**Unveiling the Future of Carbon Emissions Trading: A Machine Learning and Neural Network Perspective on Regional Markets.**

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**Abstract**

This research advances the understanding of carbon emissions dynamics across regional markets by integrating comprehensive datasets from the World Bank, the U.S. Energy Information Administration, and real-time weather data from the National Weather Service API spanning 1970-2021. This holistic approach significantly improves upon previous studies that often focused on isolated sectors or models by including extensive sectoral data, thereby enabling more accurate forecasts of carbon offset costs. The study utilized advanced machine learning models such as Support Vector Regression (SVR), Long Short-Term Memory (LSTM), and hybrid models like the Convolutional Neural Network-Artificial Neural Network (CNN-ANN) and CNN-Improved Bat Algorithm (CNN-IBFA). These models achieved impressively high R-squared values of 0.87, 0.88, 0.93, and 0.99, respectively. A dynamic dashboard developed using Flask visually presents predictions of carbon emissions and their associated offset costs, enhancing the accessibility and utility of the research findings. Employing the CRISP-DM methodology and optimized data management via AWS, the project incorporates real-time weather data to enrich the economic analysis of the impacts of carbon emissions on weather patterns. The findings not only enhanced understanding of the complex dynamics within carbon trading systems but also provided valuable insights for policy-making and climate mitigation strategies. This study lays a comprehensive foundation for future research, emphasizing the critical role of enhanced data granularity and sector-specific analysis in improving predictive accuracy, thereby aiding effective environmental policy formulation and implementation.