

Global Renewable Energy Utilization: A Five-Year Review (2019-2024)

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Abstract: Over the past five years, the world has seen a powerful shift in how we produce and consume energy with renewable sources like solar and wind taking center stage. This research looks back at the period from 2019 to 2024, highlighting the incredible momentum behind clean energy. Solar power, in particular, saw explosive growth, with global installed capacity more than tripling and electricity generation rising just as fast. Wind energy followed closely, thanks to improvements in technology and increased investment, especially in offshore projects. Driving this surge were falling costs, smarter energy policies, and a global push to cut carbon emissions. What once seemed like a niche solution is now a core part of how the world powers itself. This study captures that transition, offering a snapshot of how far we've come and how renewable energy is helping shape a cleaner, more secure future for everyone.

Keywords:

Solar power growth, Wind energy trends, Renewable energy transition, Global electricity shift, green energy development, Energy future.

1. Introduction

The past five years have marked a pivotal chapter in the world's energy story. From 2019 to 2024, the global shift toward renewable energy has accelerated at an unprecedented pace, driven by growing climate concerns, falling technology costs, and stronger policy support. Across continents, countries have scaled up their investments in cleaner power sources especially solar, wind, and hydropower in a collective effort to reduce carbon emissions and build a more sustainable future.

This momentum has not only transformed how energy is produced and consumed but has also reshaped global energy priorities. Innovations in solar panels, wind turbines, and energy storage systems have made renewables more efficient and affordable than ever before. Meanwhile, governments, industries, and communities have begun to align their strategies with long-term climate goals, pushing renewable energy from the margins into the mainstream.

This paper takes a closer look at how the world has embraced renewable energy over the last five years. It explores how much progress has been made, where the biggest gains have occurred, and what challenges still need to be addressed. By reviewing global trends in renewable energy capacity, policy changes, and market dynamics, the study aims to provide a clear picture of where we stand and where we're headed in the global energy transition.

2. Global Trends in Renewable Energy Utilization

Since the past five years, the world has seen a major shift in how energy is produced and consumed. Renewable energy is no longer just an alternative it's quickly becoming the backbone of the global power system. From 2019 to 2024, countries around the world have steadily moved away from fossil fuels and toward cleaner, more sustainable sources like solar, wind, and hydropower.

One of the most noticeable trends has been the rapid growth of solar and wind energy. These two technologies have dominated new power installations year after year, thanks to falling costs, better efficiency, and strong policy support. In fact, by 2023, nearly 90% of all new electricity capacity added globally came from renewable sources—a clear sign that the global energy transition is gaining serious momentum.

What's encouraging is that this shift isn't just happening in wealthy countries. Emerging economies are playing a bigger role in the transition, supported by international funding, technology partnerships, and a shared sense of urgency about the climate crisis.

Looking ahead, the momentum is strong—but more work is needed. Global targets like those set in the Paris Agreement will only be met if this pace continues and even accelerates. That means scaling up not just renewable capacity, but also building smarter grids, improving energy storage, and making clean energy accessible to everyone, everywhere.

2.1 Solar Energy:

Over the past five years, solar photovoltaic (PV) technology has taken the lead as the fastest growing source of renewable energy. In fact, global solar capacity more than doubled during this period a clear sign of its growing role in the world's energy mix. Countries like China, India, and the United States were at the forefront of this expansion, installing record-breaking amounts of solar power to meet rising energy demands while cutting carbon emissions. From large-scale solar farms to rooftop panels, solar energy has proven to be a flexible, affordable, and scalable solution for the clean energy transition.

Table 1: Global Capacity and Generation of Solar Energy Sources (2019-2024)

Year	Installed Capacity	Year-on-Year Growth	Electricity Produced	Year-on-Year Growth
2019	627 GW	—	595.5 TWh	—
2020	759 GW	21%	728.4 TWh	22%
2021	946 GW	25%	873.9 TWh	20%
2022	1,183 GW	25%	1,073.1 TWh	23%
2023	1,581 GW	34%	1,419.0 TWh	32%
2024	2200 GW	37.50%	2000 TWh	30%

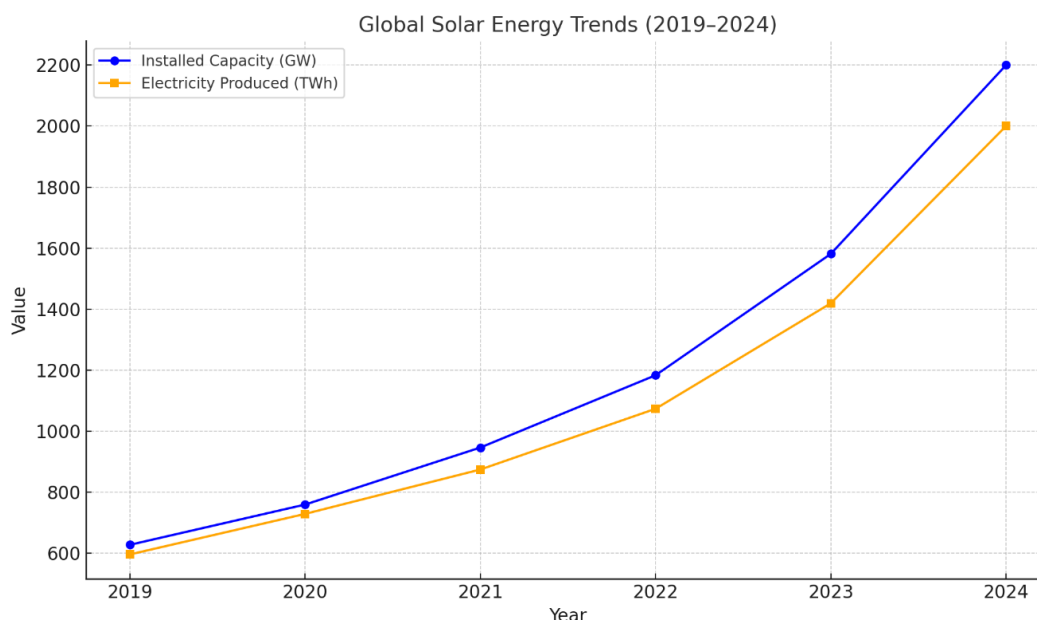


Figure 1 Global solar energy trends 2019-2024

Over the last five years, solar energy has gone from a rising star to a powerhouse in the global energy landscape. Back in 2019, the world had about 627 GW of installed solar capacity, generating just under 600 TWh of electricity. Fast forward to 2024, and that capacity has surged to an estimated 2,200 GW, producing around 2,000 TWh of clean electricity. That's more than triple the capacity—and more than triple the power delivered to homes, businesses, and cities around the world. Each year brought solid double-digit growth, with the biggest jump in 2023, thanks to cheaper solar panels, smarter technology, and strong investment from both governments and the private sector. What's clear is that solar energy isn't just part of the future it's already a major force shaping how the world is powered today.

2.2 Wind Energy: Onshore and offshore wind capacity continued to grow steadily, particularly in Europe, the U.S., and China. Offshore wind projects gained traction due to improved turbine technology and favorable policy frameworks.

Wind energy has remained a key pillar of the global renewable energy transition over the past five years. Between 2019 and 2024, the world significantly expanded both onshore and offshore wind capacity, driven by stronger climate targets, government incentives, and improved turbine technology.

By the end of 2024, total global wind power capacity reached an estimated 1,000 gigawatts (GW)—a near doubling from around 580 GW in 2019. Onshore wind made up the bulk of this growth, particularly in countries with large land areas like China, the United States, and Brazil. However, offshore wind also gained ground, especially in Europe and East Asia, where governments backed large-scale projects in coastal waters.

China led global wind deployment during this period, contributing nearly half of the world's total wind installations. The country's massive investments in wind farms—both inland and offshore—have made it the largest wind energy producer in the world. The United States also expanded its wind fleet substantially, while Europe maintained its leadership in offshore wind, with countries like the UK, Germany, and the Netherlands developing increasingly sophisticated marine wind infrastructure.

Technological innovation played a major role in making wind power more competitive. Modern turbines are now larger, more efficient, and capable of generating electricity even at lower wind speeds. These advancements have helped bring down costs, making wind power one of the most affordable sources of new electricity generation in many parts of the world.

Despite its growth, the wind sector has faced challenges—including permitting delays, supply chain constraints, and rising material costs. In some regions, public opposition to new installations has also slowed development.

Nevertheless, the sector has shown resilience, and 2024 saw a recovery in momentum, with several large-scale projects reaching completion.

Looking ahead, global wind energy is expected to continue expanding, especially offshore. With new floating wind technologies under development and increasing global cooperation, wind energy is poised to play an even larger role in helping countries meet their net-zero goals. [6-12]

Table 2: Global Capacity and Generation of Wind Energy Sources (2019-2024)

Year	Total Capacity Installed	New Capacity Added	Electricity Generated
2019	580 GW	60 GW	~1,400 TWh
2020	743 GW	163 GW	~1,593 TWh
2021	825 GW	82 GW	~1,870 TWh
2022	906 GW	81 GW	~2,100 TWh
2023	960 GW	54 GW	~2,260 TWh
2024	~1,000 GW (estimated)	~40 GW (estimated)	~2,400+ TWh (estimated)

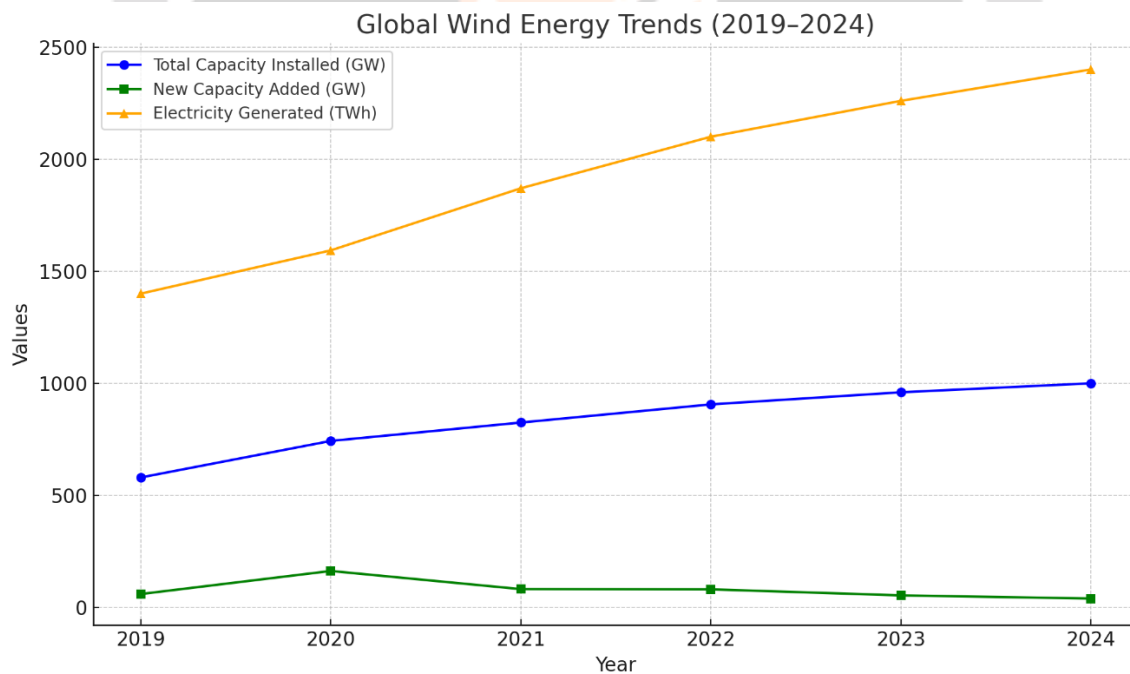


Figure 2 Global Wind Energy Trends 2019-2024

2.3 Hydropower and Other Sources:

While hydropower remains the largest source of renewable electricity, growth has been modest. Emerging technologies like bioenergy, geothermal, and ocean energy saw incremental progress.

Table 3: Global Capacity and Generation of Hydropower (2019-2024)

Year	Installed Capacity (GW)	Electricity Generated (TWh)
2019	1,310	~4,200
2020	1,330	~4,220
2021	1,350	~4,250
2022	1,370	~4,270
2023	1,390	~4,290
2024	1,400 (estimated)	~4,300 (estimated)

Table 4: Global Capacity and Generation of Geothermal Energy (2019–2024)

Year	Installed Capacity (GW)	Electricity Generated (TWh)
2019	13.5	~87
2020	13.8	~89
2021	14.2	~91
2022	14.5	~93
2023	14.8	~94
2024	15 (estimated)	~95 (estimated)

Table 5: Global Capacity and Generation of Bioenergy (2019–2024)

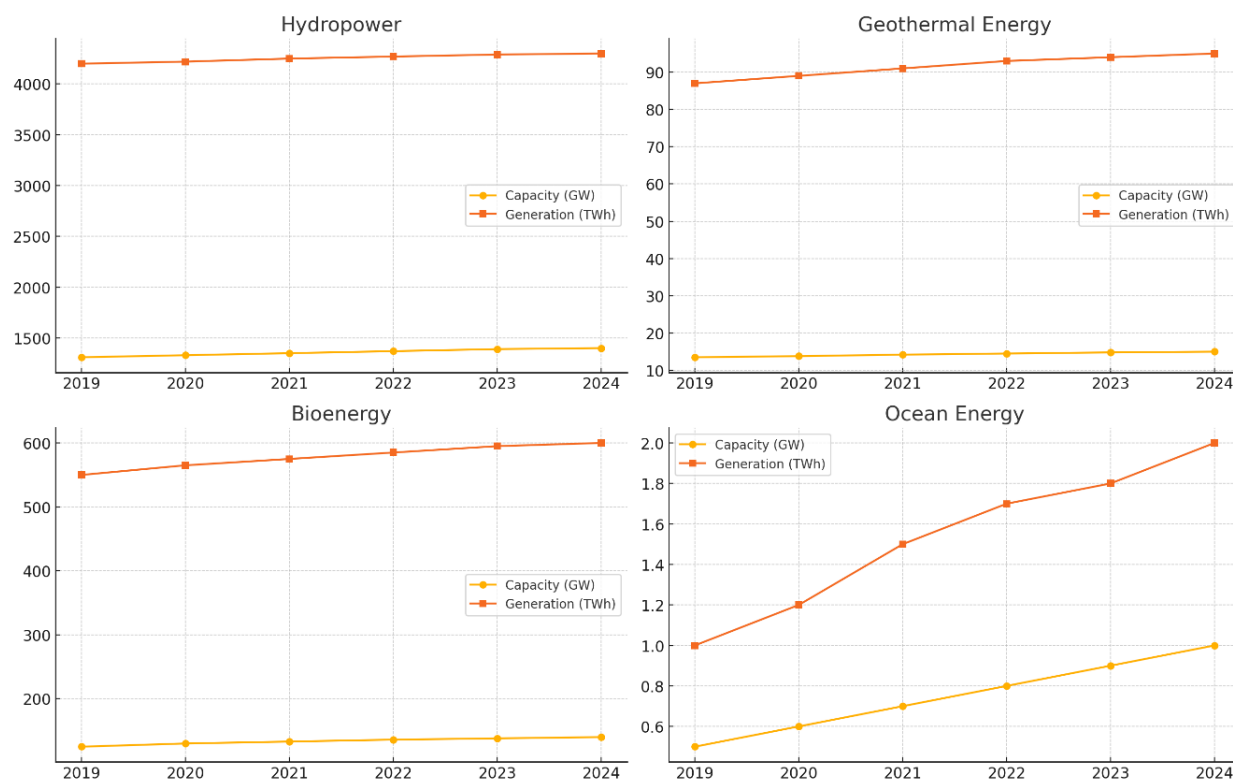
Year	Installed Capacity (GW)	Electricity Generated (TWh)
2019	125	~550
2020	130	~565

Year	Installed Capacity (GW)	Electricity Generated (TWh)
2021	133	~575
2022	136	~585
2023	138	~595
2024	140 (estimated)	~600 (estimated)

Table 6: Global Capacity and Generation of Ocean Energy (2019–2024)

Year	Installed Capacity (GW)	Electricity Generated (TWh)
2019	<0.5	<1
2020	<0.6	<1.2
2021	<0.7	<1.5
2022	~0.8	~1.7
2023	~0.9	~1.8
2024	~1 (estimated)	~2 (estimated)

Global Renewable Energy Trends (2019–2024)

*Figure 3 Global Renewable energy Trends 2019-24*

Over the past five years, hydropower has remained the world's largest single source of renewable electricity, even as wind and solar have grown rapidly. By 2024, global hydropower capacity exceeded 1,400 GW, contributing roughly 4,300 TWh annually to the grid. Despite its maturity, growth in this sector has slowed, mainly due to environmental concerns, project delays, and limited suitable new sites especially in developed regions.

However, countries in Asia, South America, and Africa continued to expand small- and medium scale hydro projects to meet both energy and water management needs. Innovations like pumped-storage hydropower and retrofitting existing dams also gained attention for their role in stabilizing grids increasingly powered by intermittent renewables.

In addition to hydro, geothermal, bioenergy, and ocean energy contributed a smaller yet important share to the renewable mix. Geothermal saw modest expansion, especially in East Africa, the U.S., and Southeast Asia. Bioenergy, both solid and gas-based, remained relevant for power generation in countries with strong agricultural and forestry sectors. [13-16]

3. Conclusion

In just five years, the world has made remarkable strides in embracing renewable energy especially solar and wind. What once felt like a distant goal is now very real: solar panels and wind turbines are powering homes, cities, and industries across the globe like never before. Between 2019 and 2024, solar capacity more than tripled, and wind energy continued its steady climb, thanks to smarter technology, falling costs, and strong support from both governments and investors. This shift hasn't just been about numbers it's about changing how we think about energy and where it comes from. The global move toward clean power is no longer a side project; it's at the heart of building a safer, greener, and more sustainable future. This study reflects that journey and shows that with the right choices, a low-carbon world is not only possible it's already taking shape.

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