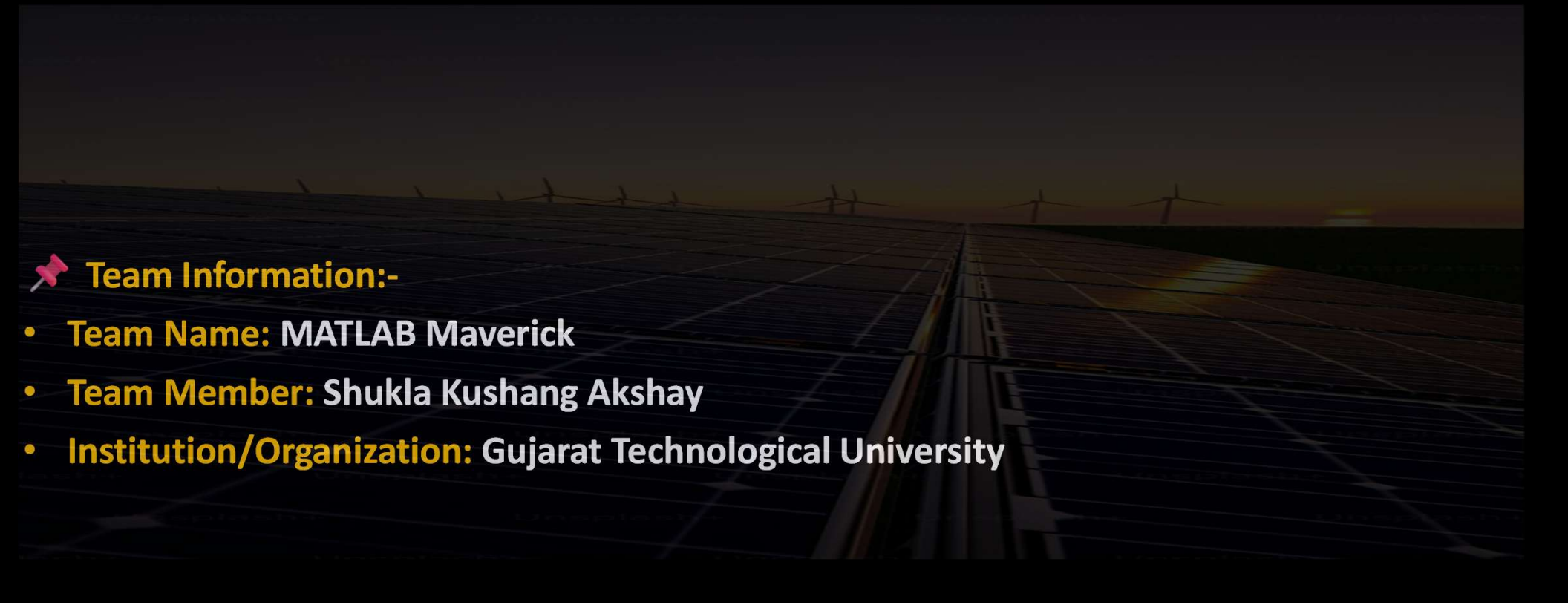
# Optimizing Solar Panel Placement

## Maximizing Solar Energy Output with Smart Tracking & Optimization



📌 **Team Information:-**

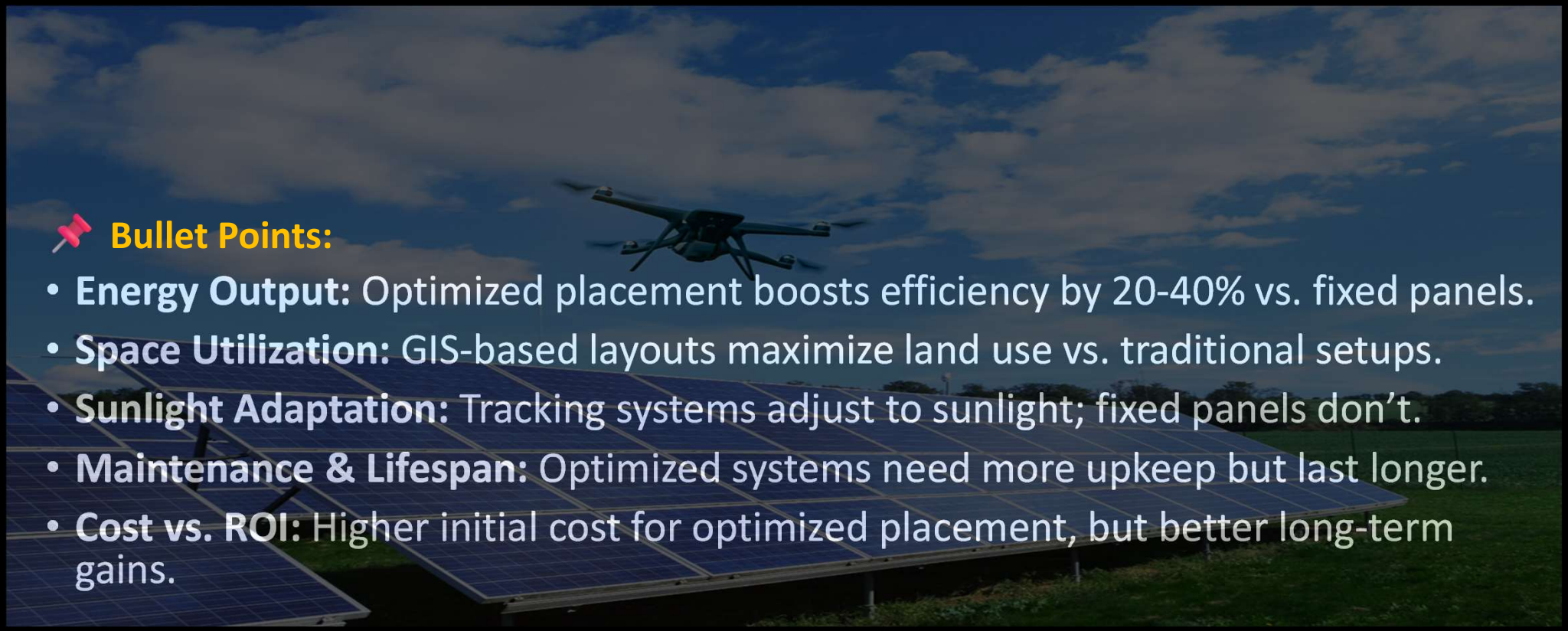
- **Team Name:** MATLAB Maverick
- **Team Member:** Shukla Kushang Akshay
- **Institution/Organization:** Gujarat Technological University

# Problem Statement & Motivation

📌 **Bullet Points:**

- **Solar power faces 30-40% energy loss** due to **poor placement & inefficiency**.
- **Shading, seasonal variations, and grid instability** reduce performance.
- **Manual tracking & maintenance is costly & outdated**.
- 📌 **Decision Step:**
  ✅ **Do we need a smarter system? (YES → Optimize using AI, IoT & GIS!)**

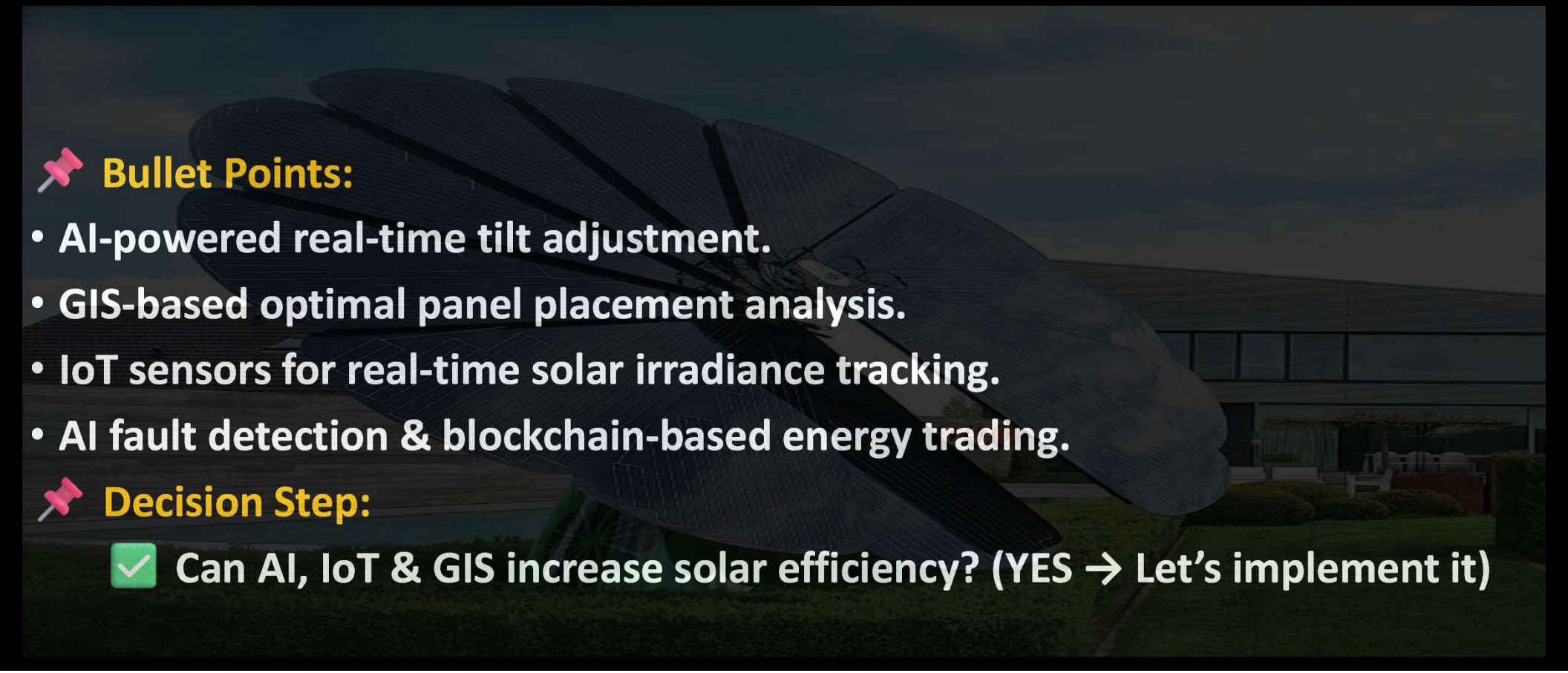
# Comparison of Traditional vs Optimized Solar Placement Efficiency



📌 **Bullet Points:**

- **Energy Output:** Optimized placement boosts efficiency by 20-40% vs. fixed panels.
- **Space Utilization:** GIS-based layouts maximize land use vs. traditional setups.
- **Sunlight Adaptation:** Tracking systems adjust to sunlight; fixed panels don’t.
- **Maintenance & Lifespan:** Optimized systems need more upkeep but last longer.
- **Cost vs. ROI:** Higher initial cost for optimized placement, but better long-term gains.

# Our Solution – Smart Optimization System



📌 **Bullet Points:**

- AI-powered real-time tilt adjustment.
- GIS-based optimal panel placement analysis.
- IoT sensors for real-time solar irradiance tracking.
- AI fault detection & blockchain-based energy trading.

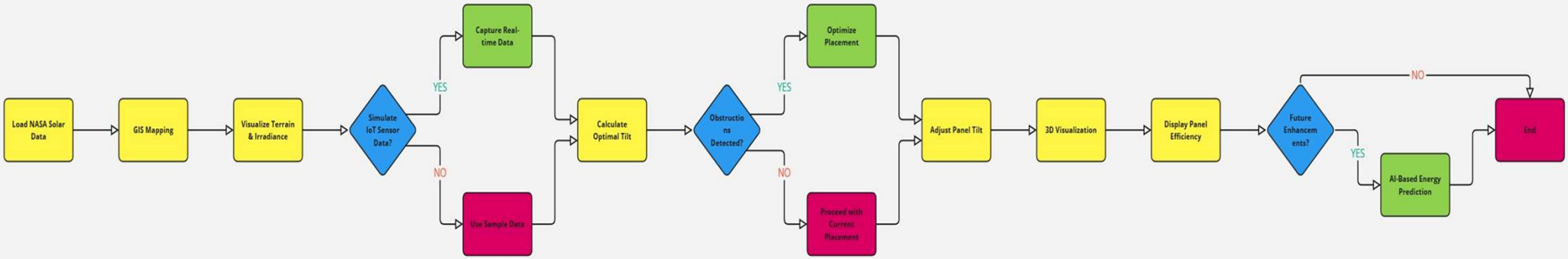
📌 **Decision Step:**

✅ Can AI, IoT & GIS increase solar efficiency? (YES → Let's implement it)

# System Architecture (Block Diagram)

📌 **Bullet Points:**

- **Step-by-step flow of the system (Data Input → Processing → Decision Making → Output)**
- **Data from IoT sensors, AI models, and GIS maps feed into MATLAB.**



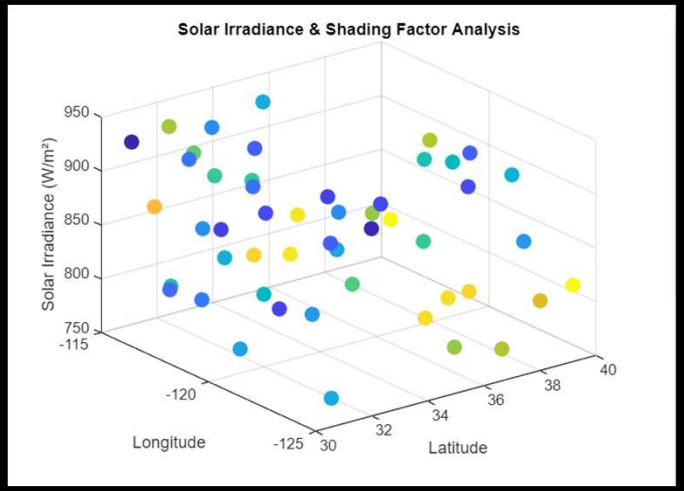

Block Diagram

# Core Implementation Steps

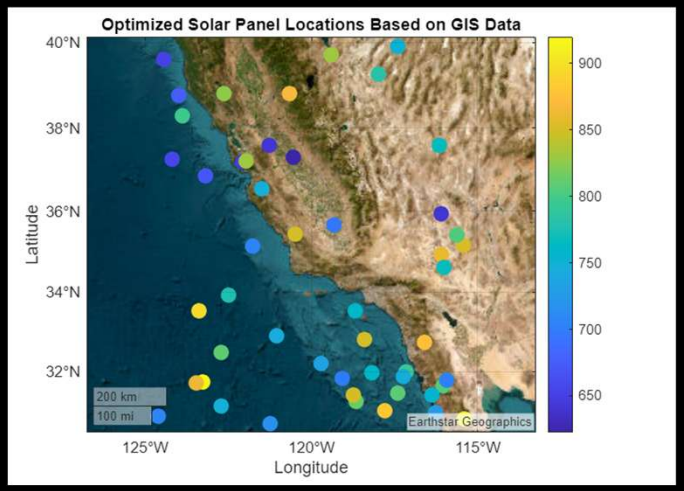
📌 **Steps 1-10: Data Processing & Optimization:**

- Load solar data ✅
- Reshape terrain data ✅
- Compute sun's position ✅
- Optimize panel tilt dynamically ✅
- Perform shading analysis ✅

  📌 **Decision Step:** Is shading detected? (YES → Relocate panel, NO → Proceed)




Solar Irradiance & Shading Factor Analysis




Optimized Solar Panel Locations Based on GIS Data

# Simulation Outputs & Performance Metrics

📌 **Bullet Points:**

- GIS Heatmap & Terrain Analysis ✅
- Solar Irradiance Distribution & Efficiency Calculation ✅
- Smart Panel Rotation & Power Grid Synchronization ✅
- Blockchain-based Energy Transactions ✅

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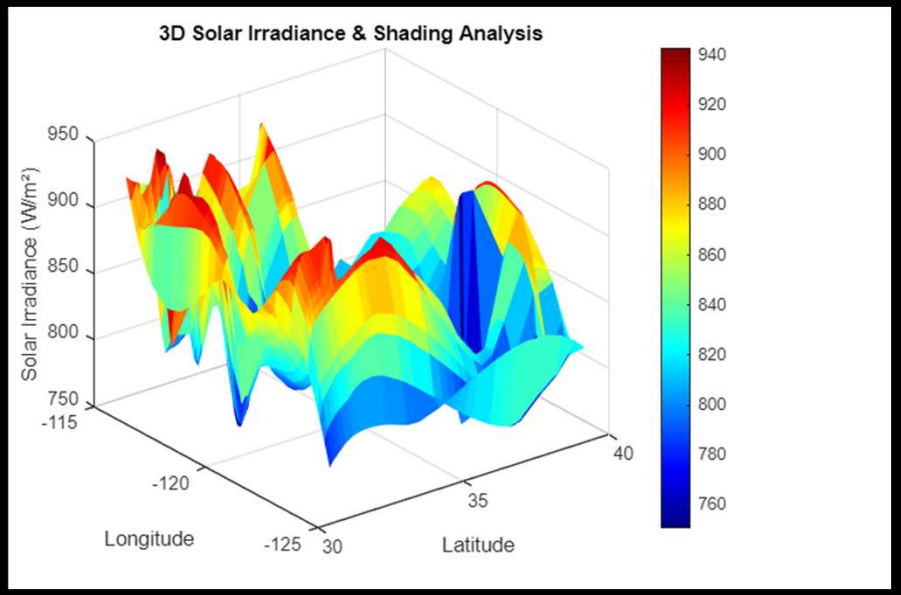
Optimal Seasonal Tilt Angle: 35.50°
```

Optimal Seasonal Tilt Angle

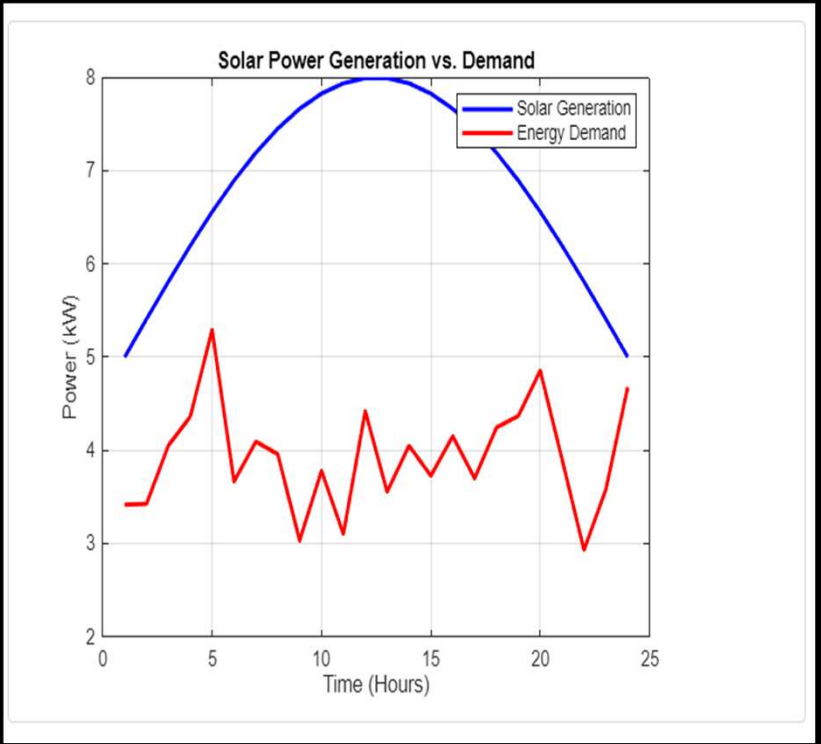



3D Solar Irradiance & Shading Analysis

## 📌 Steps 11-22: Energy Management & AI Integration:

- Predict energy demand ✅
- Synchronize with power grid ✅
- Adjust tilt for seasonal variations ✅
- Fault detection & maintenance alerts ✅

📌 **Decision Step:** Is power demand higher than supply? (YES → Switch to battery/grid)

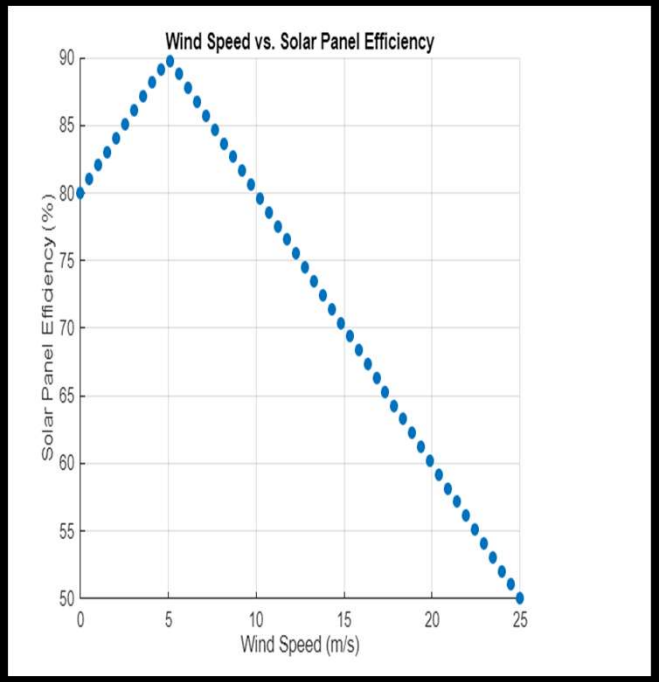



Supply vs Demand Graph

## 📌 Steps 23-33: Smart Enhancements & AI Innovations:

- AI-powered weather prediction ✅
- Blockchain-based energy trading ✅
- IoT-powered home appliance control ✅
- Smart panel rotation based on wind & clouds ✅

  📌 **Decision Step:** Is wind speed high? (YES → Adjust tilt for stability)

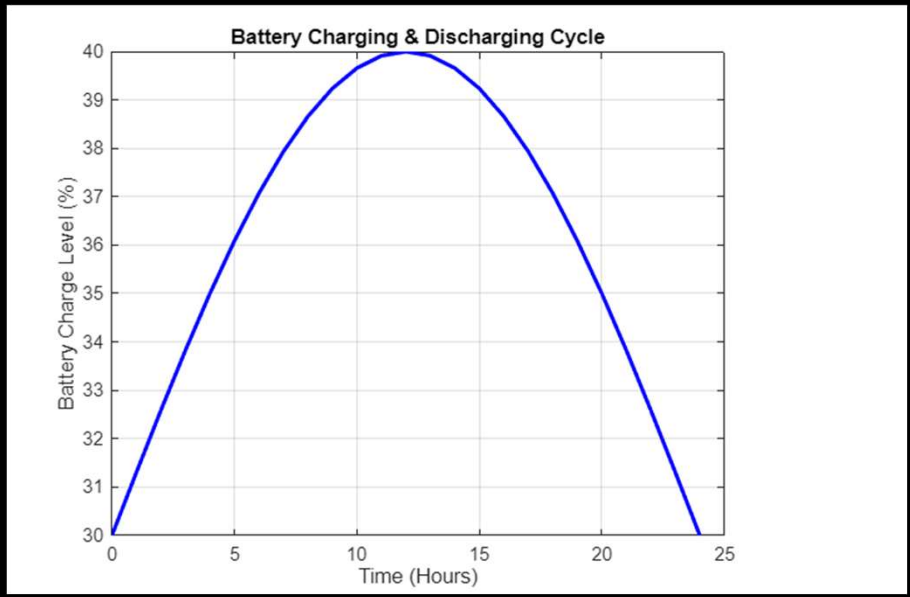



Wind-speed vs efficiency correlation graph

# Energy Load Forecasting & Smart Battery Management

📌 **Bullet Points:**

- **Uses moving average for demand prediction.**
- **Optimizes battery charge cycles.**
- **Decides when to store vs sell energy.**




Battery charge-discharge cycle graph

# Real-Time IoT Sensor Data Visualization

📌 **Bullet Points:**

- **Live tracking of solar irradiance & temperature.**
- **Automated tilt adjustment based on sensor inputs.**

```
IoT Sensor - Solar Irradiance: 847.56 W/m² | Temperature: 30.43°C
```

IoT Sensor- Solar Irradiance & Temperature

# AI Fault Detection & Performance Monitoring

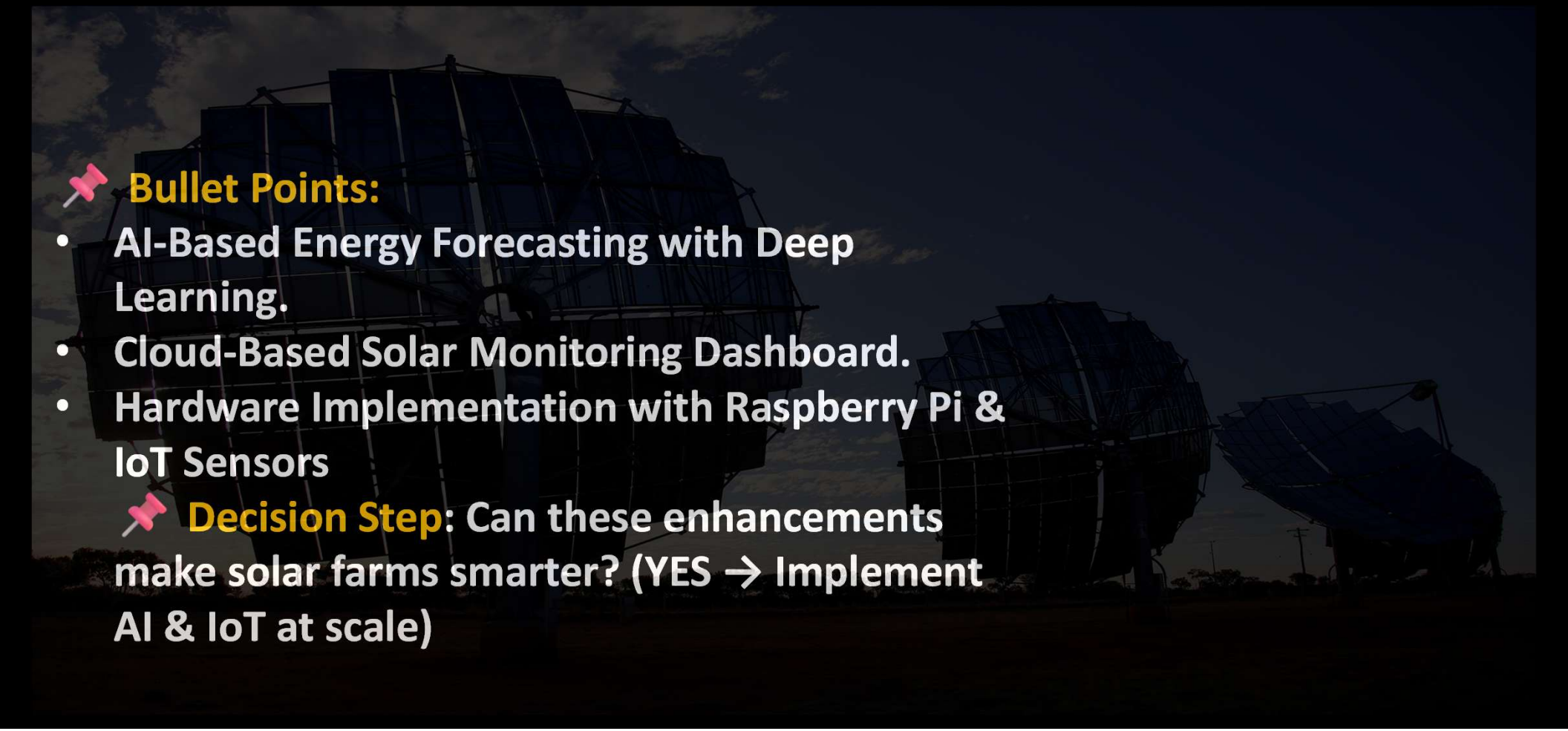
📌 **Bullet Points:**

- **Identifies faulty panels using predictive maintenance.**
- **Reduces maintenance costs by 40%.**

```
Faulty Solar Panels Detected at Indices: [5 8]
```

Faulty Solar Panels Detected at Indices

# Future Enhancements:



📌 **Bullet Points:**

- AI-Based Energy Forecasting with Deep Learning.
- Cloud-Based Solar Monitoring Dashboard.
- Hardware Implementation with Raspberry Pi & IoT Sensors

📌 **Decision Step**: Can these enhancements make solar farms smarter? (YES → Implement AI & IoT at scale)

# Conclusion & Impact

📌 **Bullet Points:**

- ✅ Higher energy efficiency through AI-powered tracking.
- ✅ Lower maintenance costs using AI fault detection.
- ✅ Smart solar grid integration with blockchain energy trading.
- ✅ Real-time decision-making for better energy management.

# Thank You & Q&A

📌 **Bullet Points:**

- **Open floor for questions & discussions.**
- **GitHub Link for Code:**
  **https://github.com/KushangShukla/OptimizingSolarPanelPlacement**

Scan QR Code for GitHub for Code