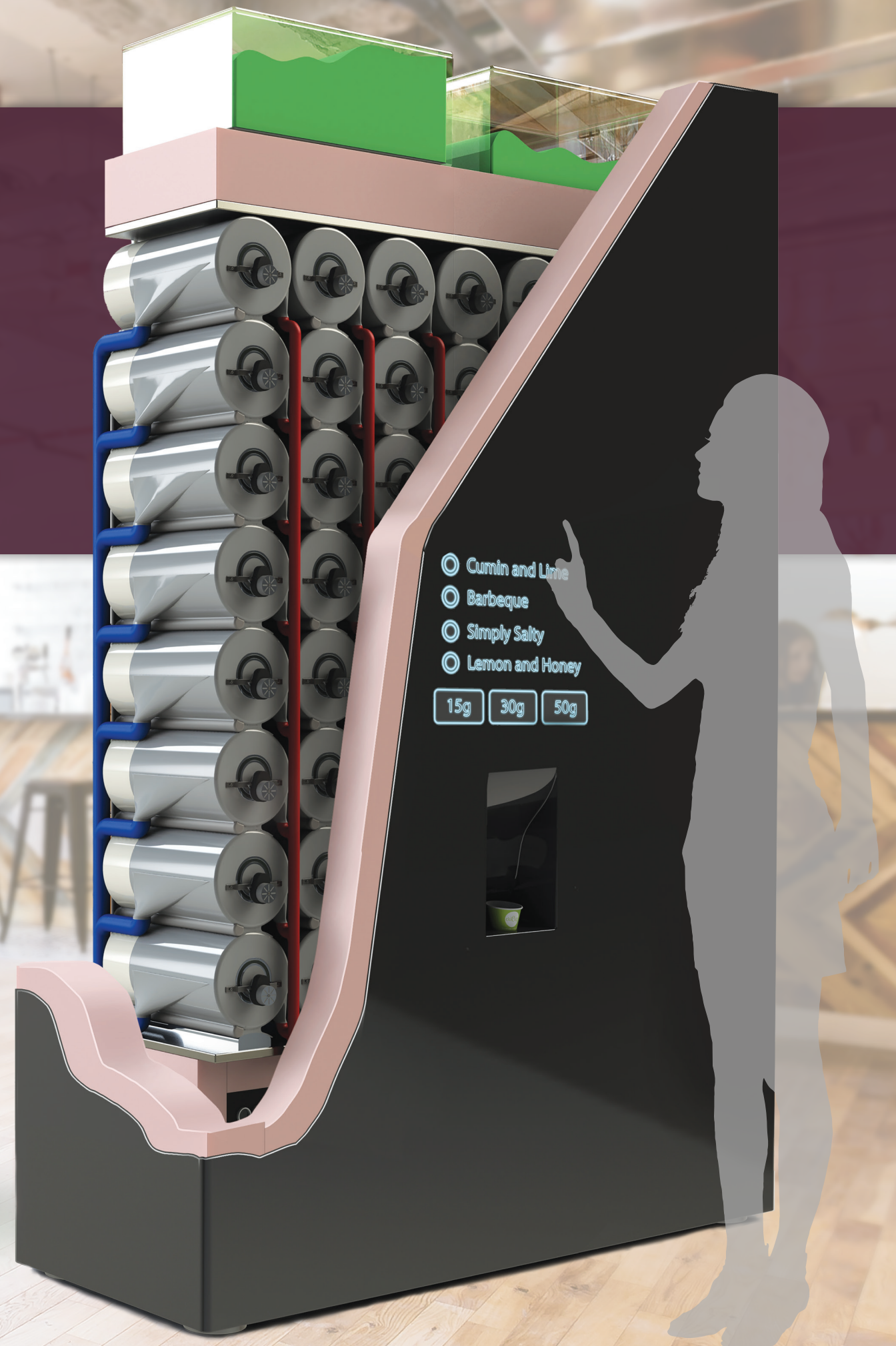




Roasted crickets vending machine Project Summary



Future of food

The name under which the project started.

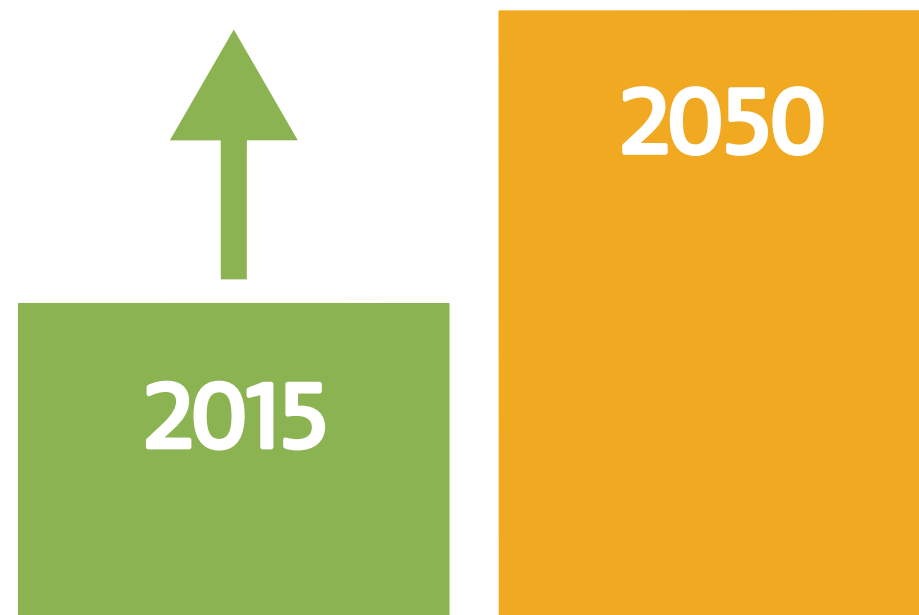
Problem

Currently, the world population is 7.3 billion. Predictions suggest the number will rise to 8.5 billion by 2030, 9.7 billion by 2050 and 11.2 billion by 2100. This means doubling the meat consumption in the next 30 years if we continue eating like we do now. Current methods of meeting the food demand are simply unsustainable and have a vastly negative impact on the environment.

18% of the Greenhouse gas (GHG) global human induced emissions are from livestock production. The number includes transport of livestock and feed.

 WORLD RESOURCES INSTITUTE

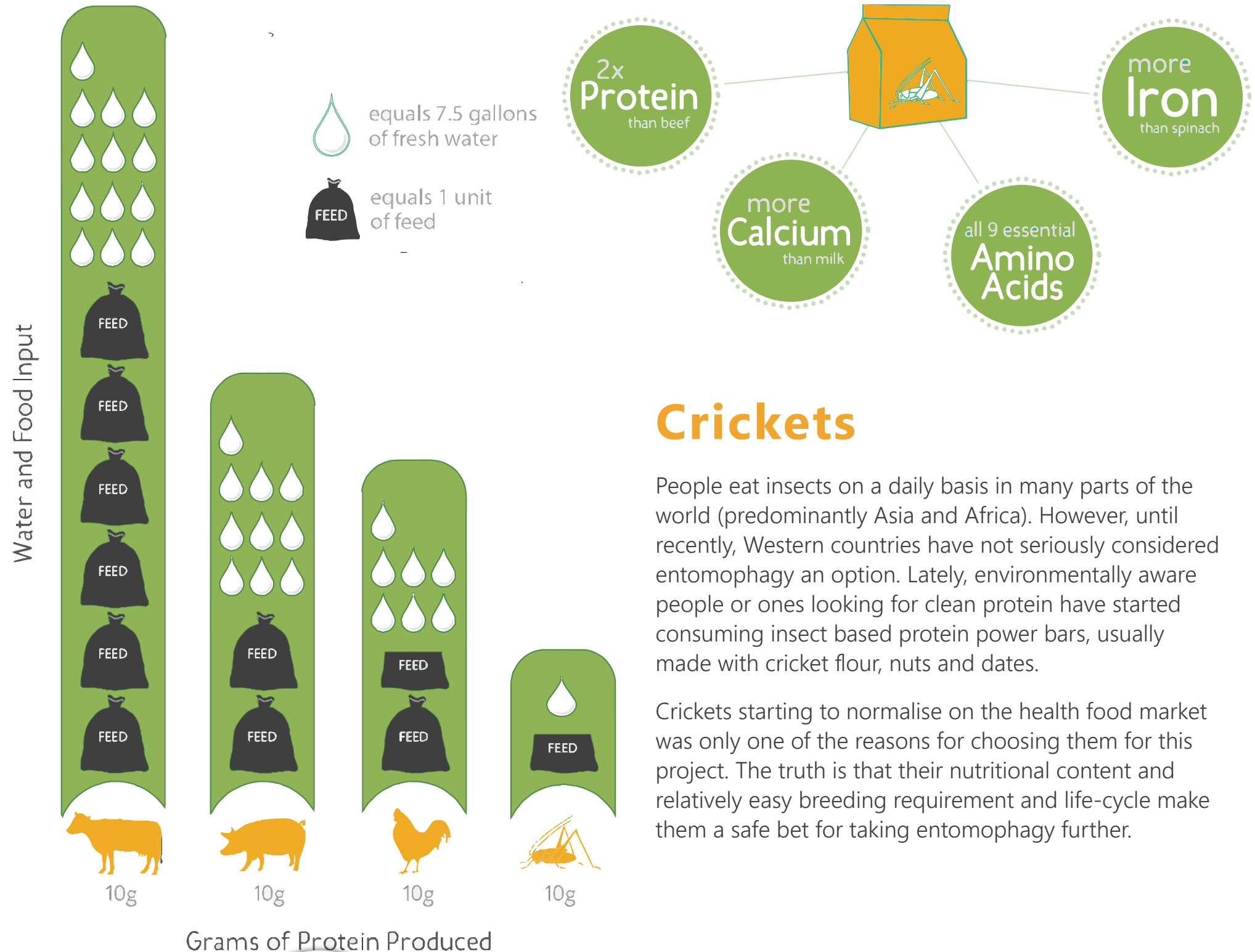
50% **REQUIRED INCREASE** in food calories to feed **9.7 billion** people by 2050



What is Entomophagy

Entomophagy - (/ˌɛntəˈmɒfədʒi/, from Greek ἔντομον éntomon, "insect", and φαγεῖν phagein, "to eat") is the human use of insects as food.

There are numerous publications focusing on the nutritional value of insects as food. Not only are they proven to be a much more efficient and environmentally friendly source of food, but they are also incredibly protein rich and provide all the necessary macro and micro nutrients for a healthy human diet.



Crickets

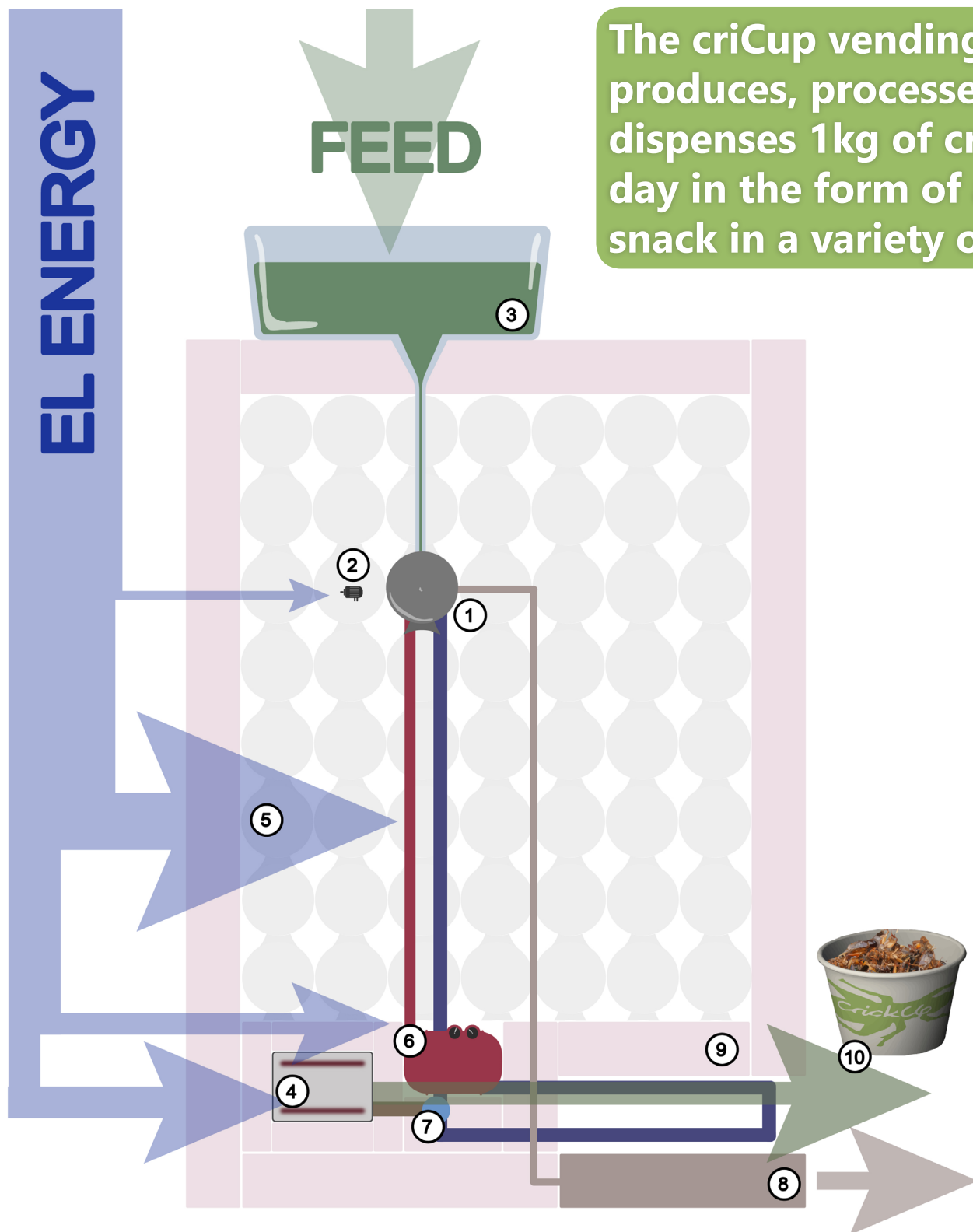
People eat insects on a daily basis in many parts of the world (predominantly Asia and Africa). However, until recently, Western countries have not seriously considered entomophagy an option. Lately, environmentally aware people or ones looking for clean protein have started consuming insect based protein power bars, usually made with cricket flour, nuts and dates.

Crickets starting to normalise on the health food market was only one of the reasons for choosing them for this project. The truth is that their nutritional content and relatively easy breeding requirement and life-cycle make them a safe bet for taking entomophagy further.

EL ENERGY

FEED

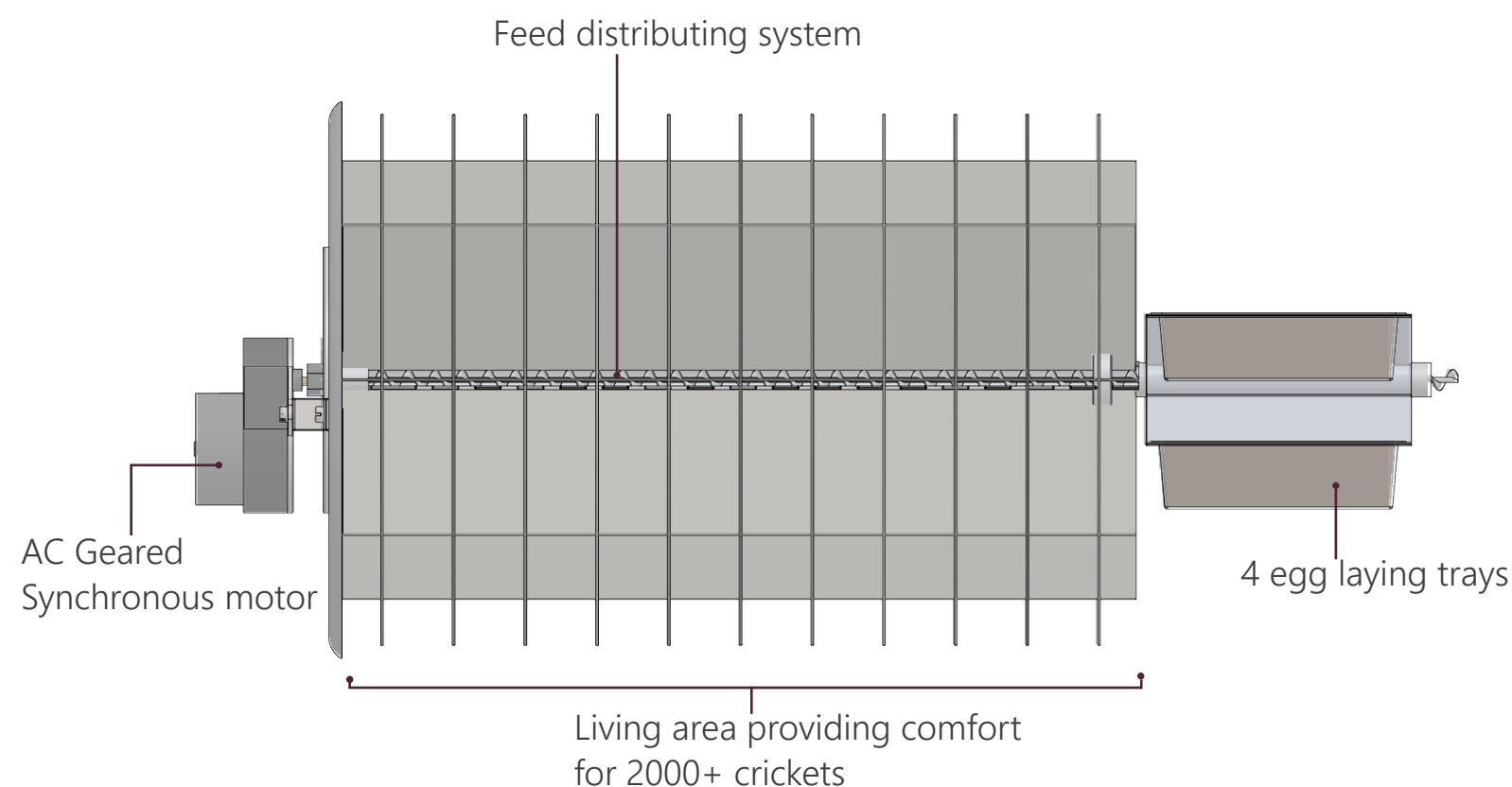
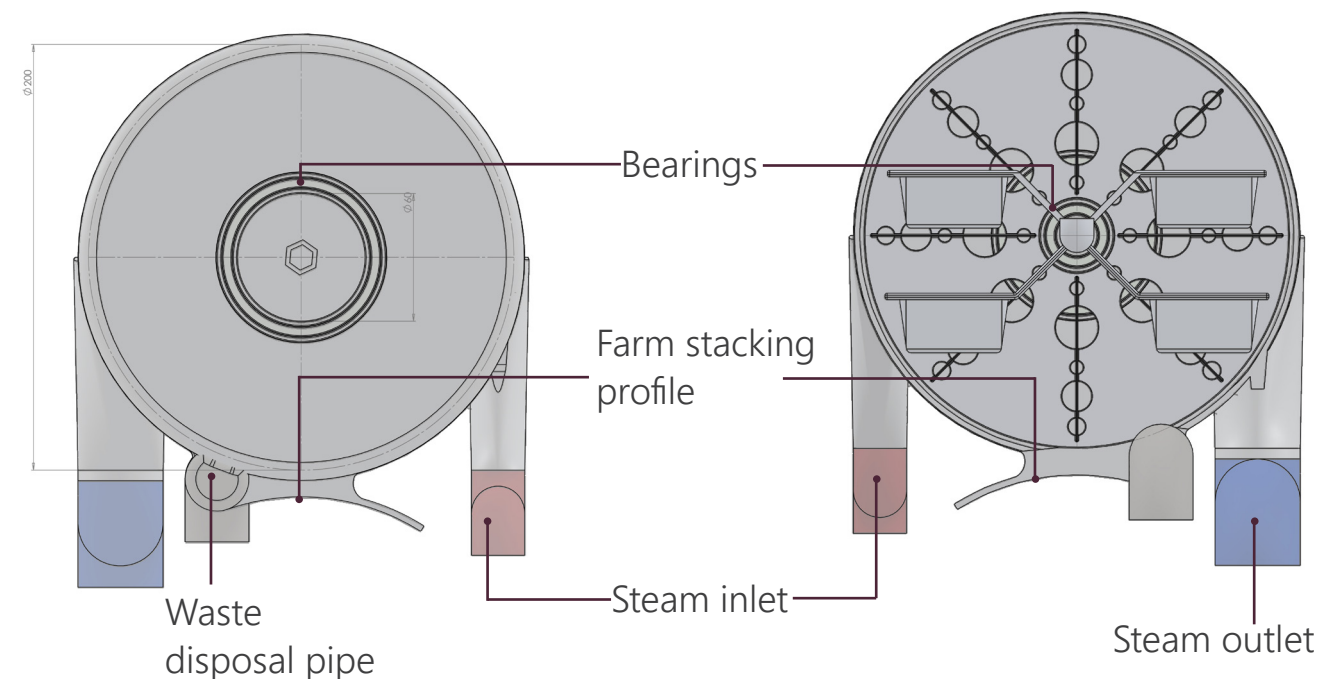
The criCup vending machine produces, processes and dispenses 1kg of crickets a day in the form of a healthy snack in a variety of flavours.



- ① Unit farm, 2000 crickets x 56
- ② Synchronous motor, 1RPH x 56
- ③ Feed storage tank, 1 month x 2
- ④ Oven, 220°C, 6 minutes
- ⑤ Heater for farm area of 1m³
- ⑥ Boiler and hot pipe
- ⑦ Filter separating crickets and water
- ⑧ Waste
- ⑨ Polyurethane Foam
- ⑩ 0.5kg roasted crickets a day

Solution overview

56 cricket farms, carefully designed for maximum efficiency.



Phobia, no more!

for full story:



← don't like the leg
getting to a more detailed
drawing is what makes
me uneasy

Looking At a drawing

Anxiety level
while
drawing [26]

Legs &
face I
don't like

I am trying
to transform
disgust into
fascination

*Colouring my drawing made me
spend more time with it and
generate more positive emotions
related to bugs.

Apart from it being a personal
challenge it was important to know
that even a severe fear should not
be a problem when it comes to
introducing insects to our diet.



I had a really really bad phobia. And a lot of stories involving
insects, crying, and screaming.

Partially reading about exposure therapy, partially making up
my own route, I started brainstorming different ways I could
design my way out of the phobia.

I came up with redrawing drawings at first. From very
simplistic to a bit more complex ones. I had a bit of trouble
even with the first one, mainly worrying about getting to the
next though.

I was quite happy with my progress cause by the end of the
day I could watch videos with actual crickets meter away
from the screen and with just one eye closed.

After a couple of unsuccessful attempts to eat crickets,
contracting panic attacks and getting close to changing
my whole project, I persevered to expose myself with more
drawings, further cricket eating challenges, and eventually
starting to breed them on my own.

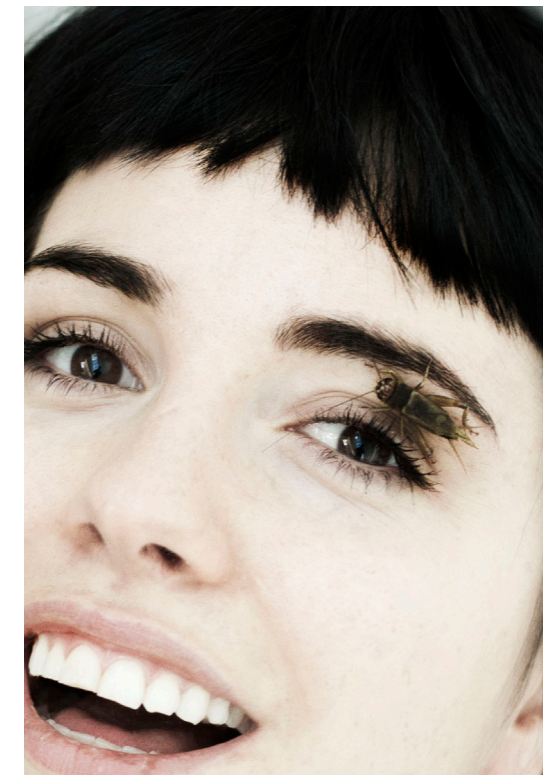
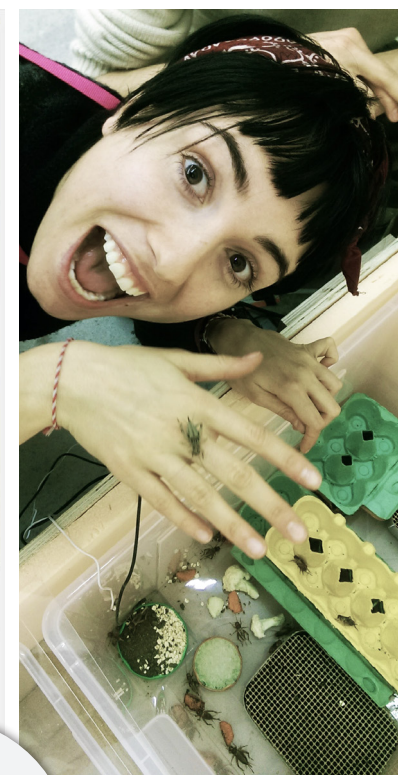
I wouldn't say it was easy, but definitely worth it.

Putting a bug on my face felt like a win.



From Entomophobia to Entomophagy: Overcoming fears for a sustainable future.

Gergana Tatarova
Channel settings



User testing and requirements

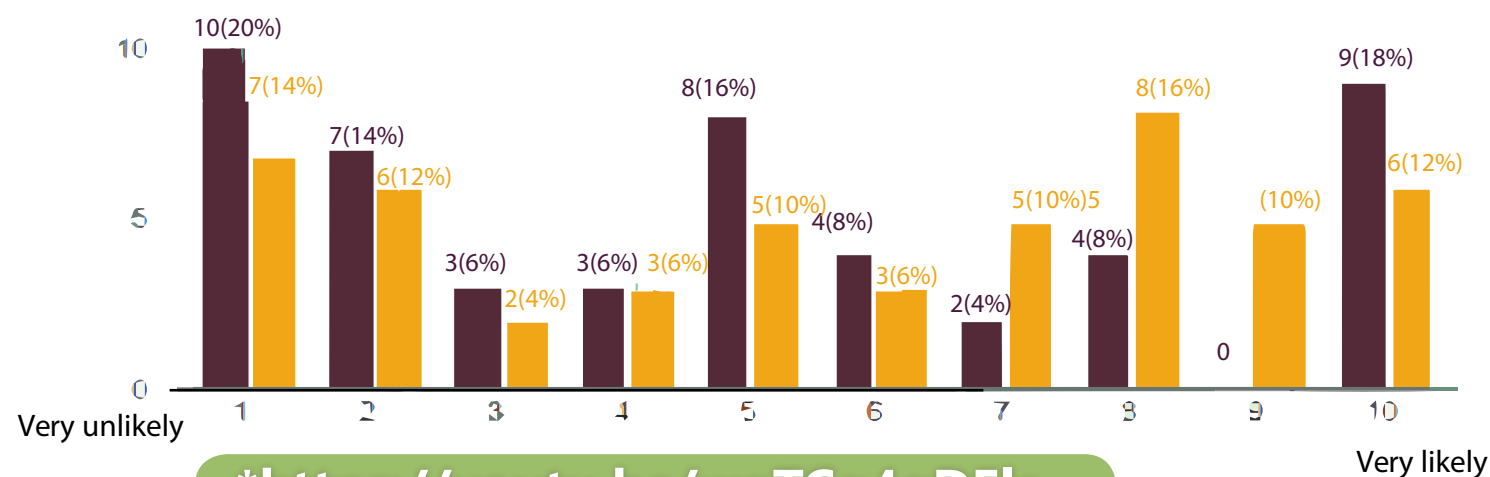
I asked 50 people how they felt about eating insects without any further information given and 30 of them were not at all excited by it. Then I provided a paragraph (below) and asked the same people about their opinion. This time 43 (23 people changing their mind) were willing to give entomophagy a try.

“Cricket flour (ground dried crickets) has more than double the amount of protein in beef and it's at least twenty times more efficient source of food with significantly lower carbon footprint and needs for space, water and feed. It is highly nutritious not only in protein but fibre, wide range of vitamins and minerals and essential healthy fats. The taste is mild and nutty that many people seem to enjoy.”

Then just to confirm what I had discovered while user tasting, I asked them whether they would eat a whole insect and whether they would change their mind if they are faced with this situation in a social context. The results difference was less dramatic this time, because I think it is more of a subconscious thing. Still more than 25% of people changed their mind.

How likely are you to want to try a whole insect?
62% unlikely, 38% likely

Will you be more willing to try whole insects if it was part of an event at your workplace or a conference and everyone around you was eating and liking them?
36% unlikely, **64% likely**

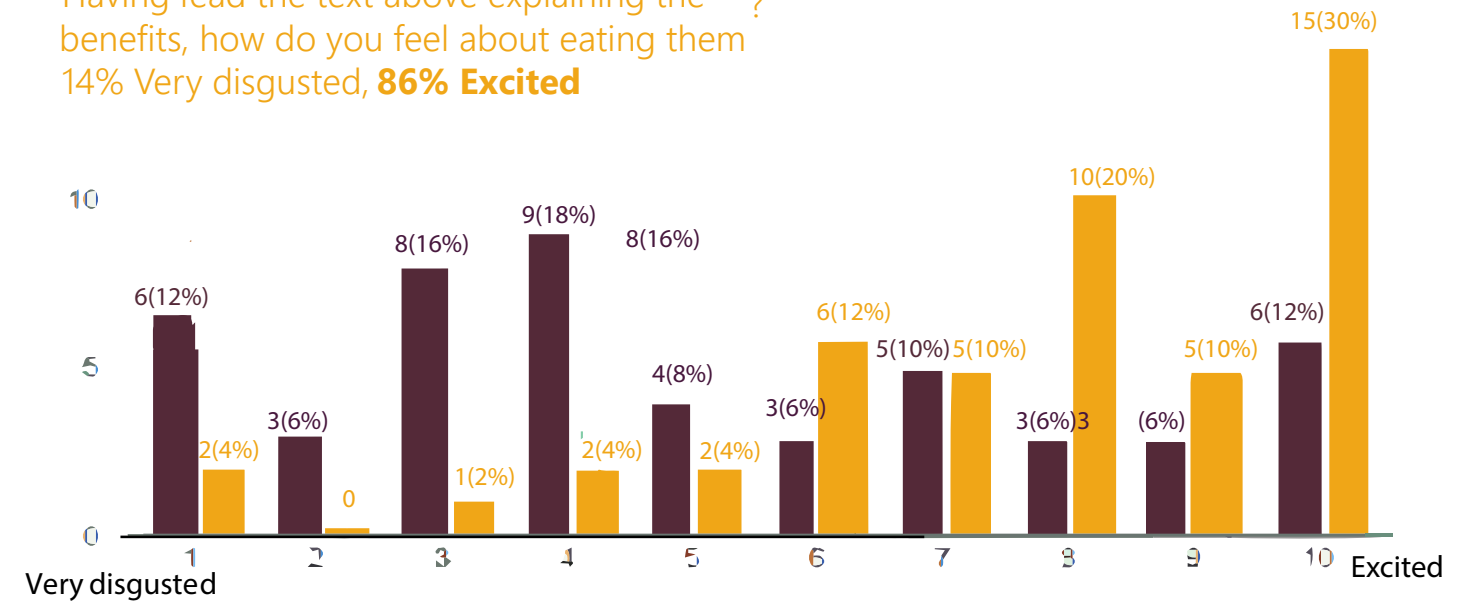


*<https://youtu.be/wgTCq4qDEls>

How do you generally feel about the idea of using insects as food?

60% Very disgusted, 40% Excited

Having read the text above explaining the benefits, how do you feel about eating them?
14% Very disgusted, **86% Excited**



It turned out that educating people about the benefits of Entomophagy and letting them try it in a social context are the two most important outcomes from user testing.

Getting vegetarian friends eat my home roasted crickets* made me decide on vending whole crickets.

The most important thing I noticed was that there were people who wouldn't want to try an insect, but when they see someone they know eating one, they change their mind! Peer Pressure!



Cricket testing

Farming

I got the courage to farm my own crickets. Reading literature on the topic and browsing around the mighty internet gave me sufficient knowledge to build my farm and continue building my understanding of crickets, their life-cycle, habits and preferences.

for more:

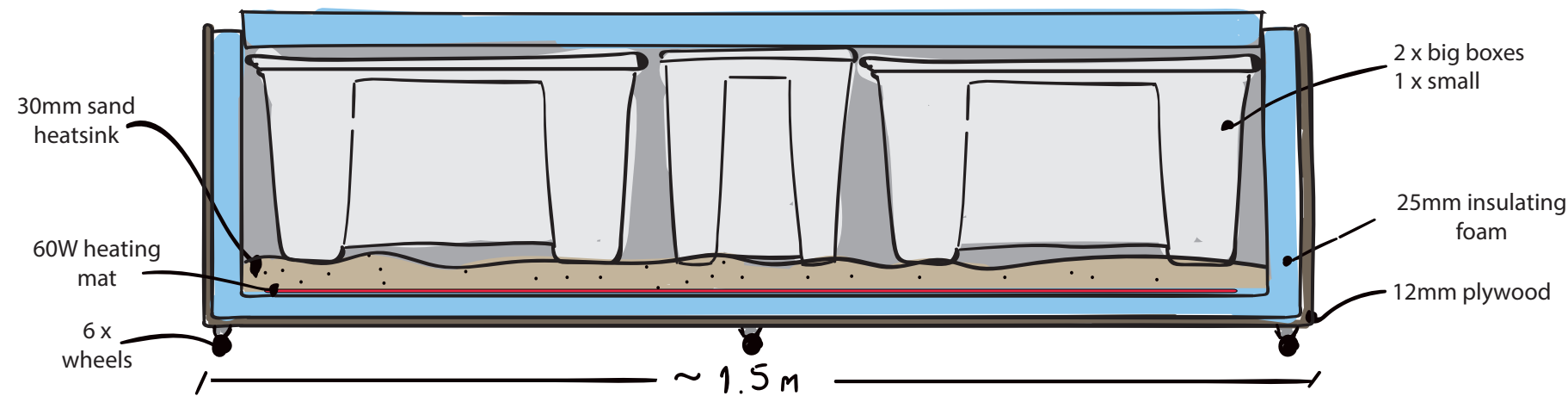


Harvesting

Freezing them at first, I came across a text that suggests boiling them for best decontamination and quick death. I decided to give that a little twist by steaming them. Bought a steam cleaner to experiment with. Needless to say, it was pretty efficient.



Plan:



Execution:



Cooking

Experimenting with different temperatures and lengths of cooking, also thinking about efficiency. 220 °C for 5minutes gave the best result.

30cm² required to roast 20 crickets. For 2000 - 3000cm².



Cricket requirements

Temperature:

The cricket life cycle varies greatly with temperature - faster development in warmer environment. Thus, by controlling the temperature the output of the machine can be amended in accordance with the demand.

30°C and kept above 25°C and below 35°C at all times.

Rearing density:

Studies suggest that density is another important factor for cricket breeding. The rearing group should neither be too large nor too small. **The aim of the cricket living area design is to give 4cm² per cricket or more.** Having 2000 crickets per unit farm yields **8000cm² of surface area per unit.**

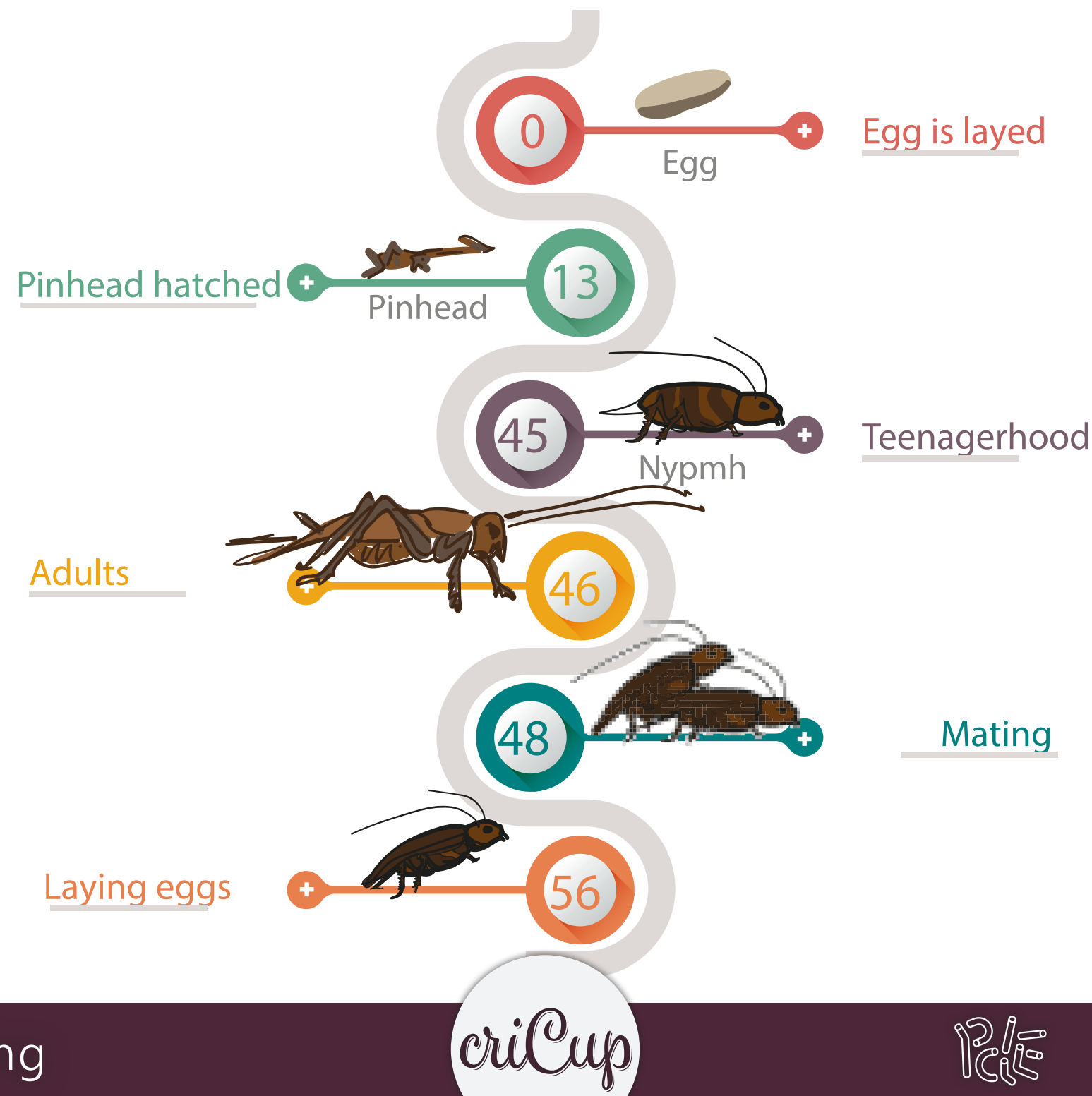
Cleaning:

The current design utilises a slow rotation of the units, while a jet of **hot steam** is used to decontaminate every unit farm after harvesting, thus preparing it for the next generation.

Harvesting:

Hot steam is used for cleaning and harvesting purposes.

It takes 56 days from laying an egg to its being able to hatch an egg i.e. close the cycle. This is why there are 56 farms - each one on a different day from the cycle.



Light regime:

Light has no important role in providing comfort. On the contrary, crickets prefer darker places.

Feeding:

After considering a few in depth studies about cricket feed it was decided to choose **Poultry feed as the main food source** since it is cheap and readily available. It also gives a good conversion ratio (kg dry feed per kg live weight) of 1.3

Oviposition:

Egg laying trays have to be provided with a damp, relatively soft, egg medium so that the female ovipositor can lay an egg inside. It is important that the medium is protected with a mesh on top, otherwise male crickets dig in and eat a big percentage of the eggs.

Cooking:

Experimenting showed that oven roasted crickets at 220 °C for 5 minutes with very little oil and spices makes them very tasty.

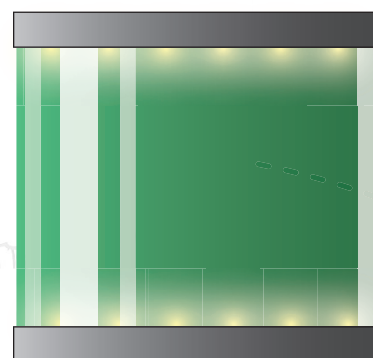
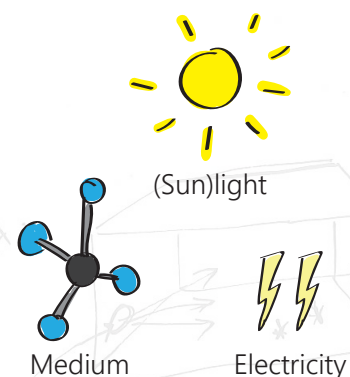
Concept development

I had this big idea - to design the kettle of the future. Everyone will have one in their home (why not on Mars).

Ideally the algae will feed on cricket and human waste and provide nutrients to the crickets (yes, they do eat it! Gave my crickets Spirulina) and to humans.

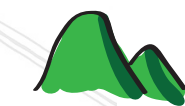
Modules:

Inputs:

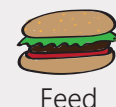


Algae farm

Outputs:



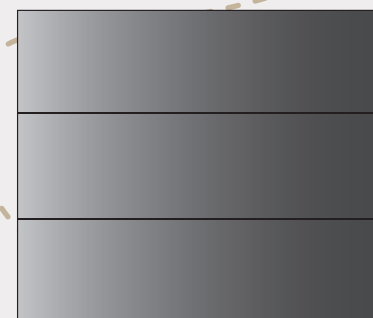
Healthy and nutritious food and feed



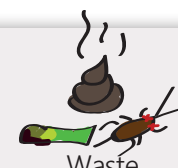
Feed



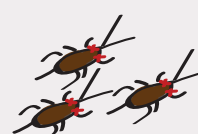
Electricity



Cricket farm

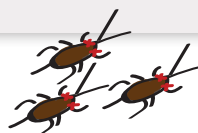


Waste



Dead, ready to cook with, crickets

While trying to overcome the challenges that the single cricket farm provides, powerful insights about a bigger machine came turning it into 56 turbine like farms.



Dead crickets



Electricity



Cricket processing unit

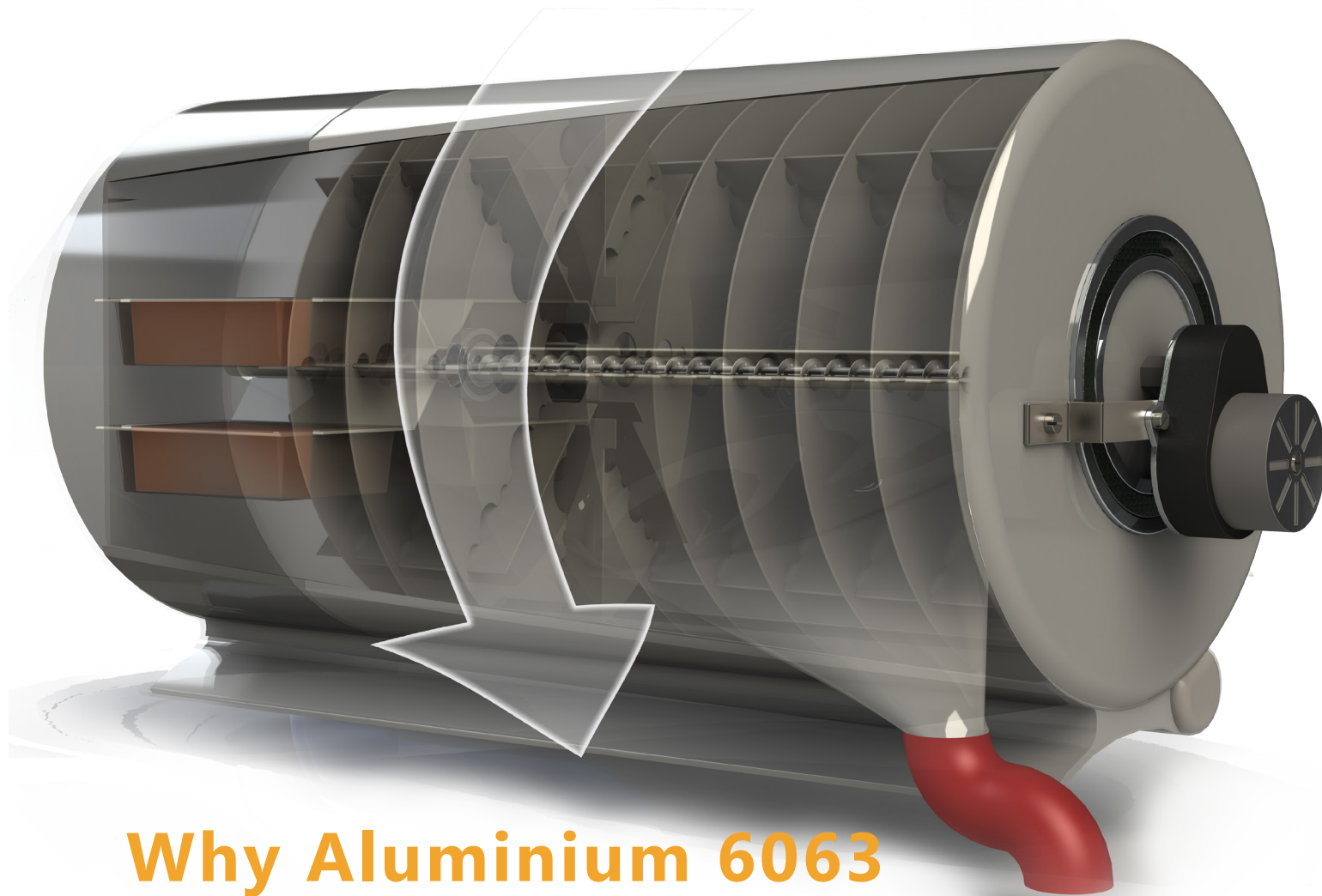


Cricket flour

Cricket flour idea abandoned due to roasted cricket success.

The current design uses chicken feed and I have illustrated it green as a reminder that I still believe in the Algae idea and it is just because it is not in the project scope.

Oven and boiler sizes determined via experimentations and calculations described above.



Why Aluminium 6063

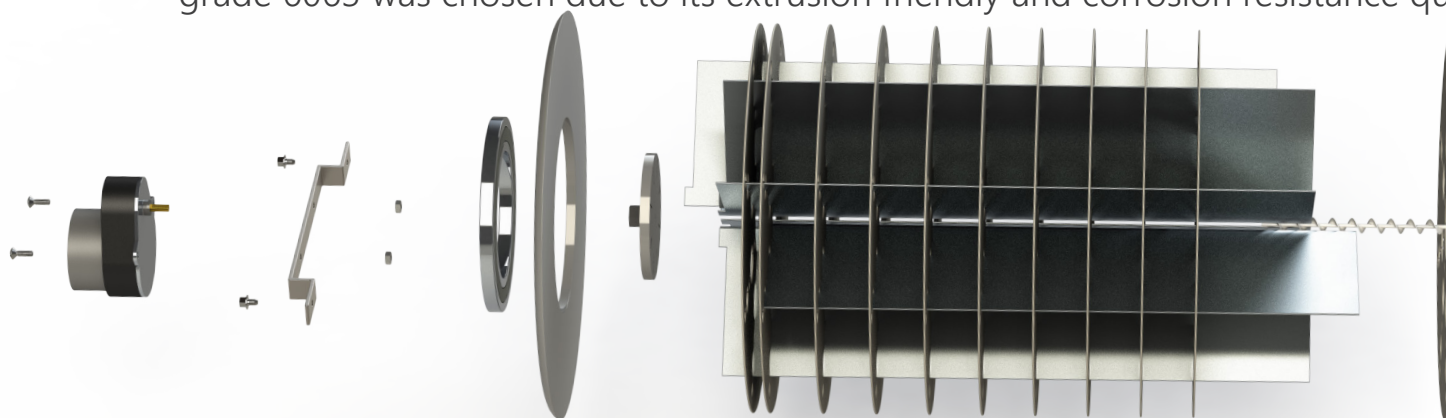
CES material selector together with experimenting with crickets themselves were used to determine the main unit farm material.

Since it is a machine with strong environmentalist character, low CO₂ footprint and recycleability were very important features. Resistance to corrosion and formability were also important due to the geometry of the unit.

Aluminium and a few types of thermoplastics appeared as the most suitable choice.

Aluminium was chosen due to cost, longevity and high heat conductivity which helps to thermally unify the area of the machine the farms are in.

Extrusion seemed like the obvious choice for the case of the unit, therefore Aluminium grade 6063 was chosen due to its extrusion friendly and corrosion resistance qualities.



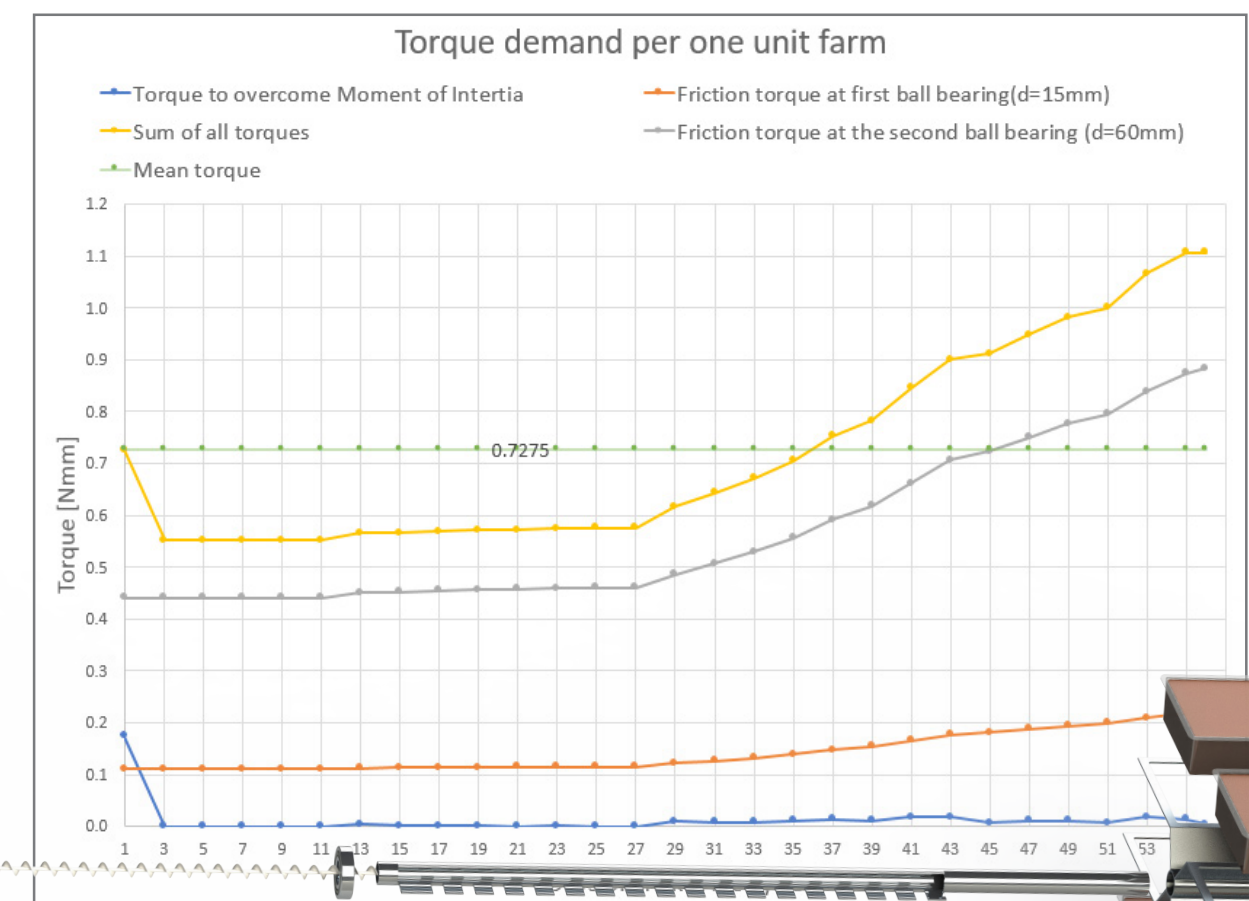
Farm details

Why AC Synchronous motor

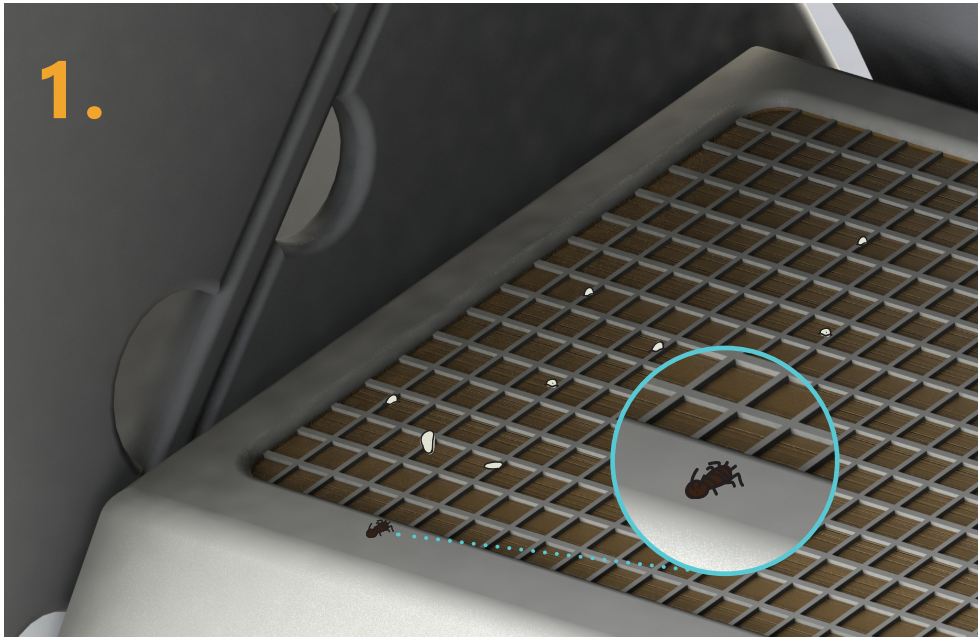
Rotating living spaces is one of the key design feature so choosing how to rotate is an important task.

Every cylinder rotates with 1RPH (0.0167rpm; 0.001745rad/s) for the entire cricket life cycle. Since it is such a low speed, and the torque required is not very large, it is sensible to have 56 separate motors controlled electronically rather than one more powerful motor and a lot of mechanics to translate the rotation across all farms.

The motor of choice is an AC synchronous electromotor. Its long life, simplicity of running and longevity are just part of the reason. The power it draws is used to monitor cricket growth. The motor maintains the same angular velocity independantly of the load. When crickets grow, more torque is required, thus the motor draws more power.



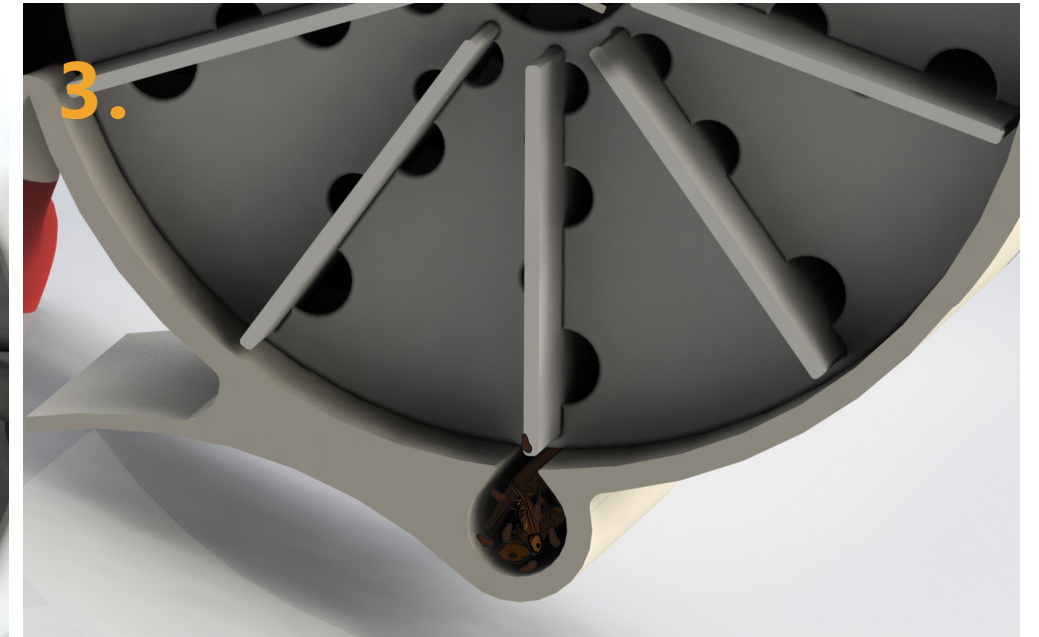
Cricket journey



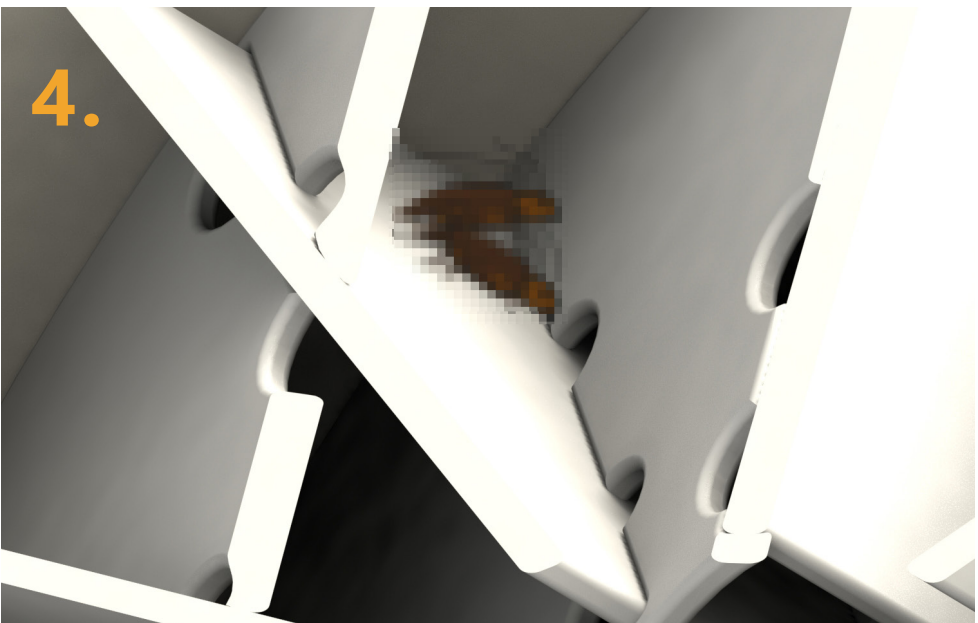
1. Eggs are hatching. Pinheads start to appear and explore.



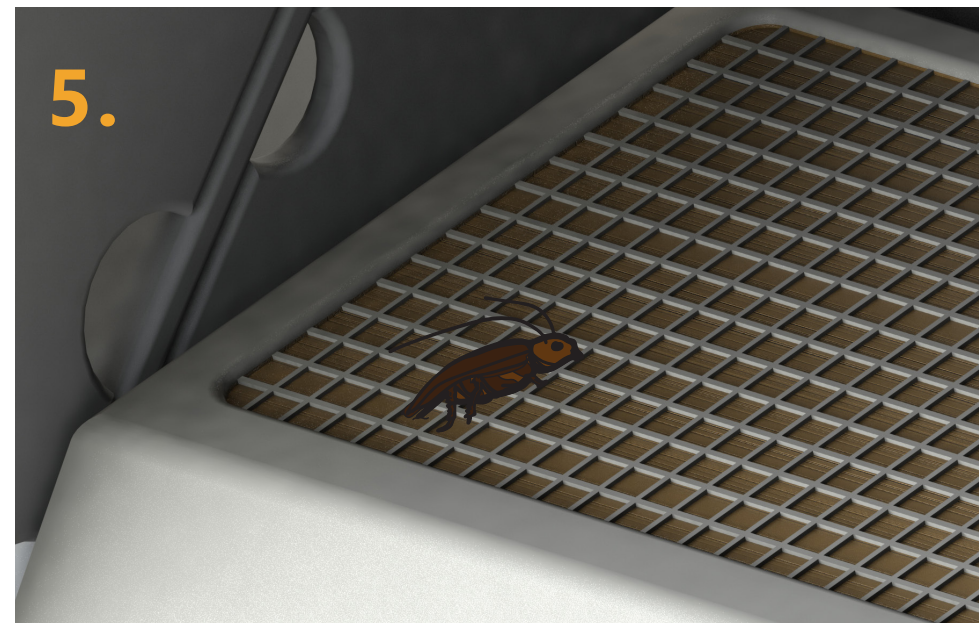
2. Over the next few weeks they eat and grow.



3. Rotation of the living space gets rid of the waste providing clean environment at all times.



4. When mature, they start mating.



5. One female can lay up to 100 eggs a day.



6. Once enough eggs are laid the adults are harvested using hot steam. It comes from a smaller inlet tube having high pressure and temperature. The farm is clean and ready to welcome the new inhabitants.

Working prototype

