

AI AGENTS IN CARBON CREDIT AUCTIONS: ENHANCING TRANSPARENCY, EFFICIENCY, AND GLOBAL CLIMATE ACTION

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INTRODUCTION

Global carbon markets are crucial for reducing greenhouse gas emissions, but they face persistent challenges:

- Opacity: Limited transparency in bidding and allocation.
- Inefficiency: Suboptimal price discovery and poor matching between buyers and sellers.
- Manipulation risks: Vulnerability to collusion, corruption, and weak institutions.

Artificial Intelligence (AI) agents offer promising solutions by improving transparency, efficiency, and trust. Inspired by Elinor Ostrom's Nobel-winning work on governing the commons, this research explores how AI can support fair and sustainable carbon credit auctions.

OBJECTIVES

- Design AI-driven auction mechanisms that improve allocation efficiency and fairness.
- Build agent-based simulations of buyers, sellers, and regulators.
- Evaluate transparency and corruption-resistance of AI-enhanced systems.
- Quantify contributions to the UN Sustainable Development Goals (SDGs).

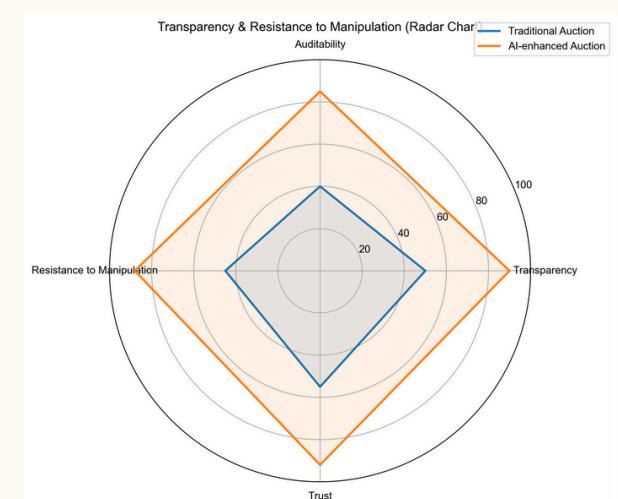
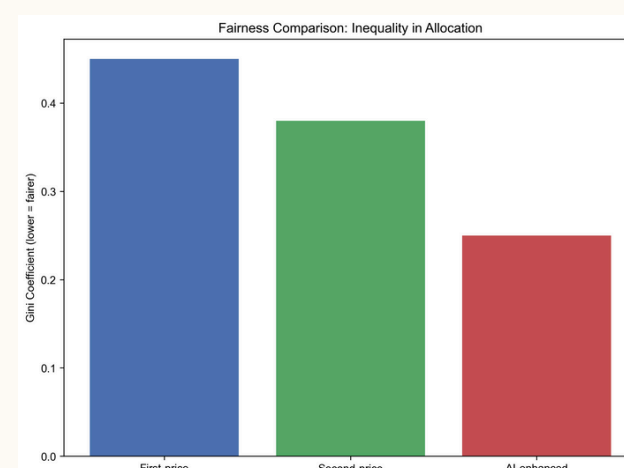
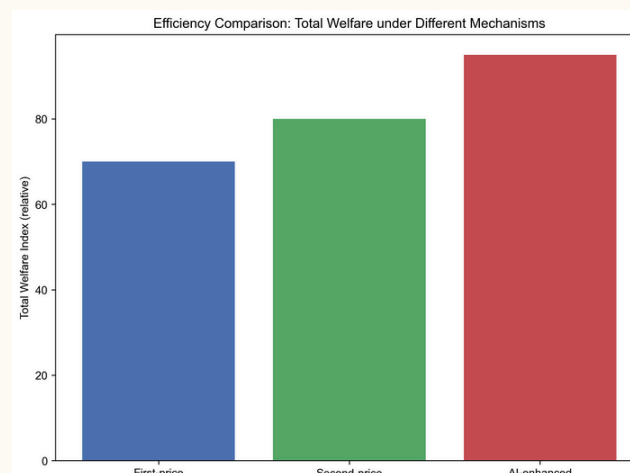
METHODOLOGY

- Theoretical Framework: Mechanism design + literature on carbon auctions and commons governance.
- Simulation: Multi-agent models using Python (industries as buyers, carbon projects as sellers, regulators as observers).
- AI Integration: Reinforcement learning for bidding strategies, anomaly detection for collusion, explainable AI for transparency.
- Verification: Blockchain-based logging for immutable audit trails.
- Evaluation Metrics: Efficiency (total welfare), fairness (Gini coefficient), transparency (auditability), resilience (resistance to manipulation).

RESULTS & VISUALIZATION

Preliminary simulation results indicate clear advantages of AI-enhanced auctions over traditional formats:

- Efficiency (Bar Chart)
 - AI-enhanced auctions achieve significantly higher Total Welfare Index compared to first- and second-price auctions.
- Fairness (Bar Chart)
 - Lower Gini Coefficient under AI-enhanced mechanisms shows more equitable distribution, giving smaller participants better chances.
- Transparency & Resilience (Radar Chart)
 - AI-driven auctions outperform traditional systems in Transparency, Auditability, Resistance to Manipulation, and Trust.



SDG CONTRIBUTIONS

- SDG 12 – Responsible Consumption & Production: Efficient allocation incentivizes sustainable practices.
- SDG 13 – Climate Action: Transparent AI-driven carbon markets accelerate emissions reduction.
- SDG 16 – Peace, Justice & Strong Institutions: Reduced corruption and stronger governance through auditable AI auction systems.

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