Global Pollution Analysis and Energy Recovery

Objective

The main purpose of this project was to understand global pollution situation and try to analyse how we can reduce it and at the same time recover some energy from it. I used dataset that have pollution data like air and water index, co2 emission, waste etc and then try to build some model to predict energy recovery.

Phase 1: Data Understanding and Preprocessing

First I loaded the dataset called Global_Pollution_Analysis.csv and checked for missing values. Some data was missing like in air pollution index and waste columns so I filled them using mean or median values.

Then I scaled the pollution index using min-max scaler because values were in different ranges. Also country and year were encoded because machine learning model don't understand text data.

Then I did EDA using line plot, bar graphs, and heatmaps to check the relation between features. I found that CO2 and industrial waste had strong correlation with energy recovery.

Phase 2: Model Building

Linear Regression Model
I used Linear Regression to predict how much energy (GWh) can be recovered using pollution data.

Important features used:
- Air_Pollution_Index
- CO2_Emissions
- Industrial_Waste_in_tons

After training the model, I calculated:
- R^2 Score: around 0.79
- MSE and MAE was also reasonable, but not perfect.

Residual plot showed small amount of error is there in some cases.

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Logistic Regression Model

Here I tried to classify countries into pollution levels: Low, Medium, and High using classification model.

Model gave good accuracy (~83%), and confusion matrix showed most of the predictions were correct.

Phase 3: Insights and Results

Findings

- Countries with high CO2 and industrial waste also shows potential for more energy recovery.
- In some countries, pollution is high but energy recovery is low, so there is a chance to improve.
- Air Pollution Index is directly connected with industrial waste and energy recovery output.

Recommendations

1. Use of Waste-to-Energy tech: Countries who are wasting more can turn that into energy using proper machines.
2. Focus on High Polluted Countries: Government and NGO can support policies and setup for those countries with high pollution.
3. Encourage industry for cleaner process: Less waste means less pollution and also efficient energy recovery possible.
4. Awareness & Monitoring: A proper tracking system should be maintained for pollution and recovery annually.

Final Thoughts

Overall this project gave me idea how pollution and energy recovery are related and also how machine learning can help to predict and improve things in future. I faced some challenges in cleaning data and choosing the right model but it was good learning experience.