

## Project Overview

The Sustainable Smart City Assistant is an AI-powered web application designed to enhance urban sustainability, citizen engagement, and data-driven governance. It combines the power of **IBM Watsonx Granite LLM** for natural language understanding and generation with a modular **FastAPI backend** and a user-friendly **Streamlit dashboard**. Key features include AI-driven **policy summarization**, **semantic document search** via Pinecone, **real-time KPI forecasting** using machine learning, **anomaly detection**, **eco-friendly tips**, and a **citizen feedback portal**. The system allows city administrators and citizens to interact with smart services, visualize key metrics, and make informed decisions to support sustainable urban development.

The primary objective of Smart City is to enhance civic engagement by transforming how governments respond to citizens. The project supports transparency and accountability in governance, ensuring timely and relevant communication that builds trust and satisfaction among the public.

## 2. IDEATION PHASE

### Problem Statement

|               |   |
|---------------|---|
| Date          | 25 Jan 2025   |
| Team ID       | LTVIP2025TMID35741  |
| Project Name  | <b>Sustainable Smart City Assistant Using IBM Granite LLM</b> |
| Maximum Marks | 2Marks  |

Many citizens experience difficulty in accessing government services and getting their queries addressed efficiently. The manual processes currently in place lead to delays, miscommunication, and frustration. A significant gap exists between government service providers and the public due to a lack of interactive, intelligent, and scalable communication systems. The need for a platform that can address these challenges and simplify the interaction process is more critical than ever.

|                            |  |   |
|----------------------------|--|---|
| <b>I am</b>                | Describe customer with 3-4 key characteristics - who are they?                                 | Describe the customer and their attributes here                             |
| <b>I'm trying to</b>       | List their outcome or "job" the care about - what are they trying to achieve?                  | List the thing they are trying to achieve here                              |
| <b>but</b>                 | Describe what problems or barriers stand in the way – what bothers them most?                  | Describe the problems or barriers that get in the way here                  |
| <b>because</b>             | Enter the "root cause" of why the problem or barrier exists – what needs to be solved?         | Describe the reason the problems or barriers exist                          |
| <b>which makes me feel</b> | Describe the emotions from the customer's point of view – how does it impact them emotionally? | Describe the emotions the result from experiencing the problems or barriers |

### EmpathyMapCanvas

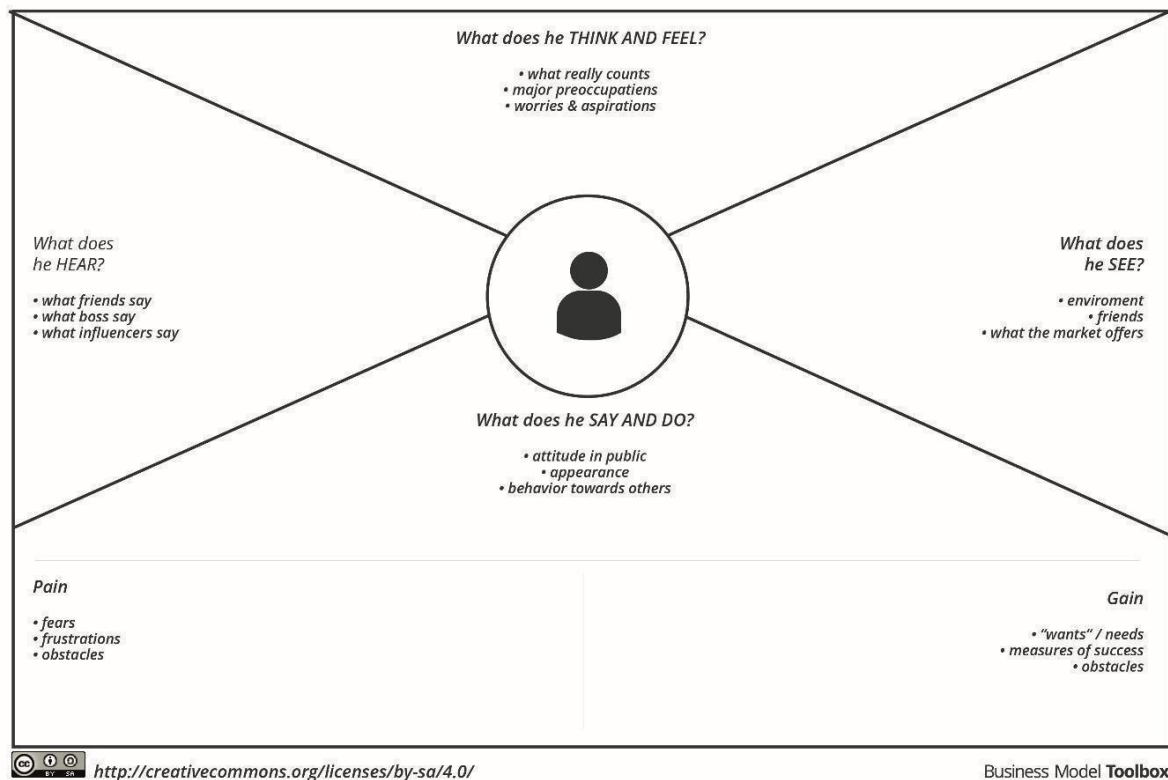
|               |  |
|---------------|--|
| Date          | 25 Jan2025   |
| Team ID       | LTVIP2025TMID35741                                     |
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| Maximum Marks | 4Marks   |

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to help teams better understand their users.

Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

## Empathy Map




## Brainstorming

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.




Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.


## Step-1: Team Gathering, Collaboration and Select the Problem Statement




### Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

 10 minutes to prepare  
 1 hour to collaborate  
 2-8 people recommended

 **Before you collaborate**

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

 10 minutes

---

**A Team gathering**  
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.


**B Set the goal**  
Think about the problem you'll be focusing on solving in the brainstorming session.

**C Learn how to use the facilitation tools**  
Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#) →

**1 Define your problem statement**


What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

 5 minutes

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**PROBLEM**

How might we [your problem statement]?



#### Key rules of brainstorming

To run a smooth and productive session

|   |   |
|---|---|
|  Stay in topic.  |  Encourage wild ideas.   |
|  Defer judgment. |  Listen to others.       |
|  Go for volume.  |  If possible, be visual. |

## Step-2: Brainstorm, Idea Listing and Grouping

2

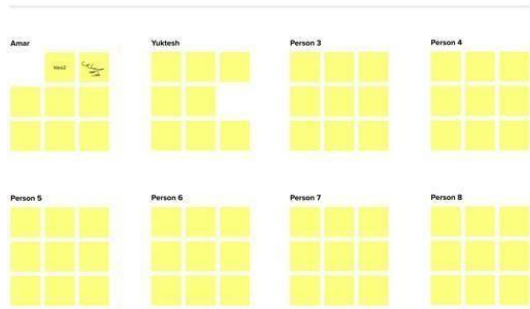
**Brainstorm**

Write down any ideas that come to mind that address your problem statement.

⌚ 10 minutes

**TIP**

You can select a sticky note and hit the pencil (switch to sketch) icon to start drawing!



3

**Group ideas**

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

⌚ 20 minutes

**TIP**

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as they're within your mind.

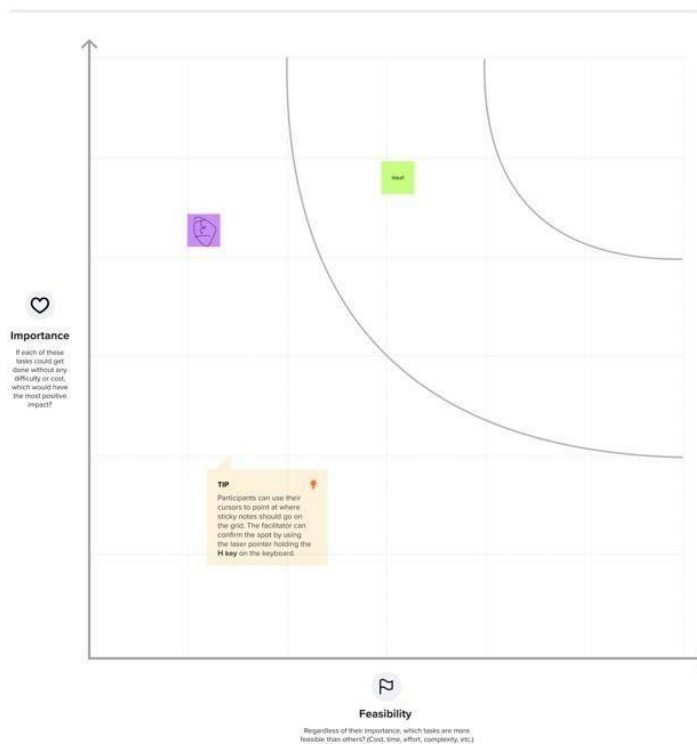
## Step-3:Idea Prioritization

4

**Prioritize**

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

⌚ 20 minutes



## 3. REQUIREMENTANALYSIS

## **Customer Journey Map**

1. A citizen accesses the Smart City platform via a web browser.
2. The user interacts with the chatbot by typing a query or concern.
3. The chatbot processes the input using IBM Granite NLP models.
4. A contextual and personalized response is returned to the user.
5. Feedback from the user is analyzed for sentiment and logged.
6. Officials monitor the feedback via a dynamic dashboard.

Each step in the journey is designed to be intuitive, time-efficient, and responsive to the unique needs of individual users. The backend system ensures smooth query routing, language comprehension, and storage of useful feedback for continuous improvement.

## **Solution Requirement**

- Responsive Web UI
  - Secure backend using Flask
  - NLP APIs from IBM Watson and IBM Granite
  - Real-time sentiment analysis engine
  - Cloud objects to store for logging interaction
  - Dashboard for visualizing trends and metrics
  - Feedback collection module
  - Admin access controls
- These requirements were gathered based on user stories, surveys, and expert interviews during the early analysis stage.

## **Data Flow Diagram**

**User Input → Flask Application → NLP Processing(Watson/Granite) → Response Generation → Sentiment Analysis → Dashboard Update**

This linear yet modular flow allows the system to be expanded in the future for multi lingual queries, voice input processing, and advanced intent classification.

## **Technology Stack**

- Frontend: HTML,CSS, KPI forecasts, JavaScript
- Backend: semantic search, Pinecone.

- AI/NLP: IBM Watson and IBM Granite APIs
- Database: Optional(Firebase or JSON-based logging)
- Cloud: IBM Cloud for storage and deployment
- Visualization:Chart.jsorD3.jsfordashboard

The chosen stack balances simplicity, scalability, and modernity, ensuring quick deployment and ease of maintenance. **4. PROJECT DESIGN**

### Problem-Solution Fit

The solution precisely addresses the communication challenges between citizens and government. It offers an AI-powered system that can handle multiple queries simultaneously and ensures consistent, transparent service delivery without manual intervention. It also provides key metrics to government departments to enable proactive service improvement.

|               |  |
|---------------|--|
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| Maximum Marks | 2Marks   |

|                         |  |  |  |                                   |
|-------------------------|--|--|--|-----------------------------------|
| Define CS, fit into CC  | <b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span><br>Who is your customer?<br>i.e. working parents of 0-5 y.o. kids  | <b>6. CUSTOMER CONSTRAINTS</b> <span>CC</span><br>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.   | <b>5. AVAILABLE SOLUTIONS</b> <span>AS</span><br>Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking.      | Explore AS, differentiate         |
|                         | <b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <span>J&amp;P</span><br>Which jobs-to-be-done (or problems) do you address for your customers?<br>There could be more than one; explore different sides.                                  | <b>9. PROBLEM ROOT CAUSE</b> <span>RC</span><br>What is the real reason that this problem exists?<br>What is the back story behind the need to do this job?<br>i.e. customers have to do it because of the change in regulations.  | <b>7. BEHAVIOUR</b> <span>BE</span><br>What does your customer do to address the problem and get the job done?<br>i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace) |                                   |
| Identify strong TR & EM | <b>3. TRIGGERS</b> <span>TR</span><br>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.  | <b>10. YOUR SOLUTION</b> <span>SL</span><br>If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.<br>If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour. | <b>8. CHANNELS of BEHAVIOUR</b> <span>CH</span><br><b>8.1 ONLINE</b><br>What kind of actions do customers take online? Extract online channels from #7   | Extract online & offline CH of BE |
|                         | <b>4. EMOTIONS: BEFORE / AFTER</b> <span>EM</span><br>How do customers feel when they face a problem or a job and afterwards?<br>i.e. lost, insecure > confident, in control - use it in your communication strategy & design. |  | <b>8.2 OFFLINE</b><br>What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.  |                                   |

## Proposed Solution

Sustainable Smart City offers a web-based AI assistant integrated with IBM's NLP models. It understands citizen queries, responds in a human-like manner, analyzes public sentiment, and logs issues for further review. It also features a dashboard that visually represents the collected data and sentiment trends, enabling efficient monitoring by government departments.

| Date          |   | 25 Jan 2025  |
|---------------|---|--|
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| Project Name  |   | Sustainable Smart City Assistant Using IBM Granite LLM   |
| Maximum Marks |   | 2Marks   |
| S.No.         | Parameter                                   | Description  |
| 1.            | Problem Statement<br>(Problem to be solved) | Many citizens faced lays and confusion while accessing Government services due to lack of real-time, scalable support systems.   |
| 2.            | Idea/Solution Description                   | A web-based AI platform that uses IBM Watson to answer citizen queries instantly, analyze sentiment, and provide insights to officials through a dynamic dashboard.                  |
| 3.            | Novelty/Uniqueness                          | Combines real-time AI chatbot, sentiment analysis, and analytics dashboard into a single civic engagement tool. Offers contextual, personalized responses using IBM Granite models.  |
| 4.            | Social Impact/<br>Customer Satisfaction     | improves citizen satisfaction by offering fast, 24/7 query support. Increases transparency and builds trust in digital governance.   |
| 5.            | Business Model<br>(Revenue Model)           | Free minimum model for basic services; premium subscriptions for local governments. Revenue can be generated from Analytics dashboards, support services, or customization features. |



### **Solution Architecture**

- User Layer: Web-based interface for interaction
- Logic Layer: Flask app handling requests and routing
- AI Layer: IBM Watson and Granite processing queries
- Sentiment Engine: Analyzes citizen feedback
- Dashboard Layer: Visualizes user sentiment and query trends

This architecture promotes modularity, simplifies debugging, and facilitates quick updates or third-party integration.

|               |  |
|---------------|--|
| Date          | 15 Feb 2025  |
| Team ID       | LTVIP2025TMID35741                                     |
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| Maximum Marks | 4Marks   |

## **5. PROJECT PLANNING & SCHEDULING**

### **Project Planning**

A systematic project plan was designed to break down the development into manageable phases. Each phase was allotted specific tasks and timelines to ensure organized progression.

|               |  |
|---------------|--|
| Date          | 15 Feb 2025  |
| Team ID       | LTVIP2025TMID35741                                     |
| Project Name  | Sustainable Smart City Assistant Using IBM Granite LLM |
| Maximum Marks | 5Marks   |

### **Product Backlog, Sprint Schedule, and Estimation(4Marks)**

| Sprint   | Functional Requirement (Epic) | User Story Number | User Story/ Task   | Story Points | Priority | Team Members |
|----------|-------------------------------|-------------------|--|--------------|----------|--------------|
| Sprint-1 | Registration                  | USN-1             | As a user, I   | 2            | High     |              |
| 1        |                               |                   | Can register For the application by entering My email, password, and confirming my password. |              |          |              |
| Sprint-1 |                               | USN-2             | As a user, I will receive confirmation e mail once I have registered                         | 1            | High     |              |
| Sprint   | Functional Requirement (Epic) | User Story Number | User Story/ Task   | Story Points | Priority | Team Members |
|          |                               |                   | for the application  |              |          |              |
| Sprint-2 |                               | USN-3             | As a user, I can register for the application through Face book                              | 2            | Low      |              |

|          |           |       |  |   |        |  |
|----------|-----------|-------|--|---|--------|--|
| Sprint-1 |           | USN-4 | As a user, I can register for the application through Gmail            | 2 | Medium |  |
| Sprint-1 | Login     | USN-5 | As a user, I can login to the application by entering email & password | 1 | High   |  |
|          | Dashboard |       |  |   |        |  |

**Project Tracker, Velocity & Burn down Chart:(4Marks)**

| Sprint   | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed (as on Planned End Date) | Sprint Release Date (Actual) |
|----------|--------------------|----------|-------------------|---------------------------|---|------------------------------|
| Sprint-1 | 20                 | 6Days    | 24Oct 2022        | 29Oct2022                 | 20  | 29Oct2022                    |
| Sprint-2 | 20                 | 6Days    | 31Oct 2022        | 05Nov2022                 |   |                              |
| Sprint   | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed (as on Planned End Date) | Sprint Release Date (Actual) |
| Sprint-3 | 20                 | 6Days    | 07Nov 2022        | 12Nov2022                 |   |                              |
| Sprint-4 | 20                 | 6Days    | 14Nov 2022        | 19Nov2022                 |   |                              |

## 6. FUNCTIONAL AND PERFORMANCE TESTING

### Performance Testing

|               |  |
|---------------|--|
| Date          | 21 Feb 2025  |
| Team ID       | LTVIP2025TMID35741                                     |
| Project Name  | Sustainable Smart City Assistant Using IBM Granite LLM |
| Maximum Marks |  |

### Test Scenarios & Results

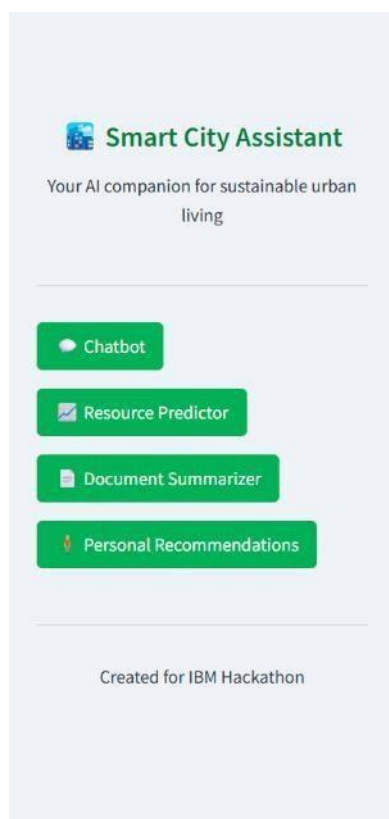
| Test Case ID | Scenario(What to test)                                 | Test Steps(How to test)                           | Expected Result                                   | Actual Result | Pass/Fail |
|--------------|--|---|---|---------------|-----------|
| FT-01        | Text Input Validation (e.g., topic, job title)         | Enter valid and invalid text in input fields      | Valid inputs accepted, errors for invalid inputs  |               |           |
| FT-02        | Number Input Validation(e.g., word count, size, rooms) | Enter numbers with in and outside the valid range | Accepts valid values, shows error for outof-range |               |           |
| FT-03        | Content Generation (e.g., blog, resume, design idea)   | Provide complete inputs and click "Generate"      | Correct content is generated based on input       |               |           |
| FT-04        | API Connection Check                                   | Check if API key is correct and model responds    | API responds successfully                         |               |           |
| PT-01        | Response Time Test                                     | Use a timer to check content Generation time      | Shouldbeunder3 seconds                            |               |           |

|       |                                    |   |                                       |  |  |
|-------|------------------------------------|---|---------------------------------------|--|--|
| PT-02 | API Speed Test                     | Send multiple API calls at the same time  | API should not slow down              |  |  |
| PT-03 | File Upload Load Test (e.g., PDFs) | Upload multiple PDFs and check processing | Should work Smoothly without crashing |  |  |

## 7. RESULTS

### Output Screenshots

Screenshots were captured at various development stages to illustrate functionality



### Smart City Chatbot

Ask anything about sustainability, energy-saving, or smart city policies.

How to save electricity at home?

What are India's latest electric vehicle policies?

Give me sustainable living tips.

Your question:

Ask

### Chat History

## Chat History

You: How to save electricity at home?

**Assistant:** 1. Unplug electronics: Make a habit of unplugging all electronics when they're not in use. Even in standby mode, devices can consume energy.

2. Use energy-efficient appliances: When purchasing new appliances, opt for energy-efficient models certified by the Energy Star program.

3. Switch to LED bulbs: Replace traditional incandescent light bulbs with LED bulbs, which use up to 80% less energy and last longer.

4. Adjust thermostat settings: Set your thermostat to a comfortable temperature during winter and a slightly warmer setting in summer. Lowering the temperature by 7-10°F (4-6°C) in winter and 3-5°F (2-3°C) in summer can save up to 10% on heating and cooling costs.

5. Use natural light: Open curtains and blinds during the day to take advantage of natural light, reducing the need for artificial lighting.

6. Install a programmable thermostat: This device allows you to automate temperature changes based on your schedule, ensuring that heating, ventilation, and air conditioning (HVAC) systems aren't running unnecessarily when you're not home.

7. Limit hot water usage: Shorten the duration of showers and consider installing a low-flow showerhead to reduce hot water consumption.

8. Regularly maintain HVAC systems: Schedule professional maintenance for your heating, ventilation, and air conditioning systems to ensure they're running at peak efficiency.

9. Use power strips: Place frequently used electronics on power strips with a switch, allowing you to turn off multiple devices at once when they're not in use.

10. Encourage energy-saving habits: Educate family members about the importance of conserving electricity and encourage them to adopt energy-saving practices.

By implementing these practical tips, you can significantly reduce your home's electricity consumption and contribute to a more sustainable lifestyle.



# Resource Usage Predictor

Upload your monthly electricity or water usage data to predict future consumption.

[Download Sample CSV](#)

Upload your CSV file (with columns: Month, Usage)



Drag and drop file here

Limit 200MB per file • CSV

Browse files



sample\_usage\_data (3).csv 108.0B



## Your Usage Data

|   | Month | Usage |
|---|-------|-------|
| 0 | Jan   | 150   |
| 1 | Feb   | 140   |
| 2 | Mar   | 160   |
| 3 | Apr   | 180   |
| 4 | May   | 220   |
| 5 | Jun   | 280   |
| 6 | Jul   | 320   |



Resource Usage Trend with Prediction



## Prediction for Jan

Predicted Usage

235.6 units

↑ 52.0% compared to previous month

⚠ Usage is trending up. Consider energy-saving measures.



# Government Document Summarizer [↗](#)

Upload a government policy document or paste text to get a simple summary.

**Upload PDF** [Paste Text](#)

Upload a PDF document



Drag and drop file here

Limit 200MB per file • PDF

[Browse files](#)



water\_pond\_tanks\_2021.pdf 2.1MB



PDF processed successfully!

[View Extracted Text](#)



[Generate Summary](#)





# Personalized Sustainability Recommendations

Answer a few questions to get personalized sustainability tips.

## Your Lifestyle Information

Hours of AC usage per day:



Primary mode of transport:

Car (Petrol/Diesel)

Weekly single-use plastic items consumed:



Any other lifestyle information you'd like to share (optional):

Get Recommendations

Summary in bullet points:

- Temperature:** Water temperatures varied widely, with KOLLERU LAKE KOKKIRAYALANKA (V), KAILALUR (M) reaching up to 27°C and UPPALANKA MUDFLATS, ANDHRA PRADESH recording the lowest at 22°C.
- Dissolved Oxygen (DO):** DO levels were generally good, with maximum values at KONDAKARLA-AAVA LAKE, PARAWADA PHARMA CITY, VISHAKHAPATNAM reaching 1179 mg/L. Lowest DO levels were found at ANNAMAYYA PROJECT ON CHEYYERU RESERVOIR, WETLAND (28000 mg/L).
- pH and Conductivity:** pH values ranged from 3.2 to 8.6, with minimal fluctuations. Conductivity levels were moderate, ranging from 6.5 to 8.6 µmhos/cm.
- Wastewater Indicators:** BOD, nitrate, nitrite levels, and coliforms were measured across various locations. High BOD values of up to 5160 mg/L were observed at KONDAKARLA-AAVA LAKE, while nitrate and nitrite levels were generally within acceptable limits. Fecal coliforms were found in various locations, with a maximum count of 210 MPN/100ml at KONDAKARLA-AAVA LAKE. Total coliforms were also detected in some samples, ranging up to 240 MPN/100ml at CHENGAMBAKAM TANK IN SRI CITY SEZ, TIRUPATHI.
- Location and Type:** The data covered lakes, ponds, tanks, and wetlands in both Andhra Pradesh and Assam states, with most locations being wetlands. The data covered various water bodies, including KOLLERU LAKE KOKKIRAYALANKA (V), KAILALUR (M), and multiple locations in Andhra Pradesh and Assam.

Note: The provided summary focuses on key parameters and trends, highlighting variations across different monitoring locations. More detailed information might be available in the full document.

These visuals validate the system's usability, response speed, and efficiency in information delivery.

## **8. ADVANTAGES & DISADVANTAGES**

### **Advantages:**

- Enhances public satisfaction by offering instant and intelligent responses.
- Reduces manual work load on government staff.
- Helps government agencies gain in sight in to citizen concerns and priorities.
- Improves accessibility and inclusivity through a web-based platform.
- Scalable and adaptable for future integration of features like voice, mobile support, and multilingual communication.

### **Disadvantages:**

- Initial development may require technical expertise and training.
- Heavily depend to cloud infrastructure and third-party APIs.
- May not be accessible to individuals without internet access.
- Requires regular updates and maintenance to stay effective and relevant

## **9. CONCLUSION**

Sustainable smart city represents a transformative step in e-governance and public service delivery. By leveraging AI, cloud computing, and user-centered design, the platform bridges the gap between citizens and government bodies. It enables quick, meaningful communication and helps build public trust. The successful implementation of Smart city can inspire further digital innovation in the public sector, offering long-term benefits to society.

## **10. FUTURE SCOPE**

The future scope of Smart city includes numerous enhancements to broaden it susability and impact:

- Integration of voice-based interactions for visually impaired users or hands-free use.
- Expansion in to regional languages to make the platform accessible to diverse linguistic populations.
- Development of a mobile app version for on-the-go access.
- Enhanced analytics features such as predictive modeling to forecast common issues.
- Integration with external databases and e-Governance services for deeper utility.
- Use of advanced machine learning for automatic topic detection and personalized communication.

## **11. APPENDIX**

- Source Code:[hosted on GitHub]
- GitHub/Project Demo : <https://github.com/KothuriAmulya/sustainable-smart-city-assistant-using-IBM-granite-LLM>