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A Global Analysis by Regions of Interest to Give Accurate Indicators to Reduce of Dependence on Non-Renewable Energy

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Abstract
Non-renewable energy is about to be depleted, so renewable energy has emerged as an alternative that has helped researchers and those interested to snore all the possibilities to make the most of the factors and natural resources available in the service of humanity. Renewable energy is used in all military, economic, industrial, agricultural, and all humanitarian activities that serve people and reduce the use of non-renewable energy. This paper represents a global analysis by regions of an interest to societies and gives accurate indicators to get rid of dependence on non-renewable energy sources and protect them from economic fluctuations while pushing sustainable development in the right direction to create jobs and alleviate poverty. The results of the paper indicated that there is a significant development in the capacity and production of renewable energy, and this indicates the presence of interest and follow-up from the countries of the world in supporting alternative energy, the highest regions were Asia, Europe, the Americas, Oceania, Middle East, and Africa. The countries with the highest renewable energy capacity and production in the world were China, USA, Brazil, and Germany. In the field of alternative energy contribution to electric power capacity and production, the percentages of South American countries were the highest, followed by Europe, and the lowest were the Middle Eastern countries.

Keywords: global indicators, Renewable Energy, Environmental Pollution, Climate Problems, IRENA, Production, Capacity, Secular Trend.

1. Introduction

The phenomenon of global warming spread due to the industrial and war industrial progress produced by developed countries, which led to the emergence of environmental pollution factors that had serious health consequences, so renewable energy entered in its various forms as an alternative to the production of other types of industrial energy to avoid its health and environmental effects. Renewable energy is produced from natural sources and is renewable at a rate that exceeds what is consumed, it is available in most countries of the world and can be exploited to serve humanity the best use. From renewable energy do not arise residues of fossil fuels harmful to the environment, global warming, and climate problems. Huge hydroelectric dams are considered one of the means of renewable energy, as there are hydroelectric power plants, and energy generation technologies based on solar and wind energy are also used, so the production of renewable electric energy has become widespread even in non-developed

countries. Developed countries occupy the first place in the production of renewable energy, and the comparison intensifies when adopting renewable energy with the size of the population in the country, such as Germany and the Scandinavian countries. The phenomenon of renewable energy trade has spread and turned it into sources of income and has become feasible investment projects adopted by countries in achieving sustainable development. Solar cells are photovoltaic converters that convert sunlight into electrical energy. Wind is one of the natural sources of renewable energy and taking advantage of its movement for ease of use, it is a safe and environmental energy that does not emit any harmful waste and alternative electric energy; it is considered the least expensive and promising wide success in its uses, and one of its advantages is that it is local energy. Hydropower is one of the types of renewable energy using the kinetic energy of running water, especially in water dams and the kinetic energy of rivers. Bioenergy is also considered another type, which is the collection of gases emitted by plant waste such as trees, vegetables, and sugarcane residues. The phenomenon of tides is one of the phenomena that can be used to generate renewable energy, and research is underway on this type and benefit from it, especially from countries overlooking the seas and oceans. This paper sheds light on one of the alternative energy sources, renewable energy, highlighting its importance through the development of its indicators and making the necessary comparisons between the regions of the world and the leading countries in their capacity and production according to their different types.The data on renewable energy (capacity and production) for the series (2015 – 2023) was used, giving an accurate analysis and survey of the indicators of main types of renewable energy, then making comparison with the electricity capacity and production. The secular trend of the series of renewable capacity and production energy was measured globally according to the statistical program (Minitab), with an estimate of the data for the next five years.

2. Methodology

The data published in (ARINA, 2024) will be analyzed by regions and determine the highest capacity and production countries for 2023 according to the sequence of their importance and for the 2015-2023 Zenith series, and it is noted from the data that the quantities produced were much higher than the renewable energy capacity. For all types of renewable energy capacity and production, the sequence of regions as shown in the subsequent tables was, Asia, Europe, North America, South America, Eurasia, Africa, the Middle East, Oceania, Central America and the Caribbean.

In total renewal energy capacity (MW), it is noted from the series that there is a noticeable development in the renewable energy capacity and the quantities produced, this development varies depending on the regions and the possibility of exploiting the available energies. The highest country in capacity was China with the capacity of (1453701), followed by the United States of America (385205), Brazil (194085), Germany (166939), Turkey (58462), Australia (54834), Iran (10954), Egypt (6709). In terms of production (GWh), the highest producing countries were China (2625256), USA (959231), Brazil (208607), Germany (251087), Russia (208607), Australia (83282), Mozambique (16319), Iran (15084), Table (1).

Table (1): Total renewal energy capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / Regions	Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
Asia	*CAP*	722384	813317	920590	1025152	1125137	1301278	1455904	1630944	1959075
	PROD.	2034473	2220177	2431989	2651916	2868684	3101868	3429264	3748551	4085920
Europe	*CAP*	465128	488677	513004	537514	574844	609134	651443	715649	785821
	PROD.	1173945	1195661	1210688	1297811	1330914	1451255	1470362	1461749	1517924
N. America	*CAP*	309486	333151	349639	367827	392949	424732	462211	492473	536976
	PROD.	1037461	1117868	1211875	1231853	1251711	1327201	1374579	1492546	1552243
S. America	*CAP*	178645	193516	202731	213538	223576	232868	247165	266925	289663
	PROD.	732691	763942	797050	826956	838096	841264	840780	940479	984569
Eurasia	*CAP*	88542	91912	96576	100719	104278	110463	115841	119154	122145
	PROD.	265957	290489	287888	305665	34321	357183	353947	362642	373523
Africa	*CAP*	34770	37476	42869	48187	1125137	1301278	1455904	1630944	1959075
	PROD.	137 604	138 341	148 628	161 983	173 792	184 970	197 613	204 542	225412
Middle East	*CAP*	15905	16719	17087	18645	21432	23618	25876	30501	35825
	PROD.	20090	24930	23614	26579	50627	45579	40528	47382	55493
Oceania	*CAP*	25747	27029	29181	34389	40267	47008	52314	58744	64400
	PROD.	71665	76765	78938	84305	91382	98130	109576	125033	131144
Central America & Caribbean	*CAP*	11888	13204	14035	14987	15892	16432	17067	17617	18559
	PROD.	38585	41119	46416	46700	45559	50594	56007	56746	58857
World	*CAP*	**1852495**	**2015001**	**2185712**	**2360958**	**3623512**	**4066811**	**4483725**	**4962951**	**5771539**
	PROD.	**5374867**	**5730951**	**6088458**	**6471785**	**6511294**	**7273074**	**7675043**	**8235128**	**8985085**

Source: IRENA, Statistics 2024

In hydropower energy capacity (MW), the highest country in capacity was China (421540), followed by the USA (103250), Brazil (89194), Norway (34401), Turkey (31779), Iran (12719), Australia (9250), Egypt (2832), Costa Rica (2372). In terms of production (GWh), the highest producing countries were China (1352200), Brazil (427114), Canada (397727), Russia (201870), New Zealand (26274), Mozambique (16184), Iran (13683), Costa Rica (9450), table (2).

Table (2): Hydropower energy capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / Regions	Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
Asia	*CAP*	500833	516836	531089	543969	555031	570511	594325	620391	630030
	PROD.	1606558	1692805	1742162	1787347	1848862	1930005	1930038	1975083	2016194
Europe	*CAP*	214429	217976	219572	220614	221543	223074	224212	225804	225728
	PROD.	597677	613411	557416	612974	567093	611690	620085	526653	617764

N. America	*CAP*	194080	195823	196402	197250	197552	197964	198861	199581	199492
	PROD.	684633	708719	752143	735914	716539	722077	691361	713113	734225
S. America	*CAP*	153571	163925	167665	172844	177772	178313	178484	180018	180962
	PROD.	643704	657677	675643	691074	683734	669030	640525	710343	781353
Eurasia	*CAP*	82535	83724	84521	85773	86583	84420	90103	90212	89812
	PROD.	250610	268693	259787	268215	299399	304494	288502	283886	289775
Africa	*CAP*	29102	31029	34119	35484	36189	37048	37529	39275	40280
	PROD.	124670	121852	130129	140282	147444	153595	160709	165506	169617
Middle East	*CAP*	15665	15881	15535	15681	15764	16074	16072	16422	16598
	PROD.	17605	21145	18436	18710	37706	27968	18473	17809	18027
Oceania	*CAP*	14239	14239	14243	14496	14506	14509	14509	14749	15542
	PROD.	39745	43018	43284	44225	43634	41509	41618	45501	49315
Central America & Caribbean	*CAP*	6957	7608	7755	8040	8154	8271	8324	8372	8418
	PROD.	23822	24553	29717	27208	23136	28794	31812	33558	35467
World	***CAP***	**1211410**	**1247040**	**1270901**	**1294150**	**1313093**	**1335185**	**1362416**	**1394824**	**1406863**
	PROD.	**3989024**	**4151873**	**4208717**	**4325949**	**4367547**	**4489162**	**4423123**	**4471452**	**4711737**

Source: IRENA, Statistics 2024

In renewable hydropower (including mixed plants) capacity (MW), the highest country in capacity was China (37600), Brazil (109903), USA (84317), Russia (50571), Norway (34409), Australia (8440), Ethiopia (4883), Costa Rica (2372). In terms of production (GWh), the highest producing countries were China (1303900), Brazil (427114), Canada (397616), Russia (200000), Norway (128240), New Zealand (26274), Zambia (17130), Iran (13683), Costa Rica (9450), table (3).

Table (3): Renewable hydropower (including mixed plants) capacity (MW) and production (GWh), by regions

Years / *Regions*	*Type*	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Asia	*CAP*	442495	454865	466419	478699	489460	503741	522654	539321	543810
	PROD.	1573781	1642577	1688397	1733601	1796452	1875449	1868553 1	1905018	1944127
Europe	*CAP*	186049	189296	191108	192253	193182	194709	195523	197128	196857
	PROD.	562627	578251	520358	578138	534132	575393	585685	486360	557381
N. America	*CAP*	175040	176622	177169	177997	178353	178563	179920	180596	180384
	PROD.	664411	686163	729280	714301	695656	700893	670632	690536	712428
S. America	*CAP*	152597	162951	166691	171870	176798	177339	177508	179044	179988
	PROD.	643126	657139	675243	690792	683325	668442	639989	709533	771452
Eurasia	*CAP*	81319	82508	83305	84557	85367	88204	88747	88856	88456
	PROD.	248689	266665	257669	266330	297606	302691	284687	282016	313217
Africa	*CAP*	26728	28166	30923	32288	32993	33852	34333	36079	37084
	PROD.	121307	118246	125567	135415	142111	148311	155558	160505	164616
Middle East	*CAP*	14385	14601	14255	14401	14484	14494	14492	14842	15018
	PROD.	17605	21145	18436	18710	37706	27968	18473	17809	18127
Oceania	*CAP*	13429	13429	13433	13686	13696	13699	13699	13939	14732
	PROD.	39624	42721	43036	44008	43269	41123	41179	44787	46893
Central America & Caribbean	*CAP*	6957	7608	7755	8034	8148	8265	8318	8366	8412
	PROD.	23822	24553	29717	27188	23127	28785	31795	33543	35437
World	***CAP***	**1098999**	**1130046**	**1151058**	**1173785**	**1192481**	**1212866**	**1235194**	**1258171**	**1264741**
	PROD.	**3894992**	**4037460**	**4087703**	**4208483**	**4253384**	**4369055**	**2427998**	**4330107**	**4563678**

Source: IRENA, Statistics 2024

In wind energy capacity (MW), the highest country in capacity was China (441895), USA (148020), Germany (69459), Brazil (29135), Turkey (11697), Russia (50571), South Africa (3442), New Zealand (1059), Ethiopia (4883), Jordan (614), Costa Rica (408). In terms of

production (GWh), the highest producing countries were China (763343), USA (439270), Germany (124816), Brazil (81632), Turkey (34945), Egypt (5677), New Zealand (2865), Jordan (1784), Costa Rica (1396), table (4).

Table (4): Wind energy capacity (MW) and production (GWh), by regions

Years / Regions	Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
Asia	*CAP*	161811	184112	204945	228978	257670	331941	384742	426482	508599
	PROD.	228939	291509	368256	440344	491437	554791	747694	869342	958453
Europe	*CAP*	143015	155727	170616	181787	196110	207896	221517	240278	255615
	PROD.	307629	307643	367189	383635	440782	488989	469134	522443	611345
N. America	*CAP*	87252	97527	104261	111662	123597	139191	154210	164389	172328
	PROD.	228701	270779	299202	322179	347953	397281	439716	496752	547863
S. America	*CAP*	9921	12923	15711	19124	20677	24208	29737	33580	39852
	PROD.	27245	40805	51682	59937	72567	79486	99927	111997	120118
Eurasia	*CAP*	4525	5801	6566	7146	7783	9868	12652	13702	14305
	PROD.	11667	15557	18156	20350	22255	26258	34924	40666	46778
Africa	*CAP*	3320	3831	4578	4571	5528	6514	6909	7745	8654
	PROD.	5457	7006	7152	7845	9727	10742	12737	12996	13136
Middle East	*CAP*	286	409	494	623	785	934	1039	1564	1866
	PROD.	380	670	948	1497	1736	2313	2762	6287	6536
Oceania	*CAP*	4318	4683	5407	6409	7881	10207	10555	11966	12911
	PROD.	13907	14595	14741	17286	20036	22761	27226	32022	37133
Central America & Caribbean	*CAP*	1246	1485	1610	1737	1955	1969	1992	2110	2128
	PROD.	3961	4380	4430	5853	6143	5698	6244	5828	6355
World	***CAP***	**415694**	**466498**	**514188**	**562037**	**621986**	**732728**	**823353**	**901816**	**1016258**
	PROD.	**827886**	**952944**	**1131756**	**1258926**	**1412636**	**1588319**	**1840364**	**2098333**	**2347717**

Source: IRENA, Statistics 2024

In onshore wind energy capacity (MW), the highest country in capacity was China (404605), USA (147979), Brazil (29135), Germany (61052), Turkey (11697), South Africa (3442), New Zealand (1059), Jordan (614), Costa Rica (408). In terms of production (GWh), the highest producing countries were China (699771), USA (439125), Germany (99692), Brazil (81632), Turkey (34945), Egypt (5677), New Zealand (2865), Jordan (1784), Costa Rica (1396), table (5).

Table (5): Onshore wind energy capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / Regions	Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
Asia	*CAP*	161083	182427	201939	224144	251373	322529	356933	393957	468310
	PROD.	227803	288687	362686	430697	479159	538993	693494	802102	913213
Europe	*CAP*	132008	143084	154805	163049	174130	182956	195090	210240	222760
	PROD.	272514	268937	315979	325086	368524	400855	385817	427883	468974
N. America	*CAP*	87252	97497	104232	111633	123568	139162	154169	164347	172286
	PROD.	228701	270676	299099	322076	347850	397136	439571	496607	557728
S. America	*CAP*	9921	12923	15711	19124	20677	24208	29737	33580	39852
	PROD.	27245	40805	51682	59937	72567	79486	99927	111997	119886
Eurasia	*CAP*	4525	5801	6566	7146	7783	9868	12652	13702	14305
	PROD.	11667	15557	18156	20350	22255	26258	34924	40666	46786
Africa	*CAP*	3320	3831	4578	5471	5528	6514	6909	7745	8654
	PROD.	5457	7006	7152	7845	9727	10742	12737	12996	13321

Middle East	*CAP*	286	409	494	623	785	934	1039	1564	1866
	PROD.	380	670	948	1497	1736	2313	2762	6287	6596
Oceania	*CAP*	5059	5425	6149	7152	8625	10951	11522	13035	14045
	PROD.	13907	14595	14741	17286	20036	22761	27226	32022	37154
Central America & Caribbean	*CAP*	1246	1485	1610	1737	1955	1969	1992	2110	2128
	PROD.	3961	4380	4430	5853	6143	5698	6244	5828	6317
World	*CAP*	**404700**	**452882**	**496084**	**540079**	**594424**	**699091**	**770043**	**840280**	**944206**
	PROD.	**791635**	**911313**	**1074873**	**1190627**	**1327997**	**1484242**	**1702702**	**1936388**	**2169975**

Source: IRENA, Statistics 2024

In solar energy capacity (MW), the highest country in capacity was China (609921), USA (139205), Germany (81739), Brazil (37449), Australia (32612), Turkey (11293), UAE (5907), Egypt (1858), Dominican Rep. (1077). In terms of production (GWh), the highest producing countries were China (428163), USA (187071), Germany (60304), Australia (34687), Brazil (30138), Turkey (16891), South Africa (8329), UAE (7753), El - Salvador (1243), table (6).

Table (6): Solar energy capacity (MW) and production (GWh), by regions, (2025 – 2023)

Years / *Regions*	*Type*	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Asia	*CAP*	90400	140225	211564	275809	331238	412092	488907	601390	839329
	PROD.	89446	136363	208434	292476	370044	442291	551859	687142	728253
Europe	*CAP*	99605	106175	112307	121572	142339	162795	190928	233906	288644
	PROD.	110520	113840	122473	129519	142386	167470	186860	235613	255714
N. America	*CAP*	27409	39098	48261	58476	71841	87978	109579	129156	156000
	PROD.	38715	53803	75372	90040	108291	132521	169462	213366	243645
S. America	*CAP*	901	1529	3712	652	8579	13422	21259	34698	49392
	PROD.	1803	3340	5547	10304	15625	22048	31815	51482	69572
Eurasia	*CAP*	316	937	3678	5652	7329	8187	9690	11551	14204
	PROD.	264	1161	3149	8244	10265	12746	16073	19722	21856
Africa	*CAP*	2125	3296	5048	7944	9293	10659	11582	12646	13438
	PROD.	3310	5130	7927	10232	13200	17423	21047	22463	23657
Middle East	*CAP*	1154	1621	2250	3535	6076	8107	10261	13992	18826
	PROD.	1844	2801	3884	6019	10881	14954	18963	22936	25849
Oceania	*CAP*	5174	6060	7468	11398	15792	20168	24895	29566	33417
	PROD.	5168	6438	8351	10276	15303	21560	28338	35480	43560
Central America & Caribbean	*CAP*	998	1205	1566	1950	2539	2822	3542	3945	4767
	PROD.	1199	1920	2379	2927	3909	4672	6155	6278	62617
World	*CAP*	**228082**	**300146**	**395854**	**486988**	**595026**	**726230**	**870643**	**1070850**	**1418017**
	PROD.	**252269**	**324796**	**437516**	**560037**	**689904**	**835685**	**1030572**	**1294482**	**1474723**

Source: IRENA, Statistics 2024

In solar photovoltaic capacity (MW), the highest country in capacity was China (609351), USA (137725), Germany (81737), Brazil (37449), Turkey (11292), South Africa (5664), UAE (5307), Australia (3264), Dominican Rep. (1077). In terms of production (GWh), the highest producing countries were China (428142), USA (183812), Germany (60304), Australia (34682), Brazil (30138), Turkey (16888), UAE (7455), South Africa (6739), El - Salvador (1243), table (7).

Table (7): Solar photovoltaic capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / *Regions*	*Type*	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Asia	*CAP*	90055	139860	211199	275229	330494	411295	487990	600473	838411

	PROD.	89071	135988	208060	292101	369663	441909	551472	686755	732165
Europe	***CAP***	97292	103862	109995	119260	140018	160474	188607	231585	286323
	PROD.	104914	108249	116578	124640	136690	162465	181671	231064	256983
N. America	***CAP***	25651	37340	46503	56702	70066	86213	108082	127659	154503
	PROD.	35171	50102	71785	86100	104756	129094	166292	210107	251218
S. America	***CAP***	901	1529	3712	5652	8579	13422	21151	34590	49284
	PROD.	1803	3340	5547	10304	15625	22048	31696	51174	60087
Eurasia	***CAP***	315	936	3677	5651	7328	8186	9689	11550	14203
	PROD.	261	1158	3146	8241	10262	12743	16070	19719	23821
Africa	***CAP***	1800	2871	4523	6959	8208	9574	10497	11561	12353
	PROD.	2894	3929	6059	7792	9593	14119	17512	19413	21524
Middle East	***CAP***	1046	1514	2142	3377	5627	7663	9817	13348	17882
	PROD.	1601	2540	3626	5637	9993	13911	17697	21668	25779
Oceania	***CAP***	5171	6057	7465	11395	15789	20165	24892	29563	33414
	PROD.	5164	6434	8346	10271	15297	21554	28333	35475	41576
Central America & Caribbean	***CAP***	998	1205	1566	1950	2539	2822	3542	3945	4767
	PROD.	1199	1920	2379	2927	3909	4672	6155	6278	6387
World	***CAP***	**223229**	**295174**	**390782**	**486175**	**588648**	**719814**	**864267**	**1064274**	**1411140**
	PROD.	**242078**	**313660**	**425526**	**548013**	**675788**	**822515**	**1016898**	**1281653**	**1419540**

Source: IRENA, Statistics 2024

In bioenergy capacity (MW), the highest country in capacity was China (31255), Brazil (17597), USA (10990), Germany (9950), Turkey (2001), Australia (871), Guatemala (870), Ethiopia (310), UAE (29). In terms of production (GWh), the highest producing countries were China (129700), USA (57146), Brazil (55145), Germany (48136), Turky (8073), Guatemala (2094), South Africa (405), Qatar (134), table (8).

Table (8): Bioenergy capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / *Regions*	*Type*	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Asia	***CAP***	23522	29854	33181	37032	41943	48670	54608	58729	62068
	PROD.	117972	124852	140770	157879	182489	199416	231628	256390	276984
Europe	***CAP***	34725	35730	37170	40038	41348	41865	41601	42458	42825
	PROD.	181062	183606	188237	193345	200357	206205	215835	204463	225576
N. America	***CAP***	16326	16445	16496	16279	15609	15454	14906	14684	14576
	PROD.	80564	82372	82280	81166	76095	72354	71329	68215	71543
S. America	***CAP***	15226	16113	16594	16892	17483	17859	18622	19552	20348
	PROD.	60517	62658	64515	65710	66377	71072	68726	67002	69113
Eurasia	***CAP***	1679	1767	1887	2005	2201	2515	3000	3278	3411
	PROD.	1455	1842	2351	2884	3811	5038	7039	8671	9145
Africa	***CAP***	1460	1523	1639	1793	1805	1819	1917	1916	1899
	PROD.	3048	3270	3112	3321	3371	3109	3147	3224	3335
Middle East	***CAP***	81	88	88	86	86	84	84	103	115
	PROD.	262	314	347	353	305	344	330	350	371
Oceania	***CAP***	1044	1079	1095	1095	1095	1097	1104	1104	1106
	PROD.	4533	4622	4406	4416	4417	4285	4291	4104	4319
Central America & Caribbean	***CAP***	2048	2276	2438	2601	2529	2655	2495	2461	2493
	PROD.	5676	6272	5994	6763	7947	6730	7221	6495	7123
World	***CAP***	**96111**	**104875**	**110588**	**117821**	**124099**	**132018**	**138337**	**144285**	**148841**
	PROD.	**455089**	**469808**	**492012**	**515837**	**545169**	**568553**	**609546**	**618914**	**667509**

Source: IRENA, Statistics 2024

In solid biofuels and renewable waste capacity (MW), the highest country in capacity was China (29765), Brazil (17070), Russia (13775), USA (8986), UK (5493), Guatemala (864), Australia (674), Ethiopia (310), UAE (18). In terms of production (GWh), the highest producing countries were China (124300), Brazil (52150), USA (46590), UK (28320), Turkey (3425), Guatemala (2075), Australia (1817), Uganda (471), Qatar (109), table (9).

Table (9): Solid biofuels and renewable waste capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / Regions	Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
Asia	***CAP***	22186	28335	31446	35053	39042	45691	51751	55709	58760
	PROD	112949	119346	135053	149041	171930	188946	220706	245499	261541
Europe	***CAP***	21564	22159	23157	25281	25832	25834	25975	26687	26930
	PROD	113905	114888	119034	124770	131575	136353	147208	138070	145317
N. America	***CAP***	13526	13636	13619	13396	12914	12867	12453	12308	12220
	PROD	65546	67606	67258	66542	62075	58806	58691	56672	59774
S. America	***CAP***	14919	15558	16214	16468	16965	17240	17984	18860	19637
	PROD	58435	60898	62533	63348	63582	67879	64654	63575	65731
Eurasia	***CAP***	1419	1462	1498	1547	1633	1750	1962	2087	2080
	PROD	246	281	568	721	1190	1950	2900	4024	4135
Africa	***CAP***	1434	1487	1600	1709	1709	1723	1777	1775	1750
	PROD	2979	3186	2994	3189	3205	2940	2981	3065	3199
Middle East	***CAP***	18	18	18	18	18	15	15	23	33
	PROD	102	105	110	114	93	106	106	106	107
Oceania	***CAP***	759	835	852	852	852	846	854	854	855
	PROD	2749	3037	2900	2851	2770	2613	2624	2419	2726
Central America & Caribbean	***CA***	2029	2250	2398	2559	2487	2610	2449	2394	2426
	PROD	5592	6185	5873	6626	7793	6555	6963	6227	7172
World	***CAP***	**77854**	**85740**	**90802**	**96883**	**101452**	**108576**	**115220**	**120697**	**124691**
	PROD	**362503**	**375532**	**396323**	**417202**	**444213**	**466148**	**506833**	**519657**	**549702**

Source: IRENA, Statistics 2024

In biogas capacity (MW), the highest country in capacity was Brazil (12446), Thailand (1569), Guatemala (863), Mexico (814), Australia (500), Ethiopia (310), Portugal (2). In terms of production (GWh), the highest producing countries were Brazil (32262), Thailand (9138), Guatemala (2075), Mexico (1762), Australia (1141), Uganda (471), Portugal (17). Table (10).

Table (10): Biogas capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / Regions	Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
Asia	***CAP***	975	1159	1376	1631	1881	2029	2370	2533	2818
	PROD	3789	4050	4475	7228	8264	8552	9478	9511	9763
Europe	***CAP***	11296	11778	12200	12921	13340	13881	13538	13686	13810
	PROD	61535	63400	64180	63579	63471	64627	63997	62849	63986
N. America	***CAP***	2685	2694	2752	2708	2633	2525	2391	2314	2294
	PROD	14795	14556	14805	14273	13662	13250	12329	11244	13253
S. America	***CAP***	279	551	375	419	514	614	633	674	694
	PROD	1298	1406	1682	1946	2338	2616	3340	2947	3412
Eurasia	***CAP***	253	298	378	440	549	742	988	1126	1266
	PROD	1208	1560	1781	2159	2598	3047	4082	4602	4915
Africa	***CAP***	26	35	38	43	54	54	99	99	107
	PROD	68	83	116	128	158	163	159	152	161

Middle East	***CAP***	62	69	70	68	68	69	69	81	82
	PROD	159	209	237	239	212	238	224	244	254
Oceania	***CAP***	282	241	240	240	240	247	247	247	247
	PROD	1778	1582	1505	1564	1645	1671	1666	1684	1699
Central America & Caribbean	***CA***	19	26	41	42	42	45	46	67	67
	PROD	84	87	122	137	155	175	258	268	271
World	***CAP***	**15877**	**16851**	**17470**	**18512**	**19321**	**20206**	**20381**	**20827**	**21385**
	PROD	**84714**	**86933**	**88903**	**91253**	**92503**	**94339**	**95533**	**93501**	**97714**

Source: IRENA, Statistics 2024

In geothermal energy capacity (MW), the highest country in capacity was USA (2674), Indonesia (16677), Turkey (11119), New Zealand (8544), Kenya (984), Italy (772), Costa Rica (263), Chile (83). In terms of production (GWh), the highest producing countries were USA (19142), Indonesia (16677), Turkey (11119), New Zealand (8544), Iceland (5916), Kenya (5325), Costa Rica (1619), Chile (465). Table (11). Figures (1 & 2).

Table (11): Geothermal energy capacity (MW) and production (GWh), by regions, (2015 – 2023)

Years / ***Regions***	***Type***	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Asia	***CAP***	3896	4001	4221	4375	4566	4572	4732	4761	5011
	PROD	23832	24372	25636	27123	27783	29456	29068	30227	31338
Europe	***CAP***	1503	1507	1558	1617	1622	1627	1633	1637	1637
	PROD	11617	11800	11885	12665	12744	12678	12340	12344	12357
N. America	***CAP***	3440	3440	3432	3393	3529	3545	3595	3647	3678
	PROD	25058	24732	25735	24148	23715	24151	23440	23678	23983
S. America	***CAP***	11	18	24	33	40	40	40	51	83
	PROD	29	51	64	214	202	216	324	465	510
Eurasia	***CAP***	702	899	1138	1357	1596	1687	1750	1765	1765
	PROD	3882	5264	6562	7857	9384	10449	11223	11568	11779
Africa	***CAP***	626	660	680	691	691	870	870	956	991
	PROD	4481	4689	4870	5168	5384	5385	5124	5354	5546
Oceania	***CAP***	1040	1035	1035	1059	1059	1093	1093	1100	1100
	PROD	8433	8389	8404	8319	8357	8400	8543	8640	8789
Central America & Caribbean	***CA***	640	630	665	665	721	722	719	735	760
	PROD	3927	3994	3896	3969	4432	4709	4592	4603	4723
World	***CAP***	**11858**	**12190**	**12753**	**13190**	**13824**	**14156**	**14432**	**14652**	**15025**
	PROD	**81259**	**83291**	**87052**	**89463**	**92001**	**95444**	**94654**	**96879**	**99025**

Source: IRENA, Statistics 2024

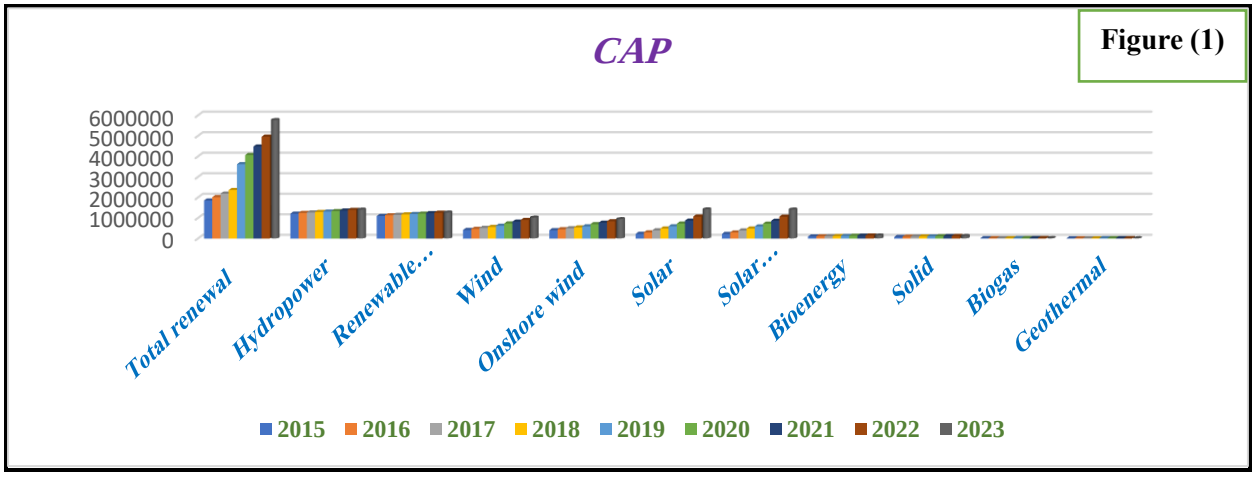


Figure (1)

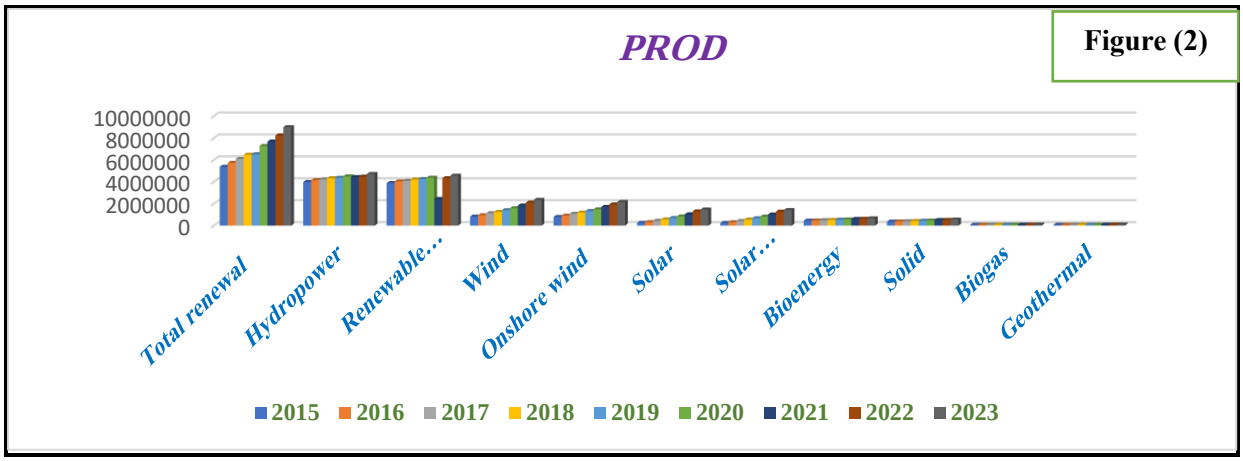


Figure (2)

3. The share of renewable energy with electricity

When comparing the capacity and production of renewable energy and its contribution to the capacity and production of electricity energy, we find that South America was the largest contributor with (71.4) for capacity and (79.2) for production for the year (2023), followed by Europe (56.9 & 41.3), Oceania (53.3 & 40.1), Asia (43.4 & 28.1), Central America and the Caribbean (38.7 & 39.9), North America (35.2 & 29.5), Eurasia (30.8 & 24.4), Africa (24.3 & 23.7), and least of all the Middle East (9.9 & 3.7), globally the proportions were (43.7 & 30.1). On the scale of the countries in capacity were, Lesotho (100%), Bhutan (99.6), Andorra (97), Costa Rica (89.4), Tokelau (88), Georgia (74.8), Canada (69.8), and Jordan (37.1). In production, the Democratic Republic of Congo, Ethiopia, Bhutan, Albania, Iceland, Nepal (100%), Costa Rica (99.3), Georgia (79.5), Greenland (77.9). Table (12). Figures (3 & 4).

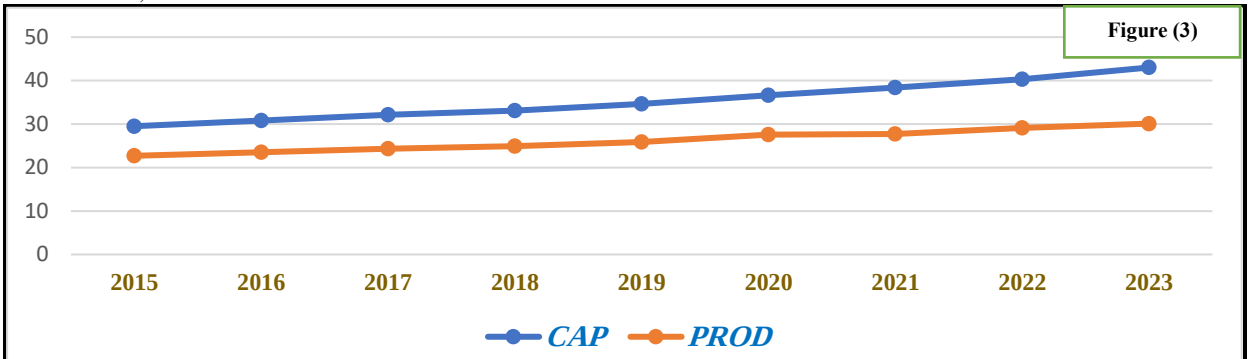
Table (12): Renewable energy share of electricity capacity & Production (%), by regions, (2015 – 2023)

Years / Regions	Type	2015	2016	2017	2018	2019	2020	2021	2022	2023
S. America	CAP	64.3	65.1	65.6	66.3	67.2	67.5	68.3	69.9	71.4
	PROD	62.7	65.3	67.6	70.0	70.7	71.6	68.5	75.0	79.2
Europe	CAP	41.3	42.9	44.5	45.5	47.9	49.8	51.9	54.4	56.9
	PROD	31.3	31.6	31.9	34.2	35.6	40.1	39.3	40.5	41.3

Oceania	***CAP***	29.7	31.6	34.3	37.9	41.7	44.9	47.4	50.2	53.3
	PROD	23.4	24.7	25.2	26.6	28.6	30.6	34.2	38.2	40.1
Asia	***CAP***	27.2	28.6	30.3	31.7	33.1	35.7	37.7	39.7	43.4
	PROD	19.7	20.4	21.2	21.7	22.6	24.0	24.7	26.2	28.1
Central America & Caribbean	***CAP***	30.6	32.6	34.2	35.0	35.6	35.8	37.2	38.2	38.7
	PROD	27.8	29.0	33.5	33.6	31.2	35.7	37.9	38.4	39.9
N. America	***CAP***	24.1	25.5	26.4	27.2	28.7	30.6	32.3	33.7	35.2
	PROD	19.6	21.1	23.0	22.5	23.2	25.4	25.5	27.0	29.5
Eurasia	***CAP***	26.0	25.5	26.2	27.0	27.5	28.7	29.7	30.1	30.8
	PROD	18.4	19.6	19.1	20.9	23.3	24.8	24.0	23.5	24.3
Africa	***CAP***	19.8	19.8	20.9	21.3	21.6	22.3	22.6	23.6	24.3
	PROD	18.0	18.2	18.7	19.8	20.6	22.5	23.1	22.8	23.7
Middle East	***CA***	5.6	5.7	5.7	6.2	6.9	7.3	7.8	8.9	9.9
	PROD	1.8	2.1	1.9	2.1	3.9	3.5	3.0	3.4	3.7
World	***CAP***	**29.5**	**30.8**	**32.1**	**33.1**	**34.6**	**36.6**	**38.4**	**40.3**	**43.0**
	PROD	**22.7**	**23.5**	**24.3**	**24.9**	**25.9**	**27.6**	**27.7**	**29.1**	**30.1**

Source: IRENA, Statistics 2024

Figure (3)



4. Secular Trend

For the purpose of knowing the general trend of the series for all types of renewable energy capacity and production, the statistical program (Minitab) was used, and its results are shown in Table (13), which indicates that the marginal tendency of all types was positive and to a high degree. The table also shows the predictive values for the next four years (2025-2030) in capacity and renewable production energy, figures (4 & 5).

Table (13): Secular trend & forecasting values

Types	***Energy***	***α***	***β***	***Forecasting Years***					
				2025	2026	2027	2028	2029	2030
Total Renewal	***CAP***	911808	513698	6562486	7076148	7589802	8103580	8617278	9130976
	PROD	4766643	432131	9520084	9952215	1038331	1081647	11248608	11680739
Hydropower	***CAP***	1194329	24154	1460023	1484177	1508331	1532485	1556639	1580793
	PROD	3978597	74027	4792894	4866921	4940948	5014975	5089002	5163029
Renewable hydropower	***CAP***	1086258	20912	1316390	1337302	1358214	1379126	1399938	1420850
	PROD	3986386	80548	4872414	4952962	5033510	5114058	5194606	5275154
Wind	***CAP***	297959	74954	1122453	1197407	1272361	1347315	1422269	1497223
	PROD	556923	187702	2621645	2809347	2997049	3184751	3372453	3560155
	CAP	302381	67119	1040690	1107809	1174928	1242047	1309166	1376285

Onshore Wind	***PROD***	554040	168964	2412644	2581608	2750572	2919536	3088500	3257464
Solar	***CAP***	-11519	186026	2034767	2220817	2406819	2892845	2778871	2964897
	PROD	05055	154344	1692729	1847073	2001417	2155761	2320215	2474559
Solar photovoltaic	***CAP***	15129	167824	1861193	2029017	2196841	2364685	2532489	2700313
	PROD	-6404	151185	1656631	1807816	1959001	2250186	2261371	2412556
Bioenergy	***CAP***	90879	6647	163996	170643	177290	183937	190584	197231
	PROD	417095	30381	751286	781667	812048	842429	872810	903191
Solid	***CAP***	73039	5879	137708	143587	149466	155345	161224	167103
	PROD	327751	24186	593797	617983	642169	666355	690541	714727
Biogas	***CAP***	15525	643	22598	23241	23884	24527	25170	25813
	PROD	84373	1467	100510	101977	103444	104911	106378	107845
Geothermal	***CAP***	11533	406	16002	16405	16811	17217	17623	18029
	PROD	79923	2217	104310	106527	108744	110961	113178	115395
Share	***CAP***	27.16	1.64	45.2	46.8	48.5	50.1	51.76	53.4
	PROD	21.54	0.93	30.8	32.6	33.5	34.5	35.49	36.42

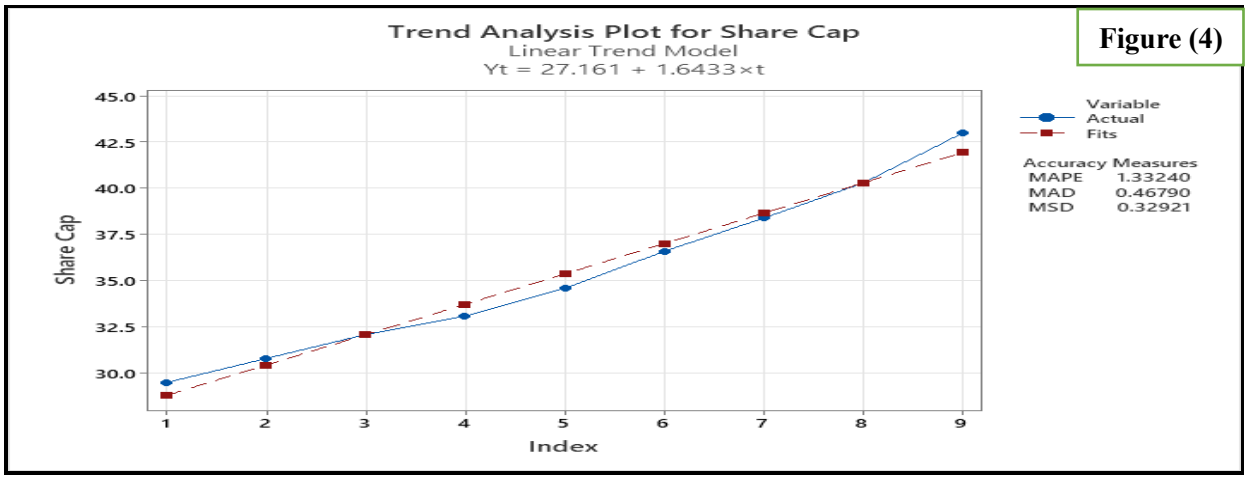


Figure (4)

Source: Minitab statistical Program outputs[13]

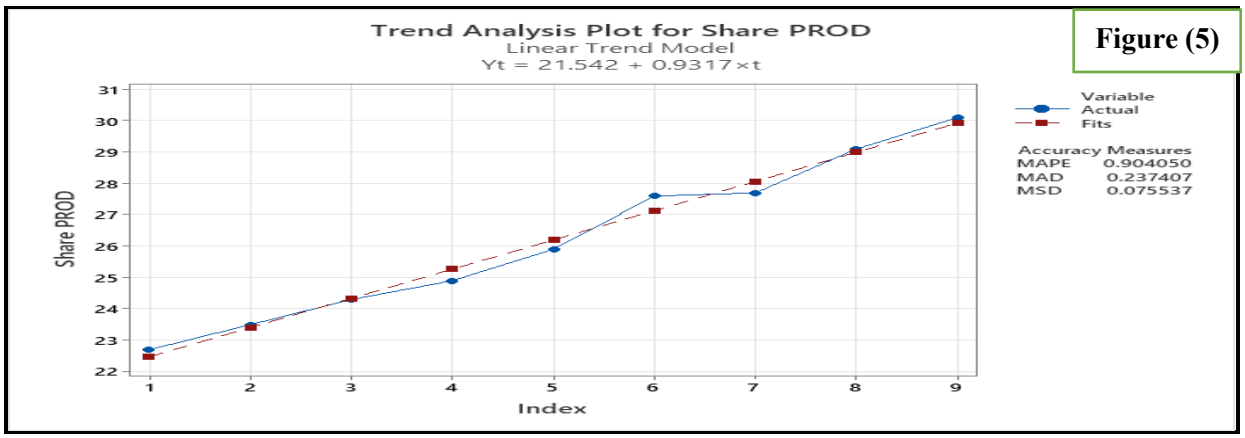


Figure (5)

Source: Minitab statistical Program outputs[13]

Conclusion

Renewable energy is characterized by its availability in most countries of the world and has no environmental impact and preserves the public health of living organisms and ensure the

continued existence and availability, and is economical to use uncomplicated technologies and is also characterized by continuity, impenetrability, and limited thermal emissions. Renewable energy helps reduce unemployment rates and increase investment because it has limited construction costs and is considered environmentally friendly, maintenance-free and reliable. Considering this, the various countries of the world should make the most of this energy, especially since data analysis indicated that the quantities produced are more than the capacity of countries, which requires focusing on the sustainability of production and consumption of this type and be an indicator of measuring the progress of countries. Through the analysis of global data on renewable energy, we find that there is an increasing competitive interest from the countries of the world in the search for natural resources that help these countries in obtaining renewable energy and avoid the exploitation of non-renewable energies and gradually moving away from them because of the advantages of renewable energy that support the economic development of countries and reduce the risks of environmental pollution. International organizations have contributed to education and advice to support the new approach to renewable energy.

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