

“Every story has an end.
But from every **ending**, comes a **new beginning**.”



Home Composting Solution for Indian Households

Setting up the Context

- **Rapid urbanisation and industrialisation** have made landfills and waste dumping grounds common sites in cities
- **Improper waste management** poses serious threats and problems.
- Cleaning up waste is much more expensive in the long run compared to its **prevention at source**.

In order to **manage waste more efficiently** and minimize waste related problems, **treating waste at its source is a must**.

“Waste is a resource that is in the wrong place at the wrong time.

Once it finds its rightful place, it will be just as valuable as any other resource.”



Planning for Success



Vision

To inch towards a greener planet by devising a solution that helps people effectively manage their household waste.

Methodology

Double diamond design process

Strategy

1. Discover

the subject to form a deeper understanding

2. Empathize

with the user to gain valuable insights

3. Synthesize

the information collected to focus on a specific problem

4. Define

design brief, user needs, design parameters

5. Explore

market trends, competitor products, similar solutions

6. Brainstorm

exhaustively to think of all possible ideas

7. Conceptualise

potential solutions & detail them out

8. Evaluate

the proposed concept by obtaining user feedback

Looking at the bigger picture

Only **60%** of the waste generated is **collected**, out of which only **18% is processed**.
Rest is dumped into landfills and open dumping grounds.

Waste Composition in India every year

Major Commercial Waste Treatment & Disposal Methods

Thermal Treatment

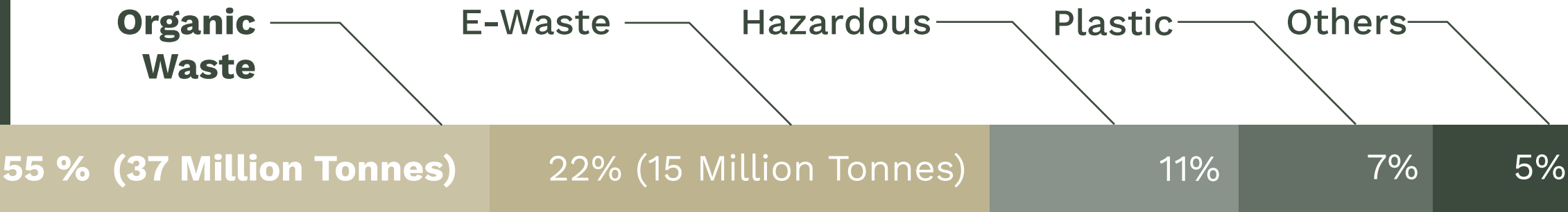
Incineration
Open burning
Gasification

Dumps and Landfills

Sanitary landfills
Open dumps

Biological Treatment

Aerobic composting
Anaerobic Digestion



Examining Household Waste



5R's to effectively manage household waste

Refuse
Reduce
Reuse
Recycle
Rot

Composition of Household Waste

Recyclable Material

Paper, glass, bottles, cans, metals, certain plastics, etc.

Biodegradable Organic Waste

Food and kitchen waste, green waste (vegetables, flowers, leaves, fruits) and paper

Hazardous Waste and toxic waste

Waste medicine, e-waste, paints, light bulbs, spray cans, batteries, etc.

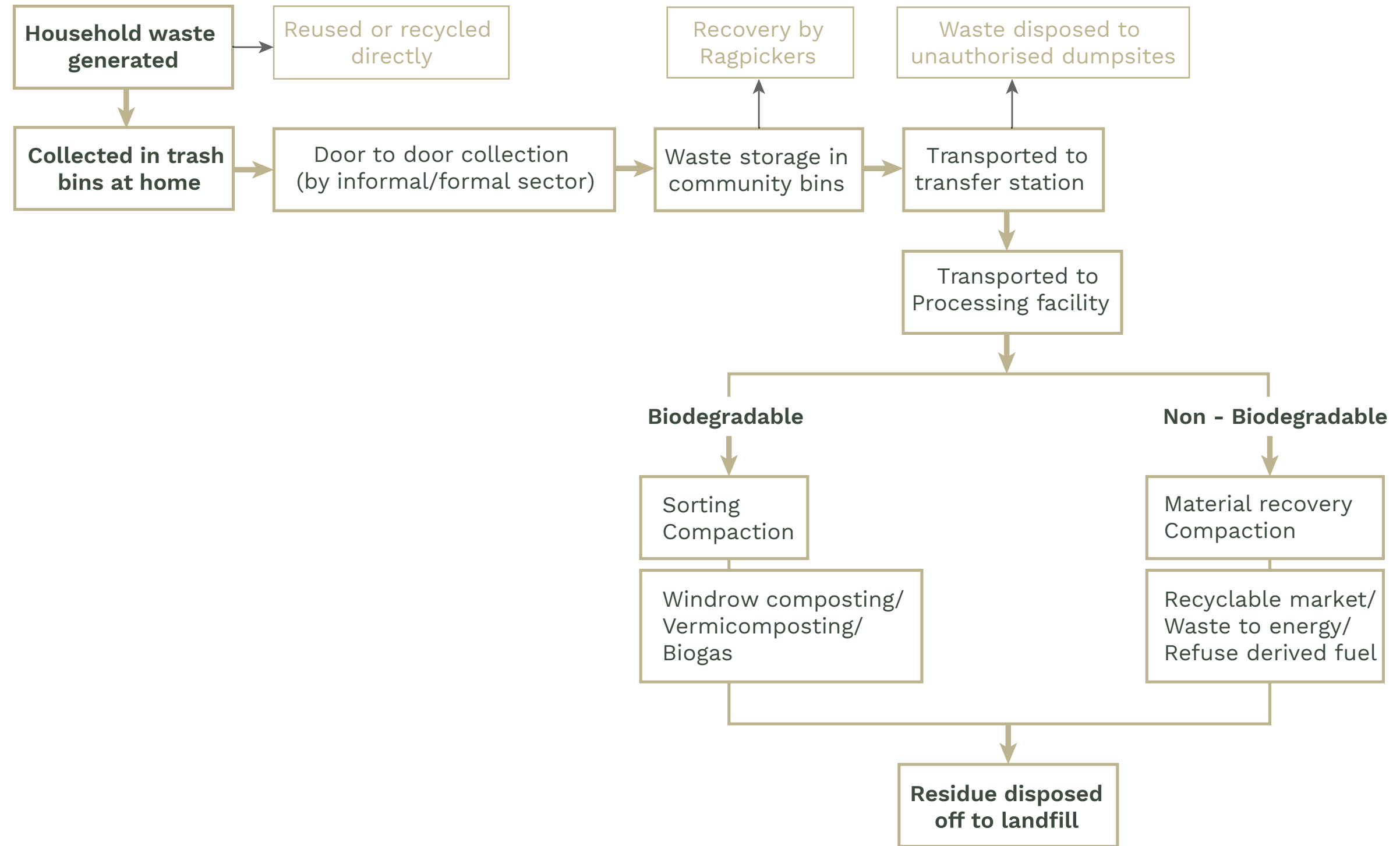
Inert Waste

Dirt, debris.



Journey of household waste

Organic waste that reaches landfills without processing, rots there and produces **harmful methane gas**.



What is Composting

Composting reduces the waste that goes to landfills and hence, reduces methane emissions.

Biological decomposition of organic waste such as food or plant material by bacteria, fungi, worms and other organisms under controlled aerobic conditions forms compost.

Compost is also known as **black gold** because it is **nutrient-rich fertiliser, organic manure** for the soil.

Balance of Greens and Browns

Greens - Nitrogen Rich

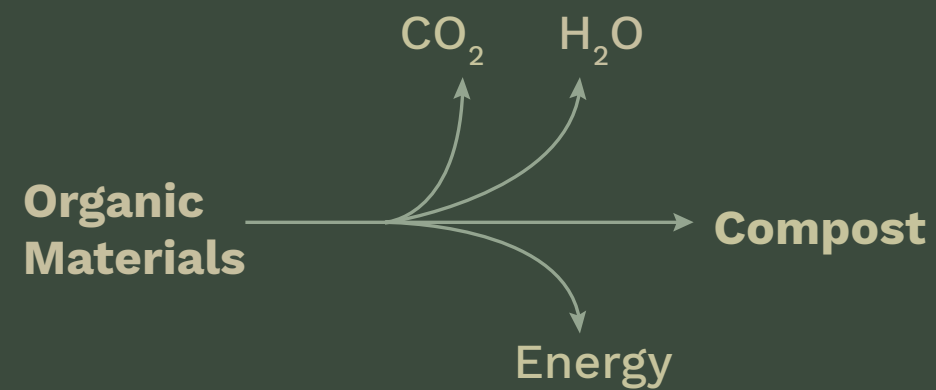
- Fruits
- Vegetables
- Coffee/tea grinds
- Green Leaves
- House plants
- Old flowers
- Grass clippings

Browns - Carbon Rich

- Dry leaves
- Newspaper (without colour)
- Shredded Cardboard
- Crushed Eggshells
- Sawdust/woodchips (untreated)
- Hay/straw



Science of composting



Physical Factors

Particle size
Moisture content
Aeration
Temperature

Chemical Factors

Oxygen

pH

C:N Ratio

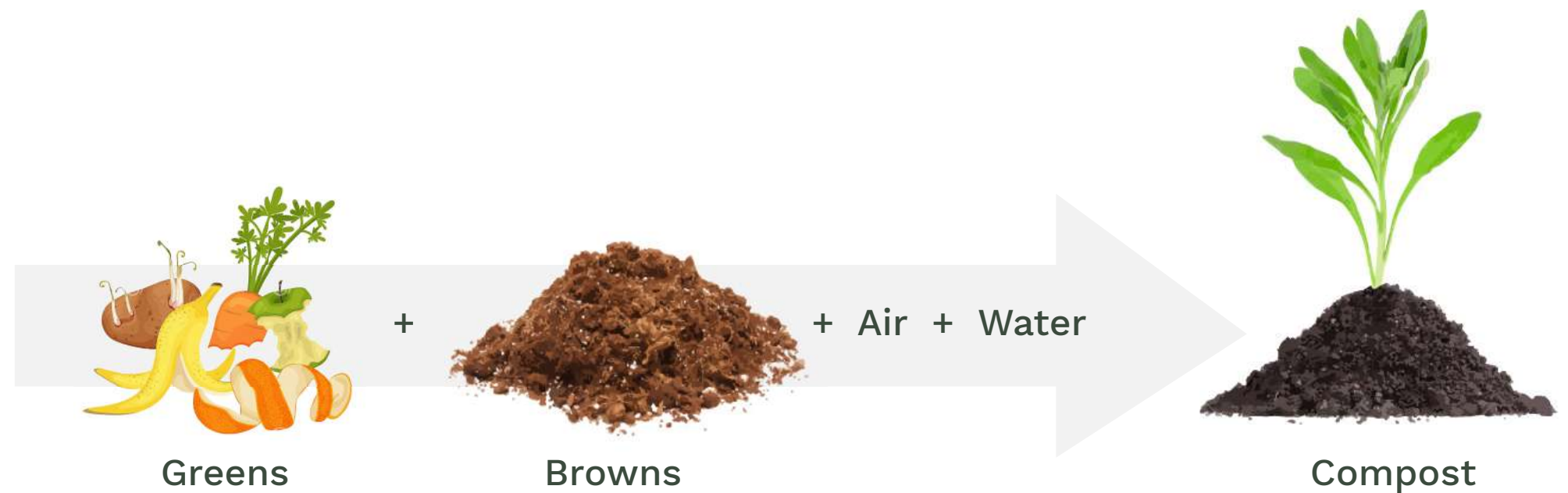
Biological Factors

Bacteria

Fungi

Actinomycetes

Higher organism



Understanding the users



For User Study, the following were conducted:

- 1. **General survey - Organic waste in Indian households** to identify potential users
- 2. **Focused survey - Composting at homes** to gain specific insights from the target audience
- 3. **Informal interviews and discussions** with users

Main reasons for NOT composting

- Time consuming
- Foul smell
- Mosquitoes and flies
- Lack of space in the house
- Process is messy and dirty

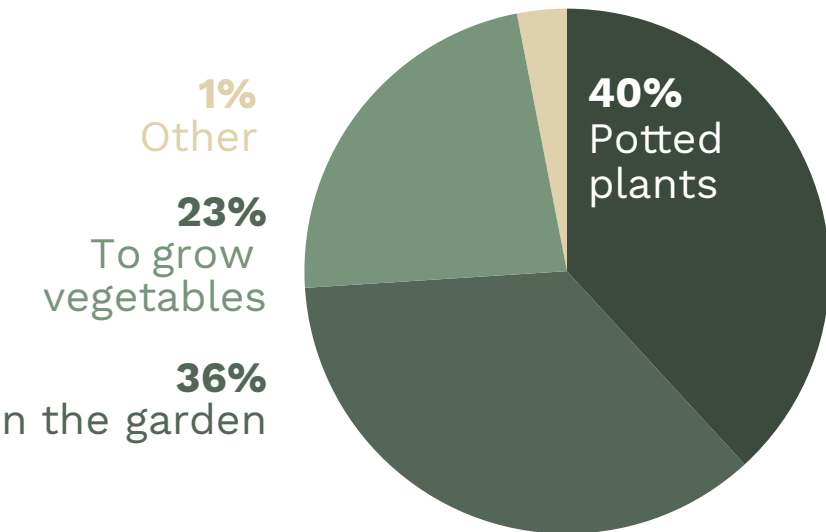
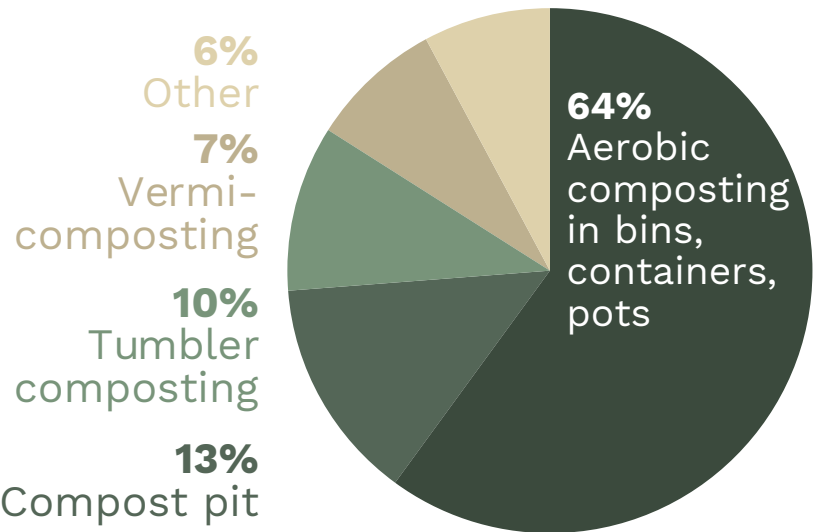
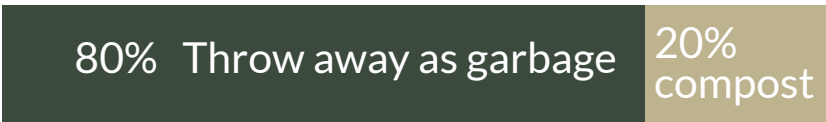
Motivations for composting

- Get free, good quality manure
- Generate nutrient rich soil
- To grow healthy fruits and vegetables
- Hobby and interest in gardening
- Leading a sustainable lifestyle
- Minimising waste going to landfills
- Making the most out of waste

Problems or difficulties faced

- Maintaining right proportion of greens and browns
- Checking up on the mixture every few days
- Foul smell
- Insects and flies
- Covering bins during rains
- Not having enough browns (bulking agent)

Organic waste management in homes



Stepping into their shoes

Insights

1. All the waste that goes in needs to be **chopped into small pieces**.
2. If the **mixture becomes too wet**, it starts **stinking and becomes difficult to correct**.
3. For a **beginner**, composting can be **tricky**. It **involves a lot of trial and error** to get one successful batch of manure.
4. Some reading is also required to learn the basics of composting like understanding the greens and browns ratio.
5. The bucket also requires **frequent effort** to make sure the composting is active. Some sort of **homemade accelerator** like buttermilk needs to be added every two days.



Identifying User needs

Primary needs

- Obtain a **ready-to-use, nutrient rich compost**
- **No foul smell**
- **No insects, mosquitoes, rodents** in/near the compost
- Process should **not be time consuming**
- **Accelerating** the decomposition process
- Easily accessible brown waste (bulking agent)
- Compost is not affected by weather changes
- Easily drain out liquid compost every 3-4 days
- Compact yet effective system

Latent needs

- To mix **browns (carbon) and greens (nitrogen)** in the **propotionate ratio** of 30:1
- To **maintain right composition** of all the important elements (carbon, nitrogen, oxygen, water) to accelerate composting time
- To **minimize the trial and error involved** in composting due to change in constituents and its quantities every time
- To **cut the organic waste in to smaller pieces** for easy absorption/decomposition by microbes
- To be able to effectively mix and turn the mixture for adequate air supply

Design Brief



Design Direction

Standardizing the composting process

to ensure that irrespective of the differences in the input, output would remain constant every time

Redefined Brief

To design a product that can effectively treat the daily organic waste produced in urban households by turning it into a valuable resource using the science of composting.

Design parameters

- Indoor use
- Compact
- Odour free
- Hygienic (should not attract mosquitoes/ flies)
- Easy to use
- Little/no assistance required
- Energy efficient
- Maintenance free
- Easy to clean
- Affordable
- Long lasting

Living Setting

Houses with **devoted gardening/plantation space** (garden, backyard, terrace, balcony, etc.)

Target Audience

People aged between 25-65 years:

- who are **passionate** about gardening and/or are **environmentally conscious**
- who lead a busy lifestyle and **do not have enough time for composting** on a regular basis

User Personas



Humanising the users by creating fictional profiles to better understand their needs, emotions, experiences and behaviours.

“The Organic Enthusiast”



Mrs. Rina, 45, Homemaker

Motivations

Growing organic fruits and vegetables for her family

Frustrations

Rectify the compost once it goes bad is tedious

Goals

Reducing the corrections needed for active composting

“The Green Thinker”



Mr. Vijay, 63, Retired Teacher

Motivations

Having the satisfaction of giving back to the environment

Frustrations

Need to throw away waste in garbage once the bins are full and composting starts

Goals

Being able to handle composting at home single-handely

“The Plant Lover”



Mrs. Avni, 32, Journalist

Motivations

Passion for gardening and growing plants which flower more

Frustrations

Compost needs to be thrown away because it becomes too wet and stinks due to negligence

Goals

Producing fertile manure at home with little time and effort

Competitor Study



Counter-top kitchen bins



Electric Composters



Aerobic Compost bin



Tumbler Bins



Bokashi Bins



Determining Product Scope



Input
Vegetable and fruit scraps • Garden waste • Cooked food • Dairy Products • Egg, fish, meat • Pet animal waste

Output
Pre-compost • **Ready-to-use compost •** Soil amendments • Dehydrated organic matter

Process Time
Actual time (30-40 days) • **Shorter cycle (15-20 days) •** Quick 1-2 days cycle

Mode of operation
Electrical • **Manual**

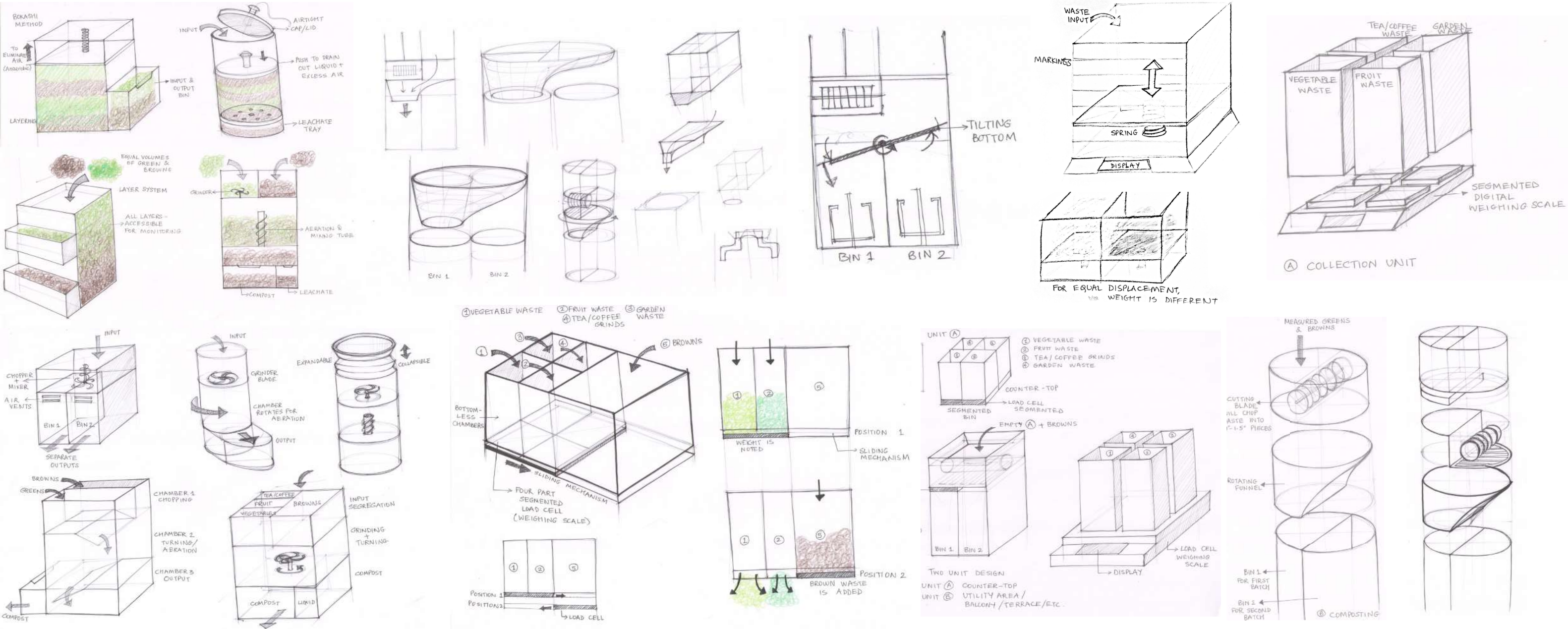
Design Approach
Radical • **Incremental**

Key Product Attributes



- **Standardizing process** for results consistency
- Estimating **proportionate amounts green and brown** waste
- Batch-wise composting
- Manually operated
- Regulation of air flow
- Shredding of waste
- Easy cleaning, maintenance free
- Accelerated composting time

Ideation Sketches

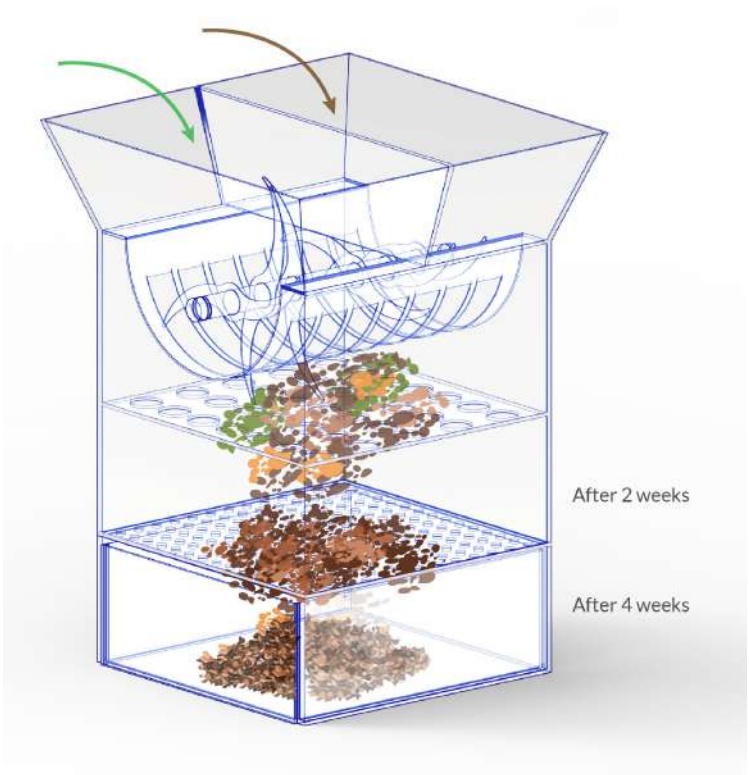


Concept Generation & Evaluation



Concept 1

Decreasing sieve sizes for continuous composting



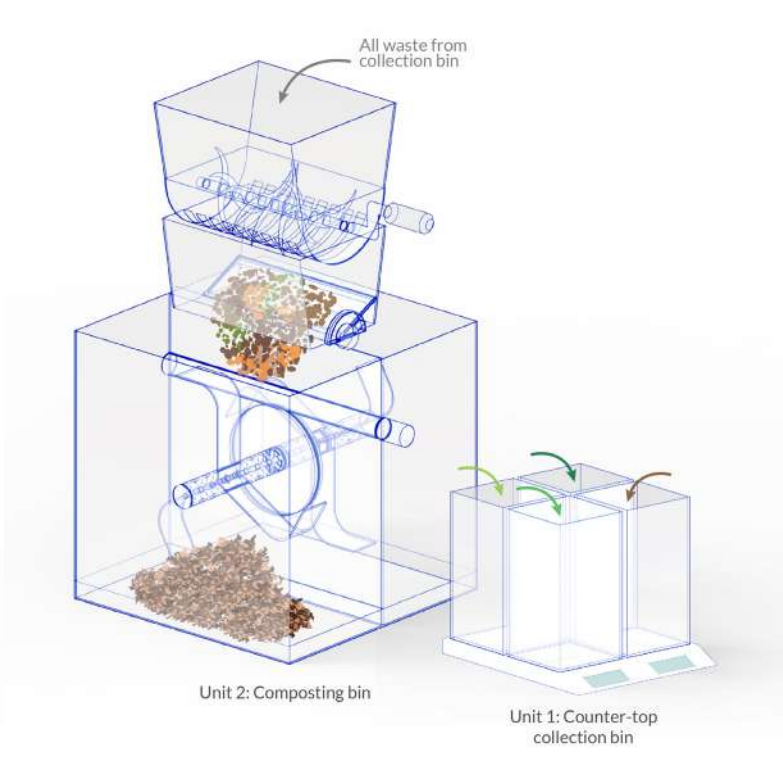
Concept 2

All-in-one unit for batchwise composting



Concept 3

Two separate units - one for waste collection and other for batch wise composting



Key Criteria	Weightage	C 1	C 2	C 3
Reduction of trial and error	4	2	5	5
Minimization of frequent inspection	4	4	3	4
Acceleration of composting time	3	1	3	3
Ease of use and maintainence	3	4	4	3
Reliability for consistent results	3	2	3	4
Product learning curve	2	5	3	3
Robustness	2	2	4	4
Total Scores		59	76	80

Selected Concept

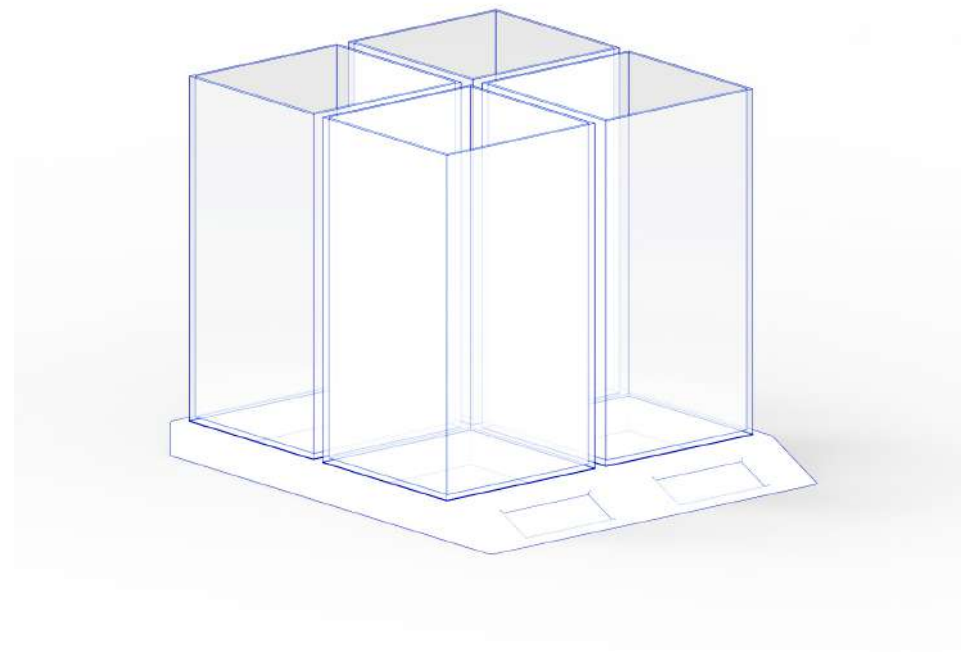


Two Part Solution

Two parts are separated for increased user convenience as waste can be collected and segregated in the kitchen everyday, and then dumped in the composter every 4-5 days.

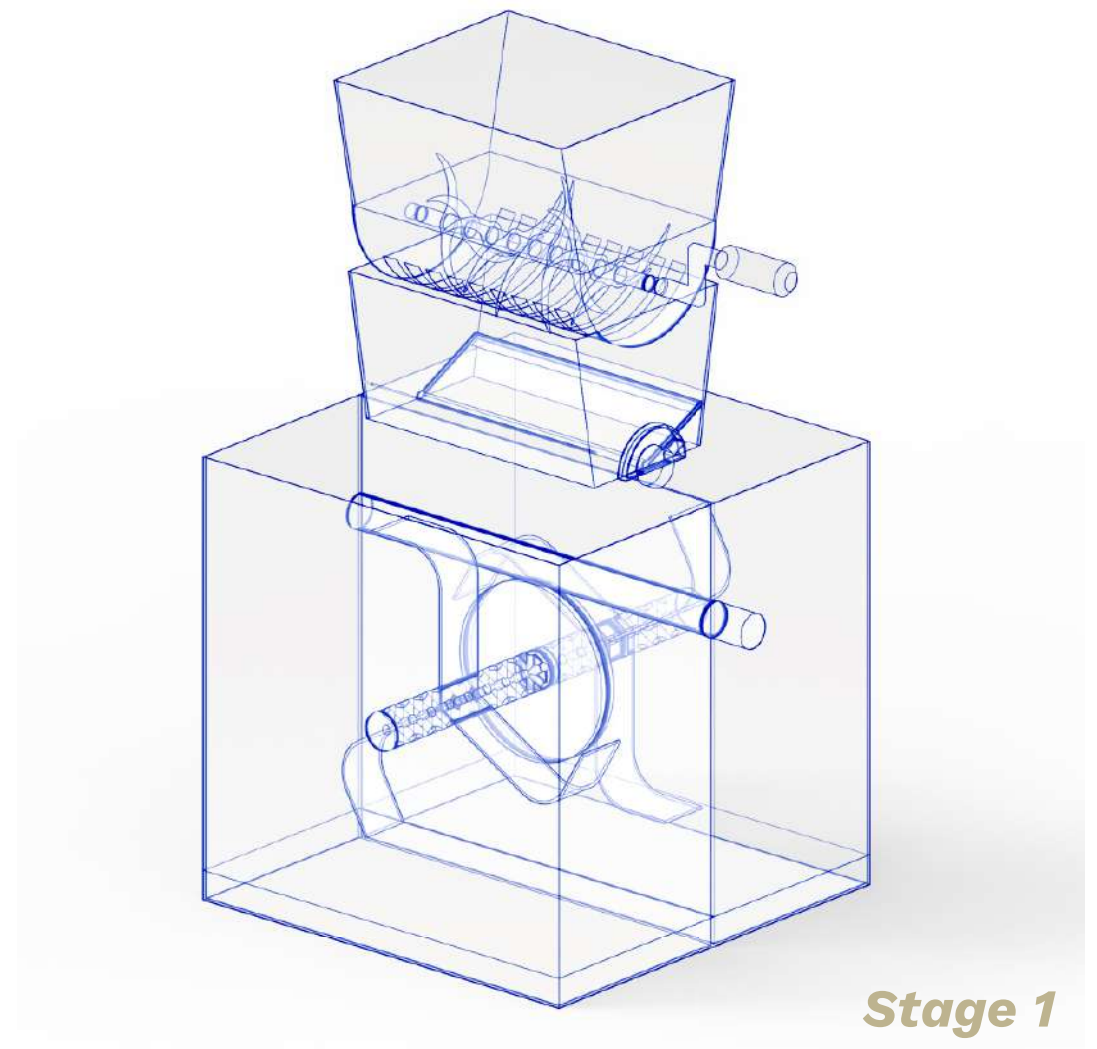
Part 1 : Counter-top bin unit

Main function: To collect the different types of kitchen waste and estimate the amount of brown waste needed for a successful compost



Part 2 : Composting unit

Main function: To effectively compost the waste mixture collected in the bin



Stage 1

Concept Principle



C:N Ratio of 30:1

A carbon-to-nitrogen ratio is a ratio of the mass of carbon to the mass of nitrogen in a substance. Similar organic matter like fruits, vegetables, leaves have an approximately equal C:N ratio (with some expectations).

The optimum C:N ratio for a fast, odour free and fertile compost is 30:1.

If the C:N ratio is too high (excess carbon), decomposition slows down.

If the C:N ratio is too low (excess nitrogen) the pile starts to stink.

Waste (100g)	Carbon	Nitrogen
Fruit	8g	0.5g
Vegetable	12g	1g
Tea/coffe	25g	1g
Cocopeat	29g	0.24g

Case I - Solving for Fruit waste

To calculate - Amount of cocppeat needed (say X) for 100 g of fruit waste, to maintain C:N ratio of 30:1 in the mixture?

$$\frac{\text{Total carbon content in mixture}}{\text{Total nitrogen content in mixture}} = \frac{30}{1}$$

$$8 + 0.29 X = 30 (0.0024 X)$$
$$X \approx 31 \text{ g}$$

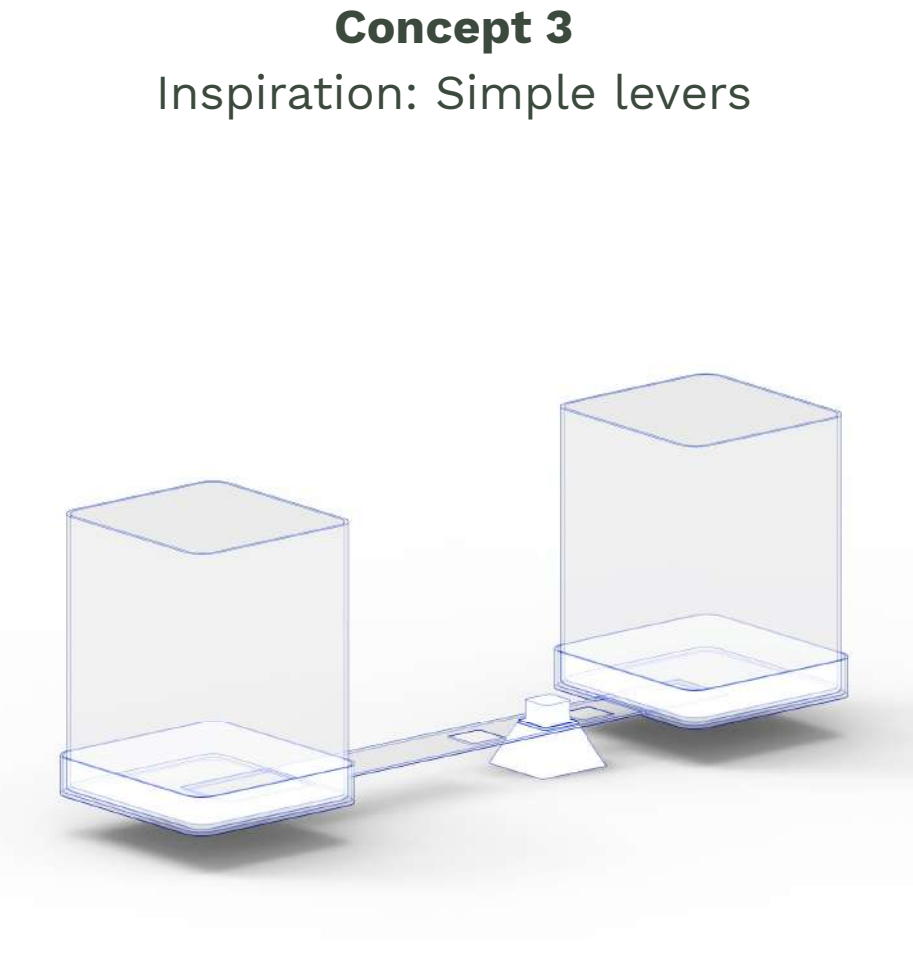
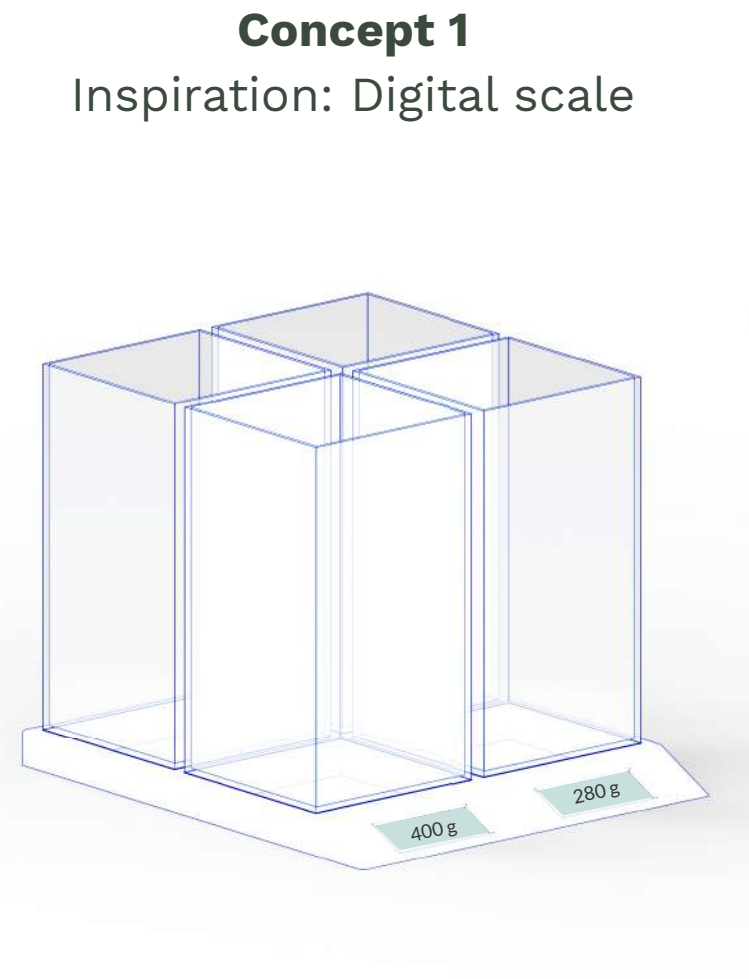
Hence,
for 100 g of Fruit waste, 31 g of cocopeat is required.

Similarly, on solving for case II and III -
for 100 g of vegetable waste, 80g of cocopeat is required.
for 100g of tea/coffee waste, 23g of cocopeat is required.

Part 1 : Exploring Concepts



Concepts were explored based on how to maintain different weight ratios.



Key Criteria	Weightage	C 1	C 2	C 3
Accuracy and consistency	3	5	3	2
Ease of use and cleaning	3	4	3	4
Product life	2	2	4	5
Product learning curve	1	4	2	2
Aesthetic appeal	3	4	2	3
Compactness	2	3	2	2
Added cost	1	2	4	5
Total Scores		55	42	48

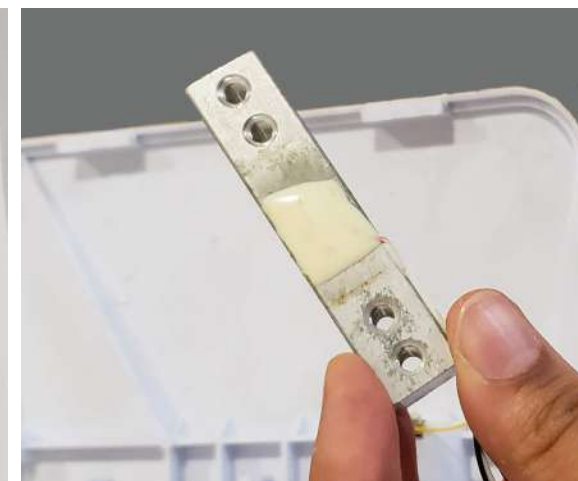
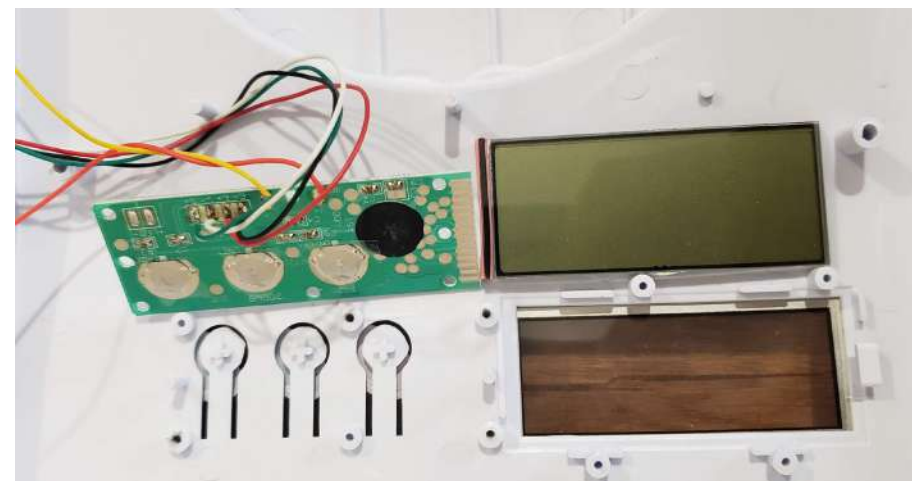
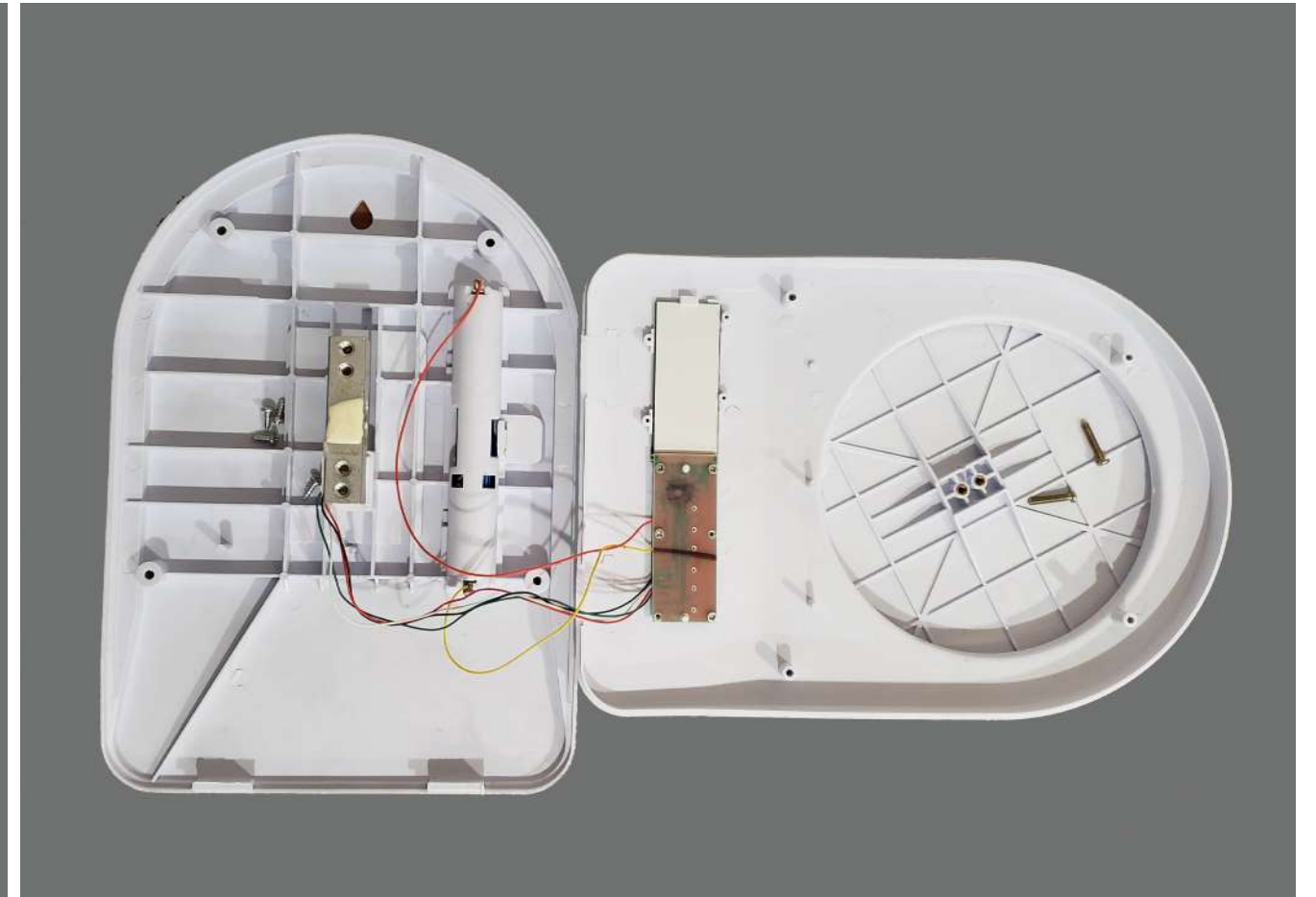
Part 1 : Concept Development



To better understand how a load cell works, a digital kitchen scale was opened up and reverse engineered.

Key Specifications :

- Dimensions - 168 x 240 x 35 mm
- Body material - ABS
- Net weight - 347 g
- Maximum weight - 7 kg
- Load cell type - High precision “strain-gauge” sensor
- Accuracy resolution - 1 g, 0.1 oz
- Power supply - 2AA x 1.5V battery



Part 2 : Concept Development

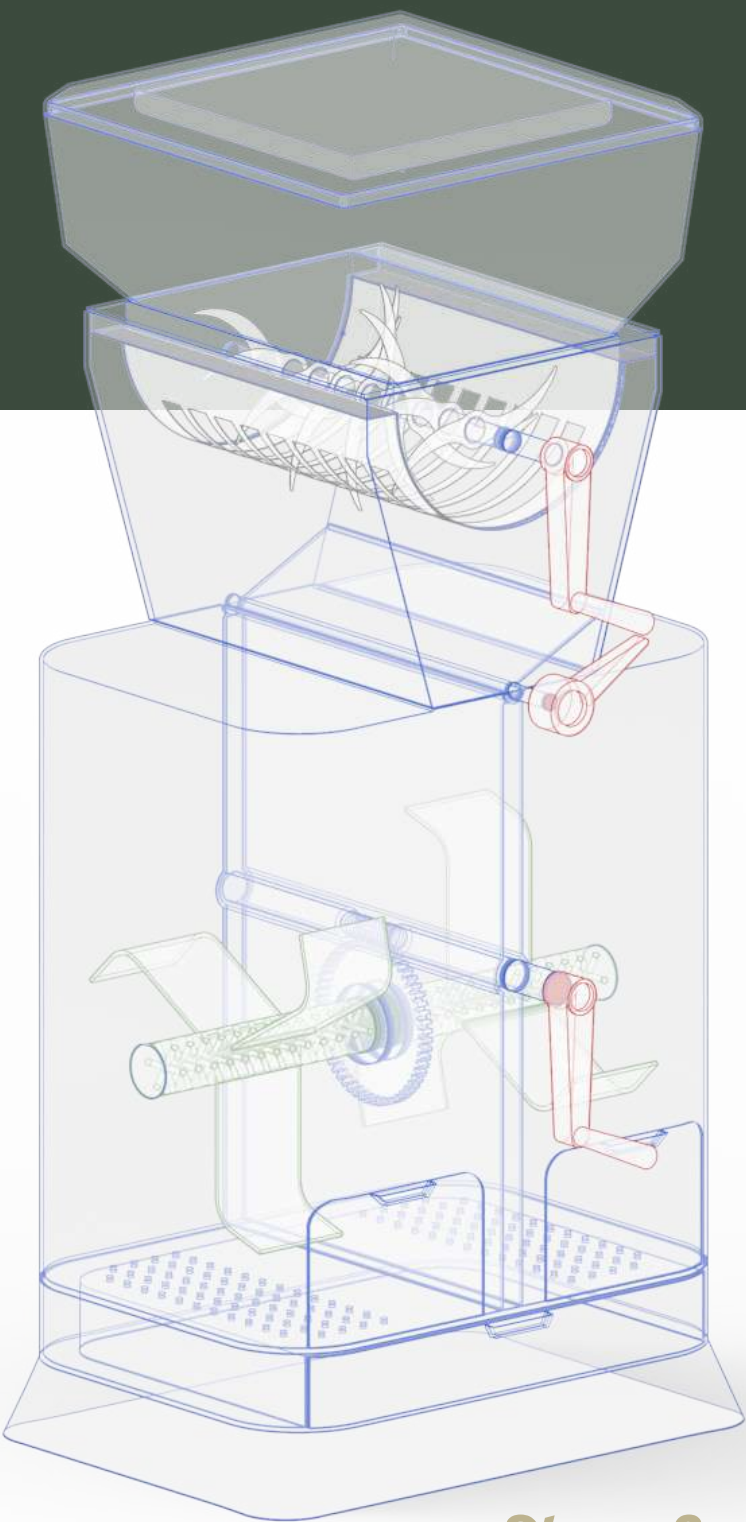
Final concept w.r.t functionality and mechanism.
Some modifications were made later to suit the final form.

Operations to be performed

- 1. Throwing the waste collected from unit
- 2. Chopping of waste, roughly into 1-2 cm
- 3. Directing the waste to one of the two bins
- 4. Aerating the waste
- 5. Collecting the compost batchwise
- 6. Collecting the leachate
- 7. Prevent bad odour from spreading
- 8. Prevent mosquitoes

Components needed

- 1. Hopper
- 2. Cutting blades, handle for manual opeartion
- 3. Divided funnel, knob for manual operation
- 4. Aeration blades with hollow shaft, handle for manual operation
- 5. Separate composting bins for two batches, removable from main body for washing
- 6. Separate liquid collection chamber
- 7. Air filter
- 8. Covering lid



Stage 2

07 • Conceptualisation

Form Exploration



Sophisticated • Modern • Sleek • Minimal

This form was finalised as it is essentially a geometric form which has a subtle and elegant overall appeal that blends well with the surroundings. But it has an accentuated chamfer and fillet that is the highlight of the form. There are only two main surfaces to the product, connected by the chamfered edge which runs in a continuum.



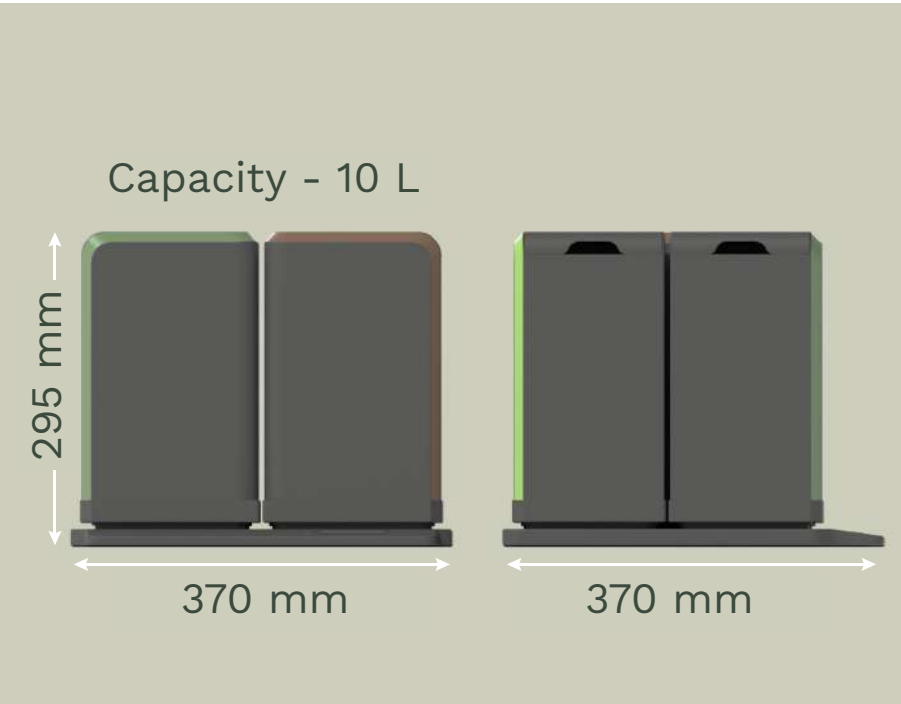
Colour, Material, Finish

Based on potential product environments, products placed in such spaces and textures from nature, so that the product blends into the surroundings.

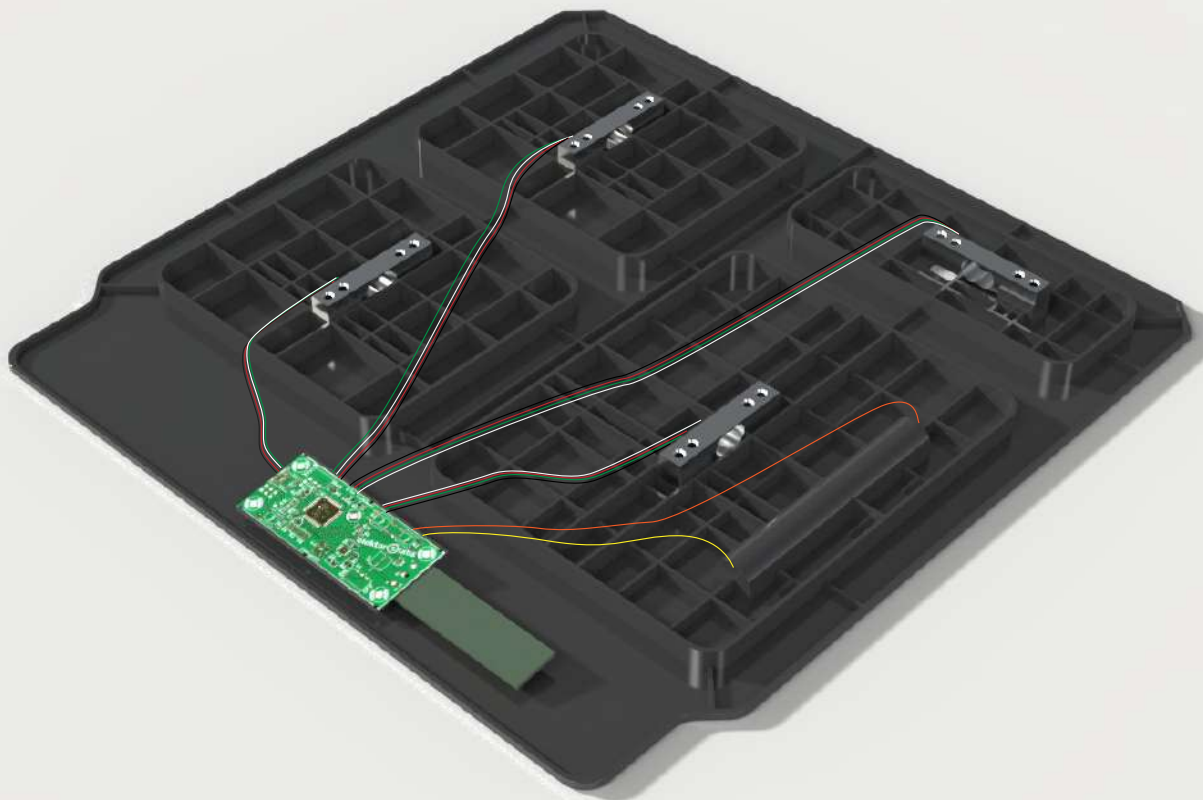
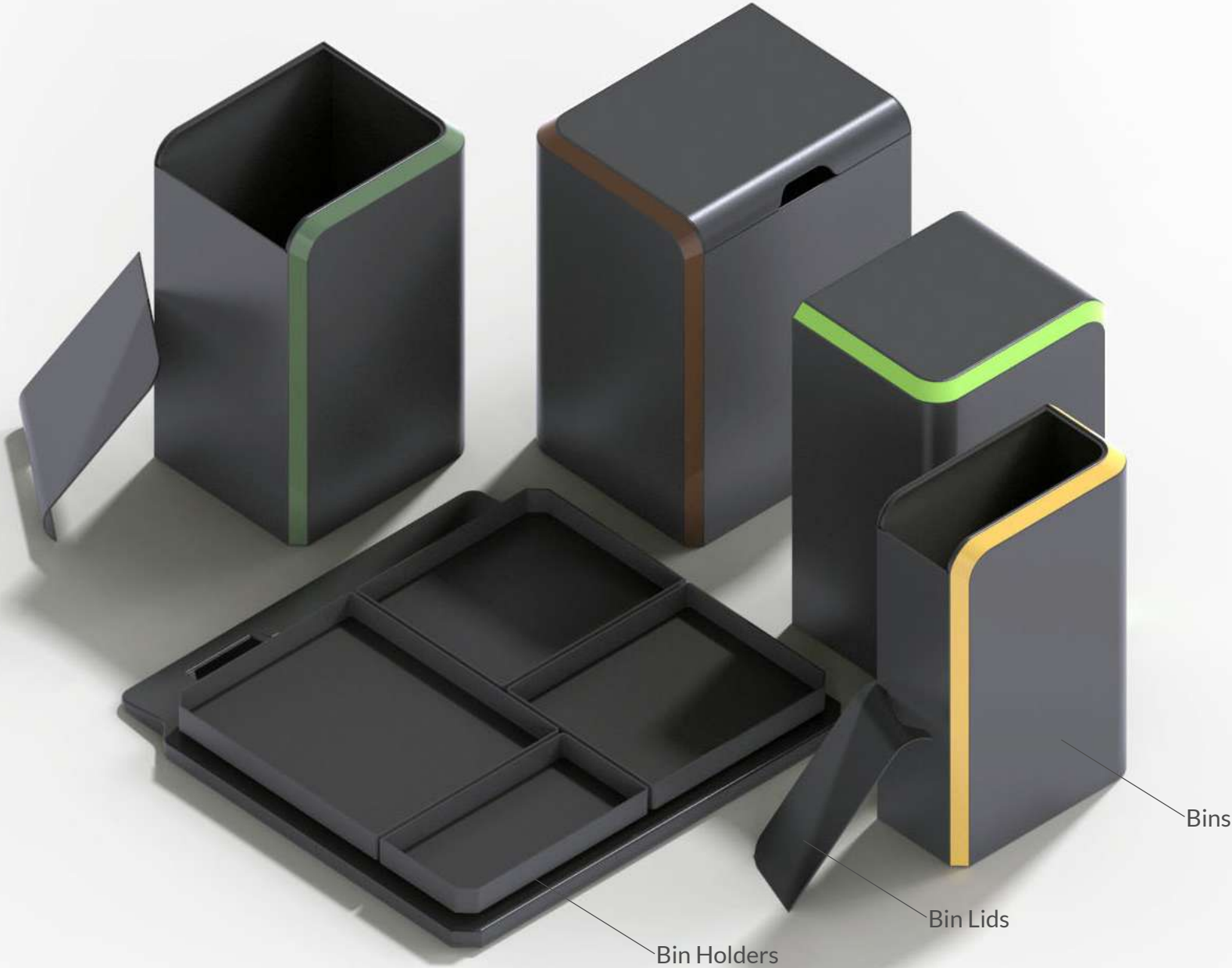
Material- ABS (Outer Body), Finish - Matt (Powder Coated)



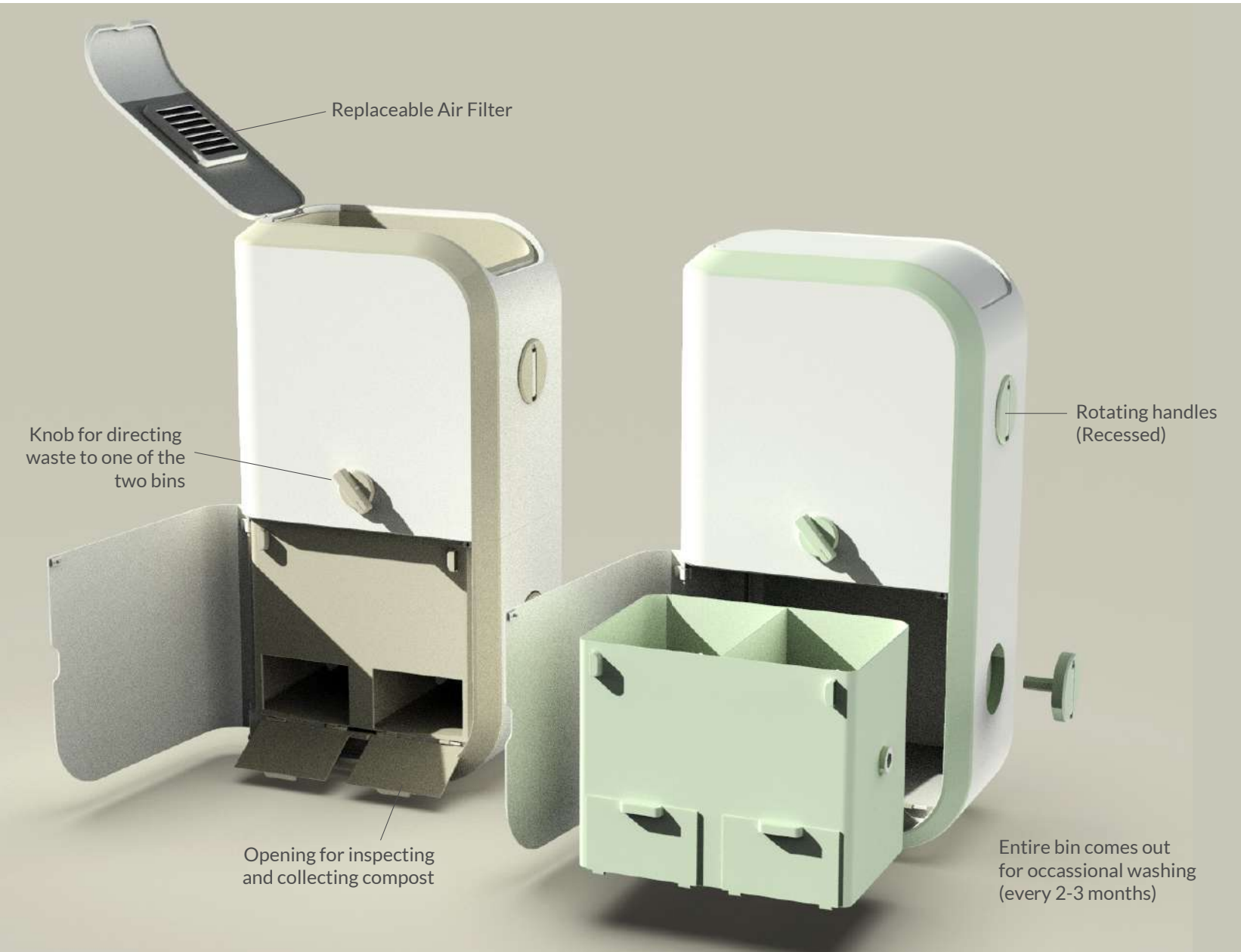
Dimensions and scale

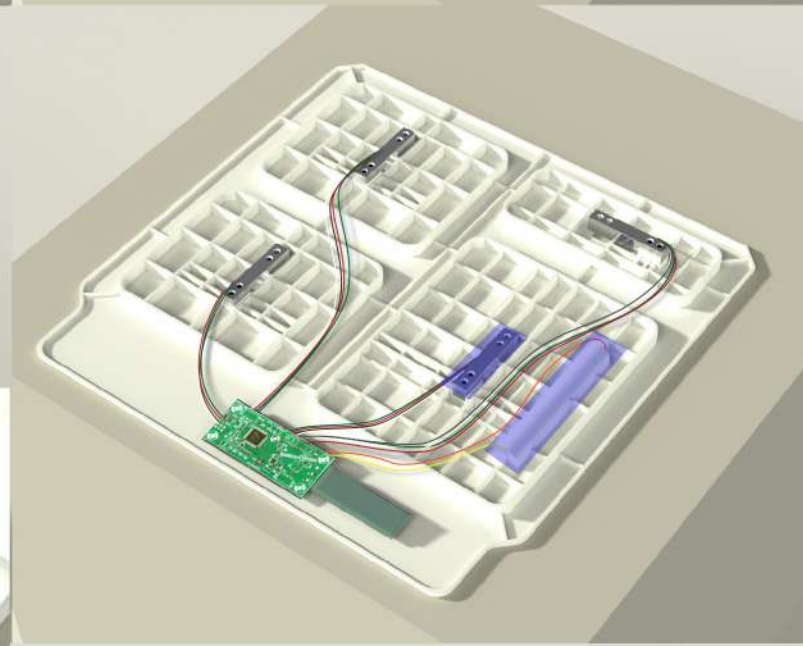
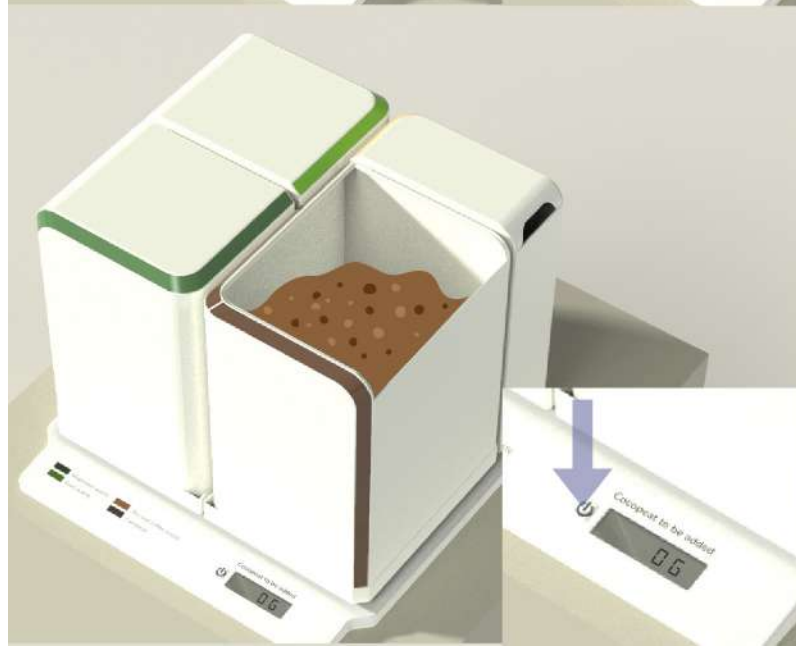
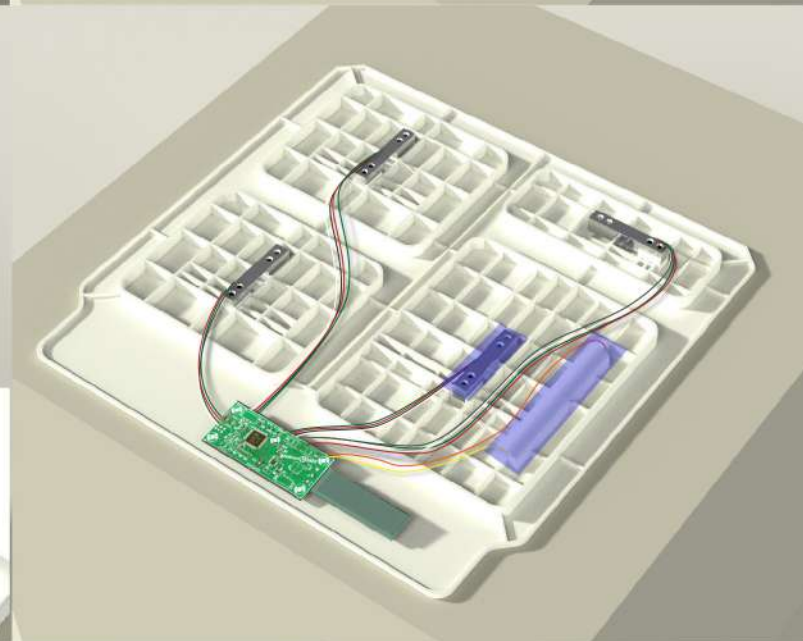
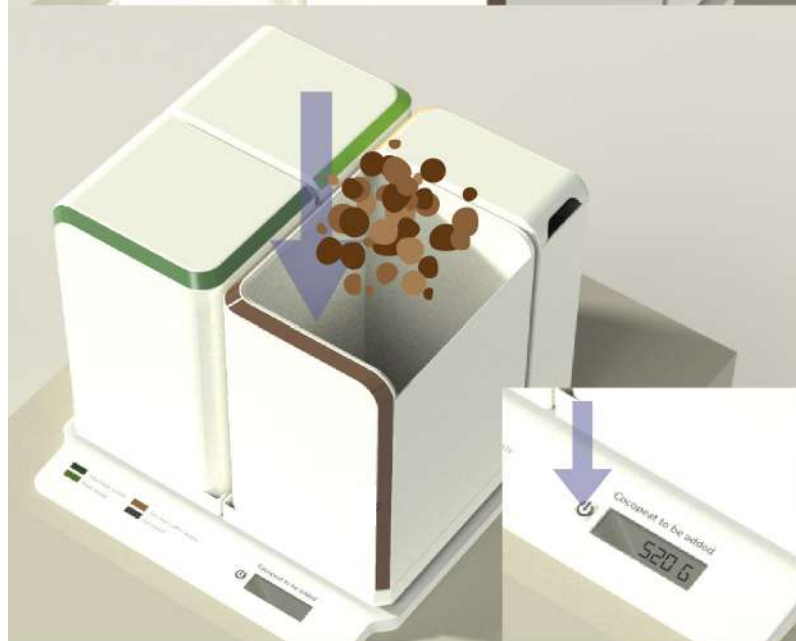
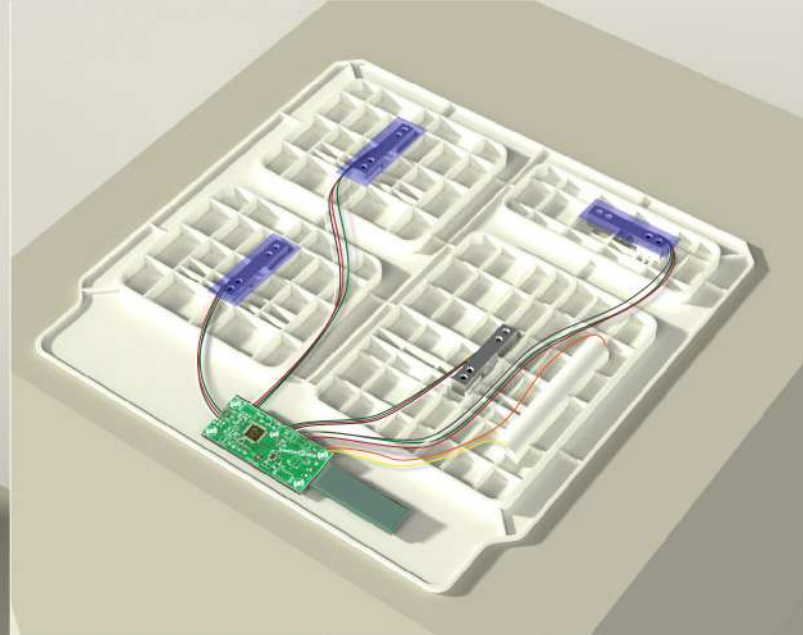
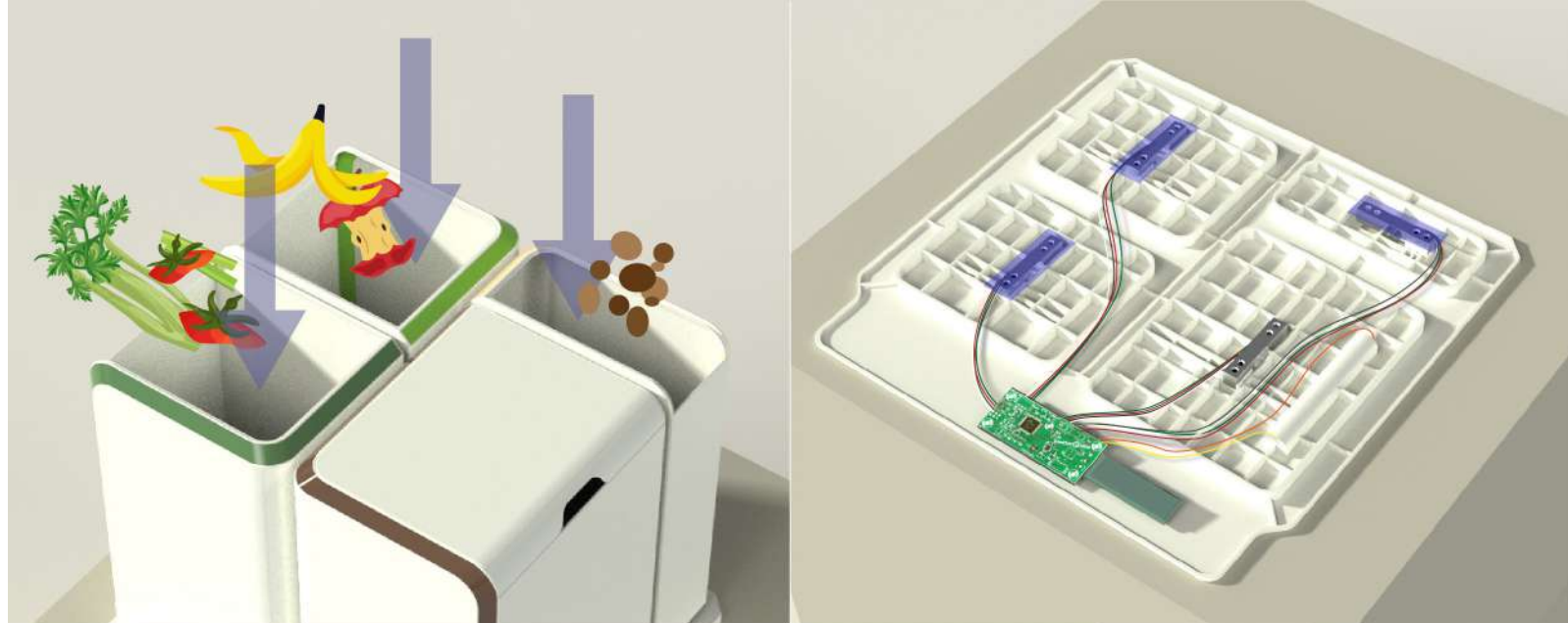


Part 1: Working



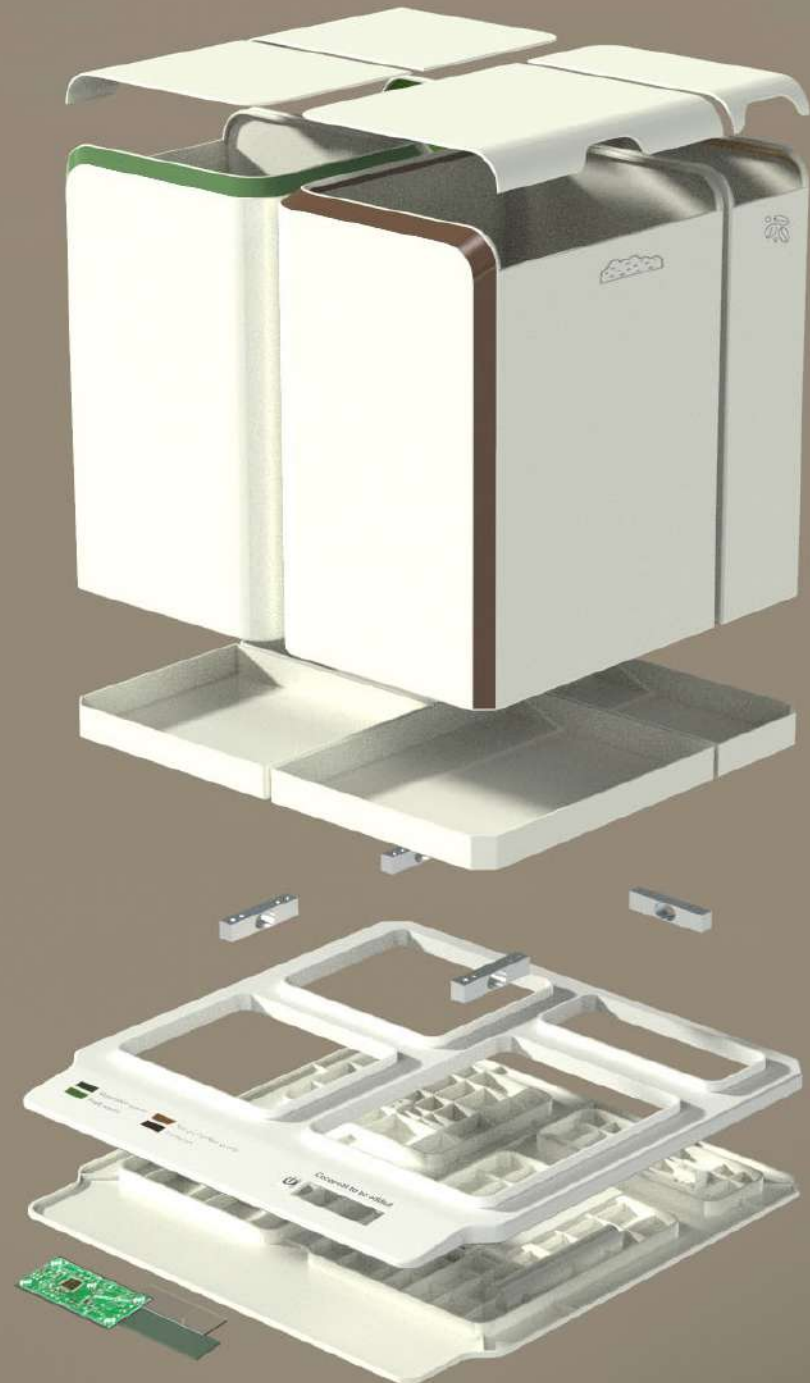
Part 2: Working



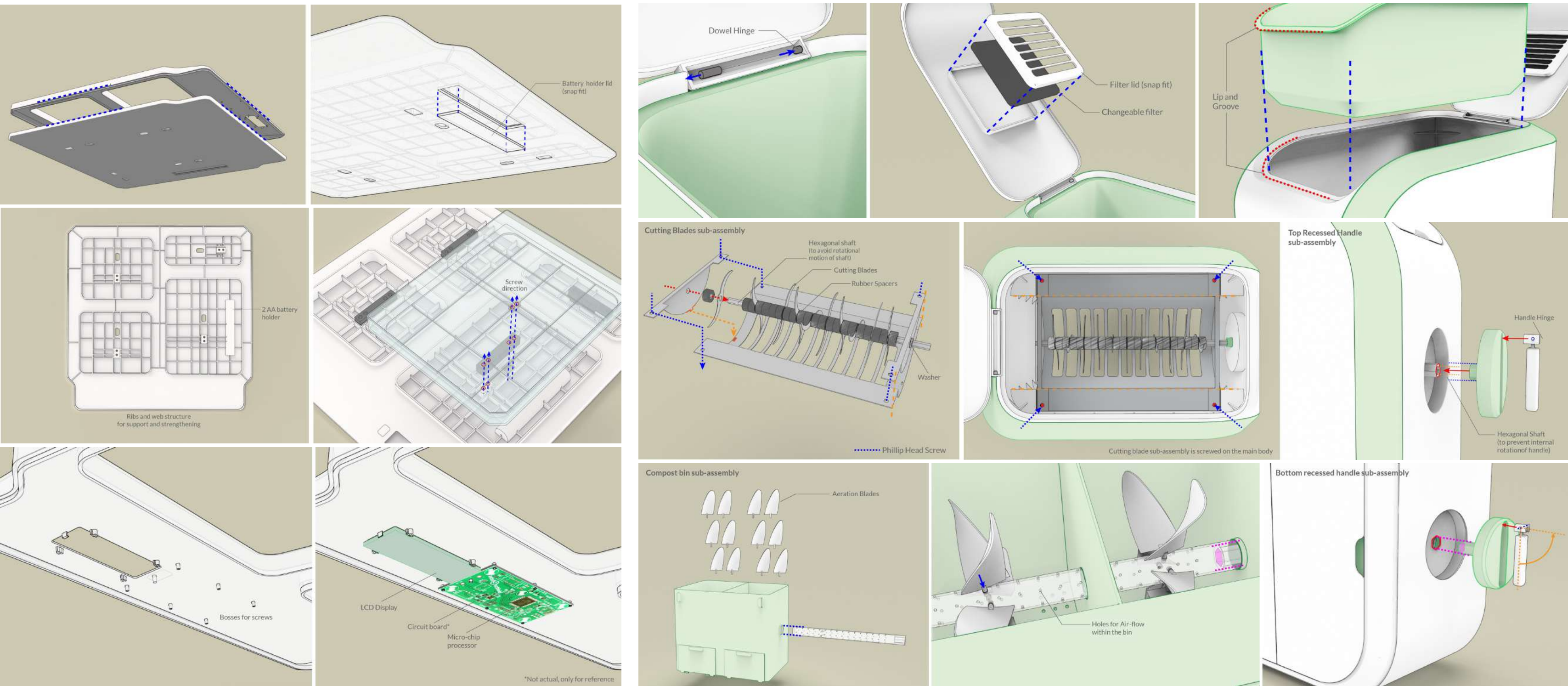


After 2 weeks

Exploded view



Details & Sub-assembly



Branding & Identity

Brand Name Green Thumb

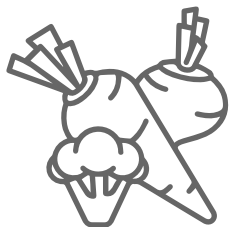
noun
an exceptional aptitude for gardening or for growing plants successfully

Brand Logo



Iconography (Stickers)

Vegetable waste



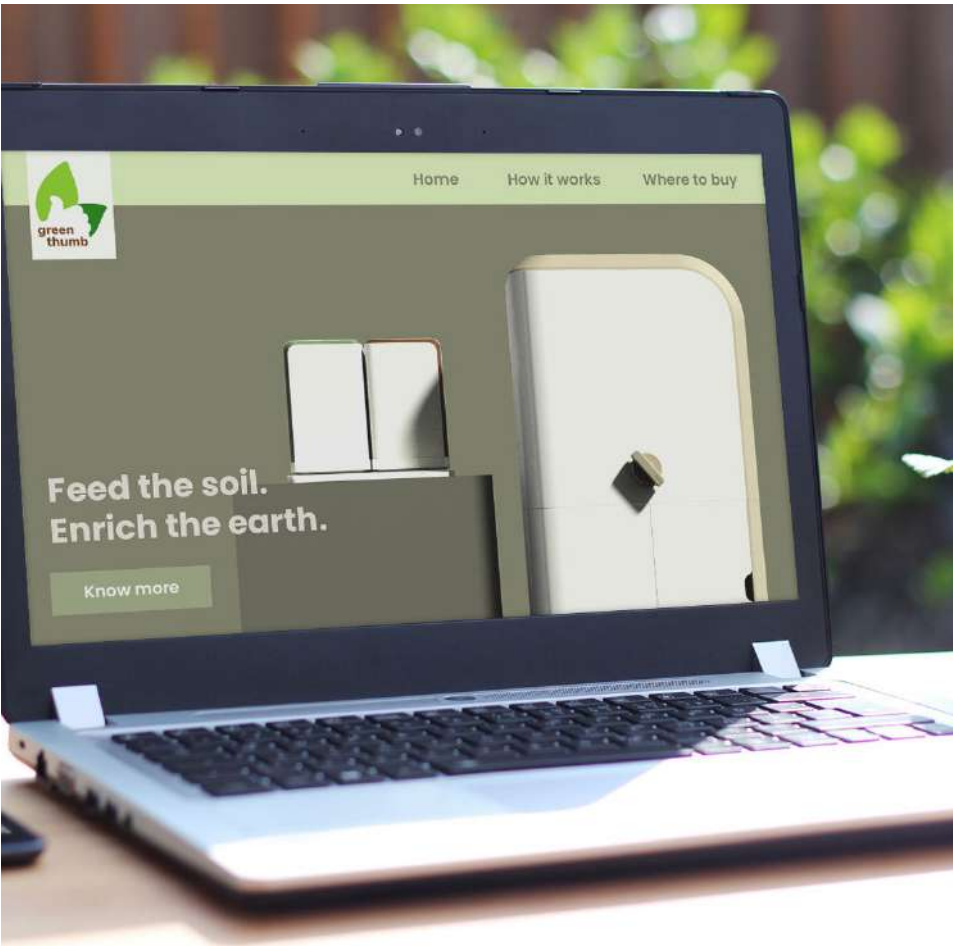
Fruit waste



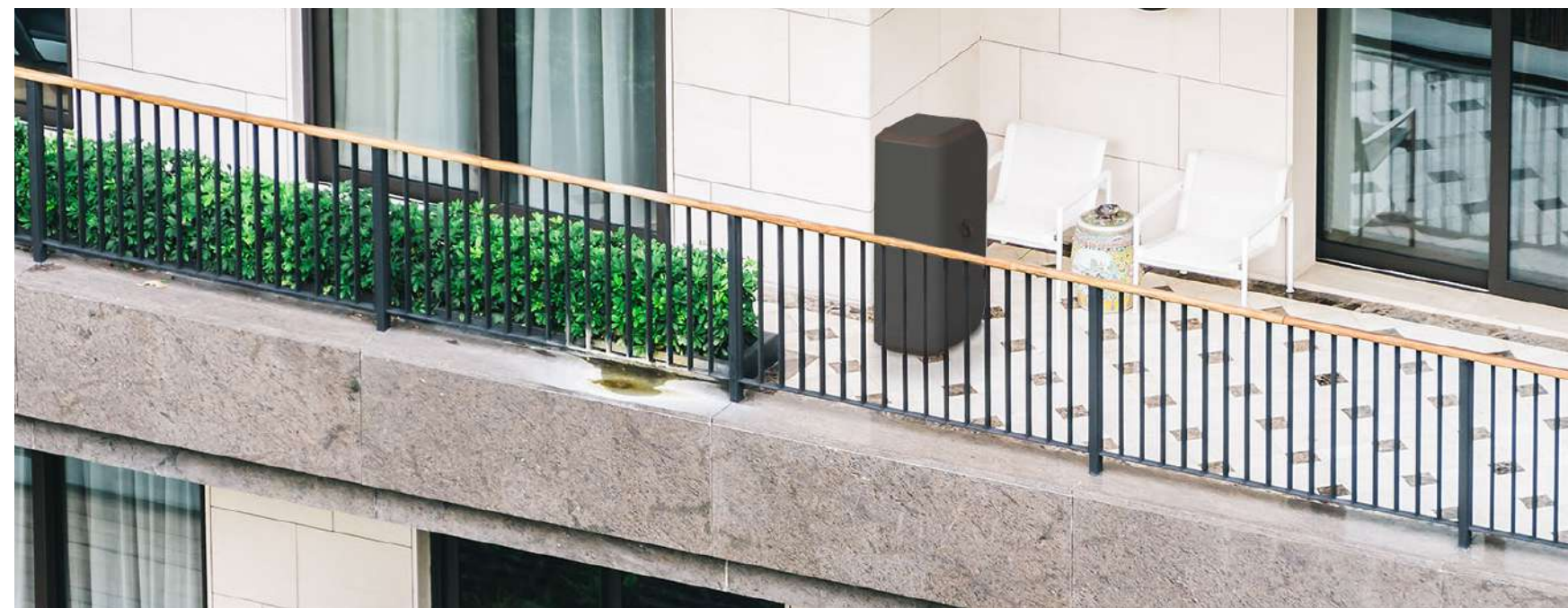
Cocopeat



Tea/Coffee waste



Context Renders



Product Usage

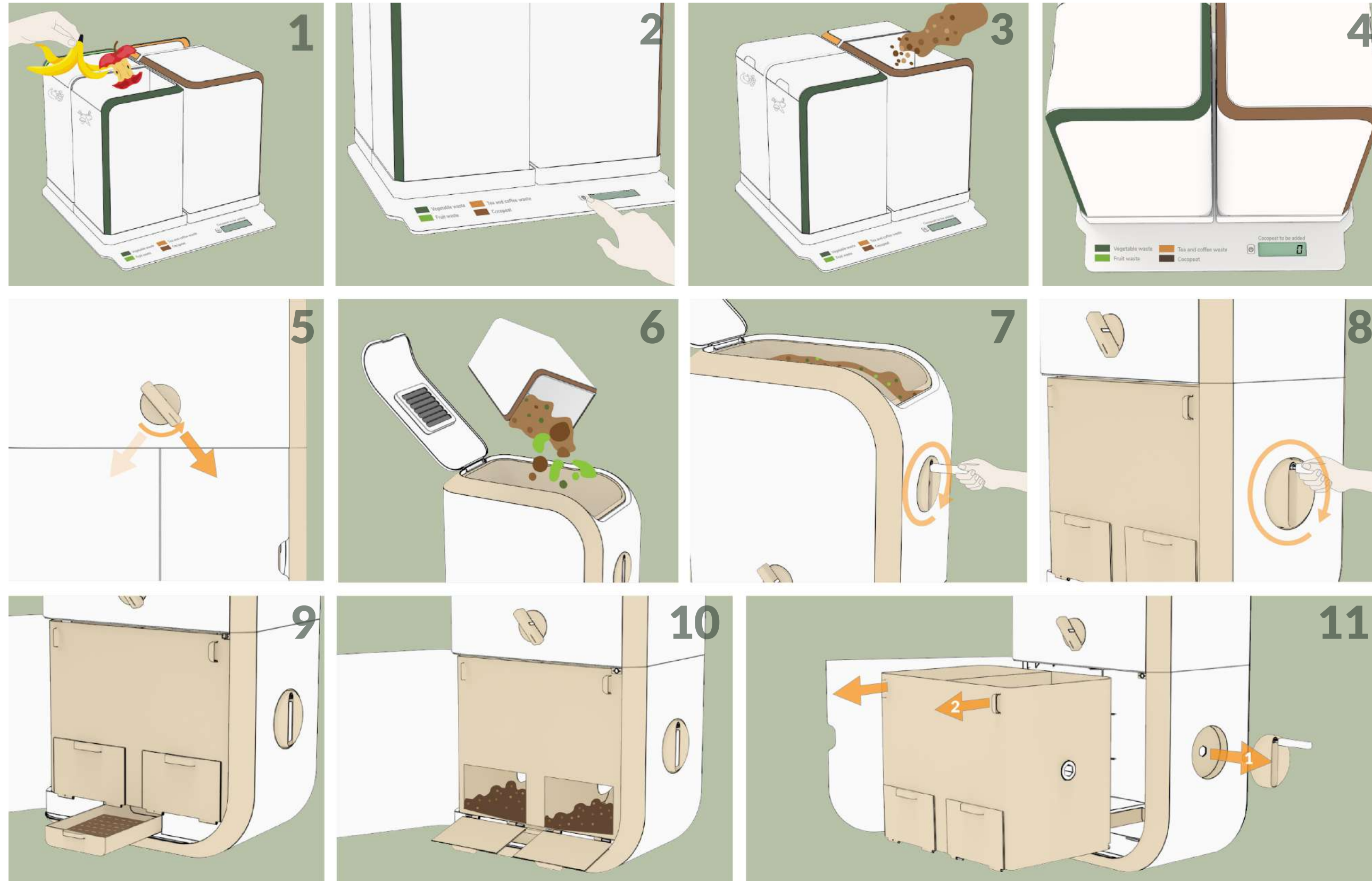


Some user comments

"Measuring the waste is a unique approach to home composting."

"Love the concept of having a shredder and aerator in the composter."

"Don't have to buy two identical composters anymore."



The End

“From every **ending**,
comes a **new beginning**.”

