Advantages and Disadvantages

Problem Statement

Urban cities today face mounting challenges related to **sustainability**, **infrastructure efficiency**, **citizen engagement**, and **data overload**. City administrators, planners, and citizens struggle to process vast volumes of policy documents, respond to citizen issues in real-time, detect anomalies in infrastructure usage, and forecast future demands for utilities like water and electricity.

Despite the availability of smart city technologies, most solutions remain siloed, difficult to interpret, and lack **AI-driven decision support**. There is a clear need for a centralized, intelligent assistant that can:

- Automate **policy summarization** and **semantic search** across legal documents.
- Enable **citizens** to report issues or ask sustainability-related questions easily.
- Forecast **KPI trends** and detect **anomalies** in real-time for proactive governance.
- Provide **eco-friendly suggestions** to drive awareness and behavior change.

Hence, the project **"Sustainable Smart City Assistant Using IBM Granite LLM"** aims to create a **modular, AI-powered platform** that leverages **IBM Watsonx's Granite LLM**, **FastAPI**, and **Streamlit** to bridge the gap between **smart technology** and **effective urban decision-making**.

✓Advantages

1. **AI-Driven Decision Making**
   Uses IBM Granite LLM for summarization, report generation, and chat responses — aiding faster and smarter decisions.
2. **Improved Citizen Engagement**
   Citizens can report problems, provide feedback, and ask sustainability-related questions in real-time.
3. **Policy Simplification**
   Automatically summarizes lengthy and complex policy documents into simple, citizen-friendly language.
4. **Real-time KPI Monitoring & Forecasting**
   Helps city planners predict future consumption or pollution patterns using historical KPI data.
5. **Early Anomaly Detection**
   Detects unusual usage patterns in utilities, potentially preventing disasters or misuse.
6. **Modular Architecture**
   Clean separation of frontend (Streamlit), backend (FastAPI), and ML/AI services allows easier scaling and maintenance.

7. **Semantic Search Capabilities**
   Uses Pinecone vector DB to retrieve relevant sections of uploaded documents via keyword search.
8. **Scalable & Configurable**
   Environment variables, modular routing, and reusable components allow for deployment in multiple cities with minimal changes.
9. **Enhanced UI/UX**
   Beautiful and intuitive user interface with icons, cards, and dashboards for easy interaction.
10. **Educational Use Case**
    The Eco Tips module promotes environmental awareness among students and the general public.

✖Disadvantages / Limitations

1. **Dependency on External APIs**
   The application heavily depends on IBM Watsonx and Pinecone. If API limits are reached or services are disrupted, key features may fail.
2. **Data Privacy Concerns**
   Uploading sensitive policy or infrastructure documents to cloud APIs (like Watsonx) may raise privacy/security concerns.
3. **Scalability Challenges with Free Tiers**
   Pinecone and Watsonx free plans have limitations on API calls, storage, and throughput.
4. **Model Accuracy & Bias**
   The Granite LLM, though powerful, may occasionally generate biased, incorrect, or vague responses.
5. **Real-time Streaming Not Fully Supported**
   Current implementation is API-based and not yet equipped for handling real-time streaming sensor data.
6. **Requires Technical Setup**
   Non-technical city staff might find it difficult to install and configure unless properly packaged/deployed.
7. **Limited Offline Functionality**
   Most features require an active internet connection and cloud service access — not suitable for low-connectivity areas.