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A Million Scenarios One Green Result

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Abstract

When sustainability and green energy did not correlate with economic interests, green energy was a hard target.

However, using the latest technological advancements, variables changed and green energy became a fact, as governments, firms and individual consumers race towards the use of sustainable renewable energy.

1,048,487 possible scenarios were conducted by a model developed in the Holy Spirit University of Kaslik, of which 1,047,490 scenarios proved that ceteris paribus, at a 99.9% confidence level, green transition of the entire planet will be realized before 2077.

Using a combination of historical data from the US government, the European Union and supranational organizations, the mathematical results are charted to be understandable not just by scholars and elites, but by every single human individual, after all, sustainability and climate change will impact the entire world.

Henceforward, the question of green and sustainable energy as proven through maths, technology and science below is no longer a matter of if, but a matter of when.

I. INTRODUCTION

How can an individual be against clean energy, are beauty, progress, and life not universally agreed upon as positive qualities for humanity?

Unless this individual is a stakeholder in a pollution-based company, and stakeholders are not limited to owners, employers and managers but also to every individual realizing interest by such companies, where lobbies keep on pushing the limit to make the destruction of nature economically lucrative, however, due to a combination of elements including but not limited to technological development and consumer awareness, the global transition toward green energy has become inevitable. The question is no longer if this transition will occur, but when.

➢ *In the Past: The Missing Attribute*

Previously, studies regarding sustainable energy would include hundreds of positive attributes, such as the positive impact on the environment, the significant effect on human health and the importance of clean energy to preserve and protect future generations, hundreds of positive arguments that were only missing a single fact, is it economically feasible?

➢ *Today: The Chain is Completed*

After immense progress in the field of green energy, this research demonstrates how green energy today is not only feasible, but even lucrative as in some cases, both from the viewpoint of entrepreneurs and consumers, green energy does not only match traditional energy in terms of cost but even outmatch it.

While in the near past it was just an aspiration, today it is finally realizable, due to a combination of factors, of which some are governmental such as tax incentives, some are related to consumer awareness due to scholars and journals such as the Discover sustainability, and some related to technological advancement and immense investments of major firms in research and development, which rendered the commercial use of sustainable green energy not only viable but also lucrative.

➢ *The Future of Energy*

Given the significant progress achieved, not merely a presumption but a logical deduction that the world is heading straight towards sustainable energy and as data

will be discussed throughout this contemporary research, firms, small, medium and large, and consumers, poor and rich, are heading towards green energy exponentially, and even if the end goal is not environmental in itself for many of the firms and consumers, yet seeking green energy due to cost efficiency has significant positive influence on the environment.

However, as bold as the claim that transition to green energy is a question of when, not if, real time data in addition to appropriate software and hardware are needed to prove mathematically the argument, and this study addresses precisely that need, as scientists combined efforts to develop a mathematical model and run a 1 Million plus scenario analysis (1,048,487 Scenarios) to predict the possibility that green energy will reach 100% before 2077, all at a significant 99.9% confidence interval.

II. LITERATURE REVIEW

➢ *Cost Trends and Competitiveness*

During the past decade—and through to 2023–2025–utility-scale renewables have solidified a cost structure advantage. IRENA (2024; 2025) documents additional global LCOE reductions in 2023, following decades-long learning-curve improvements and economies of scale. In the United States, Lazard (2025) demonstrates that unsubsidized new solar and wind are among the lowest-cost generation alternatives. Battery prices—the most important addition to variable renewables—dropped ~20% in 2024 to $115/kWh (Bloomberg, 2024), the largest one-year decline since 2017, powered by oversupply, declining commodities, and rising use of LFP (Bloomberg, 2023), in addition to the previous notions, the sanctions on petroleum products exported by Russia (Beainy et Al., 2024) encouraged companies, and countries to search for alternatives that included green energy.

➢ *Power and Transport Deployment Trends*

Renewable deployment is growing globally at record speed. The IEA (2024) anticipates ~60% growth in the use of renewables in electricity, heat, and transport between 2024–2030. Transport electrification supports power sector decarbonization: the IEA (2025) reports over 17 million electric vehicles sold in 2024 with a 20% global market share. Charging infrastructure and battery supply chains are expanding together (IEA, 2025).

➢ *Policy Frameworks and Targets*

Policy continues to be a key driver—and source of uncertainty. In Europe, the European Commission (2023) introduced a binding 2030 renewables target of at least 42.5% renewables (RED III). The United States, NREL (2023) discovers that the Inflation Reduction Act greatly influences raising low-emissions capacity additions and reducing system costs. Policy proposals in 2025, however, may decrease clean energy and electric vehicle incentives, potentially causing delays in investment timelines (Rhodium Group, 2025; Washington Post, 2025).

➢ *System Reliability and Integration into the Grid*

Increasing evidence is that high penetrations of wind, solar, and storage can allow for reliability with new planning and flexibility markets. NREL (2023; 2024; 2025) outlines plausible paths to extremely high levels of clean electricity with commercially ready technologies. Supporting analysis concludes that offshore wind transmission has the potential to enhance East Coast grid reliability and alleviate congestion costs (Reuters, 2024).

- *Enablers:*

Storage, digitalization, and learning Reduced battery costs improve the cost economics of short-duration storage (Bloomberg, 2024). In the meanwhile, the IEA (2024a) emphasizes digitalization, better siting, and faster permitting in reducing balance-of-system costs and deploying renewables at scale.

Bottlenecks and headwinds still to come Even though the global financial system has reached a peak in stability and prosperity (Beainy, Kamel, & Bteish, 2025), macro-level finance expense, supply-chain risk, and policy risk continue to be leading risks. IEA (2024a) records the responsiveness of renewable build-out to capital expense and permitting horizons, while Rhodium Group (2024; 2025) identifies grid stress and uncertain incentive duration as to-the-downside risk factors. Latest evidence indicates rather to a strong run for renewables (IRENA, 2024; Lazard, 2025; NREL, 2025).

III. RESEARCH METHODOLOGY

➢ *Research Design:*

The world is heading towards green energy, and while the path is obvious, the pace is unpredictable, yet using a combination of the latest available information, hardware and software, the Holy Spirit University ok Kaslik built a model to predict the possibility of becoming 100% green by 2077 at a confidence level of 99.9%.

➢ *Data Sources:*

Before testing the above hypothesis, evidence supporting the current global trend toward renewable energy was examined, with data from the US government for the US economy, from the European Union for EU countries and from the international energy agency for the rest of the world. In addition to the above resources, real data from Statista validated through comparison with the world bank historical data are used to build the model.

➢ *Model Development, Validation Techniques and Analytical Methods:*

While supporting arguments are presented graphically to aid accessibility, the testing of the thesis relies entirely on quantitative analysis, applying a combination of advanced statistical methods and computer science techniques. The model used in the study applies a combination of historical trend analysis to capture the trajectory off renewable energy adaption, a scenario simulation generating 1,048,487 possible scenarios to be able to reflect a wide range of Political, environmental, social, technological, economic and legal (PESTEL)

pathways, and computational tools that leverages high-performance software and hardware to handle the large-scale simulations efficiently.

To Verify that the model is reliable, cross-dataset validation was used, in addition to an extremely high required confidence interval (99.9%), while analytical methods included regression analysis and descriptive statistics.

IV. ARGUMENTS AND RESULTS

➢ *The Case of Electric Vehicles in the United States*

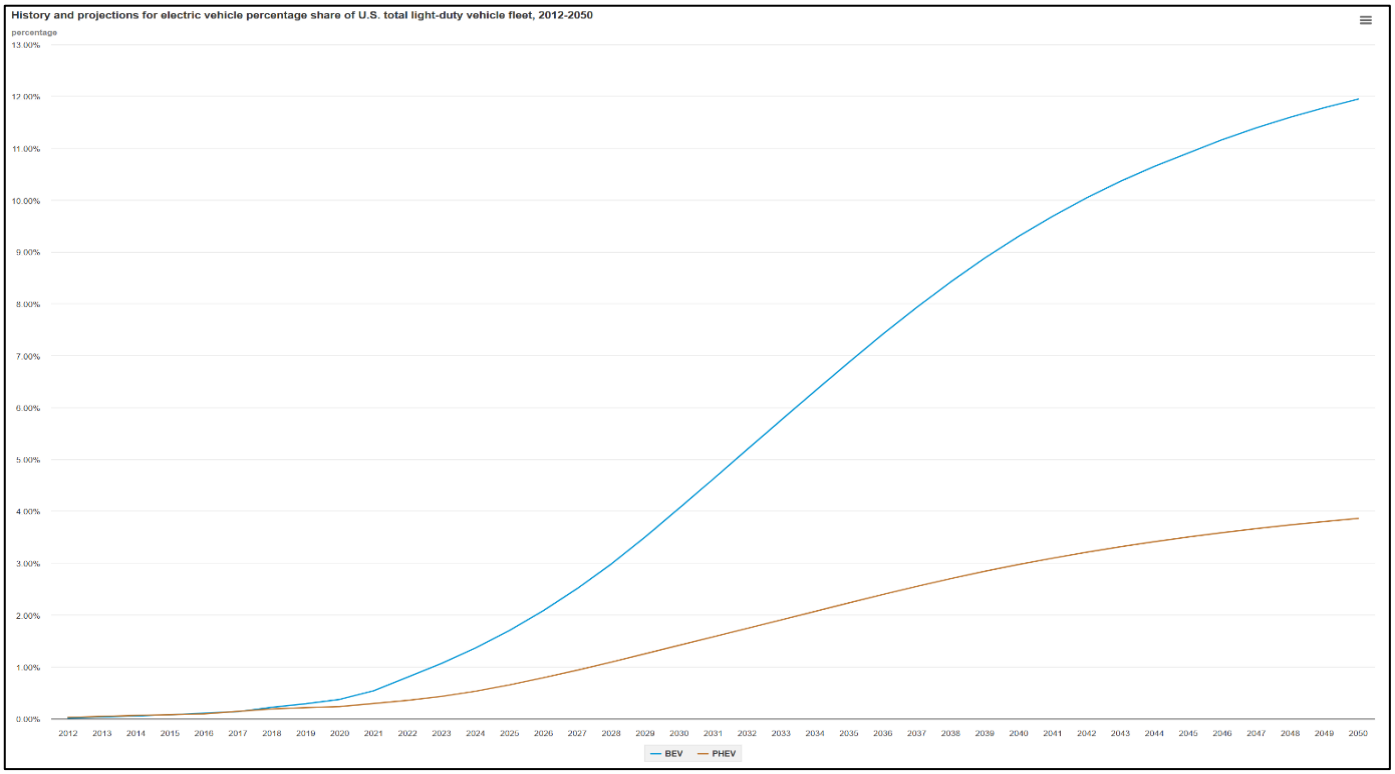

Fig 1The Case of Electric Vehicles in the United States
Source: (US Government EIA 2025)

According to the US Government, the use of hybrid vehicles (in orange) will increase steadily, but the use of fully electric battery vehicles (BEV in blue) has and will continue to increase exponentially, which signifies a combination of three elements that are necessary for such a hike, an increased consumer awareness of the importance of renewable energy, combined with governmental support through tax incentives and finally a technological breakthrough that made green energy for transportation viable and commercially lucrative for mass production.

➢ *The Case of European Energy Consumption*

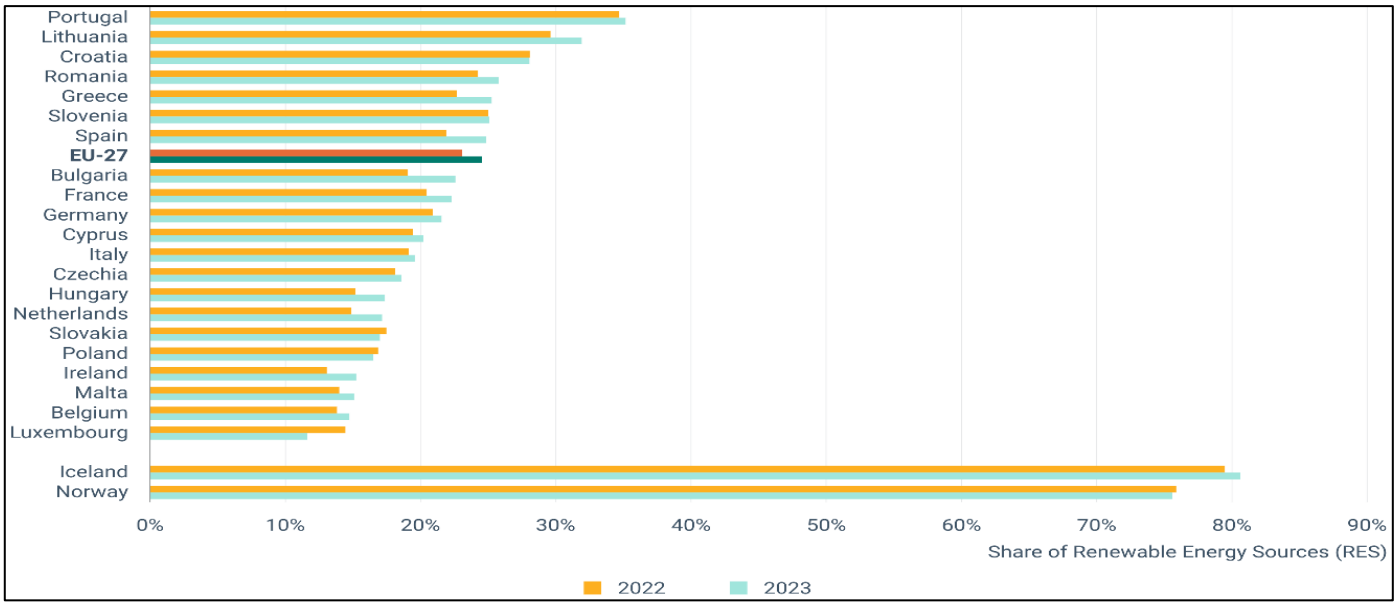

Fig 2 The Case of European Energy Consumption
Source: (European Union, 2025)

On a year-to-year basis, consumption from renewable energy sources increased in Europe by 10% from 22.2% to 24.5%, this increase is significant because Europe is the world's largest Gas consumer, Iceland being the first country in history according to the European union to reach an outstanding 80% consumption based on renewable energy sources, in the medium term, the target according to the European Union is 42.5% by 2030, which marks a 73% increase within seven years.

➢ *Renewable Energy Shares, Actual and Target*

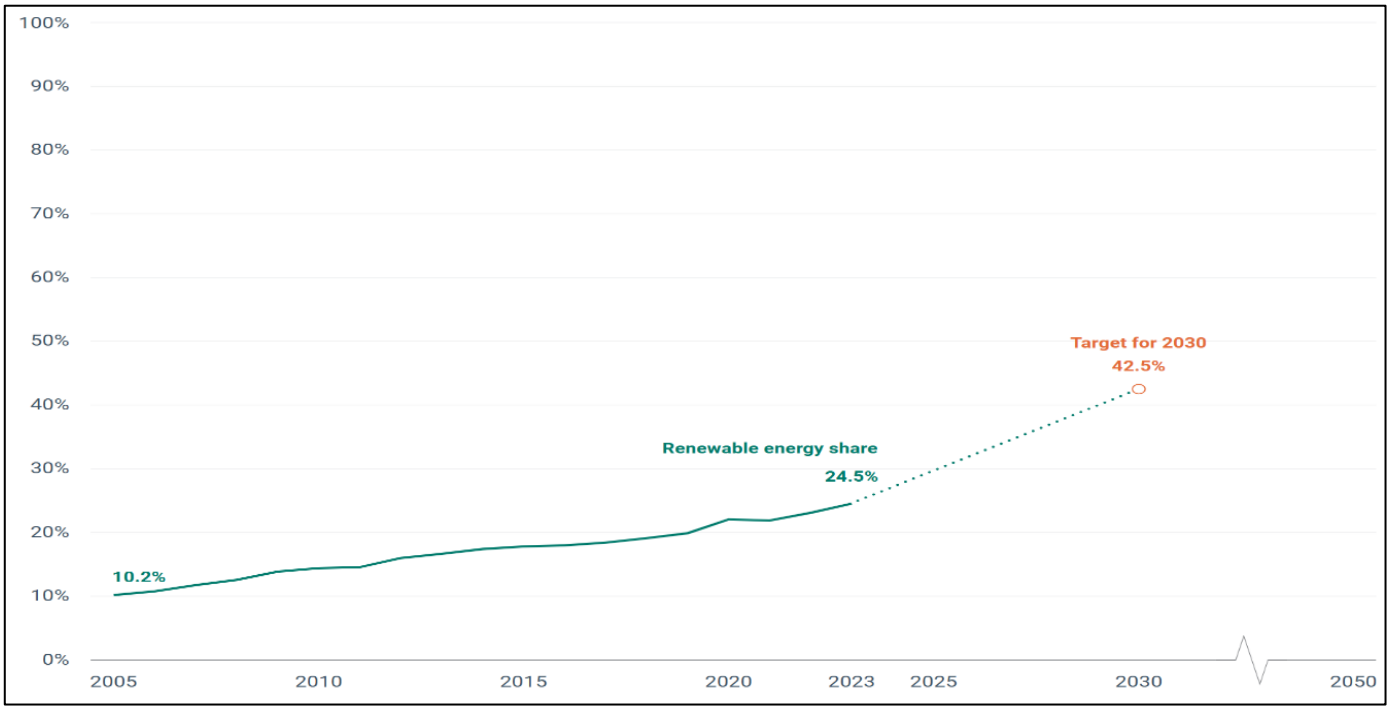

Fig 3 Renewable Energy Shares, Actual and Target
Source: (European Union, 2025)

➢ *The Case of Worldwide Energy Production*

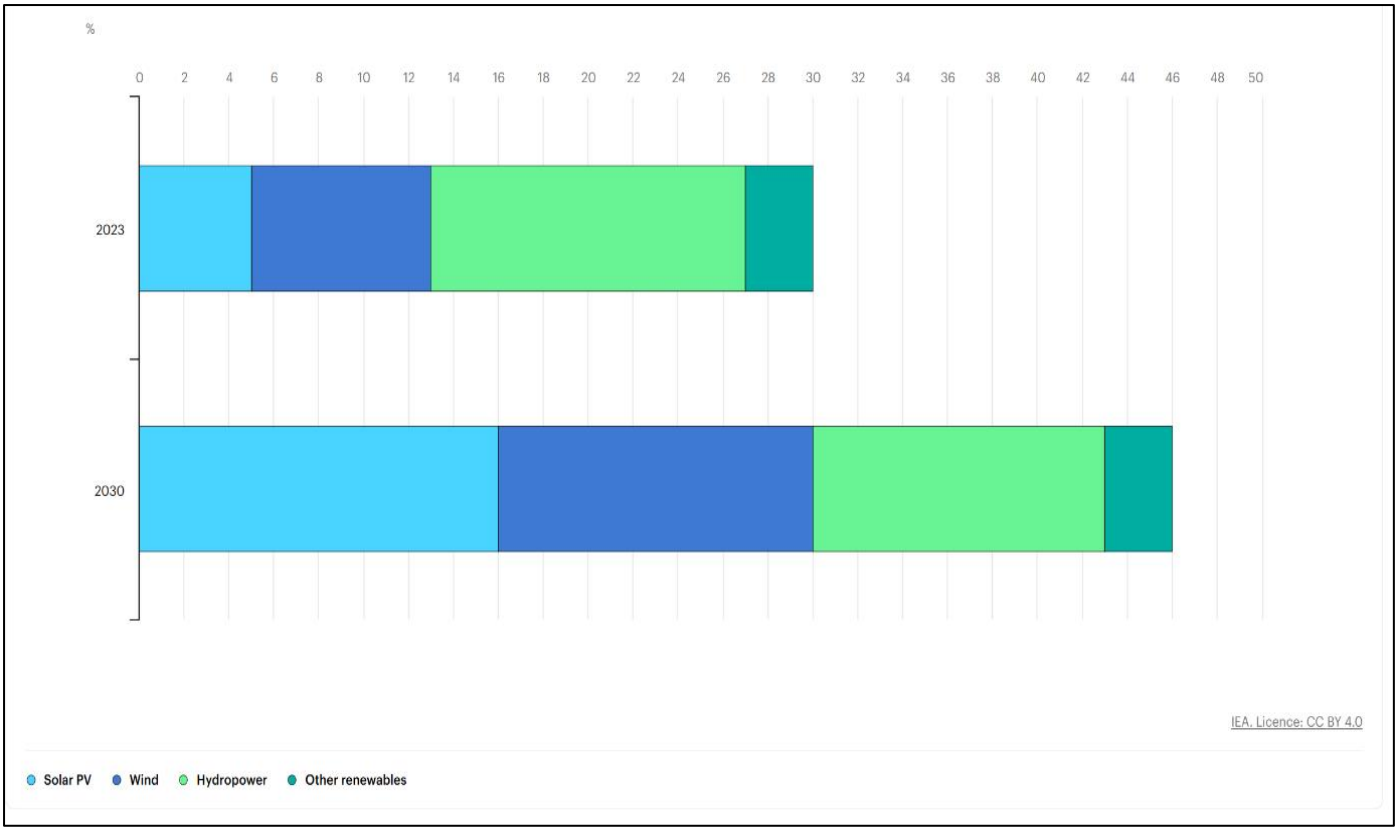

Fig 4 The Case of Worldwide Energy Production
Source: (International Energy Agency, 2025)

Internationally, most countries whether developed or developing, are following the American and European energy trends, goals are varying between the former and the latter, as the main goal of developed government is sustainable growth, while economics and access to energy services are the main objectives of developing governments, yet no matter the aim, the result is a significant 16% forecasted increase in the production of energy through renewable sources, almost half of the global energy production will be through the use of the sun, wind and water, all of which are entirely free as sources and more affordable to convert to energy as technology develops (Beainy & Kamel, 2023).

Almost 80% of the total increase is due to solar technology breakthroughs, and as renewable energy becomes both cheaper and more efficient, a scientist ought to expect that the forecasted 46% of 2030 will be surpassed.

Previously, it was thought that developing countries would avoid green energy due to prioritization of their economies over environmental considerations, however, as progress rendered green energy more affordable, sustainable energy is now the trend worldwide.

V. RESULTS OF THE MONTECARLO SIMULATION

➢ *Visualization of the Montecarlo Simulation*

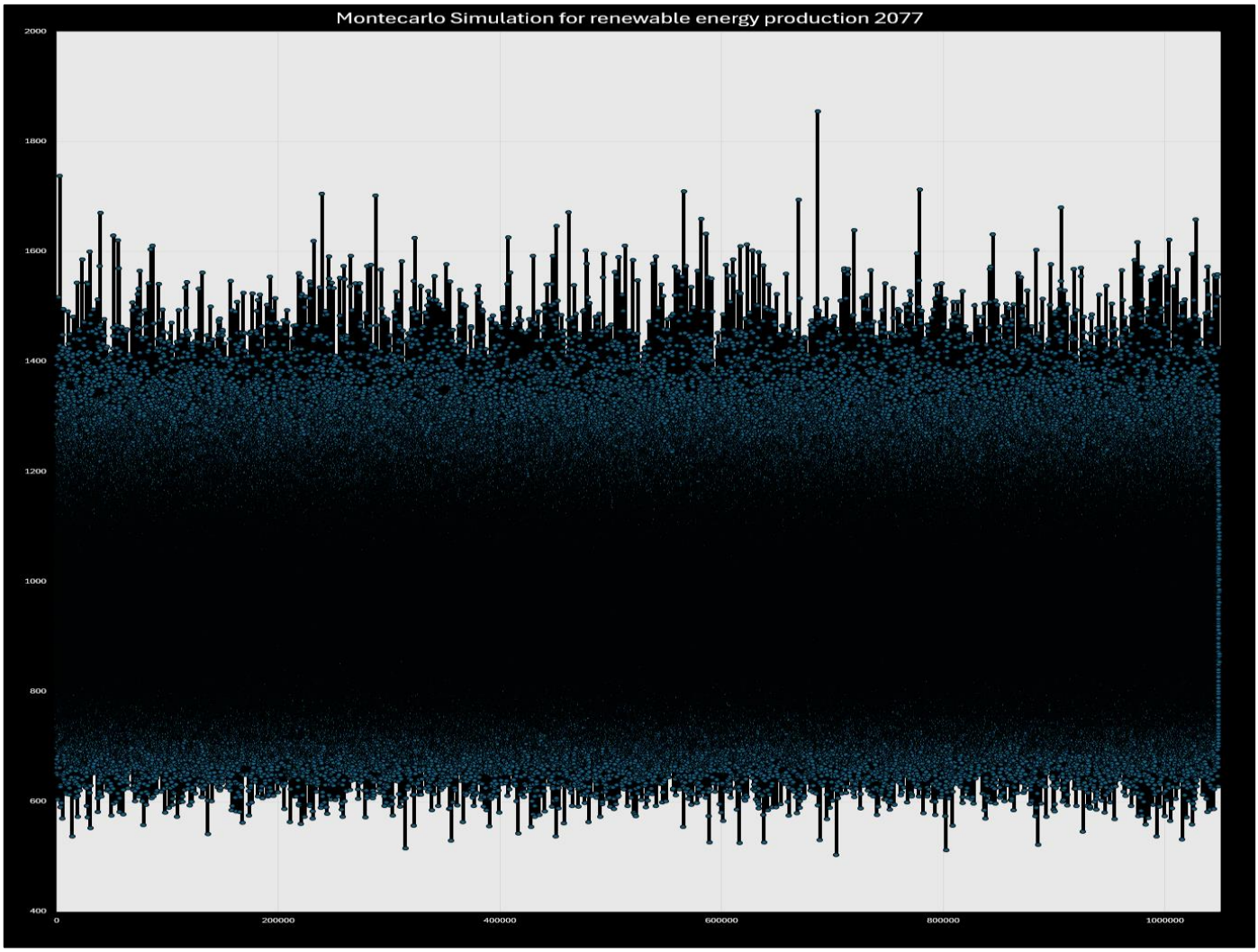

Fig 5 Visualization of the Montecarlo Simulation

According to the above, using historical data from Statista, and environmentally friendly hardware to calculate the mean, standard deviation and cumulative renewable energy production, 1,047,490 out of 1,048,487 scenarios applied that renewable energy production by 2077 will be sufficient to cover the need of the entire population, providing a significant 99.9% confidence level which is one of the highest confidence levels in mathematical sciences today.

Renewable energy production will easily surpass 640 exajoules noting that a single exajoule is 24,000,000,000 kg of oil-fossil fuel equivalent (MSCI, 2025).

VI. CONCLUSION

The world is progressing quickly, and as we enter the era of Artificial Intelligence, further breakthroughs in green energy can be expected.

However, what further enhance the quality of this scientific study is that technological development was not taken into account, for scientists should not base their studies on assumptions but on facts and current technologies.

And Given the current technology, Ceteris paribus, it is safe to conclude that the world can be 99.9% confident that before 2077, the world will finally become, entirely green.

REFERENCES

[1]. Beainy, R. H., Khalil, F. C., & Kaspard, J. A. Europe's Response: Impact of Sanctions on Russia.

[2]. Beainy, R. H., & Kamel, J. K. (2023). The importance of technology, R&D and AI in the US economy. Migration Letters, 20(8), 573–584. https://doi.org/10.59670/ml.v20i6.4882

[3]. Bloomberg. (2023, November 26). Lithium-ion battery pack prices hit record low of $139/kWh. Bloomberg.

[4]. Beainy, R., Kamel, C., & Bteish, M. (2025, October). In God We Trust. International Journal of Innovative Science and Research Technology, 10(10), 412–419. https://doi.org/10.38124/ijisrt/25oct233

[5]. Bloomberg. (2024, December 10). Lithium-ion battery pack prices see largest drop since 2017, falling to $115/kWh. Bloomberg.

[6]. European Commission. (2023). Renewable energy targets (RED III). European Commission.

[7]. IEA. (2024a). World Energy Outlook 2024. International Energy Agency.

[8]. IEA. (2024b). Renewables 2024: Analysis and forecasts to 2030. International Energy Agency.

[9]. IEA. (2025a). Global EV Outlook 2025. International Energy Agency.

[10]. IRENA. (2024). Renewable Power Generation Costs in 2023. International Renewable Energy Agency.

[11]. IRENA. (2025). Renewable Power Generation Costs in 2024. International Renewable Energy Agency.

[12]. Lazard. (2025). Levelized Cost of Energy+ (Version 18.0). Lazard.

[13]. National Renewable Energy Laboratory (NREL). (2023). Evaluating impacts of the Inflation Reduction Act and Bipartisan Infrastructure Law on the U.S. power system. NREL.

[14]. NREL. (2024). Maintaining grid reliability—Lessons from renewable energy. NREL.

[15]. NREL. (2025). 100% clean electricity by 2035 study. NREL.

[16]. Reuters. (2024, March 21). US offshore wind could ensure East Coast grid reliability—study. Reuters.

[17]. Rhodium Group. (2024). Taking Stock 2024: U.S. Energy & Emissions Outlook. Rhodium Group.

[18]. Rhodium Group. (2025). Taking Stock 2025. Rhodium Group.

[19]. The Washington Post. (2025, June 28). Senate tax bill seeks to gut clean energy; Musk calls it 'utterly insane'. The Washington Post.

[20]. https://www.eia.gov/energyexplained/use-of-energy/transportation-in-depth.php

[21]. https://www.eea.europa.eu/en/analysis/indicators/share-of-energy-consumption-from

[22]. https://www.iea.org/data-and-statistics/charts/global-electricity-generation-by-renewable-energy-technology-main-case-2023-and-2030

[23]. https://www.msci-institute.com/chart/global-primary-energy-consumption-generation-in-2023/#: ~:text=Global%20 consumption %20 of %20 energy %20 reached, million % 20tons %20 of %20 oil %20 equivalent.)

[24]. https://data.worldbank.org/indicator/EG.FEC.RNEW.ZS