Roadmap for Decarbonization of the campus

- Manipal University, Jaipur

WASTE ROADMAP STRATEGIES

Strategy 1: Waste segregation and management

The source separation process involves the segregation of various types of solid waste at the source. By sorting waste, one can identify items that can be reused and set aside items that should be recycled, reducing your overall waste output.

The following should be considered when separating waste:

1. Types of waste (biodegradable and non- biodegradable)
2. Treatment and disposal methods

To implement this strategy, we need following-

- Purchase different types of **dustbins with labels-**
    - I. Dry bin (recyclable waste, paper, cardboard)
    - II. Dry bin (aluminum, glass, plastic)
    - III. Wet bin (food and garden)
    - IV. E waste (cds, wires, electronics)
    - V. Hazardous (medical)
    - VI. Others
- **Third-party contractors** (to collect dry recyclable and e-waste)
- **Quantitate data** (measuring and recording the waste collected + maintain the recycling waste cost)

Total= 70460 Rs

Strategies : **Waste**

Implementation Steps

Step 1- Segregation Bins-
Have color coded dustbins every 150m-300m, so that the users can make the right choice easily.

Step 2- Encourage Participation-
Waste minimization display on the site noticeboard for awareness at site level.

Step 3- Waste Tracking-
It is important to keep track of how much waste the university generates.

Step 4- Waste Management Plan-

- Assign responsibility (set a management team)
- Define target for waste minimization and circularity
- Tracking of waste generated and output created
- Identify the waste destinations and transport modes
- Communication and training to support and encourage participation
- Reviewing of the plan and periodic updating

Step 5- Waste monitoring solutions-
An ultrasonic sensor is used to measure fullness levels. This helps to detect important incidents such as container's waste level, or in situations like fire, or sudden movements.

Initial Cost Estimation

Cost of 1 bin (100 lts)- INR 1,600/- (one time)
Cost of 15 bin (50 lts)- INR 24,000/- (one time)
Total- INR 24,000 /-
Third party waste hauler- **INR 50,000/month** (recurring)
Approximate revenue generated per year by selling dry waste- **INR 70,460/-**

Timeline

The strategy should be implemented in phases where the bins are purchased in phase one, along with the 3rd party waste hauler. Waste sensors can be added in phase 2, so that users will be adequately informed of the segregation by then.

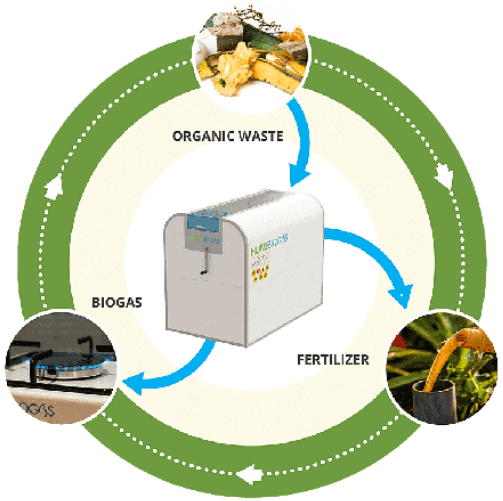
Disclaimer- the waste hauler cost and revenue generated by selling waste is a tentative amount. The cost may be change based on the waste hauler hired and the amount of waste generated in the campus.

Strategies : **Waste**

SOURCE-
https://www.amazon.in/Nilkamal-AIR-MATIC-Plastic-Wastebin/dp/B08KP22PFG/ref=sr_1_1_sspa?adgrpid=57946502054&ext_vrnc=hi&gclid=CjwKCAjwkaSaBhA4EiwALBgQaMaNvruc7nt8xcUgKsNYpGeXyhfVr4ORGAiMmYpBub43CVuaM1G9UBoCsf0QAvD_BwE&hvadid=381526451458&hvdev=c&hvlocphy=1007768&hvnetw=g&hvqmt=b&hvrand=37361489966701756l5&hvtargid=kwd-688298438778&hydadcr=6503_1957732&keywords=dustbin+100+ltr&qid=1665733372&qu=eyJxc2MiOiIzLjc3IiwicXNhIjoiMy4wNSIsInFzcCI6IjAuMDAifQ%3D%3D&sr=8-1-spons&psc=1

Strategy 2: Organic Waste to Biogas

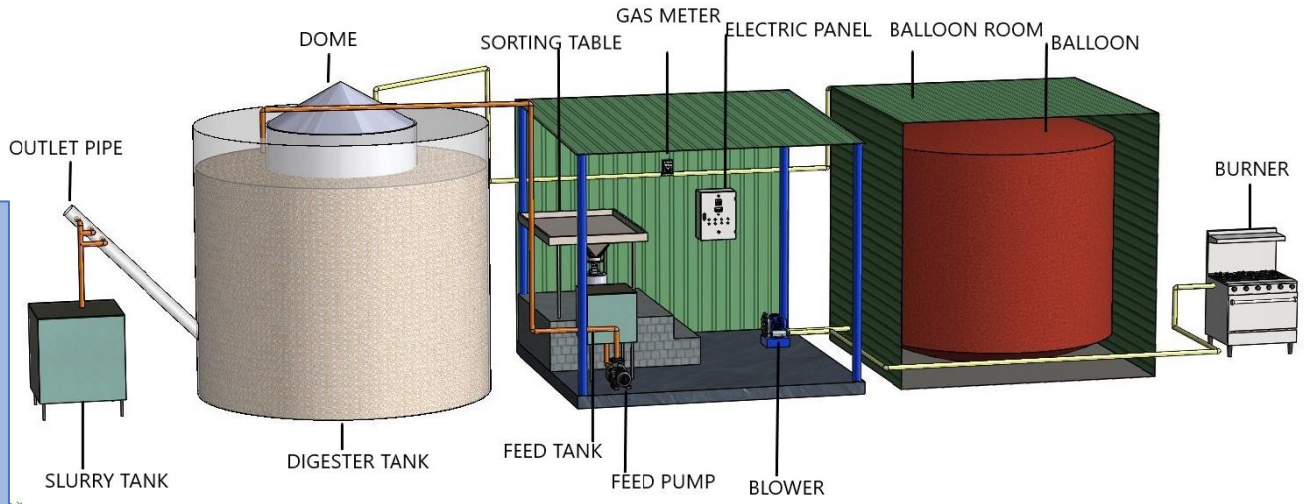
Biodigesters break down organic material such as food waste, agricultural residues, and animal and human manure into biogas, which can then be used for heating, cooking, transportation, and other uses.



To implement this strategy, we need following-

- **Organic waste segregation bin** in appropriate locations.
- **Staff** to feed the waste and run the machine.
- A **Bio-gas plant** that can convert the organic waste into biogas that can be used for cooking.
- **Quantitate data** (measuring and recording the waste collected + maintaining the bio-gas generated)

Organic waste comprises food, green material, landscape and pruning wastes, organic textiles and carpets, lumber, wood, paper products, printing and writing paper, manure, biosolids, and sludges.



Strategies : **Waste**

Implementation Steps

Step 1- Install organic waste collection bins in appropriate locations all over the campus

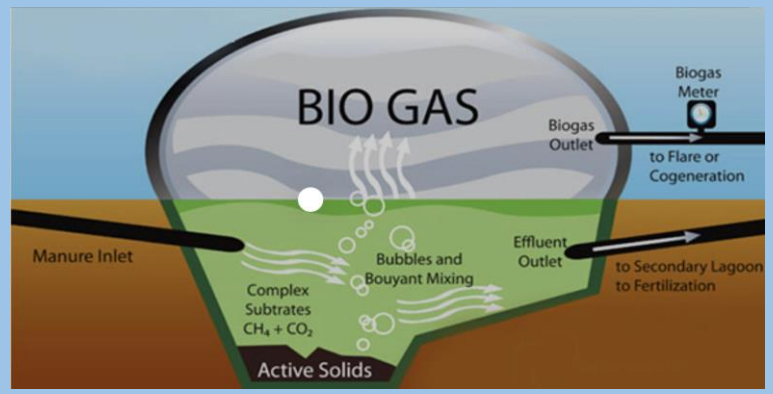
Step 2- Invest in a biogas plant on site and look for a secluded area so that noise doesn't bother anyone. Once the organic waste has been inserted into the machine, it is converted into a gas, which can be used for cooking reducing usage of gas cylinders. Waste is processed by compost machines into usable gas within 15 days.

Step 3- Hire and Educate- Hire a staff of 2 persons and educate them on running the plant and its details.

Step 4- Maintenance and Storage - Make sure the by product manure is stored and handled with care. Store it under dry conditions, so that it can be used properly as required. It is important that there are always Routine operations for predigester and digester tanks

Bio-Gas Plant Details

- **Technology Provider-** 'NISARGUNA' BARC technology
- **Plant Capacity-** 300kg/day
- **Biogas Quantity Generated-** (18-24) CUM of biogas daily, equivalent to (8-10.5)kg LPG, annually contributing to generating about (2.9-3.8) tonnes of LPG equivalent renewable energy. This helps in reducing approximately (73-96)tonnes of carbon -di-oxide annually.



Cost Estimations

Cost of Biogas Plant- INR. 1,00,000 (one time)
Cost of staff(2)- INR 24,000 (recurring)
Total- INR 1,24,000

Approximate revenue generated is INR 6,000/- per megaton. **(1MT= INR 6,000)**

Timeline

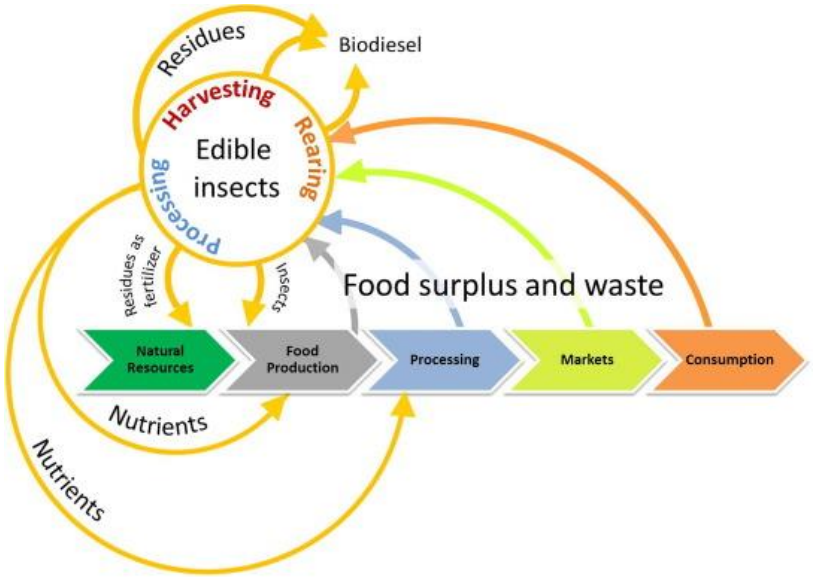
This strategy can be implemented in the scope 1 as the installation and running of the bio-gas is quite simple. The organic waste can be used as a renewable source immediately.

Disclaimer- the waste hauler cost and revenue generated by selling waste is a tentative amount. The cost may be change based on the waste hauler hired and the amount of waste generated in the campus.

Strategy 3: Circular Food System For The Campus

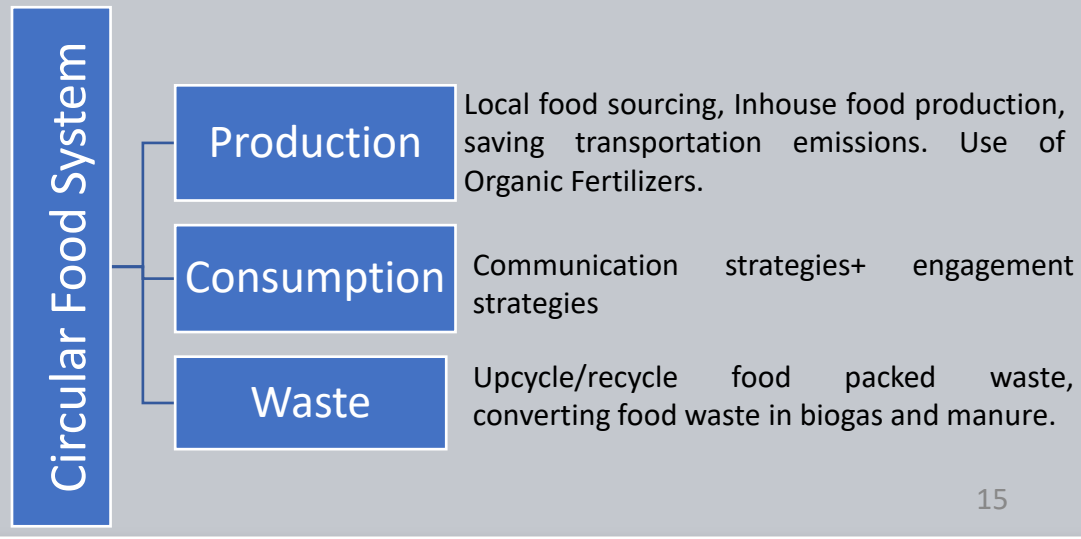
Currently, the regularly consumed fruits, vegetables, grains, cereals, dairy, and bakery products are bought from supermarkets or mandis without considering how much waste they generate (packing, emissions). It is called the Linear Food System. As part of the proposed circular food system, in any product or food or vegetable the entire life cycle from its production to its disposal is considered.

In a circular food system, regenerative production is prioritized, reuse and sharing are encouraged, resource inputs and pollution are minimized, and resource recovery is assured. Thus, they close resource loops and seek cross-sector synergies (e.g. with water and energy systems) to enhance a university's resilience.



To implement this strategy, we need following-

- **Tracking food cycle-** Understanding the contexts and needs of the consumers, as well as identify gaps and challenges that exist across the food chain.
- **Setting up- I**n house food production or sustainable and local sourcing of food (mandating a distance , for instance within 10 kms).
- **Logistics-** Understanding the routes used to transport food to the campus and the use of fossil fuel-powered cars?
- **Food Contractors-** The kitchen staff can share their weekly requirements with local farmers and understand seasonal crops and rotation of crops for menu planning.
- **Advanced Food system-** Smart food processing and waste.
  Organic fertilizer- Mandate the use of only organic fertilizer.



Strategies : **Waste**

Implementation Steps

Step1- Analyse Existing Food System-

Analyze the current food system, from food production to its waste.

Step 2- Design Circular Food System-

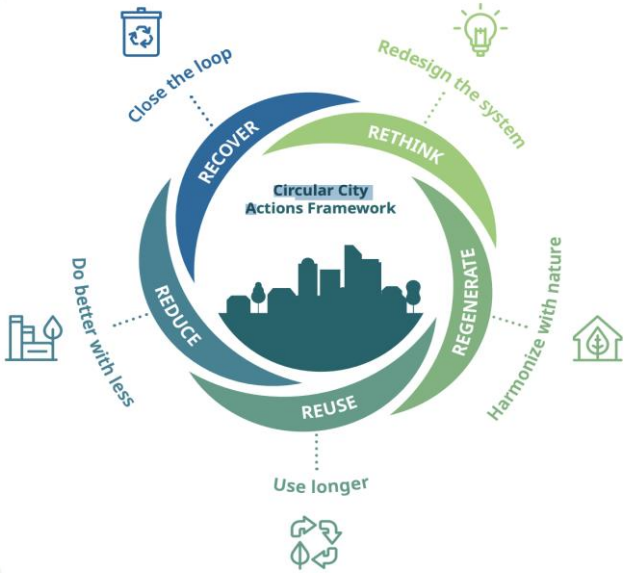
- *Rethink*

encourage re-usable water bottles by creating infrastructure for water re-fill stations. Facilitate synergies among water, energy and food systems.

- *Regenerate*
  1. Sustainable and local sourcing of Food- The raw and processed food needed should be within a range of 10 kms to control the transportation emissions. When food is produced locally,. there is direct access to the farmers. This way, we can ascertain what is the wastage on the farm, what chemicals are used, and what is the seasonality. These will help improve regenerative food production.
  2. In house food production- Identifying places on the University's campus where food can be grown. For instance, agroforestry practices can be used in the periphery of the campus. Green house food production is also recommended.

- *Reuse*

Utilize existing products, infrastructure and resources.



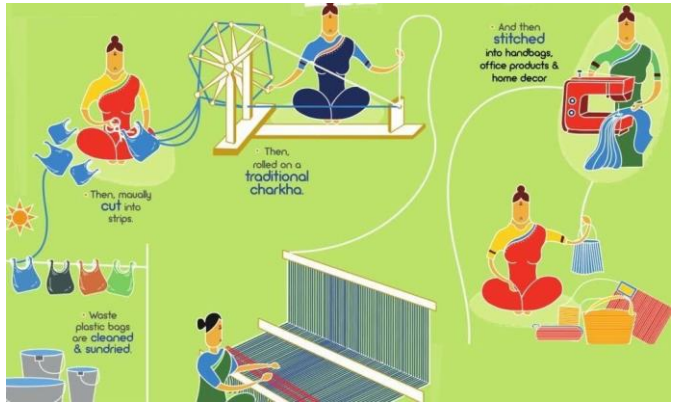
- *Reduce*

Talk to near-by bakery and dairy vendors for returnable packaging. Local sourcing of food will also avoid farm wastes. During consumption of food by students and visitors identify ways to reduce waste. One idea is to redesign serving spoons and educate students to take multiple refills instead of a plate full. The other idea is to place weighing scales underneath food waste bins located in the dining halls. This way students realize how much they are dumping food. Every day the previous day's kilogram reading of the waste can be put up on a board next to the food bin.

Strategies : **Waste**

- *Recover*

Recovery of food waste at the end of its life and facilitation of its re-introduction into production processes as compost, biogas. All the packaging waste, for instance milk pouches must be washed and kept separately, plastic wrapping packets should be washed and kept separately. The university can further send them to NGO's like Ecokarri, Rechakra who upcycle these into usable products ; thereby reducing the waste going to landfill. Similarly, every PET water bottle used on the entire University campus must be collected and stored separately. These can then be sent to a pyrolysis facility for converting into fuel. All the used oil from each of the contractors should be collected in one place. This oil can then be sold to local soap manufacturers for biodiesel units that used cooking oil as a raw material.



Approaches to make the Food System Circular

- Yellow boxes depict suggested ideas for circularity
- Green boxes depict the activity which can lead to circularity
- Dotted green arrows show the component of circularity
- Dark blue boxes are possible solutions that need to be explored further

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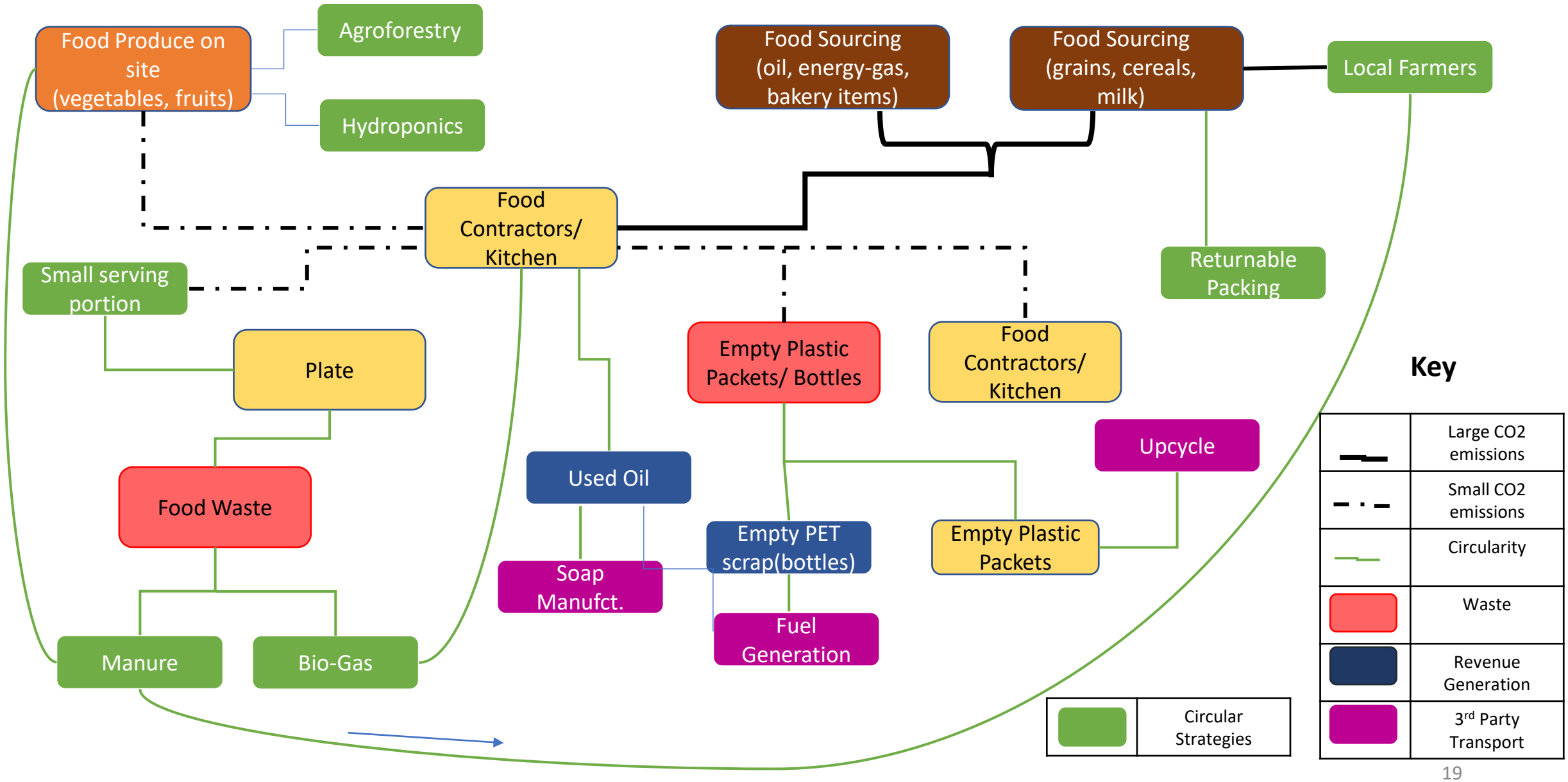

Strategies : **Waste**

Step3- Educate -
It is imperative to educate all the food contractors (kitchen staff, supply chain management) so that everyone is on the same page and the circular food system can be easily implemented.

Step 4- **Monitoring and execution system-**
This circular food system would require a lot of resources, co-ordination amongst different managements, students and staff. It is better to set up a monitoring team initially which can guide and review the steps every few weeks and intervene when necessary.

Timeline

The strategy needs to be implemented in phases; strategies such as local sourcing, reusable bottles, and returnable packaging for dairy and bakery items can be implemented in Phase 1.
Others, such as greenhouse production for food, can be implemented in Phase 2. As time passes, users will become comfortable with the new system, and soon it will become an integral part of teaching and learning.

Initial Cost Estimation

Strategies like local food sourcing, can be implemented at no cost.

Cost of planting trees for Agroforestry- INR 1,56,000
Cost of staff - -INR 1,20,000
Cost of constructing Hydroponics -INR 2,600 to 3,500/m2

Approximate revenue generated per kg by selling used oil and PET scrap 80 **Rs/k**

SOURCE-
Hydroponics- https://www.agrifarming.in/hydroponic-farming-in-bangalore-how-to-start-setup-cost-companies-and-suppliers