Carbon Footprint Prediction and Optimization

Leveraging Machine Learning for a Sustainable Future

13 CLIMATE ACTION

Machine Learning for Sustainable Development

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What is Carbon footprint?

- *The **total amount of greenhouse gases** (GHGs) released into the atmosphere by a person, organization, or product.*

- *Measured in **metric tons of** carbon dioxide equivalent **(CO2)**.*

- *A carbon footprint is calculated by **adding** up **all the emissions from a product** or service's **entire life cycle**.*
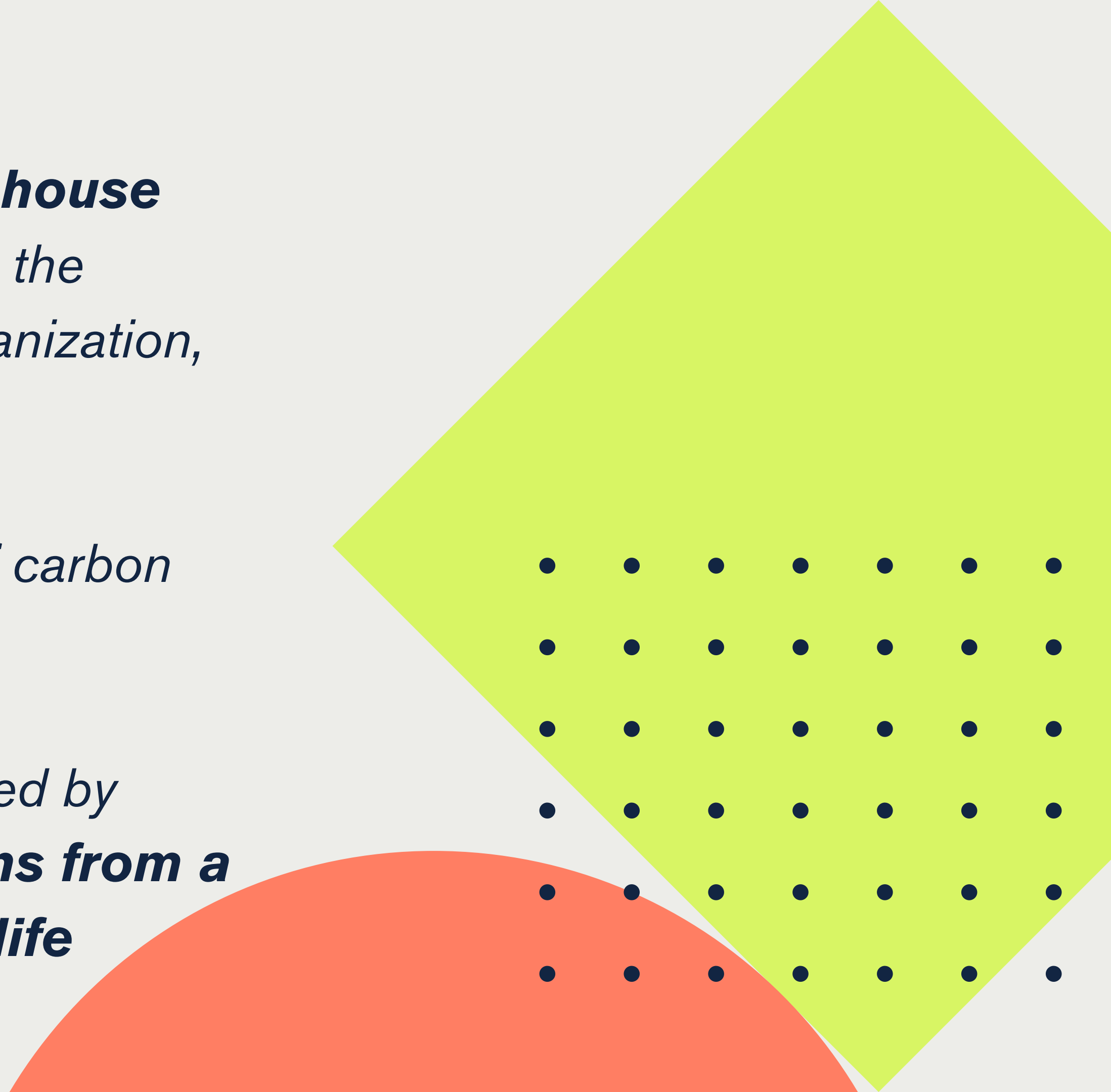
Objectives

Predict carbon footprints across industries using ML.

Optimize energy consumption and reduce emissions.

Simulate environmental impacts of policies or projects.

Provide actionable, real-time feedback for sustainability.

Title	Key focus	Algorithm used	Findings
A Comparative Study of Statistical and Machine Learning Models on Near-Real-Time Daily CO2 Emissions Prediction (2023)	Daily CO2 emissions prediction using statistical and ML models.	ANN, Random Forest, LSTM	LSTM performed best in predicting CO2 emissions with high accuracy using daily time-series data.
A Machine Learning Algorithm to Explore the Drivers of Carbon Emissions in Chinese Cities (2024)	Identifying key drivers of carbon emissions across Chinese cities.	Extra-Trees, Adaptive-Lasso	Extra-Trees provided high accuracy; energy consumption was identified as the main driver of emissions.
Nonparametric Approaches for Analyzing Carbon Emissions: From Statistical and Machine Learning Perspectives (2023)	Nonlinear modeling of carbon emissions and influencing factors.	Neural Networks, Random Forest, Kernel Regression	Neural networks showed the best performance for understanding complex relationships between emissions and factors.
Optimization of Carbon Footprint Management Model of Electric Power Enterprises Based on AI (2025)	Carbon footprint optimization in the electric power industry.	Deep Learning, Entropy-TOPSIS	I-driven carbon audit system significantly improved emissions management in the power sector.
Predicting CO2 Emission Footprint Using AI Through Machine Learning (2022)	Forecasting global CO2 emissions considering COVID-19 impacts.	SARIMAX	Post-COVID models accurately forecasted global CO2 emissions with low MAPE.

Proposed Solution

Emission Prediction
- **Tech**: *Random Forest, Linear Regression, LSTM, ARIMA.*
- **Impact**: *Accurate forecasts for emission reduction planning.*

Real-Time Monitoring
- **Tech**: *IoT sensors, AI processing.*
- **Impact**: *Immediate actionable insights.*

Supply Chain Optimization
- **Tech**: *K-Means, A* Algorithm.*
- **Impact**: *Reduced transport emissions and waste.*

Public Awareness
- **Tech**: *AI-powered apps, gamification.*
- **Impact**: *Promotes individual climate action.*

References

A comparative study of statistical and machine learning models on...
The rapid ascent in carbon dioxide emissions is a major cause of global warming and climate change, which pose a huge threat to human survival and impose far-reaching influence on the global...
arXiv.org

Nonparametric approaches for analyzing carbon emission: from...
Linear regression models, especially the extended STIRPAT model, are routinely-applied for analyzing carbon emissions data. However, since the relationship between carbon emissions and the...
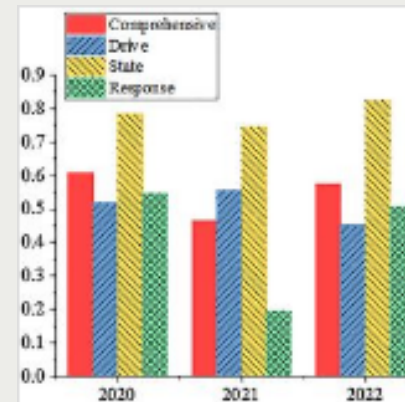arXiv.org

A machine learning algorithm to explore the drivers of carbon emissions in...
Scientific Reports - A machine learning algorithm to explore the drivers of carbon emissions in Chinese...
Nature / Oct 9, 2024

Optimization of carbon footprint management model of electric power...
This study intends to optimize the carbon footprint management model of power enterprises through...
plosone

(PDF) Predicting CO2 Emission Footprint Using AI through...
PDF | Adequate CO2 is essential for vegetation, but industrial chimneys and land, space and oceanic vehicles exert...
researchgate.net