**Project Design Phase-II**
**Technology Stack (Architecture & Stack)**

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| Date | 24 June 3035 |
| Team ID | LTVIP2025TMID30982 |
| Project Name | Sustainable Smart City Assistant Using IBM Granite Model |
| Maximum Marks | 4 Marks |

# Sustainable Smart City Assistant– Technology Stack & Architecture

## 1. Overview

The Sustainable Smart City Assistant is an AI-powered platform designed to optimize urban resource allocation, predict policy impacts, and engage residents in sustainability efforts. It leverages IBM Granite LLM integrated with geospatial analytics via a modular FastAPI and Gradio architecture.

## 2. Solution Architecture

The architecture is modular, enabling clean separation of concerns and scalability. Below is the key component flow:

- User Inputs
- City planners submit policy drafts via Gradio UI
- Residents report infrastructure issues through mobile/web forms
- API Layer
- FastAPI backend validates and routes requests
- Authentication via JWT tokens for government users
- AI Processing
- IBM Granite model analyzes policies using city datasets
- Computer vision (optional) processes resident-uploaded images of waste/energy issues
- Output Delivery
- Interactive dashboards for planners (Plotly/Dash)
- SMS/email alerts for residents with action steps

- Optional Modules
- IoT sensor integration for real-time monitoring
- Blockchain-based transparency logs for public trust

## 3. Technology Stack

| Component | Technology | Purpose |
|---|---|---|
| Frontend UI | Gradio | Rapid prototyping for city staff with form-based inputs |
| Admin Dashboard | Streamlit | Advanced analytics visualization for planners |
| Backend API | FastAPI | Handles policy simulations, data validation, and resident requests |
| Web Server | Uvicorn | ASGI server with reverse proxy for production traffic |
| LLM Core | IBM Granite (via Watsonx.ai SDK) | Processes urban policy queries and predicts outcomes |
| Geospatial Analytics | GeoPandas + Kepler.gl | Maps sustainability metrics (e.g., energy use by district) |
| Data Pipeline | Apache Airflow | Automates ETL for city datasets (energy/waste/transport) |
| Database | PostgreSQL + PostGIS | Stores geotagged urban data with spatial query support |
| Auth | IBM Cloud Code Engine | Serverless scaling for policy simulation workloads |
| Deployment | IBM Cloud Code Engine | Tracks API performance and model accuracy |