Project Plan: Urban Planning for Climate-Resilient City

1. Project Context:

Modern cities, especially those experiencing rapid urbanization, face significant challenges posed by climate change. These challenges put both the environment and urban inhabitants at risk, affecting air and water quality and exacerbating the urban heat island effect. To address these issues, it is essential to create data-driven, sustainable urban planning solutions that balance the needs of development with the health of both the environment and residents.

2. Objectives:

Our project aims to use NASA Earth observation data to support smarter, more resilient urban planning by focusing on two major challenges:

1. Reducing the impact of urban heat islands.
2. Monitoring and improving air quality in vulnerable areas.

3. TerraLens - A Data-Driven Tool for Sustainable Urban Planning

TerraLens is a **web-based platform** designed to help urban planners make smarter, data-informed decisions for climate-resilient city development. It integrates NASA Earth observation data into two interactive maps: a heatmap that visualizes urban heat islands using thermal satellite data, and an air pollution map displaying real-time air quality levels for **over 300 cities Worldwide**. These features allow

planners to identify critical hotspots and prioritize interventions where they are most needed.

In addition to data visualization, TerraLens includes a Learn section with educational materials on air pollution and urban heat islands, an About section detailing the project's mission and impact, and a Feedback section where citizens can suggest improvements for their neighborhoods.

Together with this project plan, TerraLens works as a practical tool to put ideas into action: the plan lays out the solutions, and the website helps urban planners actually make them happen in the areas that need it most.

4. Addressing the Urban Heat Island Effect

Context: **Urban Heat Islands (UHIs)** are created when the temperature of an urban area is higher than the temperature of surrounding rural areas. The sun's rays heat up urban surfaces that either retain the energy, such as pavement, or reflect it back into the atmosphere, such as certain types of building roofs and exteriors. These processes can increase the temperature of a city and can intensify temperatures to dangerous levels in larger populated areas during heatwaves, as seen during the 2003 heatwave in Western Europe.

Problem: Thermal satellite data shows that urban centers often record surface temperatures 4–6°C higher than surrounding rural areas, due to dense construction, lack of greenery, and dark building materials. This urban heat island effect increases energy consumption, health risks, and discomfort for residents.

Solution: To mitigate the urban heat island effect, we propose implementing **green infrastructure**, such as rooftop gardens, trees, and vertical green walls—together with **reflective surfaces** on public and commercial buildings. Green areas naturally cool the city through

shade and evapotranspiration, while also improving local air quality and enhancing urban biodiversity. Reflective roofs and pavements reduce the amount of heat absorbed by built surfaces, lowering surrounding air temperatures and energy consumption for cooling.

How the Website Supports It: Our website helps urban planners and decision-makers identify which areas experience the most intense heat stress by visualizing surface temperature data derived from **NASA's MODIS thermal observations**. By viewing the spatial distribution of surface temperatures on an interactive map, planners can identify urban heat islands and prioritize where cooling interventions are most urgently needed.

By using this satellite-informed heat map, city leaders can prioritize investments efficiently, ensuring that limited resources are directed to areas where they will have the largest environmental and social impact, especially communities most at risk from extreme heat.

5. **Addressing Air Pollution:**

Context: As cities continue to expand, increased traffic, industrial activity, and energy consumption have led to rising air pollution levels. Urban areas are now some of the most polluted environments on Earth, where millions of residents breathe unsafe air daily. This issue not only threatens human health but also contributes to climate change by trapping heat and damaging local ecosystems. Tackling air pollution is therefore essential for building cities that are both livable and sustainable.

Problem: Air pollution remains one of the most serious environmental and health challenges in urban areas. Satellite data shows that industrial zones and high-traffic corridors consistently

exceed safe pollution thresholds (For example: elevated levels of air pollutants such as NO_2, CO, and aerosols). This contributes to respiratory illnesses, reduced life expectancy, and a lower overall quality of life, particularly for vulnerable populations such as children, the elderly, and those with pre-existing health conditions.

Solution: To address this, we propose **creating low-emission** zones where polluting vehicles are restricted and **promoting clean transportation options**, such as electric vehicles, cycling lanes, and improved public transit systems. These measures reduce harmful emissions, lower health risks, and make urban life cleaner and healthier for residents.

How the Website Supports It: Our website provides real-time insights into air quality levels across over **300 cities Worldwide** . For each city, it displays several sensor locations that measure local pollution levels. When a user clicks on a point, the platform shows the Air Quality Index (AQI) for that area, helping urban planners identify which zones are most affected.

By integrating **NASA's MODIS data**, the map also visualizes air pollution intensity and long-term trends. This allows planners and city leaders to **pinpoint pollution hotspots** such as highways or industrial districts and **prioritize** where to implement low-emission zones or invest in sustainable mobility.

6. Expected impact:

By tackling air pollution and the urban heat island effect together, our project promotes **cleaner, cooler,** and **healthier** cities. Using NASA Earth observation data and our interactive map, urban planners can target the most affected areas for green infrastructure, reflective surfaces, and low-emission zones. These actions will reduce pollution,

lower temperatures, and improve public health, while encouraging more sustainable urban growth.

The project is also in conformity with 3 of the 17 **Sustainable Development Goals**

- SDG 3 (Good Health and Well-Being)
- SDG 11 (Sustainable Cities and Communities)
- SDG 13 (Climate Action)

through data-driven, climate-resilient urban planning.

7. Conclusion:

Our project demonstrates how NASA Earth observation data can transform urban planning into a smarter, more sustainable process. By combining scientific insights with our interactive platform, urban planners and city leaders can identify environmental challenges, design targeted interventions, and involve citizens in building cleaner, cooler, and more resilient cities. This approach ensures that urban growth benefits both people and the planet, setting a foundation for a healthier and more sustainable future.