**AI for Climate Action – Project Description**

**Title**

**Forecasting National Carbon Emissions Using Supervised Learning to Support the UN’s 2030 Climate Agenda**

**Problem Statement (SDG 13 Context)**

The 2030 Agenda for Sustainable Development and frameworks like the *Future We Want*, the *Johannesburg Plan of Implementation*, and *Agenda 21* highlight a growing concern over the gap between current mitigation efforts and what is needed to limit global warming to below 2°C or 1.5°C. Paragraph 31 of the 2030 Agenda calls for enhanced international cooperation to accelerate greenhouse gas reductions. However, progress has been uneven, and decision-makers lack accurate, real-time tools to monitor and forecast national-level emissions.

To help bridge this gap, we propose an AI-based forecasting model to predict future CO₂ emissions using historical data on national energy use, GDP, population, and climate indicators. This supports the call for “systematic observation of the Earth’s atmosphere” and integrates data-driven forecasting into environmental planning.

**SDG Goal & Target Addressed**

* **SDG 13: Climate Action**
* **Target 13.2**: Integrate climate change measures into national policies, strategies and planning.
* **Target 13.3**: Improve education, awareness-raising and human and institutional capacity on climate change mitigation.

**Machine Learning Approach**

**Approach**: **Supervised Learning (Regression Model)**

* **Goal**: Predict CO₂ emissions in metric tons per year.
* **Algorithm**: Linear Regression, Random Forest Regressor (baseline), XGBoost (advanced)
* **Features**: GDP per capita, fossil fuel consumption, renewable energy use, population size, industrial output, etc.

**Dataset & Tools**

* **Sources**:
  + Our World in Data – Greenhouse Gas Emissions
  + [World Bank Climate and Energy Datasets](https://data.worldbank.org/topic/climate-change)
  + [UN SDG Indicators Global Database](https://unstats.un.org/sdgs/indicators/database/)
* **Tools**:
  + Python
  + Jupyter Notebook
  + Libraries: pandas, scikit-learn, matplotlib, seaborn, xgboost

**Model Workflow**

1. **Data Preprocessing**
   * Cleaning missing values
   * Normalizing input features
   * Creating lagged variables for emissions trends
   * Splitting into training/test sets (e.g., 80/20)
2. **Model Training & Evaluation**
   * Try multiple regressors (Linear Regression, Random Forest, XGBoost)
   * Metrics: Mean Absolute Error (MAE), R² Score
   * Visualizations: Emission trends, prediction vs actual
3. **Interpretation**
   * Which factors most influence emissions?
   * Which countries are projected to miss emission targets?

**Ethical Reflection**

* **Bias Risk**: Not all countries have consistent or high-quality reporting. Developing countries may be underrepresented, leading to less accurate predictions.
* **Equity Considerations**: Model results should **not penalize** countries with lower historical emissions. Instead, the tool should **support just climate transitions**, offering insights for equitable resource allocation and planning.
* **Transparency**: The model must be open-source, interpretable, and aligned with the principles of the UNFCCC.

**Outcome & Impact**

This AI-powered emissions predictor can:

* Help national governments forecast future emissions trends
* Assist in **climate mitigation planning**
* Monitor progress toward SDG 13 targets
* Promote **accountability and transparency** in global climate efforts