

TEAM ECHO

# GreenPulse

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AI-Driven Urban Green Intelligence for Sustainable City Planning

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# THE CHALLENGE

## Rapid Urbanization

Aggressive infrastructure expansion is reducing critical green cover faster than replanting efforts, creating concrete jungles.

## No Real-Time Monitoring

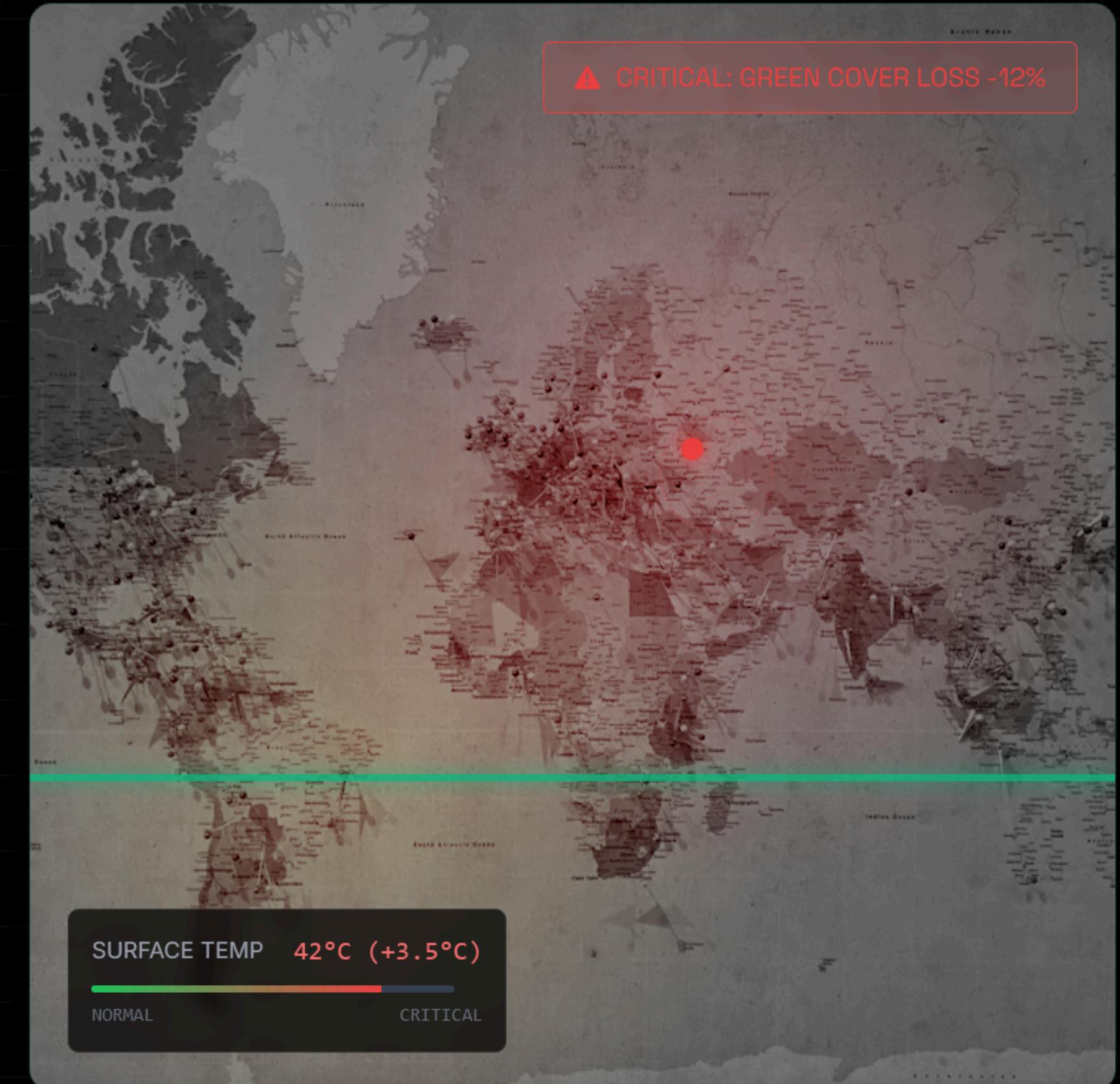
Current satellite data is often outdated or static, failing to capture illegal deforestation or rapid vegetation loss as it happens.

## Lack of Predictive Alerts

City planners react to environmental damage after it occurs rather than receiving AI-driven warnings to prevent loss.

## Rising Climate Risks

Diminishing green lungs lead to intense Urban Heat Islands (UHI), poor air quality, and severe health impacts.



# OUR SOLUTION ARCHITECTURE



## Urban Stress Analysis Engine

Integrates PM2.5, population density, land surface temperature, green cover and open land into a unified normalized framework for ward-level environmental assessment.

MOD-01



## Urban Green Priority Index

Computes a transparent weighted Priority Score for each ward:

```
Priority_Score =  
0.30 × Norm_Population_Density  
+ 0.25 × Norm_PM2.5  
+ 0.20 × Norm_Temperature  
+ 0.20 × Green_Deficit  
+ 0.05 × Norm_Open_Land
```

MOD-02



## Spatial Clustering Intelligence

Applies K-Means clustering to group wards with similar environmental profiles, revealing patterns such as high pollution + low green cover zones.

MOD-03



## Green Potential Mapping

Overlays open and underutilized land parcels to identify feasible afforestation zones. Supports Satellite, Street, and Light Gray base map modes for enhanced spatial analysis.

MOD-04

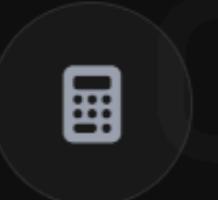
# KEY FEATURES

A comprehensive suite of tools designed for precision environmental monitoring and proactive urban planning.



## 01 Multi-Factor Stress Analysis

Combines population density, PM2.5, land surface temperature, green cover and open land into a unified environmental stress framework.



## 02 Urban Green Priority Index

Weighted scoring model calculates ward-level Priority Score using normalized environmental indicators for transparent decision-making.



## 03 Real-Time Intelligence

Live CSV streaming updates ward metrics instantly. Pathway recomputes priority scores incrementally and maintains always-fresh vector indices. Future-ready for live API integrations.



## 04 AI Natural Language Interface

Ask: "Which ward needs urgent greening?" or "Show high-priority zones near open land." Powered by Groq LLM with live streaming context.



## 05 Interactive Spatial Dashboard

Dynamic priority maps with Satellite, Street and Light Gray modes, cluster overlays and feasibility layers for afforestation planning.

# HOW IT WORKS



**REAL-TIME INTELLIGENCE:** Unlike static dashboards, GreenPulse uses Pathway's streaming engine to provide live-updating priority scores and AI-powered natural language queries via Groq LLM.

# IMPACT & USE CASES



## Urban Planning

Identify high-stress wards and prioritize plantation drives to reduce urban heat islands and improve environmental balance.

Heat Mitigation

Ward Ranking

01



## Policy Support

Enable data-backed budget allocation and greening targets with transparent environmental scoring.

Governance

Compliance

02



## Climate Research

Provide structured ward-level datasets to support academic studies on micro-climate shifts and vegetation resilience.

Research

Longitudinal Data

03



## Smart City Planning

Support smart city initiatives by integrating environmental priority maps into infrastructure and zoning decisions.

Urban Infra

Sustainability

04



## ESG & Sustainability Reporting

Enable organizations to showcase transparent green metrics and sustainability performance using standardized scoring.

ESG

Corporate

05

# TECH STACK

## CORE LANGUAGE

- JavaScript (ES6+)
- Python 3.10+
- HTML5
- CSS3

## BACKEND FRAMEWORK

- Pathway (Real-time Streaming Engine)
- Incremental Computation
- Live Vector Indexes

## STREAMING DATA

- Live CSV Ingestion
- Pathway Connectors
- Continuous Ward Updates

## DATA PROCESSING

- Pathway Streaming Transforms
- Turf.js (Spatial Ops)
- Weighted Scoring Engine

## CLUSTERING ENGINE

- skmeans (Real-time on Live Data)
- Ward Segmentation

## MAPPING ENGINE

- Leaflet.js
- Satellite / Street / Light
- Layer Control

## AI INTEGRATION

- Groq LLM (Mixtral-8x7B)
- Natural Language Query Engine
- Context from Live Streaming Data

## LLM ORCHESTRATION

- Pathway LLM xPack
- AI Query Routing

## DEPLOYMENT

- Docker Containerization
- Production Streaming Pipeline

# —COMPETITIVE ANALYSIS : why we win



## Priority-Driven Planning

Unlike ArcGIS Urban and QGIS which provide raw spatial tools, GreenPulse delivers a built-in weighted Priority Score specifically designed for green intervention ranking.

COMPARED TO

ArcGIS Urban • QGIS

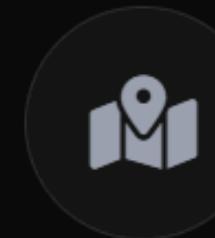


## Explainable Scoring

Google Earth Engine enables deep analysis but requires coding expertise. GreenPulse provides transparent, formula-based scoring that policymakers can easily understand.

COMPARED TO

Google Earth Engine

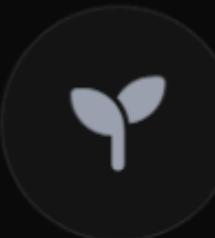


## Ward-Level Granularity

Most urban dashboards operate at city-level metrics. GreenPulse works at ward-level resolution, enabling hyper-local green intervention strategies.

COMPARED TO

Generic Urban Dashboards



## Feasibility + Need Combined

While most tools identify environmental stress, GreenPulse also overlays open land availability — bridging the gap between need and implementable action.

UNIQUE EDGE

Need + Feasibility Mapping

# FUTURE SCOPE

## PHASE 1



### Live API Integration

Connect to OpenAQ for real-time PM2.5 data and weather APIs for live temperature updates to auto-refresh priority scores.

## PHASE 2



### Mobile App

Field data collection for ground-truthing vegetation health and validating satellite-based stress indicators.

## PHASE 3



### Predictive Alerts

Machine learning models to forecast green stress zones before critical environmental degradation occurs.

## PHASE 4



### Citizen Engagement Portal

Public platform allowing citizens to suggest greening spots and participate in sustainable urban planning.



ZONE A: HEALTHY

SYSTEM READY

# Monitoring Earth's Lungs with Intelligence

Let's build smarter, greener cities.

DEMO

ZONE B: PRIORITY

