A different world: how Artificial Intelligence is reshaping the road to green economy

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Abstract: Artificial intelligence is rapidly transforming every domain, industry and, consequently, every aspect of our lives. We all had to adapt to the most transformative and rapid changing technological revolution, and we had to learn while still understanding the impact that this new reality will have on our present and future. It is clear that data driven technologies are the future, regardless of the field we are considering. The world today is seeking performance, efficiency and sustainability, all in one, as a new emerging paradigm. In this context, data driven technologies, like the AI tools, are used to support cleaner energy production, smarter resource management or more resilient infrastructures, enabling predictive analysis, optimizing renewable energy sources and reducing waste. In achieving environmental goals on the path to green economy, AI is becoming indispensable. Machine learning algorithms can be used to accurately predict climate patterns or streamline farming practices to minimize water usage and reduce chemical fertilizers, for example and, thus, enabling organizations and governments to effectively plan their strategies.

Like any other transition, this one too comes with serious challenges. There are ethical considerations, data privacy, energy consumption of the AI tools that need to be addressed to ensure that the shift to a green economy is equitable and sustainable. For that to be a reality, policymakers, environmentalists and the civil society must find a way of working together to shape the proper AI solutions that are both innovative and aligned with long-term environmental stewardship.

In the light of the innovations brought about by new technologies, our study aims to examine the current status of the significant efforts that are being made toward achieving a long-standing concern: the green economy. This concern isn't new, but we cannot help but wonder whether artificial intelligence will have a positive impact on this topic, whether global decision-makers will be able to keep up with the extremely fast developments occurring and, most importantly, whether the average person will understand and embrace the growing significance of technology in every one's life, in ways that were not anticipated until recently.

Key word: Artificial Intelligence, Green economy, Sustainability, Green

1. Introduction

The global economy is at a crossroads: either it will make the energy transition and grow in an environmentally responsible way, or it risks embarking on an unsustainable and very likely irreversible course. Today, everything is changing at an unprecedented pace due to all the continuous technological advances, and the world is at a turning point where sustainability and artificial intelligence meet, and the combination of these two revolutionary forces has the power to completely reshape economies, cultures, and the environment.

In this regard, governments around the world have realized the importance of a sustainable economy and have begun to focus on reducing their carbon footprint, which has had a significant influence on their government policies. Since the 2008 financial crisis, governments have made economic growth an absolute priority, an approach that has unfortunately led many politicians and a large part of the population to place environmental responsibility lower on their list of priorities. Thus, international markets have ignored environmental impacts in the absence of concerted political will and precise incentives, which could lead to a downward spiral of environmental damage and financial difficulties.

The economic growth, progress and wealth of every country are fueled by its energy resources. Due to the energy crisis that followed World War II, many European nations studied the potential of producing biogas from animal waste, especially compost from farm animals, to compensate for the lack of liquid fuel. Because of this, the need to reduce the negative impact on the environment in sectors such as commercial, industrial, residential or agricultural has increased significantly, putting great pressure on available resources. Thus, the term "green growth" was born (Jones & Ström, 2024).

Green growth offers a path to reforming the energy economy to be sustainable, while simultaneously encouraging new industries and economic diversification. The goal of green development is to give economies the chance to grow and prosper while protecting the environment.

The green economy places a strong emphasis on the sustainable use of resources, in contrast to traditional economic models that emphasize rapid economic expansion without considering environmental impacts and that often place a higher priority on immediate returns. Also, the long-term effects of resource depletion and environmental degradation are often ignored by traditional models. The green economy, on the other hand, recognizes the finite nature of the planet's resources and aims to find a balance between ecological sustainability and economic progress, to increase equity and human well-being while drastically reducing ecological hazards and deficits. It aims to include environmental factors in every aspect of economic decision-making and recognizes the inherent value of natural capital such as forests, oceans, clean air and fertile land.

Thus, achieving sustainable development by finding a balance between environmental conservation and economic growth is considered possible only by moving to a green economy.

The application of artificial intelligence (AI) as a way to improve performance, productivity and efficiency is increasingly observed in more industries every day. At the same time, organizations find themselves in a pressured position to reduce the impact that their activity has on the environment in order to align with the green economy goals. Used thoughtfully, AI tools can enhance sustainable practices, for example by helping integrate renewable energy sources (like solar, wind or hydrogen) into existing systems or by optimizing the use or energy and waste reduction.

Smart energy system management, energy efficiency, and automated maintenance are some of the uses of artificial intelligence in green energy. This industry can increase productivity, reduce costs, and help create a more sustainable and greener future by incorporating artificial intelligence. Preventive maintenance plans for renewable energy infrastructure can be established with the help of artificial intelligence. This can save a lot of money and increase reliability by assisting in the early detection and resolution of potential problems before they lead to failures or delays.

2. Literature review

To overcome climate change and environmental degradation, there is now a global responsibility for people, governments and economies to transition to a green economy – one that is low-carbon, resource-efficient and socially acceptable. AI is increasingly recognized as a game-changer in this transition, offering creative ways to maximize energy efficiency, reduce emissions and promote green business practices across multiple sectors.

In recent years, the literature on the role of artificial intelligence (AI) in fostering the transition to a green economy has evolved considerably. This evolution reflects a growing

awareness of the potential benefits as well as challenges of AI technology in sustainability initiatives.

Initially developed as an answer to the financial crisis (Bina & La Camera, 2011), the green economy idea has gained popularity in national, regional, and international policy circles as a driver for development and growth.

Introduced by Pearce in the study *Blueprint for a Green Economy* (Pearce, Barbier, & Markandya, 1989) in the late 1980s, the term "green economy" seemed destined to become an essential component of political and policy discourse at that time. Although the term "green economy" appeared in the title of this research that had the main focus on defining sustainable development and its implications for economic growth and economic strategies, the report itself did not delve into this concept very well.

A thorough SWOT analysis is given in the study "*A panoramic view and swot analysis of artificial intelligence for achieving the sustainable development goals by 2030: progress and prospects*" (Palomare, et al., 2021) , with a focus on using AI applications to maximize resource and energy management. The importance of integrating AI into sustainable practices is underscored by the examination of the United Nation Agenda for Sustainable Development Goals, which promote the use of big data and Internet of Things (IoT) technology to improve production processes and reduce environmental contamination. This fundamental view establishes a framework for understanding the crucial role that AI plays in resource management.

The optimization of energy systems is one of the most frequently mentioned areas where AI supports the green economy. In order to more successfully incorporate renewable energy sources like solar and wind, operate intelligent electricity systems, and forecast energy demand, machine learning models are used (Rolnick, et al., 2022).

Building on this foundation, (Obracht-Prondzyńska, Duda, Anacka, & Kowal, 2022) delve into the implications of AI-based tools for smart urban development, particularly in the context of a circular economy. They highlight the nature of AI's influence, underlining both its ability to enhance sustainability through improved connectivity and resource efficiency, and the challenges posed by concerns about energy consumption.

Artificial intelligence is being used in several industries to reduce negative environmental impacts. For example, AI helps manage smart grids and forecast energy production in the renewable energy industry. Better integration of solar energy into the grid is possible through deep learning models that forecast photovoltaic energy generation (Fan , Yan, & Wen, 2023).

Overall, these studies present an analysis of the role of artificial intelligence in green economy, highlighting both the main obstacles that need to be overcome and the interesting potential uses of AI to ensure that it effectively supports sustainable growth. It is expected that there will be more research in this regard in the future as AI becomes increasingly used and new industries will likely be found that will benefit from its intensive use.

3. AI applications in the Green Economy

To ensure environmental sustainability while promoting economic growth and social well-being, the transition to a green economy requires reinventing economic models and policies. This involves implementing policies that support resource conservation, increase the use of renewable energy sources and reduce carbon emissions. The goal of the green economy transition strategy is to find a balance between environmental protection and economic growth.

Thus, for the development of a green and highly source-efficient economy, the Internet of Things (IoT0, artificial intelligence (AI) and data protection become crucial. These elements are important in creating new business models and competitive advantages in services related to the transformation of the economy, which will automatically lead to its growth.

Artificial Intelligence has become a game-changer in the green economy, contributing to innovation and sustainability in waste management, sustainable agriculture and renewable energy. These are just a few examples of industries where AI is already used. The applications of AI used in promoting a green economy are numerous and diverse, from smart electricity systems that efficiently regulate the flow of energy to AI-based forecasting systems that maximize, for instance agricultural production. For example, farmers can save water and increase food production by using AI algorithms to assess weather trends and make appropriate choices about crop planting and water supply. Natural language analysis can facilitate stakeholder collaboration in environmental projects by improving communication in efforts to promote sustainability. A notable example is Google's Deep Mind, which uses AI to reduce the energy consumption of its storage facilities by 40%. This remarkable achievement shows how AI can lead to a significant decrease in carbon footprint while maintaining operational efficiency. Such developments support the larger goal of sustainability, in addition to helping businesses and, why not, governments.

Different approaches to implementing green AI applications have been discussed. Regardless of the strategy, using a much greener architecture is the first step, as it forms the basis for developing sustainable AI. By reducing environmental impact, using resources with a low carbon footprint supports green AI.

A smart grid is a network that uses data and electrical flow to integrate digital communications and energy delivery. Due to these features, the smart grid can be optimized with automation technologies. In smart grids, artificial intelligence (AI) technologies are very useful in increasing three areas: energy management efficiency, energy consumption, and transparency. Predictive maintenance, reduced downtime and optimized maintenance schedules for solar panels and wind turbines are all possible thanks to artificial intelligence. Sustainable energy production is guaranteed by sophisticated algorithms that identify potential problems before they occur.

Artificial intelligence models are currently used in power generation systems for load forecasting and scheduling optimization. Artificial intelligence is also used to optimize energy efficiency through real-time changes in power generation and to integrate renewable energy sources.

The use of AI-based technologies to promote sustainable agriculture is changing as a result of the world's growing population and increasing food industry. Chatbots, smart sensors and AI-based drones have become increasingly popular because they can help farmers by informing them about energy-efficient irrigation systems, plant health diagnostics and farming practices. These machines are also capable of informing farmers about how to replace toxic chemical sprays used for pest control.

Artificial intelligence is also used in the transportation and logistics industry to address issues related to high energy consumption, carbon dioxide emissions, safety and the overall environment. The field of transportation has advanced so much in the last decades thanks to AI, human intervention no longer being necessary. In addition to reading maps, today's autonomous cars can also detect other vehicles, read road conditions and are said to be able to react faster than a person. Artificial intelligence improves intuition and makes quick decisions to avoid collisions, smooth traffic and even protect pedestrians. Thanks to companies like Microsoft, IBM and Amazon who have invested a lot of money in using AI as effectively as possible in their activity to reduce the impact on the environment by developing automated warehouses and fleets of electric cars.

As technological developments continue to improve efficiency and streamline operations, the shipping industry is undergoing a major transformation through digitalization. Among these, artificial intelligence is one that will elevate the shipping industry to levels of precision, reliability and efficiency that were previously unavailable. Global shipping is being continuously enhanced through the use of artificial intelligence, which is changing everything from security and cargo tracking to navigation and fuel economy. An industry that was previously slow-moving and constrained by tradition is now using automation, machine learning and predictive analysis to reduce costs, mitigate risks and improve operations. FedEx, for example, uses artificial intelligence-based technology, specifically machine learning algorithms, to provide accurate delivery time estimates. Those algorithms used by FedEx can increase the predictability of daily delivery times by analyzing a variety of factors, such as traffic and weather forecasts and finding the best delivery routes.

A study from 2024, titled *"Trade with Intelligence: How AI Shapes and Is Shaped by International Trade"* (World Trade Organisation, 2024) examines how AI can reduce trade costs, change the nature of trade in services, boost trade in goods and services, and reinterpret the comparative advantages that economies can gain. Also, AI improves ship cybersecurity, identifies potential anomalies early, strengthens system integrity, and reduces the potential threat of piracy by monitoring systems, identifying cybersecurity threats, and detecting suspicious activities to stop security breaches.

Artificial Intelligence is also revolutionizing the field of biodiversity. AI is capable of processing vast amounts of data from a variety of sources, including ecological surveys, satellite imagery and wireless sensors to identify trends, analyze habitat changes and monitor species population and ecosystems. By automating data processing and providing insights into ecological

process, including species identification, ecological modeling and conservation are prioritization, AI provides powerful tools for biodiversity assessment.

Early warning signs, weather forecasting, disaster response and recovery efforts, and post-disaster recovery and reconstruction are just a few of the benefits of integrating artificial intelligence into disaster management, which improve overall response capacity. Recent technological developments facilitate the management of natural disasters and improve the entire process, from disaster prediction to the necessary aid in recovery. For example, by analyzing seismic data, artificial intelligence can be used to predict aftershocks. An artificial intelligence system created by Google and Harvard that examined this type of data has demonstrated a greater accuracy in predicting the locations of aftershocks than the conventional techniques.

To improve working health and safety procedures, artificial intelligence has become an essential component. Organizations can create a more productive, creative and inclusive workplace through the prudent use of artificial intelligence. Automation and AI are being used by many companies to address rising levels of employee stress and restore safety in the workplace. By providing real-time information, assessing risks and tracking behavior, artificial intelligence helps create safer workplaces. By reducing human error, detecting early warning signs and improving operations, the right combination of automation and artificial intelligence can help increase worker safety. For example, technology will continue to improve the safety and security of construction industry. While new software tools help reduce errors when workers estimate prices, take measurements or forecast project completion times, autonomous construction equipment can reduce the risk of human error and potential damage. Large construction companies can also use artificial intelligence to proactively detect and mitigate workplace hazards before they become serious.

As seen in **Table 1**, AI has the potential to revolutionize the green economy by driving sustainability and innovation in many industries, such as sustainable agriculture, renewable energy, circular economy or waste management.

The table provides a structured overview of the most relevant AI tools and platforms that are already making a measurable impact in key sectors aligned with green economy principles. It outlines the sectors where AI is applied, the types of AI tools used, some concrete use cases and software examples and the environmental and economic benefits that these solutions bring.

AI is not just a technological trend, it is a critical driver of innovation and efficiency in achieving climate goals, sustainable development and a resilient low-carbon economy.

Table 1 AI tools for the green economy

GREEN ECONOMY SECTOR	AI TOOLS	AI SOFTWARE/ PLATFORMS	EXAMPLE APPLICATION	BENEFITS FOR GREEN ECONOMY
Renewable energy	• Machine learning • Predictive analytics • Computer vision	• Google DeepMind for wind • REopt Lite • Homer Energy	• Renewable energy output forecasting • Turbine performance optimization	• Increased energy efficiency • Reduced energy loss • Grid stability

			• Solar panel defect detection	
Sustainable transport	• AI for route optimization • Reinforcement learning • Autonomous vehicles	• Optibus • Waymo • Route4Me	• Route optimization for public transport • Smart traffic management • Green logistics	• Lower CO2 emissions • Reduced traffic time • Improved accessibility
Sustainable agriculture	• Vision AI • IoT+AI • Deep learning	• Climate FieldView • Plantix • Agremo	• Plant disease detection • Smart irrigation • Yield prediction	• Reduced use of water and chemicals • Higher crop yields • Soil health preservation
Waste management	• Robotics + AI • Automated sorting • Data analytics	• ZenRobotics • Recy Systems • Greyparrot	• Smart waste sorting • Monitoring waste collection points • Waste volume forecasting	• Increased recycling rates • Pollution reduction • More efficient waste logistics
Circular economy	• Data mining • AI in supply chains • Digital twins	• SAP Responsible Design and production • Circulor • Resourcify	• Product life-cycle optimization • Automated reuse/recycling platforms • Material recovery tracking	• Extended product lifespan • Reduced waste • Eco-friendly traceability
Smart&Energy efficient buildings	• AI for energy management • Adaptive control systems • Edge AI	• BrainBox AI • EcoStruxure • Buildings IOT	• Smart Hvac optimization • Adaptive lighting • Energy consumption reduction	• Lower energy consumption • Cost savings • Lower carbon emissions
Environmental Monitoring	• AI for satellite imagery • Climate ML models • NLP + Big Data	• Microsoft AI for Earth • Planet Labs +AI • BreezoMeter	• Deforestation reduction • Air and water quality monitoring • Climate trend modelling	• Faster response to environmental changes • Biodiversity protection • Data-driven policymaking

Source: authors

These industries can achieve major economic and environmental benefits by harnessing the power of AI in decision-making, optimization, and predictive analytics. However, to ensure equitable and inclusive adoption of AI, issues such as data security, scaling, and government hurdles need to be addressed. To fully leverage AI's promise in the green economy, future research should focus on improving explainability, reducing bias, and developing privacy strategies.

4. The Green Revolution

Currently, the green economy is a force in the development of economic growth, progress and prosperity for any state. Many renewable energy technologies have been established and recognized as evolution of industries by the governments. For example, the demand for energy in

sectors like agriculture, industry, commerce and households has increased immensely and put huge pressure on its resources. The level of economic growth of any nation will be indicated by the willingness to move from a traditional economy to a green economy.

AI investments

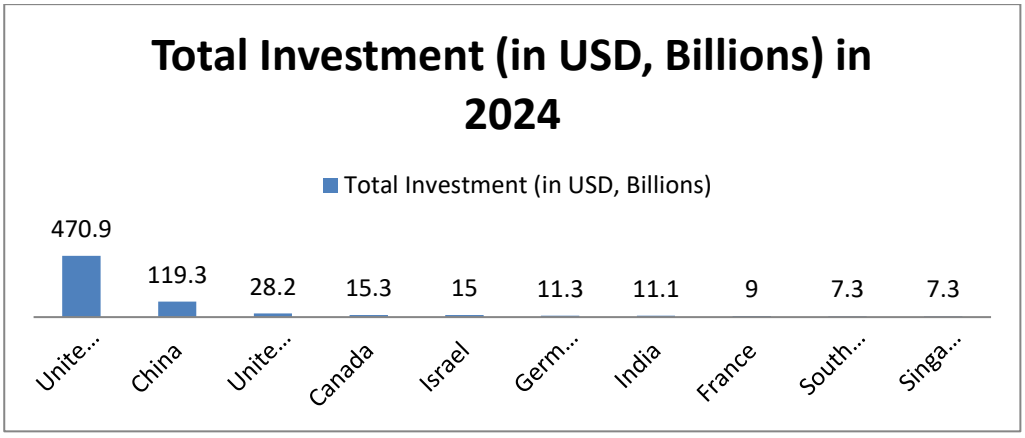
In recent years, artificial intelligence has become one of the most dynamic and competitive fields of the states. The year 2023 was notable for its special evolution, recording for the first time global investments in AI exceeding 150 billion dollars. Trends indicate a greater acceleration of growth, with forecasts that in 2027 it will reach invested amounts of over 500 billion dollars. This expansion, particularly notable for the private sector, is also receiving more and more support from governments that are starting to invest through public funds, large-scale and development strategies of AI.

According to a recent report by Stanford University (Standford University, 2025), the global artificial intelligence market grew to $279.22 billion in 2024 and is expected to grow at a compound annual growth rate of 35.9% between 2025 and 2030.

The United States continues to dominate the technological revolution. Between 2013 and 2024, the US attracted nearly half a trillion dollars in private investment in AI, more than all other countries combined. About 60% of global AI funding goes to American companies, further strengthening the US innovation subsystem. Silicon Valley serves as the global technology epicenter, where corporations such as Google, Microsoft, Amazon, and NVIDIA spend enormous amounts of money on AI-related research and development.

China, the US's rival in this particular scenario, is rapidly developing its AI capabilities. It also made significant investments in AI in year 2024, totaling $119.3 billion, followed by the UK with $28.2 billion. Chinese authorities have launched impressive plans in recent years, such as the "*Next-Generation Artificial Intelligence Development Plan*", which aims to enable China to lead the world in AI by 2030. The main focus of these efforts is on facial recognition, urban surveillance, and industrial automation, with public and private investment channeled to the key cities of Shenzhen, Beijing, and Shanghai.

Figure 1. Total investments in AI by country in 2024



Source: 2025 AI Index report

Canada and Israel also made significant contributions, investing $15 billion in AI over the past decade.

As can be seen, there is a large gap in private investment between the United States and other countries, where China recorded a slight reduction of -1.9%, while the European area recorded a very large increase of +60% since 2023.

The situation is completely different in Europe, where the model of responsible regulation and ethics reigns. The European Union has adopted a well-balanced approach to AI development, prioritizing transparency and the protection of democratic values. Programs such as *Digital Europe* or *Horizon Europe* provide financial support for AI projects in strategic sectors, such as health, energy or agriculture, or the *Next Generation EU* for post-pandemic recovery plan, which includes funds for AI infrastructure in member states. Strong research and innovation states in Europe, such as Germany, France, the UK or Sweden, have more often found themselves facing roadblocks when it comes to attracting venture capital in the context of the influence created by existing legislative gaps.

United Kingdom, France and Germany are leading the in AI investment in the European Union, where cities such as London, Oxford, Paris, Munich and Berlin are important hubs for AI development and innovation. The United Kingdom tops the investments with $2.1 billion in AI, followed by France and Germany. Together, these countries attract 77% of total AI investment in Europe between the years 2023 and 2024, making them the dominant players in the sector. France has seen remarkable growth, with investments of over $1.2 billion. The French government's proactive policies, like the *Deeptech Plan* and significant investments in innovative technologies, have supported in an important way the country's AI network. Without a doubt, Germany has established itself as a strong competitor due to its strong industrial foundation and focus on AI in engineering and manufacturing. Due to their existing digital ecosystems and robust government and private sector support, cities like Berlin and Munich are emerging as hubs for AI startups.

In the last decade, other countries have also invested in the field of AI such as Israel with investments of $15.0 billion, Singapore with $7.3 billion, Sweden with $7.3 billion, Japan with $5.9 billion, Australia with $4 billion, Switzerland with $3.9 billion and the United Arab Emirates with $3.7 billion.

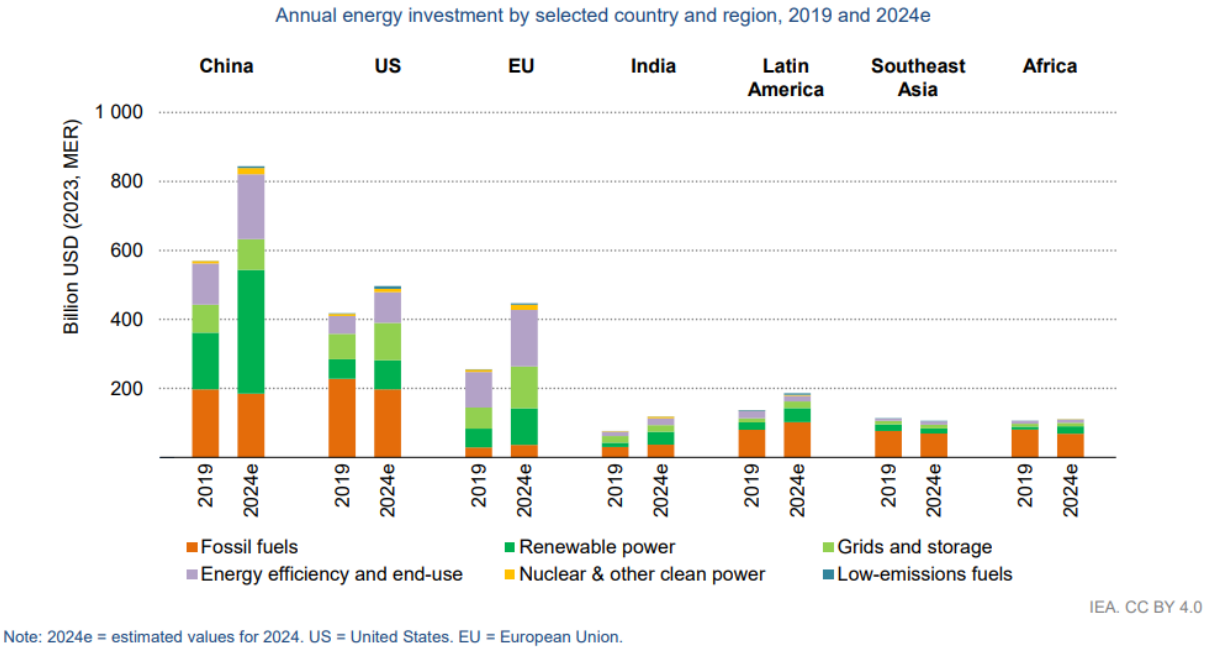
Green economy investments

If we were to present a top list of countries with the highest investments in green energy production in 2024, we would include China, the United States, Brazil, India and Canada.

For the first time in history, the investments in global energy will exceed $3 trillion in 2024, with $2 trillion made in clean energy technologies and infrastructure. Clean energy investment has grown sharply since 2020, and the costs of renewables, grids and storage now exceeds total cost of coal, gas and oil. The increases are largely driven by advanced investment in renewables, which account for half of total energy sector investment. New policy strategies,

well-managed public proposals and better network infrastructure are reflected on the progress in countries like India, Brazil, on parts of Southeast Asia and Africa. For example, in 2024, the investments in clean energy in Africa are at over $40 billion, and that is almost double that in 2020 (International Energy Agency, 2024).

Figure 2. Annual investment by country and region from 2019 to 2024



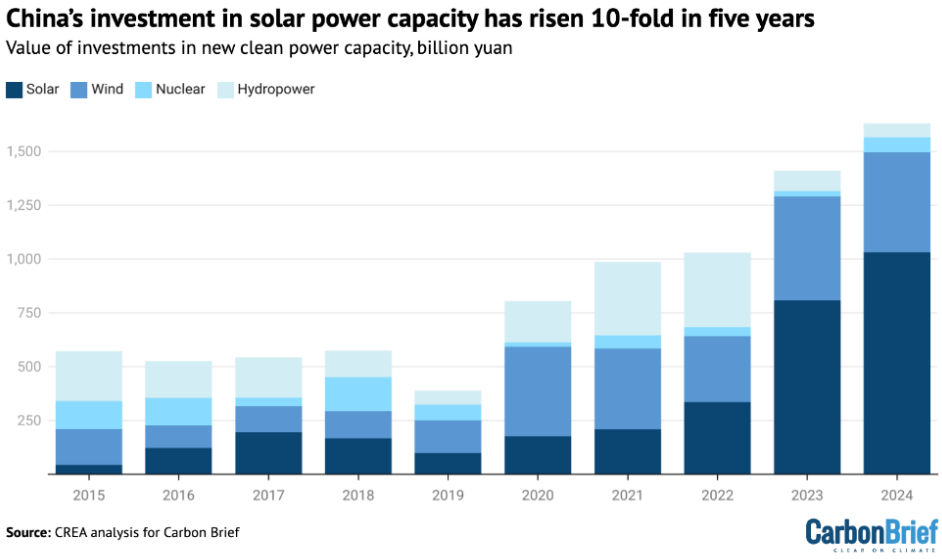
Source: IEA, 2024

The large spending in clean energy is supported by the objectives of emissions decrease, technological benefits, energy security requirements and the fact that major economies are organizing new industrial plans to rise clean energy manufacturing and to find durable market positions.

China's economy grew due to technological advances in 2024, and because of the investments made in green energy. Being the country with the largest population in the world, it also holds the title of the country that invested the most in the field of renewable energy in 2024, including through the production of the *"new trio"*, to be exact the electric vehicles, solar panels and lithium-ion batteries and being the largest producer of solar panels and wind turbines, with over 70% of global solar module production. With ambitious goals, China is starting projects in the field of solar, wind and hydroelectric energy and wants to reduce energy from non-fossil fuels by 2030.

The energy technologies contributed more than 10% to China's economic growth in 2024 for the first time in history, with sales and investments worth 13.6 trillion yuan ($1.9 trillion) (Myllyvirta, 2025).

Figure 3. China investments in green economy 2015-2024



Source: CREA.com

The most ambitious project is the *Tengger Desert Solar Park*, also called the *"Great Wall of Solar"* which has an area of over 1,200 square kilometers and is situated on the southern edge of the Gobi Desert. China has also invested heavily in recent years in offshore wind farms, which have the objective of producing significant amounts of energy.

In 2024, leading Chinese companies, spanning both private and public sectors, have intensified their investments in technologies and solutions aligned with the green economy principles. The investments reflect China's commitment to sustainability, energy transitions and global climate targets, and can be seen in the table below.

Table 2. Chinese companies that invested in green economy in 2024

No.	Company	Sector	Investment area in 2024
1.	CATL (Contemporary Amperex Technology Co. Limited)	• Battery manufacturing, • Electric Vehicle supply chain.	• Production of lithium-ion batteries, • The launch of new sodium-battery line • Battery recycling plants.
2.	Goldwind Science & Technology Co., Ltd.	• Wind power.	• Research and development in offshore wind power, • AI-driven predictive maintenance tools for turbines, • International expansion.
3.	GCL Poly Energy Holdings Limited (GCL-Poly)	• Renewable energy, • Solar Photovoltaic technology.	• Green methods to upgrade polycrystalline silicon production, • International expansion.
4.	SAIC Motor Corporation Limited	• Automotive, • Electric Vehicle.	• New EV models , • Achievement of carbon neutrality by 2045.
5.	State Grid Corporation of China	• Smart grids, • Energy infrastructure.	• Upgrading of small grids and renewable energy integration, • Launch of blockchain platform for traking

			the green electricity usage.
6.	Beijing Enterprises Water Group (BEWG)	• Water treatment, • Circular economy.	• AI wastewater recycling solutions, • Recovery systems.

Source: Authors

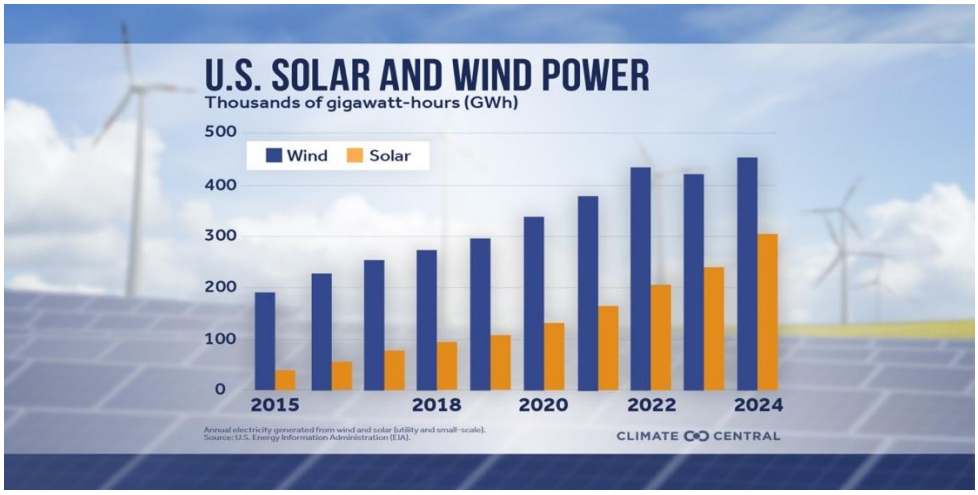
As we can see, the companies listed represent a broad spectrum of green sectors: from battery manufacturing and electric vehicles, like CATL and SAIC, to renewable energy technologies (Goldwind or GCL-Poly), smart grid infrastructure and water treatment in the context of green economy (BEWG). Also, AI, blockchain and next generation materials play an important role in their investment strategies. For example, CATL has expanded into sodium battery technology and battery recycling, addressing both innovation and resource circularity, Goldwind integrates AI-driven maintenance in the wind turbines to improve efficiency and reduce downtime and State Grid is using blockchain to track green electricity consumption.

Some of these companies are investing not only domestically, but are also looking for an international expansion, in accordance with China's ambition to be seen as an important global green tech leader.

The **United States of America** has taken important steps to increase the investments in clean energy. Through its environmental policies, the United States aims to achieve a carbon-free energy sector by 2035, through various green energy projects and incentives for faster development of new clean energy industrial capacities The strategy in this direction involves large investments in solar and wind energy, due to their very high potential in the mission of sustainable development.

In 2024, the United States generated a record of 756,621 gigawatt-hours (GWh) of electricity from solar and wind power, enough to power the equivalent of more than 70 million average American homes, triple the amount generated in 2015. Solar power is the fastest-growing source of electricity.

Figure 4. U.S. solar and wind power between 2015 and 2024



Source: Climate Central, 2025

Solar and wind power together accounted for a record 17% of total U.S. electricity production in 2024, with states such as Iowa, South Dakota, Kansas, California, Texas, Florida, and New Mexico generating at least 10% of their state electricity from combined solar and wind power in 2024. Texas, Iowa, and Oklahoma generated the most wind power (Climate Central, 2025).

Table 3. American companies that invested in green economy in 2024

No.	Company	Sector	Investment area in 2024
1.	Tesla	• Automotive, • Energy.	• Expansion of Gigafactory production
1.	NextEra Energy	• Renewable energy.	• Infrastructure of wind, solar and battery storage.
2.	Microsoft Corporation	• Technology.	• Carbon-negative technologies, • International expansion.
3.	Apple	• Technology, • Manufacturing.	• The supply chain of carbon-neutral , • Designing green products.
4.	Amazon	• E-commerce, • Logistics.	• Renewable energy, • Electric delivery fleet.
5.	Exxon Mobil	• Energy..	• Carbon capture, • Low carbon fuels.
6.	Black Rock	• Finance	• Green funds, • Sustainable infrastructure.

Source: Authors

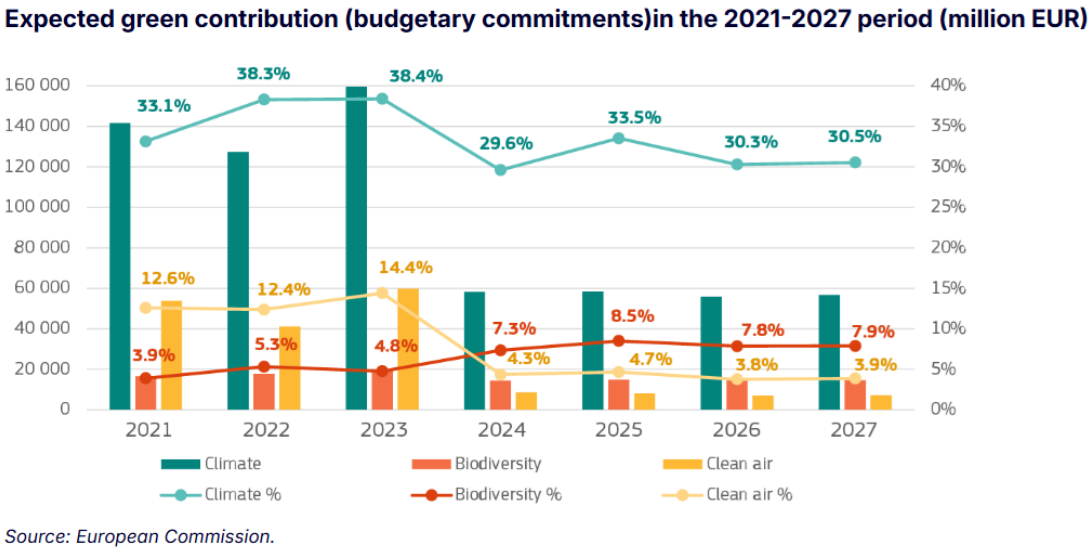
From automotive giants transitioning to electric vehicle, to tech leaders leveraging AI for climate actions makes Unites Stated of America a global force in green economy investments. The American companies from key industries are making investments in clean technologies, reinforcing the United States' position as a global leader in this field. These efforts reflect a mix of environmental, social and governance goals with strategic alignment, market innovation and climate ambition. The 2024 investments in green economy reflect a shift towards a more climate-conscious business model, with companies that are actively shaping the international market.

Another green economy business model is specific to the **European Single Market**. In 2024, European companies were investing in sustainability actions through a mix of regulatory compliance, green innovation and climate leadership, being influenced by the *European Green Deal*, *Fit for 55* and *ESG legislation*, making climate actions not only strategic, but mandatory.

The Commission uses green budgeting as a tool in order to rise the transparency of the European Union budget in terms of funding to support climate and environmental goals, in line with the European Green Deal and the Paris Agreement.

As seen in the figure below, the EU green budget is planned around four areas: climate adaptation, climate mitigation, biodiversity and clean air. It also consists of a solid '*do no harm'* component covering the environmental and climate objectives. All actions require to respect this principle, harmonized with the relevant legislation.

Figure5 . Expected green contribution in EU area 2021-2027



Source: European Commission.

Source: European Commission

The most representative companies that invested in green economy cand be analyzed in the table below.

Table 4. EU companies that invested in green economy in 2024

No.	Company	Country	Sector	Investment area in 2024
1.	Siemens-Gamesa	Germany/Spain	Wind energy	Offshore wind farms, green hydrogen production
2.	Ørsted	Denmark	Renewable energy	Development of next-gen wind turbines, circular blade technology and global expansion
3.	Volkswagen Group	Germany	Automotive	EVs, battery production and carbon neutral manufacturing
4.	Enel	Italy	Energy/Utilities	Smart grids, EV charging infrastructure, AI for energy efficiency and digitalized green services
5.	Neste	Finland	Biofuels/Chemicals	Renewable diesel and sustainable aviation fuel, circular raw materials
6.	Unilever	UK/Netherlands	Consumer goods	Net-zero supply chain by 2039, plastic reduction, green product innovation
7.	Iberdrola	Spain	Renewable energy	Large-scale wind/solar projects in EU and Latin America, green hydrogen

				and battery storage
8.	BMW Group	Germany	Automotive	Sustainable materials, carbon neutral vehicle production and solid state battery research and development
9.	Schneider Electric	France	Industrial automation	Energy management software, smart buildings, microgrid solutions for decarbonization
10.	Allianz	Germany	Finance/Insurance	ESG integrated investment portfolios, green bonds, climate risk modelling
11.	Veolia	France	Environmental services	Water reuse systems, energy recovery from waste, circular economy models
12.	Heineken	Netherlands	Beverage/Manufacturing	Carbon neutral brewing targets, sustainable agriculture, green logistics
13.	Saint-Gobain	France	Construction/Materials	Eco-design building materials, energy efficiency solutions, closed loop production
14.	E.ON	Germany	Utilities/Energy	Grid modernization, decentralized energy solutions, smart meter rollout

Source: Authors

As we can observe, these companies span multiple sectors and are aligned with both EU climate goals and global sustainability frameworks. Their most important investment directions include decarbonization as a legal obligation, focus on circular economy, green hydrogen, eco-design and renewables, consistent investments in research and development supported with EU funding and strong participation in carbon markets, supply chain transparency and climate disclosures.

China, the USA and the EU emerge as the three leading forces that are shaping the world's transition towards green economy and technology, each pursuing sustainability through distinct strategies. The table below compares their approaches, key sectors and strengths.

Table 5 Green economy comparative strategy table: China vs. USA vs. EU

Category	China	USA	EU
Main strategy	State-driven industrial transition	Tech and finance-driven innovation	Regulation-led sustainability, circular economy
Key sectors	Batteries, renewables, smart grids	EVs, clean energy, climate tech, green logistics	Renewables, hydrogen, eco-design, circular industries
Tech focus	AI in manufacturing, blockchain for energy	AI/climate tech, carbon capture, big data	AI, smart energy, eco-innovation, traceability tech
Notable companies	CATL, Goldwind,	Tesla, Microsoft,	Siemens, Iberdrola, VW,

	SAIC, GCL,State Grid	Amazon, NextEra, BlackRock	Enel, Neste, Unilever
International expansion	Strong in infrastructure export	Global through tech platforms and finance	Strong in regulation export and green tech diplomacy
Climate targets	Net-zero 2060 (national), corporate goals	Net-zero 2050 (corporate-led), ESG-driven	Legally-binding: net-zero 2050 (EU Green Deal)
Policy role	Centralized coordination with industry	Incentive-based, ESG pressure	Legally enforced climate action, green finance rules
Corporate strengths	Scale, cost efficiency, state banking	Innovation, brand influence, venture capital	Regulatory alignment, social license, eco-branding

Source: Authors

We cannot help but notice that, while the three powers have demonstrated strong momentum in the green economy, they differ in strategic focus and industrial strengths. China leverages its industrial scale and centralized planning to dominate in clean manufacturing and infrastructure. The USA relies on innovation, market driven investments and tech leadership to advance climate goals and the EU leads through regulatory frameworks, climate policy integration and circular economy principles. The three nations are important players in this global transition to green economy and their strategies, although distinct, are rather complementary than competitive.

Brazil is a powerhouse in renewable energy, largely due to its immense natural resources and has a historic chance to lead the global transition to an economy based on low-carbon. Brazil's vast, fertile land and abundant natural resources are a particular advantage for generating renewable energy. While its economy was based more on extracting the resources for export, the country has gradually shifted to a more circular approach that now understands the necessity of prioritizing the renewable energy. The country has set ambitious objectives to continue expanding its renewable energy capacity, focusing on hydropower, wind power, and bioenergy. Brazil's goal is to generate 45% of its energy from renewable sources by 2030 (Bloomberg NEF, 2024). Also, in 2023, the Economy Minister presented *The Ecological Transformation Plan*, as a demonstration to the country's promise to ecological development.

The Itaipu Dam, located on the border between Brazil and Paraguay, is one of the largest hydroelectric power plants in the world. The project highlights the commitment to connecting its abundant water resources for power generation. The country is also investing in wind farms in its northeastern region, where wind conditions are ideal for clean energy.

India, with its fast growing population and economy, is very aware of the importance of renewable energy. The country has set an objective of realizing 450 gigawatts of renewable energy capacity by the year 2030. Solar and wind power are main components of India’s strategy to reduce its dependence on fossil fuels and promote sustainable development. One of India’s most important projects is *The Bhadla Solar Park*, which is spread over 14,000 acres in

Rajasthan. This solar park is one of the largest in the world. Also, India is investing in large-scale wind farms, particularly in Tamil Nadu and Gujarat.

With the goal of reaching net zero emissions by 2050, **Canada** is investing heavily in hydropower, wind, and solar projects. Hydropower, in particular, plays a substantial role in the energy policy, given the abundant water resources. *The Muskrat Falls* project in Newfoundland and Labrador is a testament to Canada's commitment to hydropower. The project aims to provide clean, renewable energy to the region while reducing greenhouse gas emissions. Canada is also expanding its wind power capacity, particularly in provinces such as Alberta and Saskatchewan.

5. The Road Ahead: Emerging Trends

In the future, energy systems will need to be both efficient and environmentally sensitive. Such a future is made possible by artificial intelligence, which is revolutionizing the way we approach problems in various fields. AI offers amazing possibilities for a greener future, from transforming agriculture to optimizing renewable energy sources.

Recent research indicates that the integration of artificial intelligence will create millions of jobs in new industries focused on sustainability. In addition, it will influence political decisions that prioritize environmental management, shaping a future in which governments and corporations work together to create a more sustainable world.

Based on a Statista.com, the Artificial Intelligence market size was valued at US$87.04 billion in 2021, and it is projected to reach US$244.22 billion by 2025, growing at a CAGR of 26.60% from 2025 to 2031. In the global comparison, the United States is expected to hold the largest market share, with US$73.98 billion in 2025.Because AI can predict energy consumption with such precision, we can use renewable energy sources like wind and solar more efficiently. AI systems can forecast energy generation and help balance supply and demand by examining weather patterns and consumption data. This reduces reliance on fossil fuels and reduces waste.

Artificial intelligence is also contributing to waste management. More accurate identification of recyclable items is now possible thanks to innovative garbage sorting algorithms based on machine learning. This method reduces pollution in recycling streams while increasing recycling rates.

AI is widely used in climate modeling to help scientists make more accurate predictions about future climate conditions. AI can help policymakers make informed decisions by identifying trends and potential impacts of climate change through the analysis of vast amounts of environmental data. This proactive strategy is essential for reducing the dangers associated with climate change.

Green transport is the term for environmentally friendly mobility options that use less energy and emit less carbon. It includes alternative fuels, including hydrogen and biofuels, bicycle infrastructure, electrification of public transport and electric cars. In the future we will see more electric double-decker buses like those in London, we will see more countries investing

in bike parks and bike lanes in major cities, both where air pollution is a big problem and in less polluting cities with well-developed strategies in this regard. It is also possible that organizations will solve the problem of pollution related to the construction of batteries for cars, buses, trains, etc. and offer the use of hydrogen as an alternative.

While continuing to transport goods and connect communities globally, ports around the world are also fostering the offshore wind industry, facilitating the trade of sustainable fuels, and increasingly becoming multimodal hubs for electrified transport. The idea of "green ports," which incorporate state-of-the-art logistics systems and clean energy technology, emerged as ports around the world began to embrace the idea of greener operations. By fulfilling these responsibilities, ports of all sizes can make a significant contribution to the goal of net zero emissions, not only by controlling their own emissions, but also by developing into green energy hubs that facilitate the transition to secure, affordable, and sustainable energy systems. An example of this is EU-funded initiatives such as the PIONEERS project, which have the potential to help companies create cutting-edge solutions to reduce carbon emissions in the port industry. Ultimately, such initiatives aim to transform ports into energy hubs and green infrastructures by 2050. For example, the port of Rotterdam, the largest in Europe and currently one of the most important green ports in the world, has made significant investments in electrifying its infrastructure. Thanks to this, the port can operate entirely on renewable energy.

The tourism sector is rethinking its operations to comply with sustainable standards as the world grapples with climate change, biodiversity loss and the need for equitable development. Preserving the natural and cultural features that attract tourists is important, but equally important is ensuring that the sector supports regional economies and international environmental goals. The development of the accommodation industry, which is forced to reduce energy use and become more sustainable, reduce waste, conserve water, must become as green as possible. Another important factor in advancing sustainable tourism is technology. Artificial intelligence and big data can be used to control visitor flows, reducing environmental impact and reducing congestion in popular locations. Green destinations are increasingly popular, attracting tourists from all corners of the world and helping to protect the delicate ecosystems and natural beauty of destinations.

Conclusions

Businesses, society, and the environment benefit enormously from moving to a green economy. In addition to reducing negative environmental impacts, moving to sustainable practices stimulates innovation, job creation, and economic expansion. The intersection of artificial intelligence and the green economy is poised to transform our planet as we move into a new era. Imagine a time in the future where smart grids power our cities, renewable energy forecasting ensures efficient use of the sun and wind, and sustainable agriculture technology feeds the world's growing population while protecting the environment. These developments are not just possibilities; they are imminent and poised to revolutionize our lives in the years ahead.

The green economy uses AI in countless ways, from increasing energy efficiency and integrating renewable energy sources as efficiently as possible, to making agriculture greener and rethinking waste management and transportation. AI is showing what is achievable in sustainable development by incorporating it into automated resource planning, smart grids, and precision agriculture. It enables much more accurate environmental monitoring, encourages the creation of circular economy models, and facilitates the creation of evidence-based policies that adapt to changing circumstances.

While change involves risks and challenges, proactive businesses can mitigate these risks through stakeholder engagement, regulatory compliance, and strategic planning. At the same time, policymakers must make significant efforts to develop frameworks that motivate companies to strive for a more sustainable future.

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