera.

Next meeting:
30th of May

Team Meeting:
Log Week 8

Date: 30th of May
Attendees: Everyone

Topics discussed:
Presentation, start rehearsing lines and look over the final presentation and how there could be any improvements upon it.

Work items to complete:
The CAD drawings are needed to be completed in preparation for the design portfolio. Design portfolio is getting drafted.
Next meeting:
1st of June
Team Meeting:

Log Week 9

Date: 1st of June
Attendees: Everyone

Topics discussed:
Filming the final design presentation and general feeling about what's wanted in the portfolio.

Work items to complete:
CAD drawings and portfolio are ongoing project

Next meeting:
3rd of June

Team Meeting:

Log Week 10

Date: 3rd of June
Attendees: Everyone

Topics discussed:
Last meeting, organising final tasks, rest of discussions will be held over facebook.

Work items to complete:
Ongoing projects of portfolio and CAD drawings

Next meeting:
Never
Team Contribution:

Daniels Reflection:

EWB set the first year Bachelor of Engineering students a task to design a Waste Treatment System, an Alternative Cooking system and an Internet Networking system. Our team (team 16) chose to develop the Alternative Cooking system. Our team performed well throughout the task, having weekly meetings and deciding on what we were going to achieve throughout that week. This worked well as we were able to complete all of our set tasks on time and to a high standard. We each contributed equally throughout this process which is what we aimed for from the beginning. At times we were a little unaware as to what we needed to do because we weren’t given much direction so we had to find other things to do, but this provided a good break from the challenge. Overall this task has been well thought out and was fun to participate in, especially during the later stages as we can see our Cooker being developed further and finally being completed. The work was different to what we have been doing throughout the rest of the course and was a needed change, but could have linked up to the rest of the assignments and work that we did in class, as it seemed like two different units at times.

Contribution Charters:

Oral Presentation:
Sam: 2/10
Keenan: 2/10
Chris: 2/10
Andrew: 2/10
Daniel: 2/10
Total: 10/10

We each worked equally on this task and contributed to our own parts to the best of our abilities.

Video Presentation:
Sam: 1/10
Keenan: 2.5/10
Chris 2/10
Andrew: 1/10
Daniel: 3.5/10
Total: 10/10

For this section, more work was put into the prototype video as well as the editing of the final video by certain members. During the actual presentation part, we each spoke equally so would be ranked 2/10 for each member.
Portfolio:
Sam: 1/10
Keenan: 1/10
Chris: 4.5/10
Andrew: 1/10
Daniel: 2.5/10

The Portfolio consisted of all our work put together as well as the CAD section, this was done over the entire task duration but finalised and completed in the last week by only 2 team members.

Sam’s Reflection

Overall our team worked well in completing the required tasks. We met all the deadlines set, presented our PowerPoint as a group, and attended all the lectures and tutorials. Every group member attended every one of our group sessions and contributed to the completion of the portfolio in some way. We all got along and had no problems or arguments in the process of researching and designing the alternative cooking system. Every group member was willing to help each other in completing set tasks, some did more work than others but no one felt like they were doing too little or too much on the project.

Contribution
Chris: 2/10
Daniel: 2/10
Keenan: 2/10
Andrew: 2/10
Sam: 2/10
Keenan’s Reflection:

I thought that our team worked incredibly well together in the all processes of the EWB challenge. Everyone put in a very good effort, cooperated effectively and managed to meet the all deadlines of the portfolio. I thought the task was quite challenging due to the work load, yet it was enjoyable in the sense that it required a fair bit of creativity.

The first presentation was generally just for us to plan by underline the problem, recognising the problem, learning about our constraints as well as benchmarking. The group worked together for the initial planning and research stages and then for the rest we allocated ourselves jobs. My part was to complete the benchmarking against various different concepts and products.

The video presentation focused on the concept part of the project; requiring us to come up with some of our own concepts, do some concepts screening as well as make a video of our own prototype for our chosen concept. The entire group spoke on the video presentation and worked together for concept designs and screening. My main role was developing the prototype video with Daniel.

Contribution
Chris: 2/10
Daniel: 2/10
Keenan: 2/10
Andrew: 2/10
Sam: 2/10
Andrew’s Reflection:

Throughout this challenge, I observed the team working soundly and consistently throughout the course of the trimester. This task was completed through cooperation of all team members, planning ahead and weekly team meetings where ideas and directions for this task were discussed. I personally thought we completed this task above the satisfactory standard due to the fact that all team members constantly contributed to the task and not falling behind the schedule. I enjoyed this challenge in the respect that it gave knowledge into the steps required to put a design into action from the mission statement through to the prototype. This gave group members fundamental knowledge and experience for future design projects. From my point of view, the members of team 16 worked well together through all components of the EWB challenge.

Oral Presentation: (10/10 total)

- Chris Wembridge: (2/10)
- Daniel Modica: (2/10)
- Keenan Boon: (2/10)
- Sam Groves: (2/10)
- Andrew Hunt: (2/10)

Video Presentation: (10/10 total)

- Chris Wembridge: (2/10)
- Daniel Modica: (2/10)
- Keenan Boon: (2/10)
- Sam Groves: (2/10)
- Andrew Hunt: (2/10)

Portfolio: (10/10 total)

- Chris Wembridge: (2/10)
- Daniel Modica: (2/10)
- Keenan Boon: (2/10)
- Sam Groves: (2/10)
- Andrew Hunt: (2/10)
Chris’s Reflection:

For the SED102 unit a challenge was set by EWB to develop an alternative cooking system. I couldn’t. of been happier with the team I was given the opportunity to work with we all were dedicated to the task 110%. This was because our team constantly went to team meetings, always completed tasks when asked to and most of all tried to excel in all projects to obtain the highest possible score. As team leader I believe we did the best possible job we could of, with hard work we developed an excellent alternative cooking system. Negatives were that it was hard to work out what was needed each assignment as there was no real guidelines in tutorials you were made to do it yourself by searching through DSO. Overall I am happy with the cooker we have developed and the journey our team has gone through together and does not even bother me if we do not have the best idea because I’ve such a great time with my team. The task was different to CAD and I believe there should be more work towards CAD instead of so much on design but hopefully things will change in the years to come.

Contribution Charters:

Oral Presentation:
Sam: 2/10
Keenan: 2/10
Chris: 2/10
Andrew: 2/10
Daniel: 2/10
Total: 10/10

This task was completed to a high standard and showed the strength of our team and how well we worked together.

Video Presentation:
Sam: 1/10
Keenan: 2.5/10
Chris: 2/10
Andrew: 1/10
Daniel: 3.5/10
Total: 10/10

Daniel really excelled at this task, he spent a lot of hours on this, he took on most of the work such as screening and scoring and organising of the prototype and am proud of the work he did. Keenan also worked with Daniel with the prototype and making an excellent prototype video for our presentation.
Portfolio:
Sam: 1/10
Keenan: 1/10
Chris: 4.5/10
Andrew: 1/10
Daniel: 2.5/10

The portfolio was a monster task and I am extremely proud of the final project it shows all the work we have put in over this trimester and think it is of high quality. The reason for the scoring is I developed the portfolio and Daniel did all the CAD drawings.