

ESG Alpha Through Generative AI: A New Paradigm for Sustainable Trading Strategies

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Abstract

Institutional investors increasingly seek to reconcile return objectives with measurable sustainability outcomes, yet ESG information remains noisy, heterogeneous, and slow to update. This paper proposes a unified framework—**ESG Alpha Through Generative AI**—that operationalizes large-language models (LLMs) and generative modeling to construct transparent, regulation-ready trading strategies. First, we develop an LLM-powered ESG sentiment engine that ingests multi-lingual, unstructured disclosures and news, applies retrieval-augmented extraction with source attribution, and synthesizes security-level signals calibrated against established ESG taxonomies. Second, we introduce an automated scenario generator that translates narrative ESG risks (e.g., transition policy shocks, supply-chain violations, climate physical hazards) into factor-consistent return and fundamentals shocks, enabling robust portfolio construction via mean-CVaR optimization with explicit sustainability and concentration constraints. Third, we embed a “compliance-by-design” layer that maps exposures to the EU Taxonomy and related regimes (e.g., SFDR), supports pre- and post-trade checks, and preserves auditability through prompt logging, data lineage, and human-in-the-loop review. Back-tested experiments against benchmarks reliant on static ESG scores indicate improved timeliness of signals, enhanced risk-adjusted performance, and reduced drawdowns while maintaining taxonomy alignment. The paper’s contributions include: (i) an end-to-end architecture for LLM-derived ESG signal generation, (ii) a generative ESG risk-scenario apparatus for portfolio optimization, and (iii) a governance blueprint that aligns model risk management and regulatory compliance. We discuss implementation considerations, limitations, and avenues for future research on bias mitigation, domain adaptation, and supervisory evaluation.

Keywords: ESG Investing; Generative AI; Large Language Models (LLMs); Regulatory Compliance (EU Taxonomy, SFDR); Sustainable Portfolio Optimization