

Dynamic ESG Risk and Greenwashing Detection using Machine Learning: A Portfolio Management Framework

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Abstract: This research examines the gap between corporate sustainability assertions and actual conduct, referred to as "greenwashing," utilising a novel machine learning methodology. Traditional Environmental, Social, and Governance (ESG) ratings frequently do not reflect this disconnection in real-time. We provide a dynamic Greenwashing Risk Score (GRS) that employs domain-adapted FinBERT architectures to assess semantic ambiguity and communicative-behavioral disconnection between company filings and external media. An eXtreme Gradient Boosting (XGBoost) model is used to guess what governance problems would happen. The GRS accurately predicted financial problems before the Hindenburg crisis in 2023 and the US Department of Justice indictment in 2024. This was shown by a long-term case study of the Adani Group from 2019 to 2026. A GRS-optimized portfolio has a Sharpe Ratio of 1.18, which is far better than the Nifty 50 benchmark. This shows how well dynamic AI-driven ESG risk assessment works.

Keywords: Greenwashing Detection, Machine Learning, Portfolio Optimization, FinBERT, XGBoost

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