# Model Card – Rooftop Solar Verification System

## 1. Project Overview

This project is developed for the EcoInnovators Ideathon – College Edition. The objective is to verify rooftop solar panel installations under the PM Surya Ghar scheme using AI-based image analysis. The system takes geographic coordinates and rooftop images as input and determines whether solar panels are present within a specified buffer radius.

## 2. Dataset Used

Dataset 1: Alfred Weber Institute of Economics – Solar Panel Dataset (via Roboflow). This dataset consists of annotated satellite and rooftop images containing solar panel bounding boxes. The dataset is publicly available and is used strictly for academic and ideathon purposes.

## 3. Model Details

- Model Architecture: YOLOv8 (Ultralytics)
- Base Model: yolov8n
- Training Platform: Roboflow
- Inference Method: Bounding box based object detection

## 4. Inference Pipeline

1. Input is provided via an Excel file containing sample_id, latitude, longitude, and image path.
2. The YOLOv8 model detects solar panels in the given rooftop image.
3. A buffer radius of 1200 sq.ft is checked first. If no panel overlaps, a 2400 sq.ft buffer is used.
4. If multiple panels are detected, the panel with maximum overlap with the buffer is selected.
5. Output includes has_solar flag, selected buffer radius, total panel area, overlay image, and JSON file.

## 5. Use of Roboflow API

The Roboflow Serverless Inference API is used to access the pretrained solar panel detection model. The API enables fast and scalable inference without local GPU dependency. API credentials are stored securely and not exposed in public repositories.

## 6. Assumptions & Approximations

- Latitude and longitude are treated as proxy coordinates mapped to image space for overlap computation.
- Panel area is approximated using bounding box pixel area as a proxy for real-world area.
- Exact geo-referencing is not performed due to dataset limitations.

## 7. Limitations

- Pixel-based area estimation does not represent exact real-world square footage.

- Performance depends on image resolution and lighting conditions.
- Occluded or very small panels may not be detected accurately.

## 8. Ethical & Responsible AI Considerations

This system is intended for decision support and verification assistance only. Final eligibility decisions should involve human review. No personal or sensitive user data is stored or processed.

## 9. Reproducibility

The GitHub repository contains the complete inference pipeline, environment setup files, sample inputs, outputs, and instructions to reproduce the results on any standard Python environment.