

## Project Design Phase

### Solution Architecture

Date	03 November 2025
Team ID	NM2025TMID01374
Project Name	To Supply Leftover Food to Poor
Maximum Marks	4 Marks

#### Solution Architecture: Food-to-Power System:

The **Food-to-Power System** is designed to convert organic food waste into renewable energy (biogas, electricity, or bio-CNG) through a controlled, technology-driven process. It integrates **IoT sensors**, **biogas processing units**, and **energy distribution networks** to create a **smart, efficient, and eco-friendly power generation system**.

#### System Components

##### 1. Waste Collection & Input Layer

- **Sources:** Homes, restaurants, canteens, food factories.
- **Components:**
  - Smart bins with IoT sensors (for waste level and composition)
  - GPS-tracked collection vehicles
  - Sorting stations for removing plastics, metals, etc.

##### 2. Pre-processing Unit

- **Processes:**
  - Shredding food waste for uniformity
  - Adding water to form slurry
  - Adjusting pH levels for optimal digestion

##### 3. Anaerobic Digestion Unit

- **Core Process:**
  - Microorganisms break down organic matter in oxygen-free conditions.
  - Produces **biogas (methane-rich)** and **digestate (organic fertilizer)**.
- **Technology:**
  - Temperature-controlled digester tanks
  - Sensors for gas pressure, temperature, and pH

#### **4. Energy Conversion Module**

- **Options:**

- **Electricity generation:** Using a biogas generator or microturbine.
- **Fuel purification:** Upgrading biogas to bio-CNG.
- **Heat recovery:** Using exhaust heat for nearby industrial or domestic use.

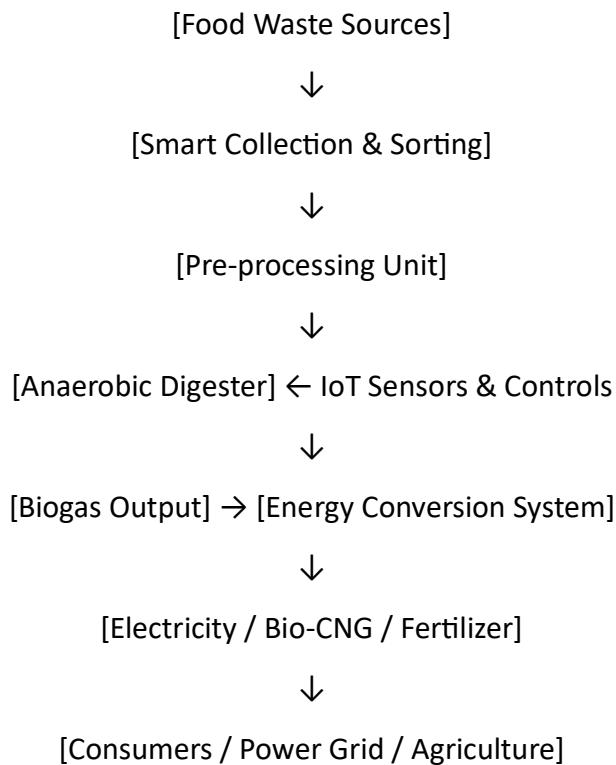
#### **5. Smart Monitoring & Control System**

- **IoT Platform:** Monitors temperature, gas flow, and efficiency in real-time.
- **Cloud Dashboard:** Displays analytics and energy output data.
- **AI Optimization:** Predicts gas yield and automates process tuning.

#### **6. Output & Utilization**

- **Energy:** Distributed to the power grid or local community.
- **Bio-CNG:** Supplied to transport vehicles or stored.
- **Fertilizer:** Digestate processed and packaged for agricultural u

#### **Data Flow Diagram**



## Technology Stack

Layer	Technology/Tools
IoT Layer	Smart bins, Raspberry Pi/ESP32, weight & gas sensors
Processing Layer	Anaerobic digester, heat exchange, gas scrubbers
Control Layer	PLC/SCADA, cloud IoT (AWS IoT, ThingsBoard, or Blynk)
Data Layer	SQL/NoSQL databases, sensor data logs
Analytics Layer	Python-based AI models for yield prediction

## Security & Sustainability Features:

- Secure data transmission via MQTT/HTTPS.
- Regular maintenance alerts and fault detection via AI.
- Reduced carbon emissions (up to 70% less methane from landfills).
- Energy-efficient, circular economy design.

## Outcome:

The **Food-to-Power architecture** ensures:

- Real-time waste-to-energy conversion.
- Scalable model for cities and institutions.
- Integration with smart grids and sustainable infrastructure.