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RETURN ANALYSIS OF GREEN INVESTMENTS VS. TRADITIONAL INVESTMENTS

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ABSTRACT

This research, titled "Return Analysis of Green Investments vs. Traditional Investments", explores the comparative performance of green sector companies and conventional sector companies over recent years. In the context of the present research, **Green Investments** refer to financial investments made in companies engaged in environmentally sustainable and renewable energy–based activities, including solar energy, wind energy, hydropower, electric mobility, and other low-carbon technologies aimed at reducing environmental impact and promoting sustainable development. Conversely, **Traditional Investments** denote investments in companies operating within conventional sectors that primarily rely on fossil fuel–based energy sources or non-renewable industrial processes, such as thermal power generation, oil and gas, and other carbon-intensive industries that do not explicitly integrate sustainability-oriented operational frameworks. By analyzing key financial metrics such as Compounded Annual Growth Rate (CAGR), daily volatility, Sharpe ratio, and maximum drawdown, this study evaluates the risk-return trade-offs of both investment avenues. The findings indicate that the green sector has outperformed the conventional sector in terms of growth and risk-adjusted returns, with a higher CAGR and Sharpe ratio. However, this growth comes with greater volatility and steeper drawdowns, making green investments inherently riskier in the short term. The conventional sector, while providing greater stability, has shown relatively lower returns. A key driver of this trend has been government initiatives in renewable energy development over the past five years, including the expansion of solar and wind projects, favorable policy frameworks, green financing mechanisms, and incentives for sustainable investments. These efforts have not only boosted investor confidence in green companies but have also contributed to their superior market performance.

Keywords: Green sector, Sharpe ratio, Conventional sector, Risk-adjusted returns, Solar and Wind energy projects.

1. INTRODUCTION

The global shift toward renewable energy has been driven by concerns about climate change, the depletion of non-renewable resources, and rising carbon emissions. Over the past few decades, rising global temperatures and environmental degradation have accelerated efforts to transition to sustainable, clean energy sources. Early adoption of green investments was primarily seen in developed economies such as the United States and European nations, where governments and corporations invested heavily in renewable energy infrastructure. Emerging economies, including India, have more recently begun prioritizing green investments, driven by both environmental concerns and economic opportunities.

1.1 Present Scenario

Today, India stands at a crucial juncture in its transition to renewable energy. With ambitious government initiatives such as the National Solar Mission, Faster Adoption and Manufacturing of Electric Vehicles (FAME), and Production-Linked Incentive (PLI) schemes, the country has witnessed significant growth in the green energy sector. According to the Ministry of New and Renewable Energy (MNRE), India aims to achieve 500 GW of renewable energy capacity by 2030, reflecting a major shift away from reliance on conventional fossil fuels. Investors and policymakers are now focusing on green finance as a strategic tool to drive economic growth while maintaining sustainability (Ministry of New and Renewable Energy, 2023; India's Renewable Energy Targets and Initiatives, https://mnre.gov.in).

1.2 Relevant Facts and Figures

As of 2023, India ranks third globally in installed renewable energy capacity, with over 180 GW (MNRE). The share of renewable energy in total power generation has risen from 17% in 2017 to nearly 40% in 2024 (CEA Reports, Date). The Green Bond Market in India has grown significantly, with over $10 billion worth of green bonds issued in recent years, attracting both domestic and foreign investors (RBI). The volatility of green investments remains a concern, with some

renewable energy stocks experiencing greater price fluctuations than traditional energy stocks due to policy changes and technological advancements. This study seeks to provide valuable insights for investors, policymakers, and researchers, helping shape future investment strategies in India's evolving green finance market.

2. LITERATURE REVIEW

The study by Wang et al. (2025), titled "Life Cycle Assessment-Based Analysis of Environmental and Economic Benefits in Construction Solid Waste Recycling", makes a substantive contribution to the literature on construction solid waste recycling by employing a life cycle assessment (LCA) framework to compare environmental and economic outcomes of recycling versus conventional landfill treatment. Drawing on scenario-based modeling within the Chinese context, the authors demonstrate that recycling significantly reduces greenhouse gas emissions and conserves natural resources, while yielding long-term economic benefits that outweigh the higher upfront costs. Their research advances existing scholarship by quantifying the environmental trade-offs and economic implications of recycling at a systems level, rather than focusing on isolated stages. Moreover, the paper identifies critical barriers, including data scarcity, market uncertainty, and policy insufficiencies, and proposes integrative strategies, such as enhanced data frameworks, market development, and strengthened regulations, to support the circular economy in construction. By linking LCA-based evidence to actionable policy recommendations, this work fills a key gap in sustainability and waste management studies and provides a robust empirical basis for promoting resource-efficient building practices.

The study by Chen et al. (2025), titled "Technical and economic analysis of renewable energy systems with hydrogen-ammonia energy storage: A comparison of different ammonia synthesis methods", significantly enriches the sustainable energy literature by performing a rigorous techno-economic and comparative assessment of six ammonia synthesis pathways encompassing traditional Haber–Bosch, plasma-catalysis, and innovative green ammonia methods within an integrated renewable energy and hydrogen–ammonia storage system framework. Addressing a notable gap in prior research that often-isolated propulsion technologies or used static LCA models, the authors contextualize energy, system dynamics, and cost-efficiency analyses within real-world operational parameters and scalable storage scenarios. Their findings demonstrate that advanced green ammonia synthesis routes, especially those leveraging renewable-powered plasma techniques, deliver substantial energy savings and emissions reductions while offering promising cost competitiveness compared to conventional methods. By combining multidimensional evaluation metrics, technical viability, economic feasibility, and environmental impact, the paper offers a holistic, practically oriented contribution that informs both academic discourse and policymaking aimed at integrating ammonia-based energy carriers into future clean energy systems.

The study by Recanatesi et al. (2025), titled "A Comparative Analysis of Spatial Resolution Sentinel-2 and Pleiades Imagery for Mapping Urban Tree Species", makes a notable contribution to the remote sensing and urban forestry literature by rigorously comparing Sentinel-2 and Pléiades multispectral imagery for species-level classification of urban trees in three historic parks in Rome. Employing object-based image analysis and Random Forest algorithms, the research demonstrates that Pléiades' very high-resolution imagery significantly outperforms Sentinel-2, achieving substantially higher overall accuracy (e.g., 89% vs. 66%) and Kappa indices (0.84 vs. 0.47) for land-cover classification, as well as more precise species identification (e.g., 84% vs. 53% user accuracy for *Pinus pinea*). By quantifying performance differentials within an operational urban context and highlighting the strong influence of spatial resolution on mapping accuracy, the paper addresses a key gap in the literature: it moves beyond coarse-scale vegetation monitoring to demonstrate the added value of very high-resolution data for precise urban biodiversity assessments and sustainable management planning.

The study by Liu *et al.* (2021), titled "A generalized TODIM-ELECTRE II-based integrated decision-making framework for technology selection of energy conservation and emission reduction with unknown weight information", presents an innovative contribution to the multi-criteria decision-making (MCDM) and green technology investment literature by developing a hybrid TODIM–ELECTRE II framework tailored for selecting energy conservation and emission reduction technologies under uncertain and subjective information conditions. Specifically, it employs double-hierarchy hesitant fuzzy linguistic term sets (DHHFLTSs) to more accurately capture expert evaluations and introduces improved comparison measures and expert-weight calculations to mitigate information loss. By integrating prospect theory–based TODIM (to reflect risk aversion) with ELECTRE II (to address non-compensatory criteria), the method surpasses the limitations of individual MCDM techniques. A case application involving an investment in emission-reduction technology demonstrates the model's practicality and reliability, while a comparative analysis with existing approaches confirms its enhanced decision quality. This work advances the literature by integrating fuzzy linguistic representation,

psychological decision modeling, and outranking methods into a coherent framework, providing robust support for complex, sustainability-focused technology selection decisions.

The study by Reed et al. (2022), titled "Integrating ecosystem markets to coordinate landscape-scale public benefits from nature", advances the literature on ecosystem market integration by conducting a comparative analysis of eleven private ecosystem markets across the UK and European peatlands, complemented by 25 interviews, scheme documentation reviews, and two focus groups. It develops a novel typology that distinguishes regional ecosystem markets, national carbon markets, and green finance mechanisms, elucidating how each operates in terms of governance, funding models, and service outcomes. Crucially, the paper identifies the role of risk-based funding structures and trusted intermediaries in regional markets, which effectively aggregate supply and demand, mitigate free-riding, and manage trade-offs between ecosystem services. Furthermore, Reed *et al.* propose six mechanisms to blend public and private finance, including co-procurement, match-funding, and carbon guarantees, and offer a strategic framework to integrate national carbon markets and green finance with sub-national schemes to enhance landscape-scale public benefits. By moving beyond siloed PES approaches, this work fills a critical gap in understanding how multi-scalar ecosystem markets can be operationally and financially coordinated to optimize conservation outcomes.

The study by Moro *et al.* (2019), titled "National innovative capacity in the water sector: A comparison between China and Europe", enriches the eco-innovation and water management literature by quantitatively comparing the national innovative capacity (NIC) of China and Europe within the water sector, based on a robust framework of environmental regulation, R&D investment, and international collaboration. Utilizing sector-specific indicators over the period 1999–2016, the authors find that while China's NIC growth is strongly driven by direct investments and private R&D, Europe's superior capacity relies more on systemic innovation strategies, regulatory rigor, and cross-border research partnerships. The paper fills a gap in existing studies by moving beyond aggregate national assessments to sector-level dynamics, thereby highlighting divergent innovation pathways: China's quantitative expansion versus Europe's qualitative efficiency. This nuanced comparative analysis offers valuable insights for policymakers aiming to foster eco-innovation in water systems through tailored national and sectoral policies.

The study by Choudhary et al. (2015), titled A carbon market sensitive optimization model for integrated forward–reverse logistics", makes a notable contribution to sustainable supply chain management literature by presenting a novel carbon-market-sensitive optimization model that integrates forward and reverse logistics design decisions to minimize both cost and carbon footprint. By embedding carbon emission parameters into a quantitative decision-making framework for facility layout and network configuration, the authors address the critical trade-off between economic efficiency and environmental sustainability in supply chain networks. Using a modified forest data structure algorithm, their model effectively outperforms conventional genetic algorithms, especially on large-scale problems, demonstrating superior performance in balancing operational costs and carbon emissions. This work fills an important gap in the literature by coupling strategic reverse logistics considerations with carbon regulatory mechanisms, offering practitioners a scalable, computationally efficient tool for designing greener, cost-effective supply chains.

In "A Comparative Study of Financial Performance between Sustainable and Conventional Investment," by Anita Handayani and Rofikoh Rokhim (2023), the authors examined the appeal of sustainable investments and compared their returns with those of conventional investments in Indonesia from 2018 to 2023. It analyzes green bonds, equities, and mutual funds using an independent sample t-test. Results show no significant difference in returns between sustainable and conventional investments, though price volatility varies. The findings offer insights for investors seeking to balance financial goals with environmental concerns.

The study on Return Analysis of Green Investments vs. Traditional Investments 3 by Xiaoyan Zhou and Gireesh Shrimali (2023) noted that "climate and environmental policies influence energy investment choices." This research explores how climate and environmental (CE) policies impact capital costs and investment in the energy sector. It finds that stronger CE policies lower capital costs for green energy and raise them for fossil fuels, especially in energy production. The policies also directly drive green investments more than through capital cost changes. The study highlights the importance of strong CE policies in promoting low-carbon energy transitions. The Intention of Individual Investors to invest in Green Bonds in Indonesia was documented by Iqbal Adhiyogo, Zuliani Dalimunthe, Rachmadi Agus Triono, and Helman Arif (2022). This study examines the factors influencing individual investors in Indonesia to invest in green bonds, highlighting the moderating role of financial literacy. Based on data from 226 investors in 2021, the study finds that risk perception significantly affects investment intentions, while environmental concern does not. Financial literacy shapes

how other factors impact intentions, without having a direct effect. The study explains 48% of the variance and recommends enhancing investor education about the benefits of green bonds, especially in developing countries.

Dragon Yongjun Tang and Yupu Zhang (2020), in their study on "Do shareholders benefit from green bonds?", analyzes the effects of green bond issuance on stock prices, institutional ownership, and liquidity. It finds a 1.4% positive stock return around announcements, driven more by increased investor attention than lower debt costs. Green bonds boost institutional ownership and market liquidity, enhancing visibility and performance. The findings highlight green bonds as effective tools for attracting long-term investors and supporting sustainable investment strategies.

The study titled "How Successful are Energy Efficiency Investments - A Comparative Analysis for Classification & Performance Prediction", by Doukas et al. (2022), contributes to the growing literature on energy efficiency investments by evaluating their performance using both traditional statistical and machine learning classification techniques. Existing research has highlighted the importance of energy efficiency projects in achieving sustainability goals, yet financial uncertainty often hinders investment. Traditional methods such as ordinal logit, probit, and linear discriminant analysis have been widely used in financial decision-making contexts, while machine learning approaches like k-nearest neighbors (k-NN) and support vector machines (SVM) are increasingly applied due to their ability to handle complex, non-linear relationships. The authors conduct a comparative analysis of five models using data from the Energy Efficiency De-risking Project and find that machine learning techniques generally outperform traditional models in predictive accuracy. This work fills a critical gap in the literature by applying these methods specifically to the domain of energy efficiency, offering valuable insights for investors, policymakers, and researchers seeking to improve the reliability of investment performance forecasting in sustainable finance.

The research literature titled "Cost Comparative Analysis of a New Green Building Code xfor Residential Project Development" on green residential building codes predominantly underscores a measurable cost premium associated with their adoption. In a seminal study, Kim, Greene, and Kim (2014) conducted a detailed case-based cost-comparison analysis of single-family homes under a new Green Building Code in Los Angeles, reporting a 10.77 % increase in construction costs relative to conventional buildings, with only a marginal two-day extension to the project schedule. This finding aligns with broader empirical research indicating that early-stage green construction often incurs higher capital expenditure, albeit with the potential for operational and lifecycle benefits. However, subsequent studies have identified variation in the green cost premium across certification levels, project typologies, and regional contexts, suggesting that while initial investments rise, economic viability can improve over time through energy savings, compliance advantages, and enhanced building performance.

The study by Stekelorum et al. (2021), titled "Green supply chain management practices and third-party logistics providers' performances: A fuzzy-set approach", represents a significant advance in the green supply chain management (GSCM) literature by shifting the emphasis from isolated practices to the synergistic configurations that drive third-party logistics providers' (TPLs) performance. Drawing on the natural resource-based view and coordination theory, the authors use fuzzy-set qualitative comparative analysis (fsqca) to examine survey responses from 232 TPLs. Their findings reveal that a tailored combination of internal and external GSCM practices—specifically green supply and eco-design packaging for smaller firms, and a broader suite of practices (excluding investment recovery and reverse logistics) for larger firms—consistently enhances both operational efficiency and financial performance. This configurational perspective challenges the linear causality commonly assumed in traditional GSCM studies and underscores the importance of organizational context and firm size in determining effective strategies. By applying fsQCA, the paper not only enriches empirical understanding of GSCM in logistics but also demonstrates methodological innovation, offering policymakers and managers nuanced guidance for designing green supply chain solutions that align with firm-specific characteristics.

The study by Aredah et al. (2024), titled "Comparative analysis of alternative powertrain technologies in freight trains: A numerical examination towards sustainable rail transport", advances the literature on sustainable freight rail systems by providing a comprehensive comparative evaluation of six alternative powertrain technologies—spanning diesel, biodiesel, natural gas, battery-electric, hydrogen fuel cell, and ammonia-hydrogen hybrids—and assessing their relative energy efficiencies and environmental performance within the U.S. freight rail sector. This work builds upon earlier LCA-based and propulsion-system studies by integrating real-world operational parameters and vehicle dynamics into a unified simulation framework. Notably, the authors demonstrate that hybrid powertrains using emerging fuels, such as hydrogen or ammonia, yield substantial reductions in energy use and CO_2 emissions compared to conventional diesel-based systems. Their methodology addresses the gap in previous research—which often focused on isolated case studies or theoretical modeling—by offering rigorous numerical analysis at the network scale (Aredah et al. 2024). By providing

clear evidence of both the trade-offs and benefits across diverse powertrain configurations, this research contributes valuable insights for rail operators, policymakers, and engineers seeking to implement cleaner heavy-haul transport technologies.

The study by Sauer et al. (2022), on "Chinese and multilateral development finance in the power sector", critically advances understanding of global power-sector finance by dissecting the comparative roles of Chinese Developmental Institutions (CDIs) and Multilateral Development Banks (MDBs) in electricity infrastructure investments from 1999 to 2020. Employing a unique dataset compiled from commercial trackers, public records, and over 1,000 supporting documents, along with 39 expert interviews, the authors reveal that CDIs have rapidly become the predominant source of public funding in the developing world's power sector. Despite rhetoric advocating greener Belt and Road Initiative (BRI) policies, CDI financing remains heavily concentrated in coal-fired power plants, although there is a clear shift over time toward more efficient coal technologies and a growing portfolio share in non-hydro renewables—increasingly in partnership with MDBs. By illuminating these dynamics, the paper addresses a crucial gap in the literature on development finance and offers decisive insights into how Chinese and multilateral actors shape the trajectories of greenhouse gas emissions in emerging economies.

"The Impact of Government Policies in the Renewable Energy Investment: Developing a Conceptual Framework and Qualitative Analysis," a study by Nurcan Kilinc Ata (2014), examines how renewable energy policies influence investment decisions in the UK, Turkey, and Nigeria. Using a conceptual framework and qualitative analysis, it finds that effective policies are key drivers of investment and growth in the renewable energy sector.

The above analyses demonstrate that very little research has been conducted in the field of green investment, hence the present research endeavor tries to compare the performance of the company involved in the green energy sector with the performance of the company dealing in sectors other than green energy.

3. RESEARCH METHODOLOGY

3.1 Statement of Research Problem:

The transition towards green investments has gained significant traction globally, yet there remains a lack of comprehensive analysis of their financial performance relative to conventional investments in the Indian market. Investors require empirical evidence to evaluate whether green investments provide competitive returns and sustainable growth while managing risk effectively. This research addresses this gap by analyzing and comparing financial performance.

3.2 Rationale / Significance of Research: As India moves towards a sustainable economic model, understanding the financial viability of green investments is crucial for investors, policymakers, and corporate decision-makers. This study provides a comparative analysis of returns, risk-adjusted performance, volatility, and the long-term sustainability of green investments versus traditional investments. It aims to inform investment decisions, assess policy impacts, and contribute to the evolving field of sustainable finance in India.

3.3 Research Design: This research follows a descriptive and comparative research design, utilizing secondary data to analyze financial trends and performance metrics.

3.4 Research Questions:

Q1. Do green investments provide competitive financial returns compared to conventional investments in India?
Q2. How does the risk-adjusted performance of green investments compare to that of traditional investments?
Q3. What are the long-term sustainability prospects of green investments in India?

3.5 Research Objectives:

To achieve the answer to the above questions, the following objectives are framed:
1. To compare the financial performance of green and conventional investments in India, focusing on returns, profitability, and price volatility.
2. To assess the long-term potential and sustainability of green investments in the Indian market, in comparison to traditional investment instruments.

3.6 Sampling Decisions:

Population:
The population comprises all publicly listed companies in India engaged in green and conventional industries.
Sample Units:
The study selects five green companies and five conventional companies based on market capitalization.
Green Sector Companies: 1. Adani Green Energy Ltd, 2. Suzlon Energy Ltd, 3. Tata Power Company Ltd, 4.JSW Energy Ltd, 5. SJVN Ltd.
Traditional Sector: 1. Bharti Airtel Ltd, 2. Avenue Supermarts Ltd (DMART), 3. HDFC Bank Ltd, 4. Indian Railway Finance.

3.7 Sampling Frame:
The study focuses on companies and financial instruments actively traded in the National Stock Exchange (NSE). Purposive sampling is used to select companies and investment instruments that align with the study's objectives. Five green-sector companies and five conventional-sector companies, basically those that are not into green or renewable energy.

3.8 Types of Data: This study exclusively uses secondary data for analysis. The sources of data are publicly available financial reports, Stock market databases (NSE, BSE), Government reports and regulatory filings (RBI, SEBI), and mutual fund house disclosures.

3.9 Data Analysis:

- Data is analyzed through: Charts and visual comparisons, Tables and frequency distributions, Descriptive statistics. **Statistical Tools/Techniques**: The following tools and metrics have been calculated and compared to derive insights from the collected data:
- **CAGR (Compound Annual Growth Rate):** CAGR measures the annualized return of an investment over a specific period, assuming the investment grows at a steady rate. It provides a smooth rate of return, eliminating the impact of short-term fluctuations. A higher CAGR indicates strong long-term growth, while a lower CAGR suggests slower growth or poor performance. Unlike average annual returns, CAGR accounts for compounding, making it a more accurate measure of investment performance.

Range & Significance: 10% - 15% → Considered good for equity investments.
15% - 20% → Strong growth, often seen in high-growth sectors.
Above 20% → Exceptional performance, but sustainability must be evaluated.
Below 5% → Weak or stagnant growth.

- **Daily Volatility:** Daily volatility represents the extent of fluctuations in an investment's price on a daily basis. It is measured using the standard deviation of daily returns and indicates the risk or uncertainty in an asset's performance. Higher volatility suggests greater price swings and higher risk. Lower volatility indicates stable and predictable performance.

Range & Significance: Below 1% → Low volatility (Stable investment, low risk).
1% - 3% → Moderate volatility (Common for blue-chip stocks).
Above 3% → High volatility (Riskier investments, growth stocks).

- **Sharpe Ratio:** The Sharpe Ratio measures an investment's risk-adjusted return by comparing its excess return (above the risk-free rate) to its volatility. It helps investors determine whether the returns justify the risk taken. A higher Sharpe Ratio indicates better risk-adjusted performance. A negative Sharpe Ratio means investment returns are worse than the risk-free rate, signaling poor performance.

Range & Significance: Below 0.5 → Poor risk-adjusted return.
0.5 - 1.0 → Moderate performance, acceptable for most investors.
1.0 - 2.0 → Good risk-adjusted return, considered strong.
Above 2.0 → excellent performance, strong return per unit of risk.

- **Maximum Drawdown (MDD):** Maximum Drawdown measures the largest peak- to-trough decline of an investment during a given period. It helps assess downside risk and an investment's ability to recover from losses. A lower drawdown indicates greater resilience to market declines. A higher drawdown suggests greater downside risk and a prolonged recovery time.

Range & Significance: Below -10% → Low risk (Stable investment).
-10% to -30% → Moderate risk (Acceptable for growth investments).
Above -30% → High risk (Risky, may take longer to recover).

3.10 Scope and Coverage of Research:
The study covers financial data from:
FY 2019-20 (1st April 2019 – 31st March 2020),
FY 2021 22 (1st April 2021 – 31st March 2022),
FY 2022-23 (1st April 2022 – 31st March 2023),
FY 2023 24 (1st April 2023 – 31st March 2024),
FY 2024-25 (Partial) (1st April 2024 – 31st January 2025).

3.11 Limitations of Research:
Exclusion of FY 2020-21: Due to extreme market fluctuations during the COVID - 19 pandemic.
Limited Sample Size: The study focuses on a select set of companies and bonds, which may not represent the entire market. **Dependence on Secondary Data:** The accuracy of findings depends on the reliability of published financial reports.

3.12 Scope for Future Research:
Expanding the study to include primary data through investor surveys. Assessing the impact of ESG (Environmental, Social, and Governance) scores on investment performance. Extending research to other emerging markets for comparative analysis. By integrating a robust analytical framework, this research provides valuable insights into the comparative performance and sustainability of green investments in India, aiding investors and policymakers in decision-making.

4. DATA ANALYSIS & INTERPRETATION

4.1 Key Financial Metrics:
The following metrics have been calculated for all the above-mentioned companies to compare their growth, volatility, and risk-return performance. CAGR (Compound Annual Growth Rate), Daily Volatility, Sharpe Ratio, Max Drawdown.

4.1.1Company-Wise Data Analysis

- **Green Sector Companies**

Table 1: Green Sector Companies Financial Metrics

Company	CAGR	Daily Volatility	Sharpe Ratio	Max Drawdown
Adani Green Ltd	99.65%	19.71%	1.767	-84.44%
JSW Energy Ltd	50.81%	4.61%	1.09	-40.06%
SJVN Ltd	34.75%	2.72%	0.73	-41.51%
Suzlon Ltd	61.02%	6.68%	0.86	-40.70%
Tata Power Ltd	40.23%	6.71%	0.95	-29.80%

(Author's own calculation)

- **Conventional Sector Companies**

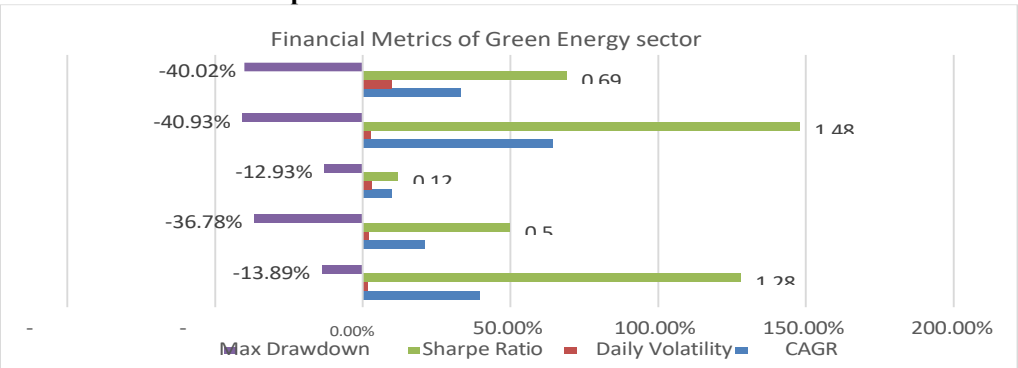

Figure 1: Financial Metrics of Green Energy Sector

Table 2: Conventional Sector Companies Financial Metrics				
Company	**CAGR**	**Daily Volatility**	**Sharpe Ratio**	**Max Drawdown**
Bharti Airtel Ltd	39.45%	1.81%	1.28	-13.89%
Avenue Supermarts Ltd (DMart)	21.05%	2.06%	0.5	-36.78%
HDFC Bank Ltd	9.68%	2.92%	0.12	-12.93%
Indian Railway Finance Corp.	64.35%	2.69%	1.48	-40.93%
Tata Motors Ltd	33.01%	9.92%	0.69	-40.02%

(Author's own calculation)

Company-wise Comparison

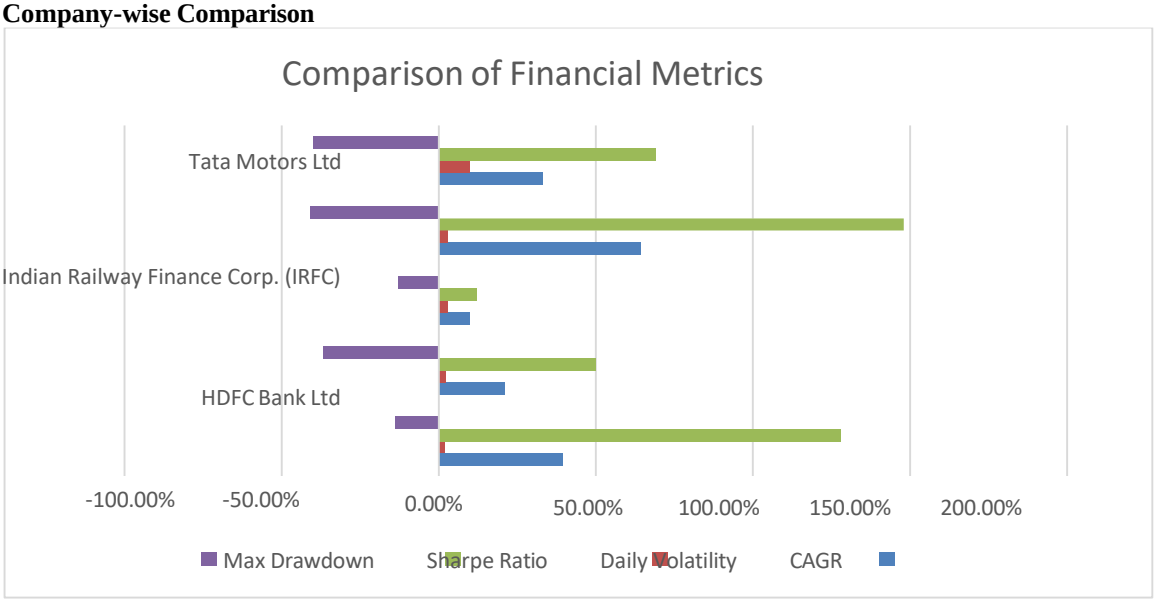

Figure 2: Comparison of all the Financial Metrics across all the Companies

❖ **Company-wise Data Interpretation**

➢ **CAGR (Compound Annual Growth Rate) Analysis**

- Adani Green Ltd exhibits the highest CAGR at 99.65%, reflecting its rapid growth in the green energy segment.
- Indian Railway Finance Corporation (IRFC) follows with a CAGR of 64.35%, making it the best performer in the conventional sector.
- JSW Energy and Suzlon Ltd also show strong growth in the Green Sector at 50.81% and 61.02%, respectively.
- HDFC Bank has the lowest CAGR at 9.68%, indicating relatively stable but slower growth compared to other firms.

➢ **Daily Volatility (Risk Factor) Analysis**

- Adani Green has the highest daily volatility at 19.71%, suggesting it is highly volatile and prone to significant price fluctuations.
- Other Green Sector companies like JSW Energy (4.61%), Suzlon (6.68%), SJVN (2.72%), and Tata Power (6.71%) exhibit moderate risk levels.
- Among the Conventional Sector companies, Tata Motors (9.92%) is the most volatile, while IRFC (2.69%), HDFC Bank (2.92%), and DMart (2.06%) are relatively stable.
- Bharti Airtel (1.81%) has the lowest daily volatility, making it the least risky among all companies analyzed.

➢ **Sharpe Ratio (Risk-Adjusted Return)**

- Adani Green Ltd has the highest Sharpe Ratio of 1.767, indicating the best risk- adjusted return despite its high volatility.
- IRFC (1.48) and Bharti Airtel (1.28) are among the top performers in the Conventional Sector, showcasing strong risk-adjusted returns.

- HDFC Bank has the lowest Sharpe Ratio at 0.12, suggesting low returns relative to risk.

➢ **Maximum Drawdown (Largest Decline from Peak)**

- Adani Green has the highest max drawdown at -84.44%, meaning its stock experienced a significant peak-to-trough decline.
- Other Green Sector stocks like Suzlon (40.70%), SJVN (-41.51%), and JSW Energy (40.06%) also saw substantial drawdowns.
- Tata Motors (-40.02%) and IRFC (-40.93%) show significant declines in the Conventional Sector, whereas Bharti Airtel (-13.89%) and HDFC Bank (-12.93%) have the lowest drawdowns, indicating resilience.

4.1.2 Sector-wise Data Analysis

To make a clear comparison between the Green and Conventional sectors, the average values of key financial metrics, CAGR, Daily Volatility, Sharpe Ratio, and Max Drawdown, were calculated. This enables a sector-wide analysis, the main goal of the research, rather than relying solely on individual companies. The following table presents a **sector-by-sector comparison of** how each sector performs across these metrics.

Sector-wise comparison table

Table 3: Comparison of all the Financial Metrics across both the sectors

Metric	Green Sector	Conventional Sector
CAGR	57.29%	33.51%
Daily Volatility	8.09%	3.88%
Sharpe Ratio	1.0794	0.814
Max Drawdown	-47.30%	-28.91%

(Author's own calculation)

Sector-wise Cumulative Annual Growth Rate (CAGR) Analysis and Interpretation

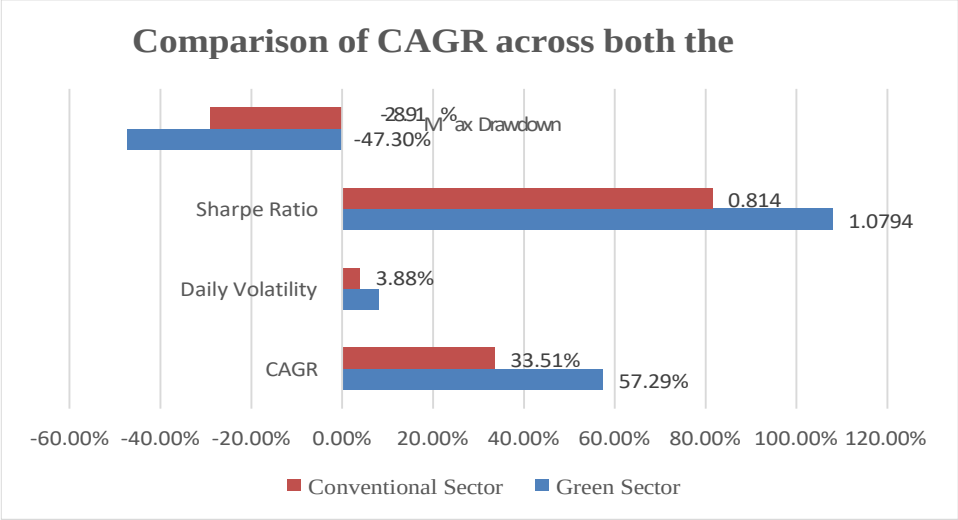

Figure 3: Comparison of CAGR across both the sectors

The analysis shows that the Green Sector has an average CAGR of 57.29%, significantly outpacing the Conventional Sector, which has an average CAGR of 33.51%. This suggests that companies in the Green Sector have experienced higher growth rates, likely driven by increasing investments in renewable energy, government incentives, and the global shift toward sustainable energy solutions.

- **Sector-wise Daily Volatility Analysis and Interpretation**

The analysis shows that the Green Sector has an average daily volatility of 8.09%, which is significantly higher than the 3.88% observed in the Conventional Sector. This suggests that stocks in the Green Sector experience more frequent and larger price fluctuations, reflecting the sector's dynamic nature, speculative interest, and sensitivity to external factors such as policy changes, technological advancements, and global energy trends.

On the other hand, the Conventional Sector demonstrates greater stability, with lower daily volatility, indicating that its stocks experience less frequent, smaller price movements. This stability makes them more suitable for risk-averse investors who prioritize consistent returns over short-term price swings.

CAGR and Volatility comparison of the two sectors highlights the trade-off between high growth and stability: Green Sector companies offer aggressive returns but higher risk, while the Conventional Sector provides more moderate but stable returns.

The Sharpe Ratio measures an investment's risk-adjusted return by comparing its excess return (above the risk-free rate) to its volatility. It helps investors determine whether the returns justify the risk taken.

The analysis shows that the Green Sector has an average Sharpe Ratio of 1.0794, which is higher than the 0.814 observed in the Conventional Sector. This suggests that, despite its higher volatility, the Green Sector has provided superior risk-adjusted returns, making it a more attractive option for investors willing to take on additional risk.

In contrast, the Conventional Sector, with a lower Sharpe Ratio, indicates that its returns are not as high relative to the risk it takes on. While these stocks offer more stability, their risk-adjusted performance is lower than that of the Green Sector.

This comparison highlights that while Green Sector investments carry higher risk, they have delivered better returns per unit of risk, whereas the Conventional Sector offers a more conservative risk-return profile.

- **Maximum Drawdown (MDD) Analysis and Interpretation**

The analysis shows that the Green Sector has an average Max Drawdown of -47.30%, significantly higher than the -28.91% observed in the Conventional Sector. This indicates that stocks in the Green Sector have experienced more severe declines, making them more susceptible to market corrections, economic downturns, or sector-specific risks.

On the other hand, the Conventional Sector has a lower Max Drawdown, suggesting that companies in this sector have shown better resilience during market downturns. The lower drawdown aligns with the sector's lower volatility, suggesting a more stable, defensive investment profile.

This comparison highlights the risk-reward trade-off: the Green Sector offers higher potential gains but deeper losses during market downturns, whereas the Conventional Sector provides greater stability with lower downside risk.

Scatter Plot of all the 10 companies for Risk-Return Comparison

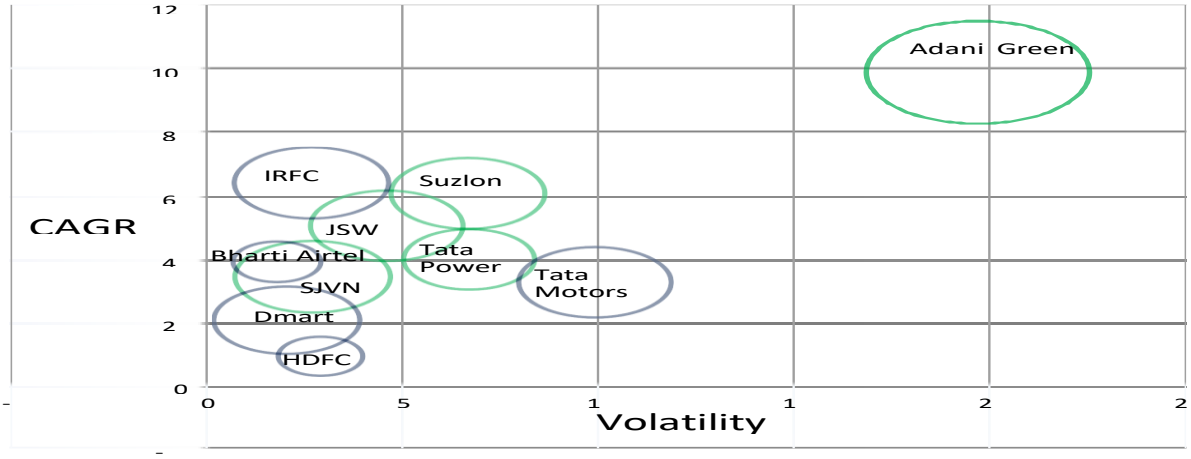

Figure 4: Scatter Plot of the Companies

Analysis of Scatter Plot

The scatter plot shows the relationship between CAGR (Compounded Annual Growth Rate) and Daily Volatility for 10

companies, grouped into the Green Sector and the Conventional Sector. The chart conveys multiple dimensions of data using bubble color, position, and size, making it an effective tool for comparative analysis.

Understanding the Elements of the Scatter Plot

- **Color of the Bubbles (Sector Differentiation):**
  - **Green-colored bubbles represent companies in the Green Sector.**
    Blue-colored bubbles represent companies in the Conventional Sector. This distinction allows for a clear comparison of how companies in both sectors perform with respect to risk (volatility) and return (CAGR).
  - **X-Axis: Volatility (%)**

The X-axis represents each company's daily volatility, which measures the stock's price fluctuations. Lower volatility indicates a more stable stock, whereas higher volatility suggests greater price fluctuations and, thus, higher risk. Companies positioned further to the right have higher volatility, while those towards the left have lower volatility.

- **Y-Axis: CAGR (%)**

The Y-axis represents the CAGR, which indicates the annualized return an investor would earn over a given period. Higher placement on the Y-axis indicates higher growth potential, while lower placement suggests relatively lower returns.

- **Size of the Bubble: Max Drawdown (%)**

The size of each bubble corresponds to the Max Drawdown, which represents the largest peak-to-trough decline in stock price before recovery. Larger bubbles indicate greater downside risk, meaning these stocks have experienced significant historical drawdowns, making them more volatile and potentially riskier investments. Smaller bubbles indicate relatively lower drawdowns, implying greater stability during market downturns.

Interpretation of the Scatter Plot

- **Green Sector vs. Conventional Sector (Growth vs. Risk Trade-Off):**
  - The Green Sector (green bubbles) generally exhibits a higher CAGR but also higher volatility than the Conventional Sector. Adani Green stands out with an exceptionally high CAGR but also exhibits the highest volatility and the largest drawdown, suggesting a highly risky yet high-reward investment. Other Green Sector companies, such as Suzlon, JSW Energy, and Tata Power, also show relatively strong growth but with noticeable volatility and drawdown risks.
  - **Conventional Sector Stability:**
    The Conventional Sector (blue bubbles) shows more stability, with lower volatility and smaller drawdowns, making these stocks relatively safer investments. HDFC Bank, DMart, and Bharti Airtel exhibit lower volatility and CAGRs, indicating they are less risky but also offer modest returns. IRFC (Indian Railway Finance Corp.) stands out among conventional companies, with a high CAGR and relatively low volatility, making it a strong performer with balanced risk-reward characteristics.
  - **Trade-off Between Risk and Return:**
    There is a clear trade-off between volatility and return: stocks with higher volatility (Green Sector) tend to have higher CAGRs, whereas those with lower volatility (Conventional Sector) offer more stable but lower returns. Investors seeking aggressive growth may prefer Green Sector stocks, but must be willing to tolerate higher risk, while those looking for stability may lean toward the Conventional Sector stocks with moderate returns.
  - **Max Drawdown and Risk Assessment:**
    Adani Green, despite its exceptional returns, has the largest bubble, indicating the highest drawdown, making it extremely risky. Stocks like IRFC, Bharti Airtel, and DMart have smaller bubbles, indicating lower drawdowns, making them more stable investments during downturns.
    Tata Motors, though positioned with moderate volatility and returns, has a relatively large bubble, suggesting it has experienced significant price corrections in the past.

5. MAJOR FINDINGS

- **Green sector stocks exhibit higher growth but carry greater risk.**
  The average compound annual growth rate (CAGR) of the green sector is 57.29%, significantly higher than the 33.51% observed in the conventional sector. This suggests that companies in the green sector have experienced stronger growth over the period analyzed. However, this rapid growth is accompanied by increased volatility. The green sector's daily volatility is 8.09%, more than double that of the conventional sector at 3.88%. This indicates that while green stocks have shown higher returns, they also experience greater price fluctuations, making them inherently riskier investments.

- **Risk-adjusted returns favor green sector stocks.**
  The Sharpe ratio, which measures return per unit of risk, is higher for the green sector at 1.0794 than for the conventional sector at 0.814. A higher Sharpe ratio suggests that green stocks have delivered better returns relative to the level of risk taken. This means that despite their higher volatility, green sector investments have provided superior compensation for the risk assumed by
  investors. However, this does not eliminate the possibility of substantial losses during market downturns.
- **Green stocks are more susceptible to steep declines**.
  The maximum drawdown, which represents the largest peak-to-trough decline in value, is significantly higher in the green sector at -47.30% compared to -28.91% for the conventional sector. This means that during adverse market conditions, green stocks tend to suffer sharper declines in value. Investors must account for this increased downside risk when considering green sector investments, as they may experience deeper, more prolonged drawdowns than conventional stocks.
- **Company-specific trends reveal different risk-return profiles.**
  Adani Green exhibits the highest CAGR of 99.65%, making it the fastest-growing stock. However, it also has the highest volatility (19.71%) and the deepest drawdown (-84.44%), indicating that while it offers tremendous growth, it is also highly unpredictable and susceptible to large losses.
  Suzlon and **JSW Energy** are positioned in the middle of the green-sector spectrum, offering moderate volatility and strong growth potential. Both stocks maintain a balance between risk and return, making them less risky than Adani Green but still attractive growth investments.
  Tata Motors has a relatively lower CAGR (33.01%) compared to green stocks but comes with significant volatility (9.92%), making it riskier than other conventional sector stocks.
  IRFC stands out in the conventional sector with a high CAGR (64.35%) and relatively low volatility of 2.69%, suggesting it has delivered strong returns with lower risk.
  HDFC Bank is the most stable stock, with the lowest CAGR (9.68%) but also the least volatility (2.92%), making it an ideal investment for risk-averse investors.
  DMart, **Bharti Airtel**, and **SJVN** offer moderate returns with controlled risk, providing a balanced investment option within the conventional sector.
- **Sector-based trade-offs require careful investor consideration.**
  The findings indicate a clear trade-off between growth and stability. Investors seeking high returns may find the green sector attractive due to its rapid growth rates, but they must be prepared for heightened volatility and deeper drawdowns. Conversely, those who prioritize capital preservation and lower risk exposure may lean toward conventional stocks, which offer greater stability but lower growth.

- **Reasons for the trade-offs between the two sectors**
  Over the past five years, the Government of India has implemented a series of strategic initiatives aimed at bolstering the renewable energy sector, which have significantly contributed to the green sector's outperformance compared to the conventional sector.
- **Government Initiatives in Renewable Energy (2019-2024):**
  Ambitious Capacity Expansion Targets: India set a goal to achieve 500 GW of renewable energy capacity by 2030, encompassing solar, wind, bio-power, and hydroelectric applications. This commitment underscores the nation's dedication to transitioning towards sustainable energy sources.
  Development of Solar Parks: The government launched initiatives to develop 50 solar parks across 12 states, each with a capacity of at least 500 MW. This large-scale infrastructure development has been pivotal in accelerating the adoption of solar energy.
  Annual Renewable Energy Bids: In April 2023, India announced plans to issue bids for 50 GW of renewable energy capacity annually over the next five years. This strategy aims to systematically increase renewable energy adoption and achieve the 500 GW target by 2030.
  Green Finance Mobilization: The government has actively promoted green finance, attracting investments from banks, non-banking financial companies (NBFCs), venture capitalists, and private equity funds. This financial support has been crucial in funding renewable energy projects and fostering sector growth.
  Sovereign Green Bonds: India incorporated green bonds into its climate finance strategy, showcasing its commitment to expanding renewable energy production and reducing carbon intensity. These bonds have provided an additional avenue for funding sustainable energy projects.

6. CONCLUSION & RECOMMENDATIONS

This research provides a comparative analysis of the **green sector** and **conventional sector** stocks, focusing on key financial metrics such as CAGR, volatility, Sharpe ratio, and maximum drawdown. The findings highlight distinct characteristics of both sectors, revealing the trade-offs investors face between high-growth, high-risk investments and more stable, moderate-return options. The green sector has demonstrated significantly higher growth potential, with an average CAGR of 57.29% compared to 33.51% for the conventional sector. However, this rapid growth comes with higher daily volatility (8.09% vs. 3.88%) and a larger maximum drawdown (-47.30% vs. -28.91%), indicating that while green stocks can deliver superior returns, they also experience sharper declines and greater price fluctuations. The Sharpe ratio analysis further confirms that, despite the higher risk, green stocks have provided better risk- adjusted returns (1.0794 vs. 0.814).

Overall, this study underscores the importance of aligning investment decisions with individual risk appetite and return expectations. Green sector stocks appeal to those willing to accept high volatility in exchange for higher potential returns, while conventional sector stocks are more suitable for investors seeking stability and lower risk.

The Government of India's proactive initiatives in the renewable energy sector have been instrumental in driving robust growth and improving performance metrics in the green sector. Also, the analysis confirms that green investments offer higher returns but come with greater risk, while traditional investments provide stability at the cost of lower growth. The viability of green investments depends on an investor's risk tolerance and long-term vision. Those seeking aggressive growth opportunities may find green stocks more rewarding, while risk-averse investors may prefer the stability of traditional stocks. Ultimately, a balanced portfolio strategy that incorporates both sectors can help optimize returns while effectively managing risk.

7. SUMMARY & RECOMMENDATIONS

In summary, the analysis shows that the green sector has significantly outperformed the conventional sector in growth, largely due to strong government initiatives and policy support. Over the past five years, India has aggressively expanded its renewable energy infrastructure through initiatives such as solar parks, annual renewable energy capacity bids, green finance mobilization, and sovereign green bonds. These measures have facilitated increased investments, improved risk-adjusted returns, and higher growth rates in green companies. Findings indicate that the green sector has a higher CAGR and Sharpe ratio, suggesting superior long-term returns, but also greater volatility and deeper drawdowns, reflecting the risks associated with emerging industries. The conventional sector, on the other hand, has shown more stability but lower growth potential.

Recommendations

- **Strategic Portfolio Allocation** – Investors should consider allocating a portion of their portfolio to the green sector for **higher returns**, while balancing it with conventional investments to manage risks.
- **Long-Term Investment Approach** – Given the higher volatility of green investments, investors should adopt a **long-term perspective**, allowing time for the sector to stabilize and mature.
- **Government Policy Continuation** – Policymakers should continue supporting the renewable sector through incentives, financing options, and infrastructure development to sustain its growth trajectory.
- **Risk Management Strategies** – Investors should diversify within the green sector, selecting companies with strong fundamentals and lower drawdowns to mitigate risks.
- **Encouraging Corporate Sustainability** – Traditional companies should increase green investments and integrate sustainable practices to remain competitive in the evolving market landscape.

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