Global Progress Toward Renewable Electricity: Tracking the Role of Solar (Version 5)

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***Abstract*—Photovoltaics (PV) represented ∼70% of newly installed global electricity generating capacity for 2024, continuing a trend of increasing fractional contribution over each of the past 5 years. Year-to-year growth in both PV installations and PV-generated electricity continued at remarkable levels (∼32% and ∼28%, respectively), while grid scale battery storage again demonstrated triple digit fractional growth (113%). The contribution to electricity generation from combined low-carbon sources (hydro, nuclear, wind, and solar) exceeded a new threshold of 40%. Following its initial publication in 2021, this annual article collects information from multiple sources and presents it systematically as a reference for IEEE Journal of Photovoltaics readers.**

***Index Terms*—Energy, energy storage, solar energy, solar power generation.**

I. Introduction

The year 2024 was a year of growth across the full global energy landscape: primary energy growth of 1.8%, electricity generation growth of 4%, and growth in the consumption of all major fuel types, both fossil and renewable [1]. Generation from nonhydro renewable energy sources (solar, wind, geothermal, and biomass) contributed 17.4% of global electricity. Photovoltaics (PV) represented ∼70% of newly installed global electricity generating capacity in 2024, with record installations in both China (278 GW_{AC}) and the US (38 GW_{AC}). Newly installed capacity for hydro, PV, and wind combined was ∼90% of the total, as shown in Fig. 4(c). The introduction to the 74th Statistical Review of World Energy noted “Energy remains indispensable to human activity and development. Yet the patterns of demand and supply are shifting…Total energy demand increased across all regions, but the growth was far from evenly distributed, reflecting stark regional variations shaped by economic development, climate conditions, and energy policy” [1].

Total electricity generation from all sources in 2024 was ∼31256 TWh, reflecting a continuing trend of increased electrification, for both total demand and fractional role of electricity. Electricity consumption comprised ∼19% of primary energy, an increase of 0.4% from 2023. One should note that any comparisons must account for the recent change in how the Statistical Review of World Energy, as well as U.S. Energy Information Administration (EIA), reports primary energy associated with hydropower, solar, and wind. The move away from fossil fuel equivalents for these sources means that overall primary energy appears to decrease, in comparison to earlier reports. This creates a discontinuity in a calculation of fractional electricity (e.g., from the 17.4% originally reported for 2023 to 18.6% using the new accounting). Thus, the shift to 19% for 2024 global electricity is not as dramatic as it initially appears (if compared with 18.6% instead of 17.4% for 2023).

PV continues to be the most rapidly growing electricity generating technology. From 2023 to 2024, solar generating capacity increased by 32% (as reported by the Statistical Review of World Energy data, for PV increasing from 1407 to 1859 GW_{AC} and as reported by International Renewable Energy Agency (IRENA) for all solar increasing from 1414 to 1866 GW_{AC}). Electricity production from solar sources grew by 28%–30%, depending on which data source is consulted. The percentage of global electricity generated by PV was 6.8% for 2024, based on the ratio of gross electricity generation from solar to gross electricity generation from all sources reported in [1]. That value was 5.5% for 2023, reflecting the still relatively small but rapidly growing (24% year-to-year growth) global electricity contribution from PV.

The goal of this annual article is to present data, in consistent graphical and tabular form, tracking the global progress of renewable energy. As discussed in the initial 2021 publication [2], multiple institutions provide global energy data on a yearly basis. These organizations have varying missions and reporting times for annual updates. They also vary in their use of original sources and methodologies. Methodologies can change over time, and some organizations share and cross reference each other’s data. Assembling this collection of frequently cited sources in one place is meant to illustrate major trends as well as the nature and degree of variations within the source group.

Here, we provide 2024 updates to the following three sets of graphs:

1) annual generation and capacity by broad fuel source for global electricity (see Section II);
2) fractional yearly generation and newly installed capacity for specific fuel sources with a focus on renewables (see Section III);
3) generation and capacity over time with a more detailed breakout of fuel sources including PV (see Section IV).

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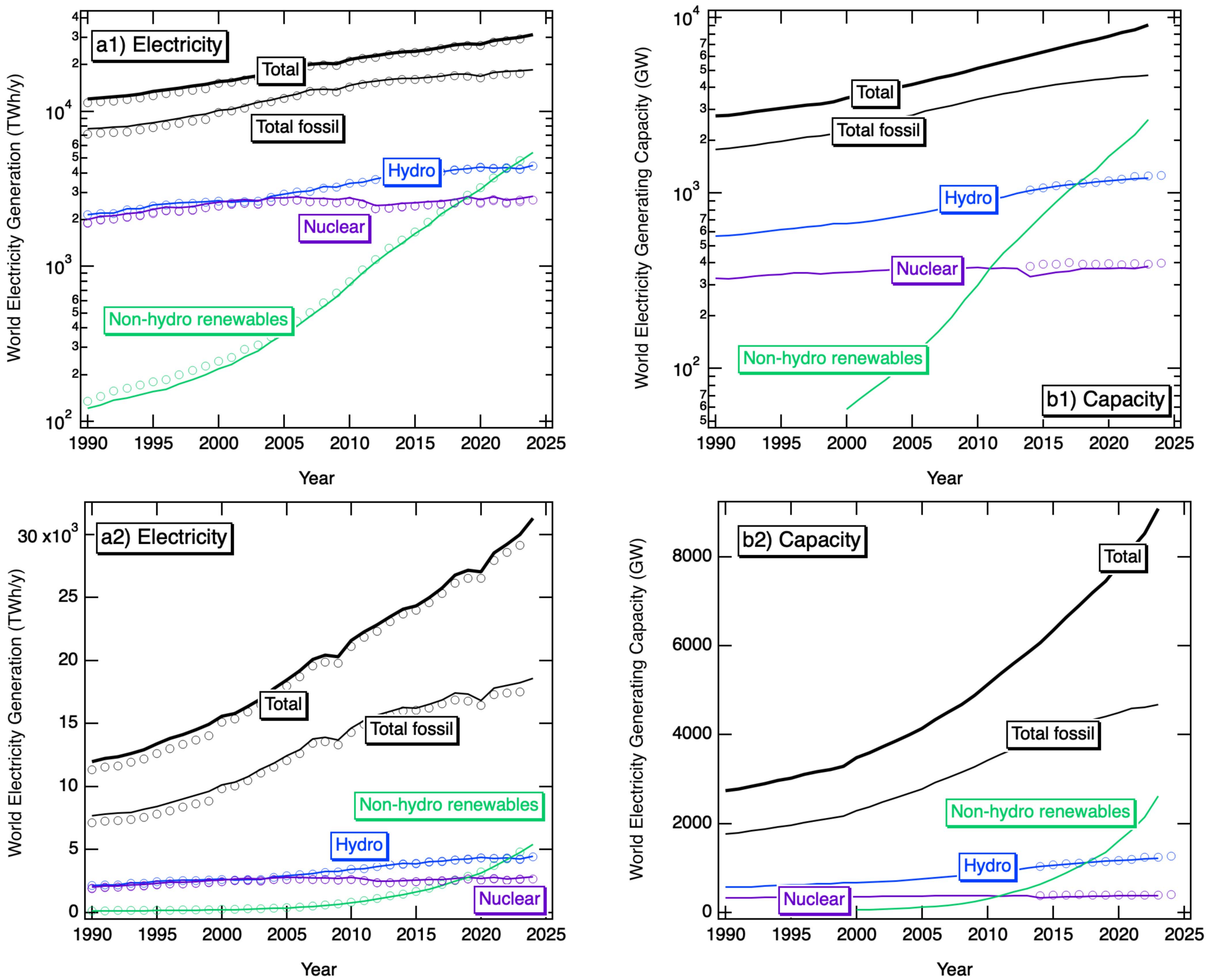

Fig. 1. (a) Annual electricity generation using both (a1) logarithmic and (a2) linear scales. (b) Electricity generating capacity using both (b1) logarithmic and (b2) linear scales. Data graphed as lines are indicated by bold text in Tables I and II. Open circles indicate other data from Tables I and II.

This year, for the first time, we present both linear and logarithmic y-scale axis versions of the graphs in Sections II and IV. We also add two new graphs that are useful in comparing the overall growth in electricity demand with the increase in low-carbon electricity generation. In Section V, we track energy storage, a section added in Version 4 [3] when grid scale battery storage data were added to the Statistical Review.

Data are drawn from the following six primary sources:

1) the Energy Institute Statistical Review of World Energy [1];
2) the international data presented by the EIA [4];
3) the World Nuclear Association (WNA) [5],
4) the International Energy Agency (IEA) [6];
5) the IRENA [7];
6) REN21 [8].

Short summaries of the mission and history for these organizations were provided in the Appendix of the 2021 publication [2]. The timing of each yearly update is triggered by the release of the Statistical Review of World Energy, which occurred this year on 26 June 2025.

II. Tracking Progress Toward Renewable Electricity

Fig. 1 shows yearly global electricity generation (a1 and a2) and generating capacity (b1 and b2) from 1990 to 2024. Source data are presented in Tables I and II, respectively. The data are presented with both logarithmic (a1 and b1) and linear (a2 and b2) y-axes. We have made this addition this year because linear graphs may be preferred for presentations to broad audiences and the growth of the renewable sources can now be clearly seen on a linear scale. Data from the Statistical Review of World Energy, 74th edition [1] are indicated in Fig. 1(a1) and (a2) by solid lines, with open circles used to mark the EIA and WNA data values. For Fig. 1(b1) and (b2), solid lines represent the data in bold in Table II, with open circles used to mark the other data sources. Data source variations, of interest for detailed understanding and

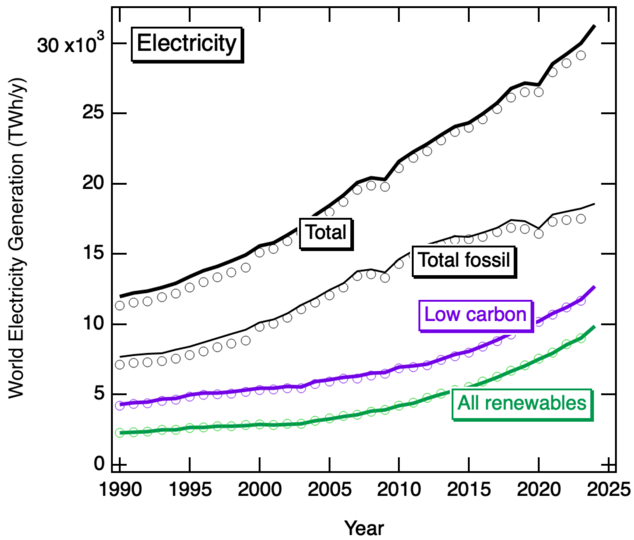

Fig. 2. Global electricity generation as a function of year combining hydro, wind, solar, geothermal, and biomass as "all renewables" and combining all renewables with nuclear as "low carbon." Data taken from Tables I and II (and the described combinations of those) with lines for the BP/EI data and open circles for the EIA data.

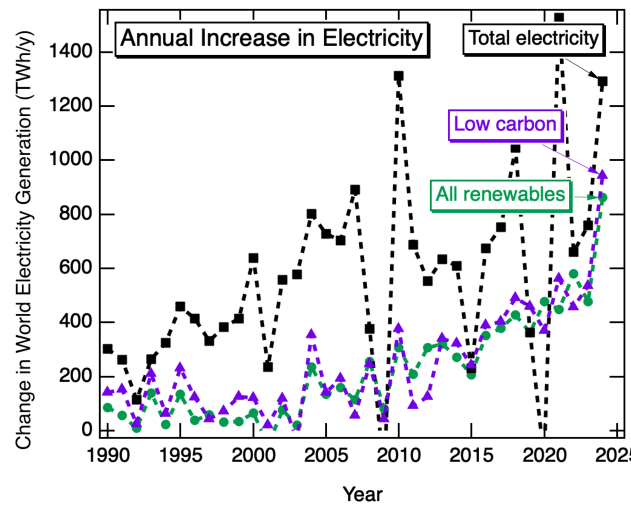

Fig. 3. Year-to-year increase in electricity generation, grouped as total electricity, low carbon, and all renewables. Data are derived from the data in Fig. 1.

analysis, are apparent in the tabulated data, but are generally not significant when plotted on either the logarithmic or linear scales over this period of time.

Electricity generation [see Fig. 1(a1) and (a2)], a measure of energy provided, is presented in TWh, where 1 TWh = 3.6×10^{15} J. Installed nameplate capacity [see Fig. 1(b1) and (b2)] is the rated output of a generator or other electric power production equipment under specific conditions designated by the manufacturer. The "capacity factor" is the ratio of the actual output of a system or collection of systems under true operating conditions (reflecting, e.g., variable resource, facility downtime, performance variations, large scale climate effects, etc.) and the output of that electricity source operating continuously at its commercial product or plant rating. Capacity factors for electricity generating technologies vary significantly, both within a technology depending on the performance, and between technologies as determined by the physics of the particular energy conversion process and the variability of the electricity demand. Actual electricity generation [see Fig. 1(a1) and (a2)] is the most relevant information for understanding and tracking the evolution of the energy system in terms of contributing fuel sources. Installed capacity [see Fig. 1(b1) and (b2)] allows one to track the status of global installations and new technology investment.

The growth over the past five years in the generation from PV and wind makes it of interest to group the generating sources in various ways to document the trends in both the growth of all renewables and the growing contribution of "low-carbon" sources. These are presented in Fig. 2 using a linear y-axis, a new figure in this year's summary. As described earlier, one sees here that total electricity demand continues to grow over time, with a gradually increasing slope. Total fossil fuel generation is also increasing, although more slowly in recent years, and renewables are growing rapidly. When solar, wind, nuclear, and hydro are combined ("low-carbon" electricity sources), one sees that their fractional contribution has been increasing steadily since $\sim$ 2005, reaching 40% of total electricity in 2024. This increase has been driven primarily by the growth in solar and wind. Nuclear power generation has remained relatively flat, resulting in similar shapes for the "all-renewables" and "low-carbon" traces. Hydropower has grown slightly.

To help illustrate trends in source generation increases in comparison to overall demand growth, we have plotted in Fig. 3 the year-to-year change in generation for total electricity in comparison to the "low-carbon" and "all-renewables" categories. One sees the overall increase in electricity consumption, with significant year-to-year variations (reflecting, e.g., economic slowdowns and the global pandemic). Growth in the contributions from renewables is rising at a rapid rate, particularly since 2010, but is not yet of sufficient magnitude to meet the overall growth in demand, though the growth in 2024 would have met increased demand in all but four of the last 20 years. We note that the comparison between the growth of low-carbon electricity and the growth of total electricity demand is a critical metric because it defines the needed growth each year in fossil fuels to avoid blackouts.

As in previous years, it is important to note that different organizations report source data using different fuel subcategories. In Fig. 1, the statistical review values for total fossil generation and capacity are determined by summing component data for oil, gas, coal, and "other" (where "other" is reported to include "uncategorized generation, statistical differences, and sources not specified elsewhere, e.g., pumped hydro, nonrenewable waste, and heat from chemical sources").

Nonhydro renewable totals are calculated by subtracting the sum of total fossil, nuclear, and hydro from the total electricity value. This addresses the fact that individual values for certain nonhydro renewable components (PV, wind, concentrating solar power, geothermal, etc.) were not uniformly reported in earlier

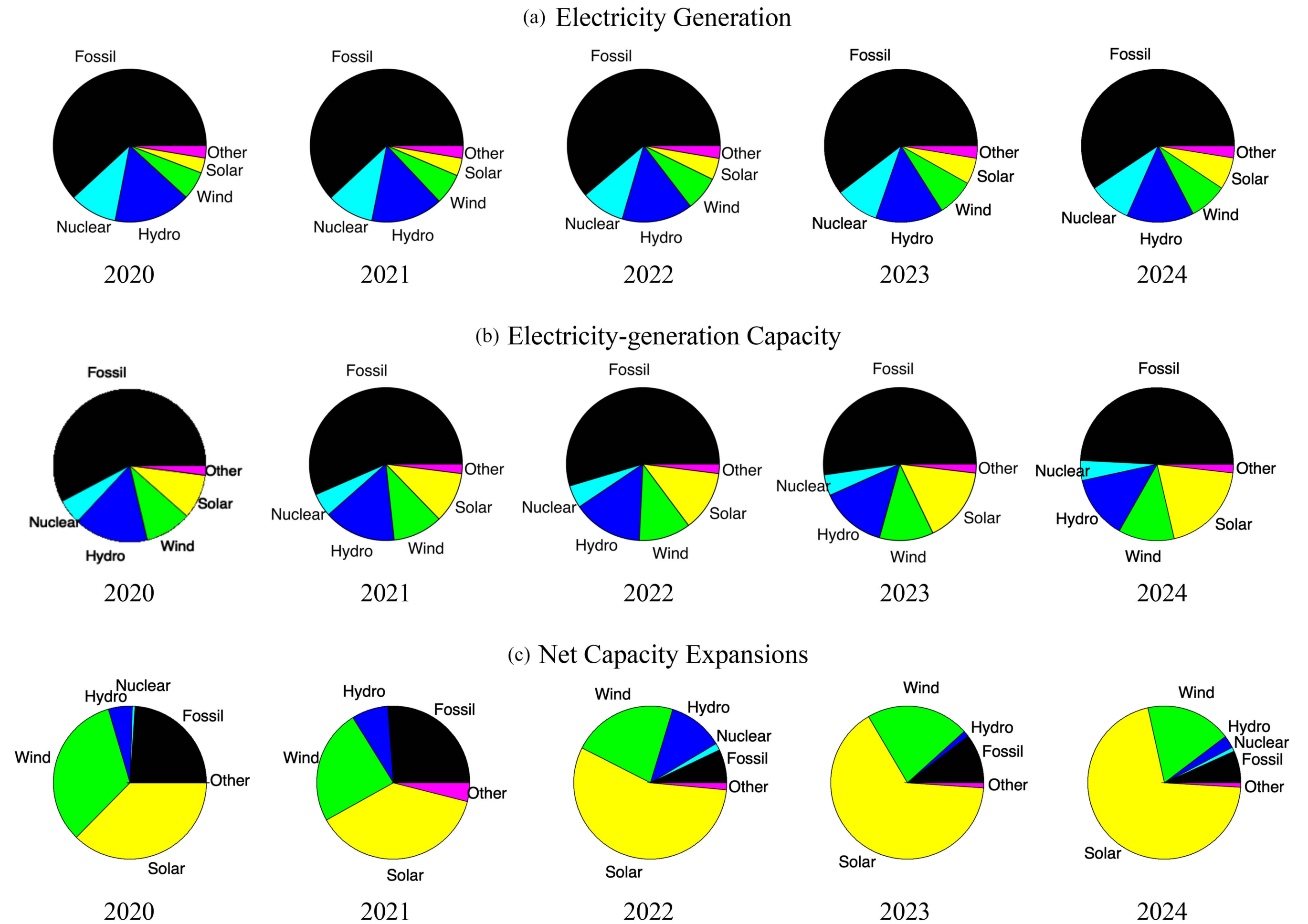

Fig. 4. Pie charts showing technology shares for global (a) electricity generation, (b) electricity-generation capacity, and (c) net expansions of electricity-generating capacity. Data taken from Tables I, II, VIII, and IX and summarized in Tables III–VII.

years. Data reporting for renewables continues to evolve rapidly, e.g., with the addition of PV capacity and grid scale battery storage data to the Statistical Review of World Energy. EIA values are taken directly from the website [4] by selecting the desired categories.

III. Tracking the Rate of Change

In Fig. 4, we plot global data for the past five years (2020–2024) in the form of pie charts for fraction of electricity generation by source [see Fig. 4(a)], fraction of current total installed electricity generating capacity [see Fig. 4(b)], and fraction of net expansions of electricity generating capacity for the given year [see Fig. 4(a)]. Data for fossil, nuclear, and hydro are drawn from Table I and are summarized per year in Tables III–VII. Data for wind, solar, and other technologies are drawn from Table VIII as well as summarized in Tables III–VII, with the electricity generation data in Fig. 4(a) taken from Tables I and VIII and the electricity-generation capacity data in Fig. 4(b) taken from Tables II and IX. The net expansions of the electricity-generating capacity data in Fig. 4(c) are obtained by subtracting the data in Fig. 4(b) for each year from the following year. The choice of datasets to use for Fig. 4 is detailed in the Appendix. Some values in Tables III–VII are not directly available and were calculated from multiple source data. The choice of data sources for the most recent pie charts (i.e., 2024) is driven in part by when various sources update their yearly data.

The pie charts show a consistent trajectory in recent years: the global electricity system continues to be dominated by fossil fuels [see Fig. 4(a)] but is also undergoing an increasingly rapid rate of change in terms of newly installed capacity [see Fig. 4(c)]. By plotting electricity generation, generating capacity, and net capacity expansions (new installation minus any decommissioning), the pie charts illustrate both where we stand today and the new installations that will shape the future electricity generating mix. One sees that, despite the high fraction of new electricity generation coming from solar, the rate of growth has been hitting somewhat of a ceiling. The addition of Fig. 3 drives this point home: when the growth of electricity generation is primarily from low-carbon sources (dominated by solar and wind), further significant increase in the growth rate of solar and wind will necessarily be associated with either increased degree of electrification or retirement of fossil-fuel-driven electricity generation.

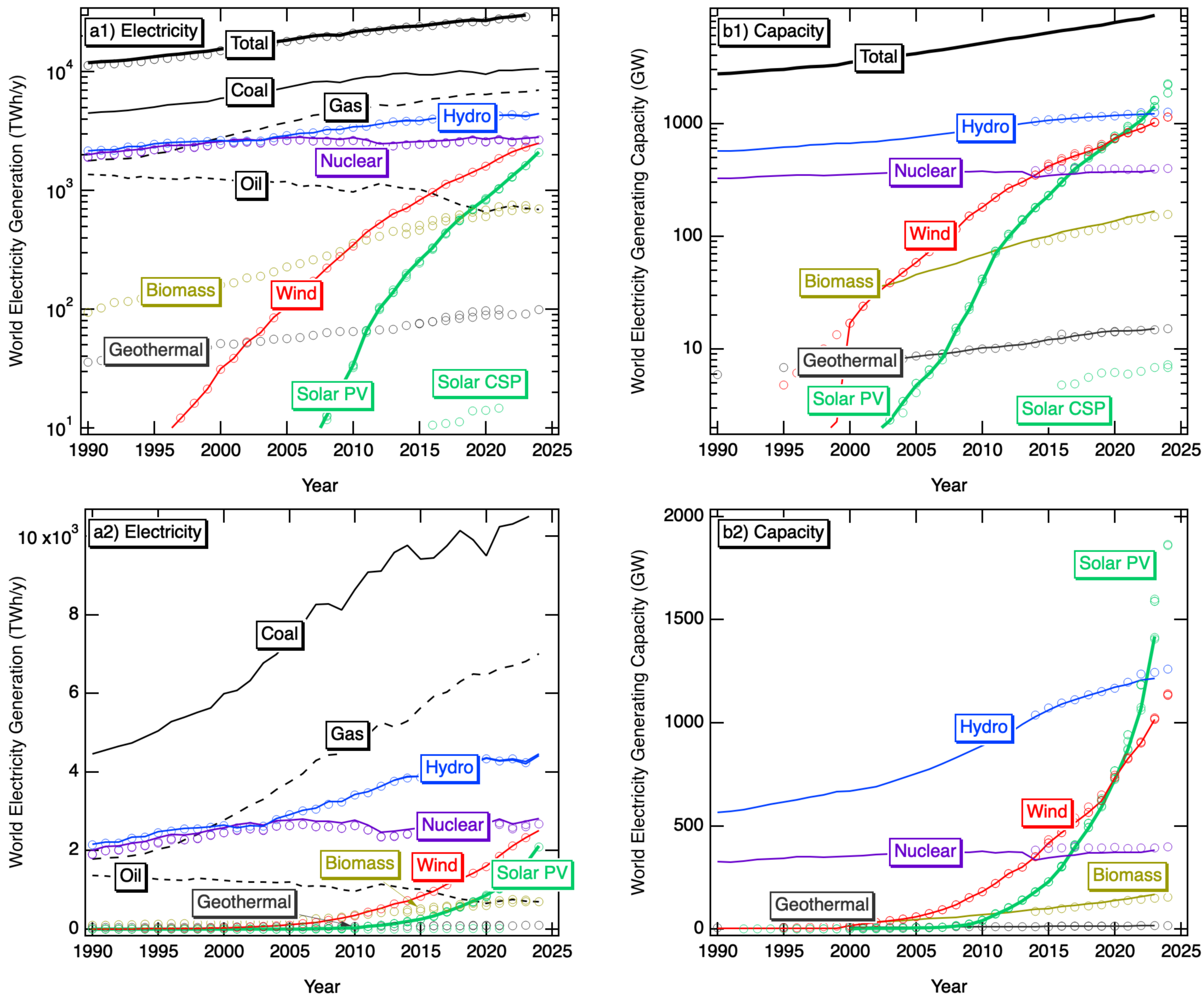

Fig. 5. (a) Annual electricity generation [logarithmic (a1) and linear (a2)]. (b) Electricity generating capacity [logarithmic (b1) and linear (b2)] by fuel. Data are tabulated in Tables I, II, VIII, and IX (see Appendix) with lines for the bolded data and open circles for the other sources.

IV. Tracking the Role of the PV

Fig. 5 shows yearly global electricity generation [see Fig. 5(a)] (both logarithmic (a1) and linear (a2) y-axes) and generating capacity [see Fig. 5(b)] (both logarithmic (b1) and linear (b2) y-axes) from 1990 to 2024, now breaking out the contributions to the "nonhydro renewables" in Fig. 1. Coal remains the largest fuel source for global electricity. Source data are presented in Tables I, II, VIII, and IX, respectively. In Fig. 5(a), the solid lines again represent data from [1], with open circles used to mark other data sources. For Fig. 5(b), solid lines represent the data in bold in Table IX, with open circles used to mark the other data sources. We note again that source variations, although of interest for detailed understanding and analysis, are relatively minor when assessing major trends over the time frames of interest.

Global PV installed capacity at the end of 2024 exceeded 2 TW_{DC}. The 1-TW_{DC} threshold was reached in 2022. Only two years were required to double that value, reflecting the rapid growth in global manufacturing capacity. China alone now has more than 1 TW of PV installed. Both wind and solar electricity generation are approaching magnitudes comparable to that of nuclear power plants and are likely to cross that threshold within the next year or two.

Five different sources for solar capacity (Statistical Review of World Energy, EIA, IEA, IRENA, and REN21) are presented in Table IX. Variations here can arise for multiple reasons. Among these are variations in reporting PV capacity as W_{DC} or W_{AC}; differences that arise in reports of PV shipments versus installations, variations in cross-border electricity accounting, or handling of the balance between new and retired resources; and changing methodologies in source reporting. Those with interests in pursuing these variations can find further details in the primary sources. Solar data in many cases remain a combination of PV and solar thermal. PV continues to be more than two orders of magnitude greater than concentrated solar

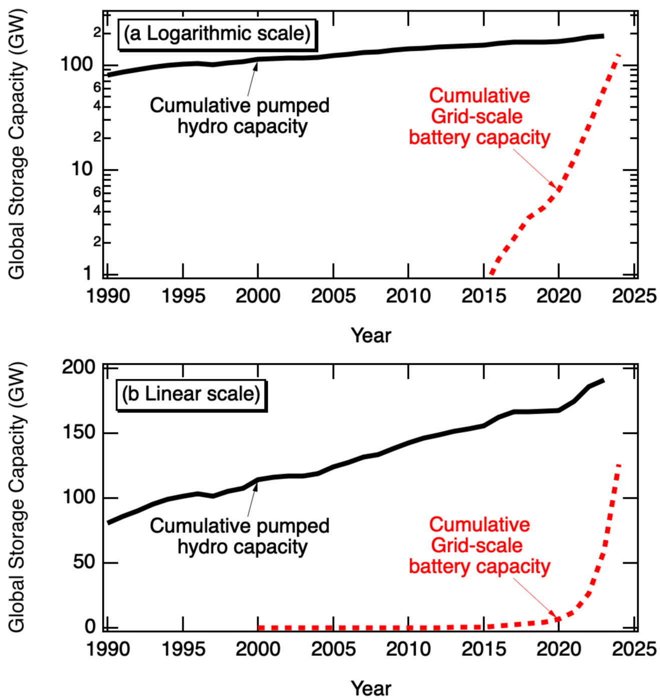

Fig. 6. Global pumped-hydrostorage capacity (EIA, thick black line) and grid-scale batteries as reported by the Statistical Review of World Energy shown on (a) logarithmic and (b) linear scales.

power (CSP), both in terms of installed capacity and electricity produced, but this variation in solar and PV categorization can cause some differences in the reported data. Tables VIII and IX indicate whether solar data is solar thermal and PV or PV only. These tables also indicate our assessment of which data are W_{DC} or W_{AC}. However, we note that there may be inconsistencies in the documentation of dc and ac PV ratings and that some sources may include a mixture of ac and dc data.

While PV only supplies a relatively small fraction of electricity worldwide (6.8% in 2024), there are many locations in which it already supplies enough electricity to frequently exceed demand during daylight hours. The growth of PV in those areas benefits from load shifting to daytime hours and from storage, enabling electricity generated during the day to be used at night. To explore one aspect of this change, Section V documents the growth of battery storage.

V. Tracking Energy Storage

In the 2024 publication [3] (Version 4), we introduced a figure comparing pumped hydrostorage with grid scale battery energy storage (BESS). With the addition of 2024 data, Fig. 6 shows continued rapid growth in grid scale battery storage systems compared with EIA data for cumulative global pumped hydropower capacity. Given the rapid battery growth, we have also introduced Fig. 6(b) with a linear capacity scale. Of the 126.1-GW cumulative BESS reported, the largest installations are in China (60% at 75.2 GW), followed by the US (25.7 GW) and combined capacity in Europe (11.1 GW). Grid scale battery storage capacity in the US now exceeds its pumped hydro capacity (∼19 GW [9]) for the first time and one can predict that the global transition will occur in 2025 or 2026.

VI. Conclusion

The year 2024 was marked by growth in electricity demand, degree of electrification, and electricity produced from technologies across the board. PV provided approximately 7% of 2024 global electricity generation. PV-generated electricity increased in 2024 from 1651 TWh to 2112 TWh (an increase of 461 TWh); global electricity generation increased from 29 963 TWh to 31 256 TWh (an increase of 1293 TWh). As in recent years, and as indicated in Fig. 3, while PV is growing rapidly, the growth, in addition to being uneven around the globe, is not able to meet all of the new load each year. If PV deployment growth continues at recent levels (e.g., 25% year to year or more), newly installed PV will likely be able to meet overall demand growth within the next five years. However, increasing electricity demand for artificial intelligence and machine learning is an important variable and projections for this growth, even within the U.S., vary dramatically [10].

The average fractional contribution of PV, so-called grid penetration, continues to grow in many countries around the world. At the end of 2024, ∼19 countries had PV-electricity-generation levels in excess of 10% on their national grids, based on the ratio of solar electricity to total electricity from [1].

The global PV R&D community continues to be very active. As of this writing, cell efficiency records for Si heterojunctions have reached 27.8%, and silicon-perovskite hybrid tandem record cells have reached 34.9%, significantly exceeding the dual junction III–V nonconcentrator record. A certified efficiency of 30.6% for a 1185 cm^2 Si/perovskite module was announced in June of 2025. Monocrystalline Si continues to be the dominant PV technology, and progress continues to be reported in reliability, bifaciality, energy and water consumption metrics, and integration of PV into areas such as agrivoltaics, building integration, and floating PV.

Future growth in PV-generated electricity depends on continued momentum across this full evolutionary chain—PV research to PV manufacturing to PV shipments to PV installation to PV electricity. Monitoring these connections and reporting this progress remain the focus of this article, "tracking the role of solar."

Appendix

The sources of the data reported in Figs. 1 through 5 were described in detail in [2, Appendix (Version 1)]. The same sources, as enumerated in Section I, were consulted for Version 5, following the release of the 74th Statistical Review of World Energy on 26 June 2025. Updated data from other sources were downloaded starting 1 July 2025.

TABLE I
GLOBAL ELECTRICITY GENERATION BY TECHNOLOGY CATEGORY (TWh FOR INDICATED YEAR)

Category	Fossil		Nuclear			Hydro			Nonhydro RE		Total	
Source	BP/EI	EIA	BP/EI	EIA	WNA	BP/EI	EIA	REN21	BP/EI	EIA	BP/EI	EIA
Year												
1985	**6339**	6043	**1489**	1426	1328	**1979**	1952		**79**	55	**9886**	9464
1986	**6494**	6104	**1595**	1519	1440	**2006**	1992		**86**	60	**10181**	9660
1987	**6811**	6399	**1735**	1655	1600	**2033**	1996		**92**	66	**10671**	10100
1988	**7057**	6614	**1891**	1796	1727	**2098**	2072		**95**	69	**11141**	10534
1989	**7518**	7054	**1945**	1845	1832	**2088**	2060		**108**	118	**11658**	11062
1990	**7681**	7141	**2001**	1910	1890	**2159**	2144		**121**	134	**11961**	11310
1991	**7791**	7244	**2096**	1998	1988	**2209**	2183		**127**	145	**12223**	11551
1992	**7880**	7288	**2112**	2017	2009	**2208**	2189		**136**	157	**12336**	11633
1993	**7932**	7367	**2185**	2083	2073	**2341**	2314		**142**	163	**12600**	11906
1994	**8193**	7568	**2226**	2127	2111	**2356**	2337		**148**	171	**12924**	12183
1995	**8420**	7804	**2323**	2211	2191	**2483**	2454		**156**	179	**13382**	12627
1996	**8713**	8066	**2407**	2293	2269	**2517**	2490		**161**	185	**13797**	13011
1997	**9003**	8347	**2390**	2273	2264	**2561**	2545		**174**	200	**14129**	13340
1998	**9314**	8621	**2431**	2317	2298	**2581**	2552		**185**	212	**14511**	13678
1999	**9603**	8831	**2524**	2394	2379	**2600**	2589		**199**	228	**14926**	14016
2000	**10120**	9821	**2581**	2451	2444	**2647**	2625		**217**	244	**15565**	15114
2001	**10336**	10026	**2654**	2518	2511	**2579**	2571		**232**	259	**15800**	15345
2002	**10775**	10485	**2696**	2547	2553	**2626**	2616		**261**	290	**16358**	15906
2003	**11387**	11070	**2641**	2519	2505	**2623**	2622		**284**	311	**16936**	16493
2004	**11835**	11535	**2761**	2620	2616	**2817**	2790		**325**	349	**17737**	17266
2005	**12421**	12065	**2769**	2627	2626	**2911**	2910		**364**	393	**18465**	17965
2006	**12931**	12613	**2803**	2661	2661	**3022**	3014		**411**	440	**19167**	18701
2007	**13767**	13427	**2746**	2610	2608	**3072**	3044		**475**	502	**20060**	19554
2008	**13898**	13546	**2737**	2601	2598	**3252**	3179		**550**	579	**20437**	19879
2009	**13697**	13319	**2699**	2566	2558	**3246**	3238		**636**	671	**20278**	19770
2010	**14632**	14293	**2768**	2635	2630	**3430**	3413		**759**	797	**21589**	21110
2011	**15229**	14921	**2652**	2521	2518	**3493**	3473		**904**	949	**22278**	21836
2012	**15658**	15238	**2471**	2350	2346	**3641**	3637		**1061**	1105	**22831**	22302
2013	**15951**	15661	**2490**	2368	2359	**3788**	3766	3791	**1236**	1310	**23465**	23078
2014	**16238**	15981	**2541**	2422	2410	**3889**	3837	3874	**1406**	1475	**24073**	23686
2015	**16227**	16024	**2575**	2451	2441	**3879**	3852	3884	**1623**	1669	**24304**	23966
2016	**16510**	16194	**2614**	2491	2477	**4016**	3989	4013	**1838**	1924	**24977**	24561
2017	**16860**	16541	**2637**	2518	2503	**4068**	4033	4058	**2165**	2239	**25730**	25290
2018	**17416**	16871	**2700**	2570	2563	**4189**	4157	4178	**2471**	2542	**26777**	26103
2019	**17319**	16790	**2796**	2677	2657	**4243**	4206	4226	**2781**	2861	**27139**	26497
2020	**16827**	16415	**2689**	2593	2553	**4359**	4332	4344	**3142**	3225	**27017**	26526
2021	**17792**	17270	**2803**	2697	2653	**4294**	4271	4276	**3655**	3711	**28544**	27907
2022	**17995**	17412	**2679**	2594	2545	**4335**	4326	4298	**4194**	4264	**29204**	28552
2023	**18220**	17498	**2738**	2666	2602	**4261**	4236	4210	**4745**	4785	**29963**	29140
2024	**18570**		**2817**		2667	**4453**		4419	**5415**		**31256**	

Source data for Table I can be found at:
https://www.energyinst.org/statistical-review
https://www.eia.gov/international/data/world/electricity/electricity-generation
https://www.world-nuclear.org/information-library/facts-and-figures/nuclear-generation-by-country.aspx
https://www.ren21.net/reports/global-status-report/

As noted, many of these sources revise their data in retrospect, as new information comes in and/or reporting accuracy increases. Where updated tabulated data are available for download, we have incorporated updates from previous years into our Version 5 tables. The data presented in Figs. 1–3 are tabulated in Tables I–IX. The selection of data for Tables III–VII has little effect on the creation of Fig. 4(a) and (b) but can have a greater effect on the appearance of Fig. 4(c).

The electricity data in Fig. 4(a) and Tables III–VII were taken from The Statistical Review of World Energy. The capacity data in Fig. 4(b) and Tables III–VII used WNA data for nuclear, Statistical Review of World Energy data for wind and solar, REN21 data for hydro, biomass, and geothermal and EIA data for fossil for the years it was available. Data now reported in the Statistical Review of World Energy for BESS come from Rystad Energy and report utility scale battery storage projects.

EIA fossil fuel capacity data for 2024 were not available as of July 2025, and the Statistical Review of World Energy does not include fossil-fuel-generator capacity information, requiring the use of additional sources to create the 2024 pie chart in Fig. 4(c). This year we again used available data from IRENA (IRENASTAT [11], taking the difference in their reported values for 2024 and 2023. Similarly, the fossil capacity in Table VII was estimated from the EIA 2023 number using the IRENA difference between 2022 and 2023.

TABLE II
GLOBAL ELECTRICITY GENERATION CAPACITY BY TECHNOLOGY CATEGORY (GW)

Category	Fossil	Nuclear		Hydro		Non-hydro RE	Total
Source	EIA	EIA	WNA	EIA	REN21	EIA	EIA
Year							
1985	**1566**	**253**		**538**			**2393**
1986	**1597**	**278**		**552**			**2466**
1987	**1626**	**299**		**569**			**2537**
1988	**1668**	**312**		**583**			**2605**
1989	**1727**	**320**		**573**			**2686**
1990	**1764**	**325**		**566**			**2736**
1991	**1792**	**325**		**570**			**2773**
1992	**1832**	**329**		**578**			**2830**
1993	**1877**	**336**		**591**			**2899**
1994	**1925**	**339**		**604**			**2968**
1995	**1962**	**342**		**616**			**3022**
1996	**2022**	**349**		**626**			**3100**
1997	**2074**	**349**		**640**			**3165**
1998	**2117**	**346**		**650**			**3218**
1999	**2168**	**349**		**666**			**3291**
2000	**2288**	**352**		**668**		**58**	**3480**
2001	**2370**	**355**		**680**		**67**	**3588**
2002	**2478**	**360**		**690**		**76**	**3721**
2003	**2576**	**362**		**710**		**87**	**3852**
2004	**2680**	**368**		**731**		**99**	**3997**
2005	**2770**	**370**		**753**		**117**	**4134**
2006	**2918**	**372**		**774**		**137**	**4329**
2007	**3034**	**372**		**801**		**161**	**4500**
2008	**3146**	**372**		**830**		**196**	**4678**
2009	**3269**	**372**		**860**		**246**	**4885**
2010	**3417**	**376**		**890**		**298**	**5123**
2011	**3554**	**369**		**917**		**375**	**5362**
2012	**3671**	**373**		**948**		**457**	**5597**
2013	**3782**	**372**		**993**		**534**	**5832**
2014	**3912**	**333**	382	**1029**	1036	**636**	**6063**
2015	**4024**	**344**	391	**1061**	1071	**756**	**6340**
2016	**4137**	**352**	392	**1089**	1095	**888**	**6629**
2017	**4225**	**358**	400	**1110**	1112	**1038**	**6897**
2018	**4334**	**370**	392	**1133**	1135	**1188**	**7191**
2019	**4409**	**370**	392	**1151**	1150	**1354**	**7450**
2020	**4489**	**372**	394	**1173**	1168	**1610**	**7811**
2021	**4592**	**372**	389	**1185**	1197	**1854**	**8179**
2022	**4616**	**372**	394	**1206**	1237	**2142**	**8522**
2023	**4673**	**382**	393	**1215**	1244	**2618**	**9080**
2024			399		1261		

Source data for Table II can be found at:
https://www.eia.gov/international/data/world/electricity/electricity-capacity
https://world-nuclear.org/information-library/facts-and-figures/world-nuclear-power-reactors-and-uranium-requireme for the December 2024 number
https://www.ren21.net/reports/global-status-report/

TABLE III
GLOBAL 2020 DATA SUMMARY FOR CREATING PIE CHARTS IN FIG. 4

Technology	Electricity (TWh)	Electricity (%)	Capacity (GW)	Capacity (%)	Net expansion (GW)	Net expansion (%)
Fossil	16,827	62.3%	4,489	58.7%	80	24.8%
Nuclear	2,689	10.0%	394	5.2%	2	0.6%
Hydro	4,359	16.1%	1,168	15.3%	17	5.4%
Wind	1,596	5.9%	734	9.6%	111	34.5%
Solar	857	3.2%	720	9.4%	125	38.7%
Other*	696	2.6%	138	1.8%	-13	-4.0%
Total	27,024	100.0%	7,643	100%	322	100%

*Biomass and geothermal.

TABLE IV
GLOBAL 2021 DATA SUMMARY FOR CREATING PIE CHARTS IN FIG. 4

Technology	Electricity (TWh)	Electricity (%)	Capacity (GW)	Capacity (%)	Net expansion (GW)	Net expansion (%)
Fossil	17,792	62.3%	4,592	57.3%	103	27.5%
Nuclear	2,803	9.8%	389	4.9%	-5	-1.3%
Hydro	4,294	15.0%	1,197	14.9%	29	7.7%
Wind	1,861	6.5%	825	10.3%	91	24.3%
Solar	1,053	3.7%	862	10.8%	142	37.9%
Other*	746	2.6%	153	1.9%	15	4.0%
Total	28,549	100.0%	8,018	100%	375	100%

*Biomass and geothermal.

TABLE V
GLOBAL 2022 DATA SUMMARY FOR CREATING PIE CHARTS IN FIG. 4

Technology	Electricity (TWh)	Electricity (%)	Capacity (GW)	Capacity (%)	Net expansion (GW)	Net expansion (%)
Fossil	17,995	61.6%	4,616	55.2%	24	7.0%
Nuclear	2,679	9.2%	394	4.7%	5	1.5%
Hydro	4,335	14.8%	1,237	14.8%	40	11.7%
Wind	2,110	7.2%	901	10.8%	76	22.3%
Solar	1,323	4.5%	1,053	12.6%	191	56.0%
Other*	765	2.6%	158	1.9%	5	1.5%
Total	29,195	100.0%	8,359	100%	341	100%

*Biomass and geothermal.

TABLE VI
GLOBAL 2023 DATA SUMMARY FOR CREATING PIE CHARTS IN FIG. 4

Technology	Electricity (TWh)	Electricity (%)	Capacity (GW)	Capacity (%)	Net expansion (GW)	Net expansion (%)
Fossil	18,220	60.8%	4,673	52.5%	57	10.5%
Nuclear	2,738	9.1%	393	4.4%	-1	-0.2%
Hydro	4,261	14.2%	1,244	14.0%	7	1.3%
Wind	2,323	7.7%	1,019	11.4%	118	21.8%
Solar	1,651	5.5%	1,407	15.8%	354	65.4%
Other*	787	2.6%	164	1.8%	6	1.1%
Total	29,980	100.0%	8,900	100%	541	100.0%

*Biomass and geothermal.

TABLE VII
GLOBAL 2024 DATA SUMMARY FOR CREATING PIE CHARTS IN FIG. 4

Technology	Electricity (TWh)	Electricity (%)	Capacity (GW)	Capacity (%)	Net expansion (GW)	Net expansion (%)
Fossil	18,570	59.4%	4,716	49.4%	43	6.7%
Nuclear	2,817	9.0%	399	4.2%	6	0.9%
Hydro	4,453	14.2%	1,261	13.2%	17	2.7%
Wind	2,511	8.0%	1,135	11.9%	116	18.1%
Solar	2,112	6.8%	1,859	19.5%	452	70.6%
Other*	800	2.6%	170	1.8%	6	0.9%
Total	31,264	100.0%	9,540	100%	640	100%

*Biomass and geothermal.

TABLE VIII
GLOBAL ELECTRICITY GENERATION BY FUEL (TWh FOR INDICATED YEAR)

Fuel	Coal	Gas	Oil	Wind		Solar (all))		Solar (PV)		Biomass		Geothermal		Bio&Geo
Source	BP/EI	BP/EI	BP/EI	BP/EI	EIA	BP/EI	EIA	IEA	IRENA	EIA	REN21	EIA	REN21	REN21
Year														
1985	3748.4	1426.3	1110.8	0.1	0.1		0.0			31.7		22.4		
1986	3839.0	1432.7	1168.3	0.1	0.1		0.0			34.3		25.0		
1987	4058.1	1516.5	1183.2	0.2	0.2		0.0			38.2		26.9		
1988	4200.7	1541.0	1256.5	0.3	0.3		0.0			40.4		27.2		
1989	4377.0	1728.6	1350.2	2.6	2.6	0.3	0.3			81.7		32.8		
1990	4460.2	1788.7	1366.1	3.6	3.6	0.4	0.4			93.9		35.7		
1991	4557.1	1814.1	1351.5	4.1	4.1	0.5	0.5	0.09		102.7		36.9		
1992	4649.8	1828.4	1329.7	4.7	4.6	0.5	0.5	0.10		113.3		38.1		
1993	4727.8	1862.4	1268.5	5.7	5.6	0.6	0.6	0.13		116.7		39.0		
1994	4891.7	1923.7	1303.8	7.1	7.3	0.6	0.6	0.15		123.0		38.9		
1995	5038.7	2034.9	1261.8	8.3	7.9	0.6	0.7	0.17		131.5		38.1		
1996	5279.5	2100.1	1247.4	9.2	9.3	0.7	0.8	0.20		133.8		40.6		
1997	5395.6	2270.3	1245.3	12.0	12.1	0.7	0.8	0.23		143.9		42.0		
1998	5511.2	2407.8	1295.5	15.9	16.1	0.8	0.9	0.28		149.0		44.6		
1999	5630.7	2600.2	1267.9	21.2	21.3	0.9	1.0	0.35		156.4		47.7		
2000	5991.8	2772.1	1245.9	31.4	31.3	1.1	1.2	0.6		159.2		51.4		
2001	6071.6	2950.5	1210.4	38.4	38.4	1.4	1.5	0.8		167.4		51.0		
2002	6323.0	3151.5	1194.7	52.4	52.8	1.8	1.9	1.1		183.0		51.8		
2003	6768.3	3301.8	1202.8	63.3	64.5	2.3	2.3	1.4		190.3		53.5		
2004	6989.4	3550.7	1180.9	85.6	84.7	3.0	3.0	1.8		205.4		55.7		
2005	7361.1	3741.0	1193.6	104.6	104.3	4.2	4.1	2.5		227.2		56.4		
2006	7763.0	3959.5	1085.6	133.5	133.5	5.8	5.7	3.7		242.8		57.8		
2007	8253.8	4284.0	1105.7	171.5	171.3	7.8	7.6	5.3		261.7		60.4		
2008	8270.1	4427.9	1082.7	221.4	221.4	12.7	12.5	7.3	12.8	281.8		63.1		
2009	8117.7	4460.7	1003.7	276.8	277.8	21.1	20.8	11.7	20.9	306.6		65.1		
2010	8638.8	4887.3	967.0	346.4	339.4	33.9	33.3	32.0	33.8	358.5		64.7		
2011	9083.6	4939.2	1063.0	440.9	435.0	65.7	66.2	63.7	65.6	381.5		65.5		
2012	9113.2	5258.3	1143.5	530.8	521.5	101.5	103.8	98.8	101.7	411.6		66.6		
2013	9581.9	5137.1	1085.0	635.9	645.1	138.6	145.3	139.4	137.4	450.4		67.8		468
2014	9761.5	5286.7	1036.4	706.2	717.3	197.3	198.9	184.5	192.6	485.5	429	72.5		508
2015	9417.6	5632.7	1021.4	831.8	828.7	256.5	251.7	245	252.3	511.1	464	76.2	75	550
2016	9438.0	5921.2	938.6	962.7	957.6	328.0	328.3	320	324.8	558.5	504	78.2	78.5	558
2017	9751.5	6036.0	849.0	1142.5	1127.7	445.9	439.2	431	437.5	590.1	555	80.6	85	592
2018	10134.3	6296.2	763.4	1271.2	1266.9	575.6	566.2	554	560.0	624.4	581	83.9	89.3	626
2019	9902.6	6485.4	717.5	1422.3	1420.2	706.5	700.1	684	689.9	654.1	591	85.6	95	659
2020	9498.0	6456.7	658.7	1595.8	1593.9	857.3	856.5	825	835.7	684.4	602	89.1	97	696
2021	10234.0	6630.3	710.2	1860.6	1849.4	1052.8	1040.8	1020	1030.6	730.5	656	88.9	99	746
2022	10311.7	6696.1	746.2	2110.1	2111.4	1322.6	1310.5	1294	1294.5	750.8	676	90.3		765
2023	10461.0	6809.7	704.9	2322.7	2324.2	1650.9	1624.2	1614		744.3	697	91.0		787
2024	10613.2	7001.2	694.7	2511.0		2111.7		2094			701		99	800

Total, nuclear, and hydro are tabulated in Table I.
Source data for Table VIII can be found at:
https://www.energyinst.org/statistical-review
https://www.eia.gov/international/data/world/electricity/electricity-generation
https://www.ren21.net/reports/global-status-report/
https://public.tableau.com/views/IRENARETimeSeries/Charts?:embed=y&:showVizHome=no&publish=yes&:toolbar=no
https://www.iea.org/energy-system/renewables/solar-pv

TABLE IX
GLOBAL ELECTRICITY-GENERATING CAPACITY BY TECHNOLOGY (GW)

Fuel	Wind			Solar (all)		Solar (PV)			Biomass		Geothermal		
Source	BP/EI (AC)	EIA (AC)	REN21 (AC)	EIA (AC)	IRENA (AC)	BP/EI (AC)	REN21 (DC)	IEA (DC)	EIA (AC)	REN21 (AC)	BP/EI (AC)	EIA (AC)	REN21 (AC)
Year													
1985													
1986													
1987													
1988													
1989		1.5											
1990		1.8									5.9		
1991		1.9											
1992		1.8						0.05					
1993		1.8						0.065					
1994		1.7						0.09					
1995	4.8	1.7						0.11			6.8		
1996	6.1	1.7				0.2		0.15					
1997	7.6	1.6				0.2		0.2					
1998	9.9	1.7				0.3		0.27					
1999	13.4	2.3				0.4		0.37					
2000	17.0	16.9		**1.3**	1.1	0.8		0.57	32.0		8.2	**8.2**	
2001	23.9	24.0		**1.5**	1.3	1.1		0.79	33.5		7.9	**7.9**	
2002	30.7	30.7		**1.8**	1.6	1.4		1.2	35.1		8.1	**8.1**	
2003	38.6	38.7		**2.3**	2.3	2.0		1.6	37.4		8.2	**8.2**	
2004	47.7	47.7		**3.3**	3.4	3.1		2.7	40.3		8.2	**8.2**	
2005	58.4	58.4		**4.7**	4.9	4.5		4.1	45.4		8.6	**8.6**	
2006	73.1	73.1		**6.1**	6.5	6.1		5.9	49.5		8.8	**8.8**	
2007	91.5	91.5		**8.3**	9.0	8.5		8.0	52.6		9.0	**9.0**	
2008	115.5	115.6		**14.4**	15.2	14.7		14.3	56.7		9.3	**9.3**	
2009	150.1	150.1		**22.4**	23.6	22.8		22.4	63.4		9.8	**9.8**	
2010	181.1	180.9		**39.3**	41.4	41.6		39.3	67.9		10.0	**10.2**	
2011	220.2	220.1		**70.0**	72.6	73.9		70.4	74.8		10.1	**10.4**	
2012	267.3	266.9		**99.0**	102.5	104.2		100.0	80.2		10.5	**10.7**	
2013	299.9	299.8		**135.0**	139.5	140.5		137.6	88.4		10.7	**11.0**	
2014	349.4	349.2		**180.4**	179.1	180.7		177.6	94.8	86	11.2	**11.4**	
2015	416.3	416.1	433	**228.2**	227.2	228.9		228.0	99.4	91	11.8	**12.1**	
2016	467.0	466.8	487	**300.4**	299.2	301.1	303	304.7	108.6	97	12.1	**12.4**	13.5
2017	515.0	514.1	539	**395.4**	394.3	395.9	405	407.4	115.0	105	12.7	**13.0**	12.8
2018	563.8	564.2	591	**488.9**	490.3	489.3	512	511.7	121.5	111	13.2	**13.5**	13.2
2019	622.8	620.5	650	**591.4**	592.7	592.2	621	632.2	127.6	117	13.9	**14.1**	14.0
2020	733.7	733.3	745	**725.3**	723.6	720.4	767	767.0	137.0	124	14.1	**14.4**	14.2
2021	824.6	824.1	829	**869.0**	866.8	861.5	942	910	146.8	138		**14.4**	14.5
2022	901.2	902.5	906	**1068.1**	1060.5	1053.1	1183	1185	156.7	143		**14.6**	14.7
2023	1019.4	1016.7	1023	**1418.6**	1413.5	1406.7	1590	1624	167.5	149		**15.0**	14.8
2024	1134.8		1140		1865.5	1858.6	2191	2246		155			15.1

Total, nuclear and hydro are tabulated in Table II.
Source data for Table IX can be found at:
https://www.energyinst.org/statistical-review
https://www.eia.gov/international/data/world/electricity/electricity-capacity
https://www.ren21.net/reports/global-status-report/
https://public.tableau.com/views/IRENARETimeSeries/Charts?:embed=y&:showVizHome=no&publish=yes&:toolbar=no
https://iea-pvps.org/snapshot-reports/snapshot-2025/
https://www.irena.org/Data

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