Problem Statement: At what voluntary carbon price or involuntary carbon price (carbon tax) does CCUS make sense? Will the timeline be feasible as renewable sources become the dominant source of power supply?

Objective: Determine the carbon price (voluntary carbon market price or involuntary carbon tax) that makes CCUS financially viable.

Analyze whether CCUS will remain relevant or cost-effective as the energy mix shifts towards renewables by 2050.

Data Selection:

* CO₂ pricing: To evaluate the current carbon pricing trends, both voluntary (carbon credits) and involuntary (carbon taxes), and assess how they influence CCUS economics.
* CCUS projects: To analyze cost data from existing CCUS projects and how these costs relate to captured carbon. This includes operational and capital expenditure.
* CO₂ emissions: To forecast emissions reductions by sector and region, particularly looking at the effectiveness of CCUS in reducing overall emissions.
* Exchange-traded funds on carbon: For insights on market-driven incentives, such as carbon ETFs, which can provide clues about investor confidence and future carbon pricing trends.

Analysis Steps:

1. Establish CCUS Costs and Break-Even Carbon Price
   1. From the CCUS projects dataset, extract key cost data related to carbon capture and storage (CAPEX, OPEX, maintenance).
   2. Use CO₂ pricing data to estimate the range of carbon prices in both voluntary and regulatory frameworks.
   3. Calculate the break-even point: the carbon price at which the costs of operating CCUS projects are offset by the revenue or savings generated from captured carbon (using current and future projected prices).
2. Predict Future Carbon Prices
   1. Use historical data from the CO₂ pricing and exchange-traded funds on carbon datasets to build a predictive model. You could employ time-series models like ARIMA, or more advanced regression models, to forecast future carbon pricing trends.
   2. Assess how policy shifts, such as carbon taxes, might impact carbon prices by integrating economic and regulatory factors into the model.
3. Compare to the Transition to Renewables
   1. Using renewable energy projections (you may need external renewable energy forecasts), analyze how the shift towards renewable energy sources will affect the relevance of CCUS. If renewables dominate, the demand for carbon capture may decline in power generation, but could still be critical in industries like cement and steel production.
   2. Compare the cost of CCUS with other decarbonization strategies as renewables increase in the energy mix.

Model Development:

Predictive Model: You could use a regression-based approach to model the relationship between carbon pricing and CCUS deployment.

Inputs: Historical CO₂ pricing, CCUS project costs, and renewable energy penetration (if available).

Output: Predicted carbon price at which CCUS becomes profitable.

Example: Build a predictive model using a regression or random forest algorithm, with the dependent variable being the carbon price that makes CCUS cost-effective and independent variables being CCUS costs, emission levels, and renewable energy adoption.

Presentation and Insights:

Create visualizations to show the break-even carbon prices for CCUS under different scenarios (e.g., with and without a carbon tax, different regions).

Present a timeline for when CCUS becomes feasible under future carbon pricing predictions.

Discuss the implications for industries that are harder to decarbonize (e.g., steel, cement) even as renewables grow.

Suggest policy measures, such as minimum carbon prices or subsidies, to make CCUS more attractive as part of the decarbonization strategy.

Possible Findings:

You might find that CCUS is only economically feasible at carbon prices higher than current voluntary market prices.

Or, you could determine that for certain industries, CCUS will remain relevant even as renewables dominate due to the difficulty of electrification in those sectors