

ANALYSIS OF ELECTRICITY FROM RENEWABLE SOURCES IN THE EUROPEAN UNION MEMBER STATES IN THE YEARS 2004-2020

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Purpose: The purpose of this paper is to present an analysis of electricity from renewable sources in the European Union countries. Analysis includes the quantity of electricity produced from renewable sources - Electricity (hydro, wind, solar, solid biofuels, all other renewables), the amount of renewable electricity used in Transport (Renewable electricity in road transport, in rail transport, in all other transport modes, compliant biofuels, non-compliant biofuels, other renewable energies), gross final consumption of energy from renewable sources in the heating and cooling sector (final energy consumption, derived heat, heat pumps), gross final consumption of energy from renewable sources (electricity, Transport, heating and cooling (European Commission, 2021)).

Design/methodology/approach: The article presents an analysis of the volume of energy obtained from renewable sources and its use, taking into account the list of volumes, changes in volumes in subsequent years, relative values and percentage change compared to the first period from which the data are available (2004) and compared to the period immediately preceding.

Findings: By analyzing the data, conclusions can be drawn regarding the level of share and its changes in relation to renewable sources in obtaining electricity, as well as its use in aspects such as Transport or heating and cooling.

Research limitations/implications: The problem that arose during the search for the necessary data was the lack of data from all European Union countries - as a result, the analysis includes data until 2020 (when the work was being written, data from 2021 was not yet available).

Practical implications: The results of the analysis can be used to assess the possibility of implementing the climate project by the EU Member States.

Social implications: Observing the behavior of society as a result of climate policy, it can be concluded that the community is aware of the need to achieve climate goals, and an increasing percentage of people reach for solutions such as heat pumps or solar panels.

Originality/value: The article analyzed electricity obtained from renewable sources.

Keywords: renewable electricity, renewable source, final gross consumption of energy from renewable.

1. Introduction

Over 75% of EU greenhouse gas emissions come from energy production and use. It became reasonable to develop the European climate policy and create the Green Deal for Europe project, where plans for systematic reduction of carbon dioxide emissions by the European Union Member States were presented to achieve carbon dioxide neutrality by 2050 as a long-term effect. Different options for reducing carbon dioxide emissions targets are determined based on the country's gross domestic product per capita. The proposed targets for 2030 would range from -10% to -50% compared to 2005 levels and would align with the overall target of reducing EU emissions by 40% (European Parliament, 2018).

The European Union strategy focuses on three main assumptions for the clean energy transition, which will help reduce greenhouse gas emissions: ensuring affordable and secure energy supply in the EU, creating a fully integrated, interconnected, and digital EU energy market, prioritizing energy efficiency, improving the energy performance of buildings and developing an energy sector based mainly on renewable sources. To achieve the EU's 2030 energy and climate targets, EU countries must establish their 10-year integrated national energy and climate plans for 2021-2030. The national plans outline how EU countries intend to address five critical areas: energy efficiency, renewable energy, reducing greenhouse gas emissions, interconnections, and research and innovation. This work aims to present an analysis of power obtained from renewable sources in the European Union in 2004-2020 based on the factors set by the European Union (European Commission, 2021).

2. Analysis of the electricity share and its components from a renewable source

Sources are presented in the second chapter of this work, electricity in 2004-2020. The following table (Table 1) shows gross electricity production by hydropower - Hydro, wind power - Wind, Solar, Solid biofuels, and all other renewables. The change in the level of individual electricity sources in 2020 compared to 2004 was as follows:

- Hydro - change from level 29209,01 to level 29677,23 (increase by 1,6%).
- Wind - change from level 4783,32 to level 32366,81 (increase by 576,66%).
- Solar - change from level 59, 41 to level 12392,04 (increase by 20759,27%).
- Solid biofuels - change from level 3116,97 to level 7132,70 (increase by 128,83%).
- All other renewables - change from level 1936,83 to level 7513,17 (increase by 287,91%).

The last column shows the percentage share of electricity from renewable sources in subsequent years: this value increased from 15,87% in 2004 to 37,48% in 2020, i.e., an increase of 136,17%.

Table 1.
Share of component parts electricity

Year	Hydro	Wind	Solar	Solid biofuels	All other renewables	Total (RES-E numerator)	Total (RES-E denominator)	RES-E [%]
2004	29209,01	4783,324	59,41	3116,97	1936,83	39105,54	246397,32	15,87%
2005	29309,81	5733,508	125,43	3489,56	2263,44	40921,74	249498,37	16,40%
2006	29180,54	6783,305	214,06	3883,32	2649,35	42710,57	253037,44	16,88%
2007	29259,99	8180,863	324,55	4098,63	3183,68	45047,72	255265,06	17,65%
2008	29202,98	9568,501	639,52	4572,56	3534,41	47517,97	256489,11	18,53%
2009	29308,17	10978,45	1212,72	4930,92	3945,42	50375,68	243900,77	20,65%
2010	29628,52	12442,35	1996,91	5587,45	4530,60	54185,83	254596,76	21,28%
2011	29632,79	13968,62	4066,08	5772,24	5012,31	58452,04	250862,61	23,30%
2012	29507,67	15574,03	6034,10	6196,93	5760,29	63073,01	250905,47	25,14%
2013	29516,8	17280,99	7231,68	6062,11	6439,40	66530,98	248539,13	26,77%
2014	29462,78	18995,78	8097,04	6080,29	6906,30	69542,18	243143,59	28,60%
2015	29663,73	21455,14	8672,24	6194,86	7262,37	73248,33	247004,01	29,65%
2016	29596,59	23384,59	8687,41	6223,37	7392,30	75284,26	249515,58	30,17%
2017	29462,59	25710,3	9280,45	6385,33	7459,23	78297,90	251732,87	31,10%
2018	29559,81	27524,33	9718,66	6556,53	7447,71	80807,04	251466,72	32,13%
2019	29509,63	29954,82	10643,44	6926,87	7460,78	84495,53	247887,04	34,09%
2020	29677,23	32366,81	12392,04	7132,70	7513,17	89081,95	237667,51	37,48%
Suma	500688,6	284685,7	89395,72	93210,61	90697,58			

Source: <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The chart below shows the shares of renewable sources in subsequent years in 2004-2020.

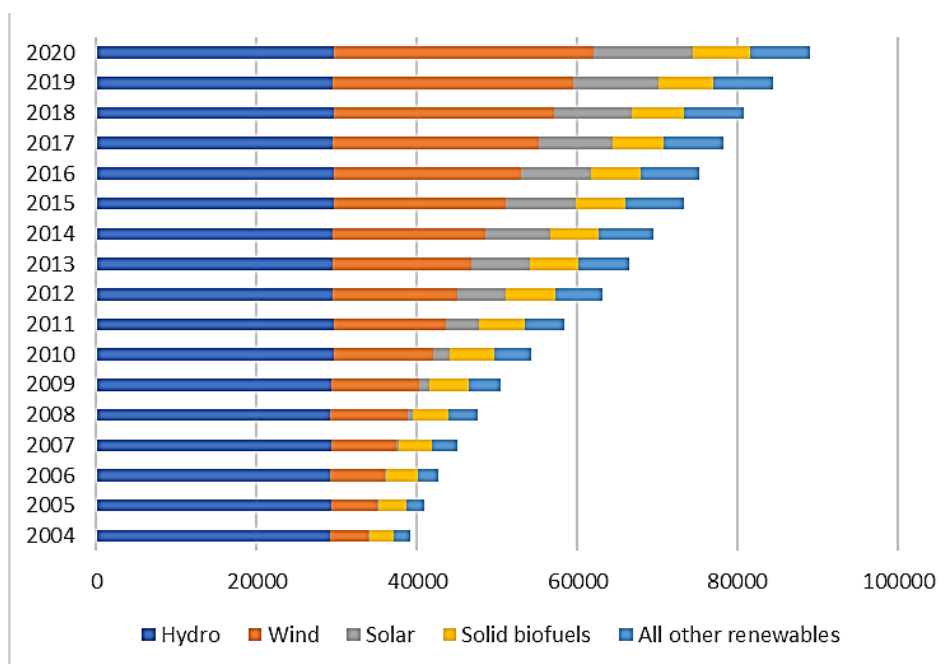


Figure 1. Quantitative share of electrical components in the years 2004-2020.

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

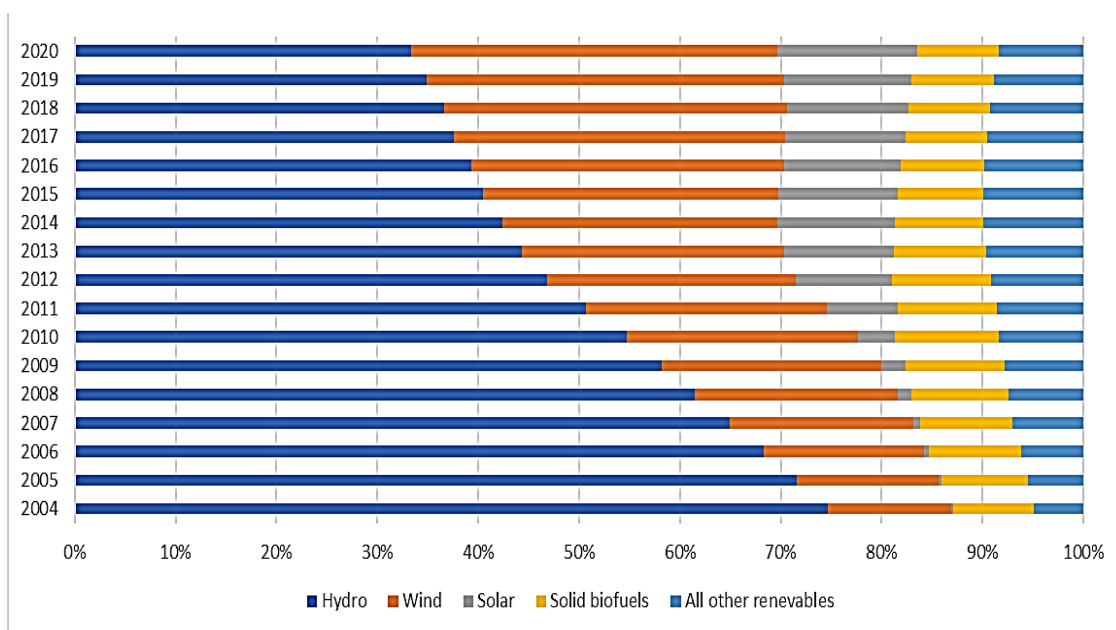
The chart presents a constant level of hydro share in electricity. However, taking into account the increase in the share of energy from other renewable sources, its percentage decreases, which is presented in Table 2.

Table 2.

Percentage share of individual electrical components in years 2004-2020

Year	Hydro	Wind	Solar	Solid biofuels	All other renewables
2004	74,69%	12,23%	0,15%	7,97%	4,95%
2005	71,62%	14,01%	0,31%	8,53%	5,53%
2006	68,32%	15,88%	0,50%	9,09%	6,20%
2007	64,95%	18,16%	0,72%	9,10%	7,07%
2008	61,46%	20,14%	1,35%	9,62%	7,44%
2009	58,18%	21,79%	2,41%	9,79%	7,83%
2010	54,68%	22,96%	3,69%	10,31%	8,36%
2011	50,70%	23,90%	6,96%	9,88%	8,58%
2012	46,78%	24,69%	9,57%	9,83%	9,13%
2013	44,37%	25,97%	10,87%	9,11%	9,68%
2014	42,37%	27,32%	11,64%	8,74%	9,93%
2015	40,50%	29,29%	11,84%	8,46%	9,91%
2016	39,31%	31,06%	11,54%	8,27%	9,82%
2017	37,63%	32,84%	11,85%	8,16%	9,53%
2018	36,58%	34,06%	12,03%	8,11%	9,22%
2019	34,92%	35,45%	12,60%	8,20%	8,83%
2020	33,31%	36,33%	13,91%	8,01%	8,43%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

**Figure 2.** Percentage of electricity components.

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

Based on the presented chart, it can be concluded that Hydro's share in electricity decreased in subsequent years, from 74,69% in 2004 to 33,31% in 2020. It means a decrease of 55,40%. A significant increase in the share was recorded for wind: the change from 12,23% in 2004 to 36,33% is an increase of 197,04%. Solar 9056,88% achieved the most significant increase in percentage share - the share in 2004 was 0,15% compared to 2020: 13,91%. A slight change in the claim can be observed for Solid biofuels: an increase of 0,45% from 7.97% to 8,01%. A rise of 70,29% for All other renewables can also be seen: from 4,95% (2004) to 8,43% (2020).

Wind also showed a significant increase (an increase compared to 2004 by 576,66%). However, the overall share of Solar in total electricity remained at a lower level of -13,91% than wind – 36,33%. Not as high as in the case of elevators, the share of all other renewables slightly increased. In contrast, the percentage of solid biofuels increased until 2010, after which it slightly decreased and remained relatively constant.

The table below (Table 3) presents changes in the share of electrical components in subsequent years concerning the base year 2004.

Table 3.

Percentage change in the share of individual electrical components in 2020 compared to 2004

Year	Hydro	Wind	Solar	Solid biofuels	All other renewables
2004	-	-	-	-	-
2005	0,35%	19,86%	111,12%	11,95%	16,86%
2006	-0,10%	41,81%	260,32%	24,59%	36,79%
2007	0,17%	71,03%	446,31%	31,49%	64,38%
2008	-0,02%	100,04%	976,49%	46,70%	82,48%
2009	0,34%	129,52%	1941,35%	58,20%	103,71%
2010	1,44%	160,12%	3261,36%	79,26%	133,92%
2011	1,45%	192,03%	6744,35%	85,19%	158,79%
2012	1,02%	225,59%	10057,08%	98,81%	197,41%
2013	1,05%	261,28%	12072,95%	94,49%	232,47%
2014	0,87%	297,12%	13529,58%	95,07%	256,58%
2015	1,56%	348,54%	14497,80%	98,75%	274,96%
2016	1,33%	388,88%	14523,34%	99,66%	281,67%
2017	0,87%	437,50%	15521,60%	104,86%	285,13%
2018	1,20%	475,42%	16259,23%	110,35%	284,53%
2019	1,03%	526,23%	17815,88%	122,23%	285,21%
2020	1,60%	576,66%	20759,27%	128,83%	287,91%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The following table (Table 4) shows the share of electricity components change from year to year. It can be seen that only the percentage of Wind and Solar had an upward trend (smaller or larger), while the share of Hydro, Solid biofuels, and All other renewables recorded decreases (in the case of Hydro, seven times during the period under examination in the year: 2006, 2008, 2012, 2014, 2016, 2017 and 2020, for Solid biofuels once: in 2013 and once for All other renewables: in 2018).

Table 4.

Percentage change in the share of electrical components from year to year over the years 2004-2020

Year	Hydro	Wind	Solar	Solid biofuels	All other renewables
2004	-	-	-	-	-
2005	0,35%	19,86%	111,12%	11,95%	16,86%
2006	-0,44%	18,31%	70,67%	11,28%	17,05%
2007	0,27%	20,60%	51,62%	5,54%	20,17%
2008	-0,19%	16,96%	97,05%	11,56%	11,02%
2009	0,36%	14,74%	89,63%	7,84%	11,63%
2010	1,09%	13,33%	64,66%	13,31%	14,83%
2011	0,01%	12,27%	103,62%	3,31%	10,63%

Cont. table 4.

2012	-0,42%	11,49%	48,40%	7,36%	14,92%
2013	0,03%	10,96%	19,85%	-2,18%	11,79%
2014	-0,18%	9,92%	11,97%	0,30%	7,25%
2015	0,68%	12,95%	7,10%	1,88%	5,16%
2016	-0,23%	8,99%	0,17%	0,46%	1,79%
2017	-0,45%	9,95%	6,83%	2,60%	0,91%
2018	0,33%	7,06%	4,72%	2,68%	-0,15%
2019	-0,17%	8,83%	9,52%	5,65%	0,18%
2020	0,57%	8,05%	16,43%	2,97%	0,70%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

3. Renewable electricity in Transport

The following table (Table 5) presents the use of renewable electricity in transport, such as: renewable electricity in road transport, renewable electricity in rail transport, renewable electricity in all other transport modes, Compliant biofuels Non-compliant biofuels, Other renewable energies. The change in the level of individual components in 2020 from 2004 was as follows:

- Renewable electricity in road transport - change from 6,72 to 112,83 (increase by 1517,11%) with the total volume of renewable electricity in road transport 421,83.
- Renewable electricity in rail transport - change from 835,81 to 1392,51 (increase by 66,61%) with the total amount of renewable electricity in rail transport 18821,68.
- Renewable electricity in all other transport modes: change from 191,96 to 282,13 (46,97% increase) with a total Renewable electricity in all other transport modes of 3990,51.
- Compliant biofuels - change from 1506,58 to 16251,87 (increase by 978,73%) with the total amount of Compliant biofuels at 171980,47.
- Non-compliant biofuels - change from 0 to 71,09 with the total amount of Non-compliant biofuels 12354,15.
- Other renewable energies – a change from 0,1 to 0,04 (decrease by 61,9%) with the total value of Other renewable energies at 4,15.

Table 5.

Amount of use of renewable electricity in Transport

Year	Renewable electricity in road transport	Renewable electricity in rail transport	Renewable electricity in all other transport modes	Compliant biofuels	Non-compliant biofuels	Other renewable energies
2004	6,72	835,81	191,96	1506,58	0,00	0,10
2005	6,65	818,51	199,06	2573,17	0,00	0,68
2006	6,76	794,45	198,61	4503,33	0,00	0,60

Cont. table 5.

2007	6,54	825,22	183,81	5796,73	0,00	1,39
2008	6,48	832,76	187,96	8951,36	0,00	0,15
2009	7,09	865,37	183,98	10466,68	0,00	0,08
2010	8,22	924,81	178,59	11924,29	0,00	0,01
2011	10,76	1033,27	218,70	7496,91	5189,53	0,03
2012	10,99	1045,59	214,33	10594,47	2903,42	0,03
2013	14,55	1138,43	227,12	10711,19	1324,68	0,32
2014	17,56	1191,41	242,18	11727,95	1282,24	0,32
2015	23,47	1280,07	278,69	11882,59	1131,81	0,05
2016	27,28	1396,97	291,80	12558,29	183,79	0,15
2017	34,48	1459,46	299,67	13806,96	112,24	0,13
2018	44,97	1492,11	302,78	15292,93	82,27	0,04
2019	76,50	1494,93	309,15	15935,19	73,08	0,03
2020	112,83	1392,51	282,13	16251,87	71,09	0,04
Suma	421,83	18821,68	3990,51	171980,48	12354,15	4,15

Source: <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The table below (Table 6) presents the results of the TOTAL RES-T numerator with multipliers, TOTAL RES-T denominator with multipliers and the percentage share of RES-T [%] in subsequent years: this value changed from 1,432% in 2004 to 10,218 % in 2020, i.e. increased by 613,56%. Based on the presented results, an increase in RES-T [%] can be stated except for 2011.

Table 6.

TOTAL RES-T numerator with multipliers, TOTAL RES-T denominator with multipliers, and percentage share of RES-T [%] in 2004-2020

Year	Total (RES-T numerator with multipliers)	Total (RES-T denominator with multipliers)	RES-T [%]
2004	3821,75	266879,51	1,432%
2005	4852,42	266782,61	1,819%
2006	6722,46	271917,20	2,472%
2007	7950,29	275407,27	2,887%
2008	11280,43	272964,79	4,133%
2009	13015,23	266121,12	4,891%
2010	14612,91	265712,72	5,500%
2011	10879,10	264345,61	4,115%
2012	14737,95	255574,21	5,767%
2013	15301,77	252070,20	6,070%
2014	16732,50	255377,27	6,552%
2015	17555,02	259945,33	6,753%
2016	19022,67	265487,03	7,165%
2017	20244,38	270958,85	7,471%
2018	22470,30	271882,92	8,265%
2019	24110,22	274111,41	8,796%
2020	24757,52	242287,93	10,218%

Source: <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The chart below presents the shares of the renewable electricity components in Transport in the years 2004-2020 in Total RES-T.

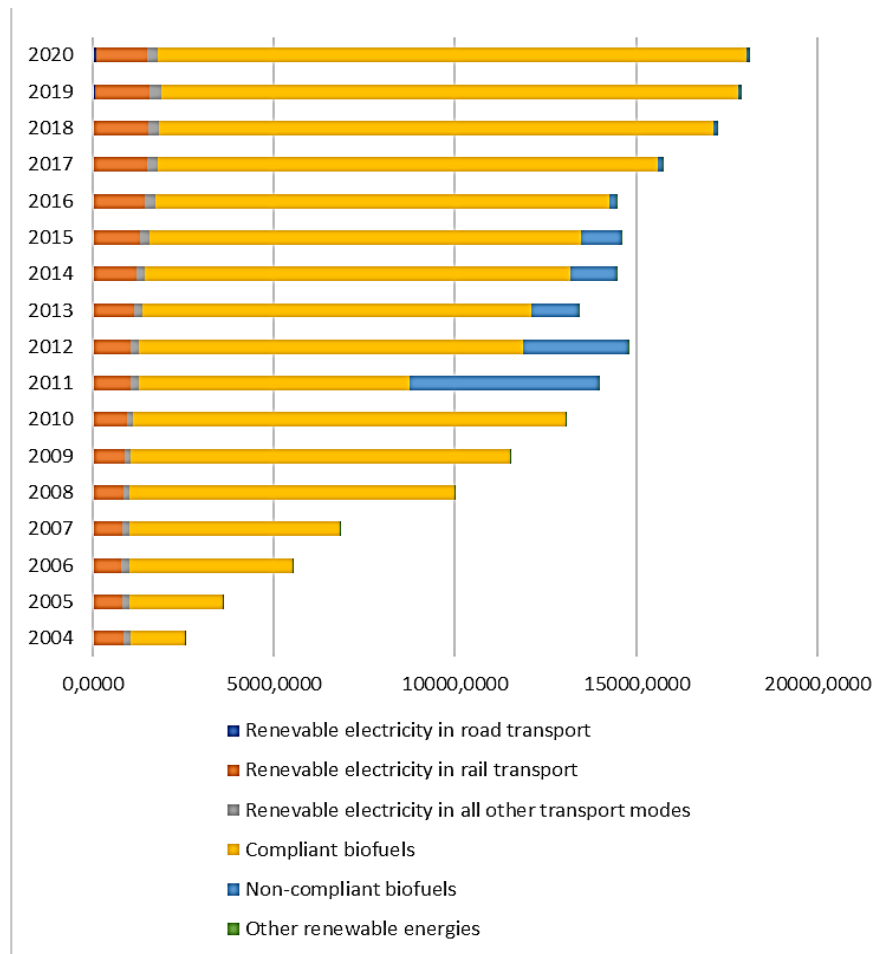


Figure 3. Share of renewable electricity in Transport.

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The presented chart shows a stable increase in Renewable electricity in road transport - an increase of 1579,11%, and Renewable electricity in rail transport - a rise of 66,61%. Increases were also recorded in the case of Renewable electricity in all other transport modes, although there were decreases here, for example, in 2006, 2009, 2010, 2012, and 2020. Energy obtained from Compliant biofuels generated the highest values throughout 2004-2020 from this source - the exception is 2009, where a significant decrease from 11924,29 to 7496,91 was recorded. The chart presents the appearance of non-compliant biofuels in the shares in 2011, which was not recorded in previous years.

For a more precise depiction of the share of individual components of renewable electricity in Transport, a table of percentage shares of the mentioned energy sources in the Total RES-T numerator with multipliers is presented below.

Table 7.

Percentage share of individual components renewable electricity in Transport in Total RES-T numerator with multipliers

Year	Renewable electricity in road transport	Renewable electricity in rail transport	Renewable electricity in all other transport modes	Compliant biofuels	Non-compliant biofuels	Other renewable energies
2004	0,18%	21,87%	5,02%	39,42%	0,00%	0,00250%
2005	0,14%	16,87%	4,10%	53,03%	0,00%	0,01394%
2006	0,10%	11,82%	2,95%	66,99%	0,00%	0,00899%
2007	0,08%	10,38%	2,31%	72,91%	0,00%	0,01752%
2008	0,06%	7,38%	1,67%	79,35%	0,00%	0,00134%
2009	0,05%	6,65%	1,41%	80,42%	0,00%	0,00061%
2010	0,06%	6,33%	1,22%	81,60%	0,00%	0,00005%
2011	0,10%	9,50%	2,01%	68,91%	47,70%	0,00029%
2012	0,07%	7,09%	1,45%	71,89%	19,70%	0,00021%
2013	0,10%	7,44%	1,48%	70,00%	8,66%	0,00207%
2014	0,10%	7,12%	1,45%	70,09%	7,66%	0,00190%
2015	0,13%	7,29%	1,59%	67,69%	6,45%	0,00031%
2016	0,14%	7,34%	1,53%	66,02%	0,97%	0,00079%
2017	0,17%	7,21%	1,48%	68,20%	0,55%	0,00063%
2018	0,20%	6,64%	1,35%	68,06%	0,37%	0,00019%
2019	0,32%	6,20%	1,28%	66,09%	0,30%	0,00015%
2020	0,46%	5,62%	1,14%	65,64%	0,29%	0,00015%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

Based on the presented table, it can be concluded that the percentage share of Renewable electricity in road transport has increased since 2004 from 0,18% to 0,46% (an increase of 159,2% compared to 2004). A significant decrease in the share was recorded in the case of Renewable electricity in rail transport: a change from 21,87% in 2004 to 5,62% - a decrease of 74,28%. A decrease can also be observed for Renewable electricity in all other transport models: a share of 5,02% in 2004, share of 1,14% in 2020. – this is a decrease in the share of 77,31%. The largest share can be observed in the case of Compliant biofuels - the change from 39,42% to 65,64% is an increase of 65,52%. Obtaining energy from a Non-compliant biofuel source was not recorded until 2010, but in 2011 the share of this source reached the level of 47,7%, followed by a decrease in subsequent years until 2020, reaching the level of 0,29%. The share in the Total RES-T numerator with multipliers was very low for other renewables energies, whose rank in 2004, 0,0025%, decreased to 0,00015% by 2020 (a decrease of 94,12%). The presented analysis is presented in the chart below (Figure 4).

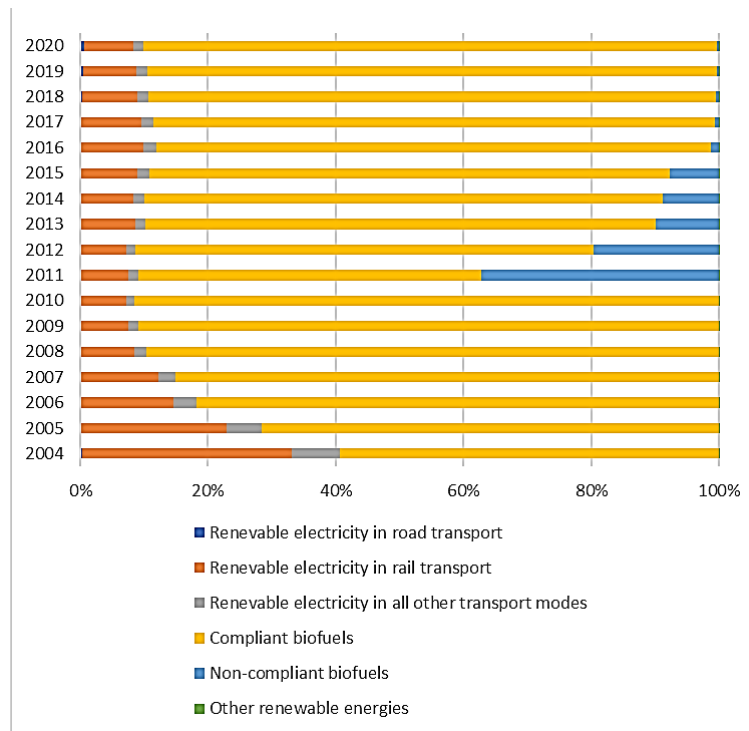


Figure 4. Percentage share of renewable electricity components in Transport.

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

For an in-depth analysis of changes in the acquisition of renewable energy sources in Transport, a table of changes in the amount of energy obtained in subsequent years was presented. The results are shown in the table (Table 8).

Table 8.

Percentage change in the share of renewable electricity components in Transport from year to year

Year	Renewable electricity in road transport	Renewable electricity in rail transport	Renewable electricity in all other transport modes	Compliant biofuels	Non-compliant biofuels	Other renewable energies
2004	-	-	-	-	-	-
2005	-1,09%	-2,07%	3,70%	70,80%	-	607,78%
2006	1,64%	-2,94%	-0,22%	75,01%	-	-10,60%
2007	-3,18%	3,87%	-7,45%	28,72%	-	130,38%
2008	-0,95%	0,91%	2,26%	54,42%	-	-89,18%
2009	9,38%	3,92%	-2,11%	16,93%	-	-47,54%
2010	16,02%	6,87%	-2,93%	13,93%	-	-90,61%
2011	30,85%	11,73%	22,46%	-37,13%	-	321,54%
2012	2,12%	1,19%	-2,00%	41,32%	-44,05%	0,08%
2013	32,41%	8,88%	5,97%	1,10%	-54,38%	913,19%
2014	20,71%	4,65%	6,63%	9,49%	-3,20%	0,00%
2015	33,68%	7,44%	15,08%	1,32%	-11,73%	-82,75%
2016	16,22%	9,13%	4,71%	5,69%	-83,76%	174,44%
2017	26,37%	4,47%	2,69%	9,94%	-38,93%	-14,79%
2018	30,44%	2,24%	1,04%	10,76%	-26,70%	-67,21%
2019	70,12%	0,19%	2,11%	4,20%	-11,18%	-16,67%
2020	47,48%	-6,85%	-8,74%	1,99%	-2,72%	4,03%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

4. Renewable electricity in heating and cooling

The table below (Table 9) presents the consumption of electricity obtained from renewable sources Heating and Cooling: Final energy consumption, Derived heat and Heat pumps and their total volume in the years 2004-2020.

Table 9.

Quantity Final energy consumption, Derived heat, and Heat pumps

Year	Final energy consumption	Derived heat	Heat pumps	Total (RES-H&C numerator)	Total (RES-H&C denominator)	RES-H&C [%]
2004	54125,42	6152,36	1752,46	62030,23	528607,85	11,73%
2005	56906,38	6704,30	2290,91	65901,59	529897,38	12,44%
2006	59208,97	7054,18	2854,21	69117,35	523214,31	13,21%
2007	63115,06	7324,87	3520,16	73960,09	499079,95	14,82%
2008	65929,34	8012,72	4221,51	78163,57	510041,19	15,32%
2009	66544,48	8474,48	4970,74	79989,71	476528,63	16,79%
2010	71366,87	10099,70	5507,69	86974,27	511776,45	16,99%
2011	66457,09	9966,71	6270,23	82694,03	474833,78	17,42%
2012	71560,23	11377,64	6844,54	89782,41	483181,30	18,58%
2013	73132,01	12198,46	7370,67	92701,14	486727,41	19,05%
2014	67886,79	12509,96	8737,36	89134,11	447206,89	19,93%
2015	70667,56	13175,58	9286,16	93129,30	458532,26	20,31%
2016	71361,27	14139,04	10034,44	95534,75	468241,11	20,40%
2017	72496,01	14773,00	10672,42	97941,43	470384,35	20,82%
2018	75303,58	14940,62	11467,23	101711,42	470797,88	21,60%
2019	76045,88	15704,10	12393,14	104143,11	464251,40	22,43%
2020	75520,82	15752,88	13316,03	104589,73	452972,90	23,09%
Suma	1157627,77	188360,61	121509,86	1467498,24		

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The values in the table above show how the quantities of Final energy consumption, Derived heat, and heat pumps changed over 2004-2020. In the case of Final Energy consumption, the values finally increased from 54125,42 to 75520,82 (an increase of 39,53%), although in 2011, 2014, and 2020, a minor increase was recorded compared to the previous year. The value of Derived heat increased from 6152,36 to 15752,88 (an increase of 156,05%), with a decrease in increases in 2011. Only the number of Heat pumps recorded only increases compared to previous years: change in value from 1752,46 to 13316,03 (an increase of 659,85%). The share of individual factors is presented in the chart below.

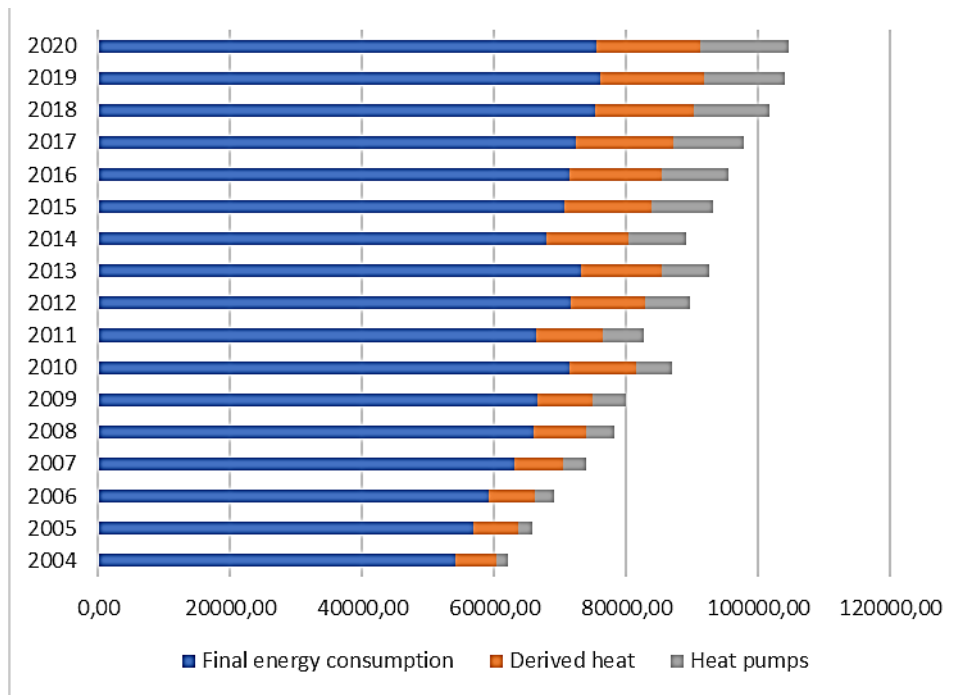


Figure 5. Heating and cooling component share.

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

This chart clearly shows Final Energy consumption as the factor with the largest share compared to the other two elements. As the analysis in the table below shows, the percentage of Final Energy consumption decreased from 87,26% in 2004 to 72,21% in 2020, still being the factor with the largest share (a decrease of 17,25%). The percentage share of Derived heat from 9,92% in 2004 increased to 15,06% in 2020 (an increase of 51,86%), remaining in second place in terms of share in Heat&Cool. The third factor - Heat pumps, increased its stake in the following years, from 2,83% to 12,73% (an increase of 350,65%).

Table 10.

Percentage of Final energy consumption, Derived heat, and Heat pumps

Year	Final energy consumption	Derived heat	Heat pumps
2004	87,26%	9,92%	2,83%
2005	86,35%	10,17%	3,48%
2006	85,66%	10,21%	4,13%
2007	85,34%	9,90%	4,76%
2008	84,35%	10,25%	5,40%
2009	83,19%	10,59%	6,21%
2010	82,06%	11,61%	6,33%
2011	80,37%	12,05%	7,58%
2012	79,70%	12,67%	7,62%
2013	78,89%	13,16%	7,95%
2014	76,16%	14,03%	9,80%
2015	75,88%	14,15%	9,97%
2016	74,70%	14,80%	10,50%
2017	74,02%	15,08%	10,90%
2018	74,04%	14,69%	11,27%
2019	73,02%	15,08%	11,90%
2020	72,21%	15,06%	12,73%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The presented analysis is confirmed by the chart below (Figure 6), emphasizing the vast share of Final energy consumption in Heat&Cool with the observed decrease in its percentage share in favor of Derived heat and Heat pumps in subsequent years.

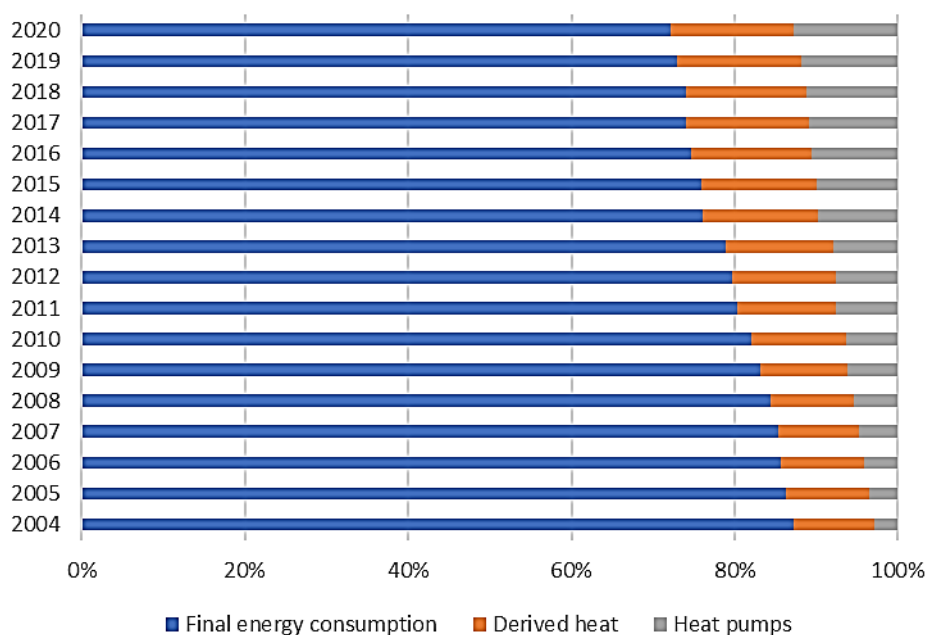


Figure 6. Percentage of components Heating and cooling.

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

In order to conduct a deeper analysis of changes in Final energy consumption, Derived heat and Heat pumps, percentage changes from year to year were determined for the analyzed period 2004-2020. The results are presented in the table below (Table 10).

Table 10.

Change in Final energy consumption, Derived heat and Heat pumps from year to year

Year	Final energy consumption	Derived heat	Heat pumps
2004			
2005	5,14%	8,97%	30,73%
2006	4,05%	5,22%	24,59%
2007	6,60%	3,84%	23,33%
2008	4,46%	9,39%	19,92%
2009	0,93%	5,76%	17,75%
2010	7,25%	19,18%	10,80%
2011	-6,88%	-1,32%	13,85%
2012	7,68%	14,16%	9,16%
2013	2,20%	7,21%	7,69%
2014	-7,17%	2,55%	18,54%
2015	4,10%	5,32%	6,28%
2016	0,98%	7,31%	8,06%
2017	1,59%	4,48%	6,36%
2018	3,87%	1,13%	7,45%
2019	0,99%	5,11%	8,07%
2020	-0,69%	0,31%	7,45%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

Based on the results presented in the table (Table 10), three decreases in Final energy consumption can be observed in 2011, 2014, and 2020, by 6,88%, 7,17%, and 0,69%, respectively. The most significant increase was followed in 2012: 7,68%. Derived heat values recorded mainly increases, with the largest in 2010 at 19,18% and one decrease in 2011 at 1,32%. The Heat pump factor recorded only increases, with the largest in 2005 at 30,73%.

5. Gross final consumption of energy from renewable sources

The table presented below (Table 11) shows the Gross final consumption of energy from renewable sources, separating: electricity, heating and cooling, and Transport over the years 2004-2020.

Table 11.
Gross final consumption of energy from renewable sources

Year	Electricity	Heating and cooling	Transport	Sum
2004	38071,05	62030,23	2541,16	102642,44
2005	39897,52	65901,59	3598,07	109397,17
2006	41710,75	69117,35	5503,76	116331,86
2007	44032,15	73960,09	6813,69	124805,93
2008	46490,77	78163,57	9978,70	134633,04
2009	49319,24	79989,71	11523,20	140832,14
2010	53074,21	86974,27	13035,92	153084,39
2011	57189,32	82694,03	8759,63	148642,98
2012	61802,10	89782,41	11865,37	163449,89
2013	65150,88	92701,14	12091,29	169943,32
2014	68091,04	89134,11	13179,10	170404,24
2015	71666,11	93129,30	13464,81	178260,22
2016	73568,20	95534,75	14274,34	183377,29
2017	76504,29	97941,43	15600,56	190046,29
2018	78967,18	101711,42	17132,79	197811,39
2019	82614,94	104143,11	17815,78	204573,84
2020	87294,49	104589,73	18039,33	209923,55
Suma	1035444,23	1467498,24	195217,50	

Source: <https://ec.europa.eu/eurostat/web/energy/data/shares>.

Over 2004-2020, the total amount of Electricity in Gross final consumption is 1035444.23, heating and cooling – 1467498.24, and Transport – 195217.50 (electricity used in vehicles is included in Transport and thus not included in electricity). The share of individual factors making up Gross final consumption is presented in the chart below.

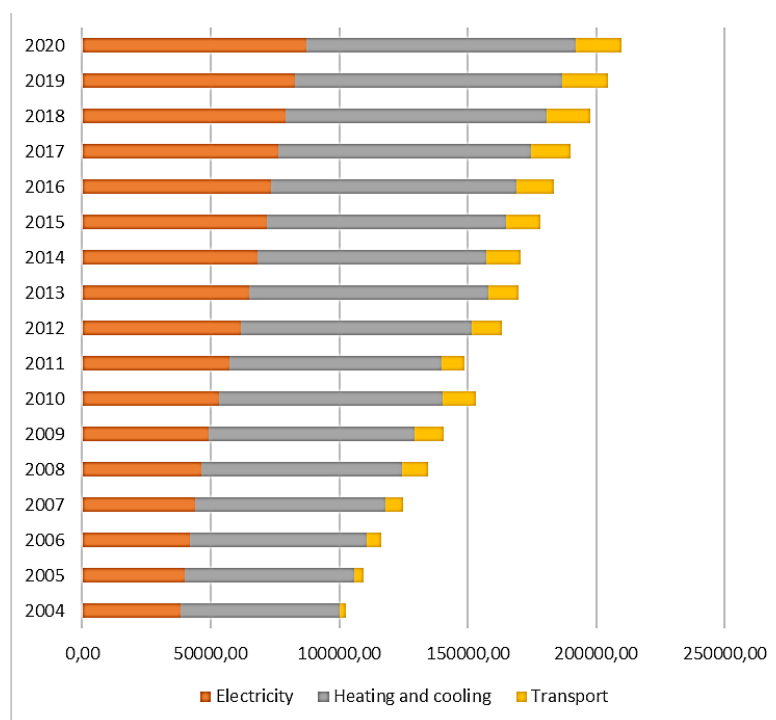


Figure 7. Share of components Gross final consumption of energy from renewable sources.

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The share of electricity increased from 38071,05 in 2004 to 87294,49 in 2020. It's the second-largest Gross final consumption factor. The largest share was recorded by heating and cooling, which reached the value of 62030,23 in 2004 and increased to 104589,73 in 2020. The smallest share is represented by Transport, whose claim changed from 2541,16 in 2004 to 18039,33 in 2020. For a deeper analysis of the allocation of individual factors, their percentage share was determined - the results are presented in the table below (Table 12).

Table 12.

Percentage share of Electricity, Heating, Cooling, and Transport

Year	Electricity	Heating and cooling	Transport
2004	37,09%	60,43%	2,48%
2005	36,47%	60,24%	3,29%
2006	35,85%	59,41%	4,73%
2007	35,28%	59,26%	5,46%
2008	34,53%	58,06%	7,41%
2009	35,02%	56,80%	8,18%
2010	34,67%	56,81%	8,52%
2011	38,47%	55,63%	5,89%
2012	37,81%	54,93%	7,26%
2013	38,34%	54,55%	7,11%
2014	39,96%	52,31%	7,73%
2015	40,20%	52,24%	7,55%
2016	40,12%	52,10%	7,78%
2017	40,26%	51,54%	8,21%
2018	39,92%	51,42%	8,66%
2019	40,38%	50,91%	8,71%
2020	41,58%	49,82%	8,59%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

The results of the table (Table 12) show that over the years 2004-2020, the share of:

- Electricity changed from 37,09% to 41,58% (an increase of 12,11%),
- Heating and cooling changed from 60,43% to 49,82% (decrease of share by 17,56%)
- Transport - changed from 2,48% to 8,59% (an increase of 247,1%)

The change in the size of Electricity, Heating, and cooling and Transport from year to year (Table 13) shows that in the case of electricity, only increases of different values were recorded - the most significant increase was in 2012: 8,07% and the smallest in 2016: 2,65%. In the case of heating and cooling, increases can usually be observed - the most significant growth in 2010 at the level of 8,73%. In the following year, one decrease was recorded - 4,92%. Concerning Transport, increases are mostly observed – the largest was in 2006 at 52,96% and one decrease in 2011 at 32,8%. The results of the analysis are presented in the table below.

Table 13.

Volume change: Electricity, Heating and cooling and Transport from year to year

Year	Electricity	Heating and cooling	Transport
2004	-	-	-
2005	4,80%	6,24%	41,59%
2006	4,54%	4,88%	52,96%
2007	5,57%	7,01%	23,80%
2008	5,58%	5,68%	46,45%
2009	6,08%	2,34%	15,48%
2010	7,61%	8,73%	13,13%
2011	7,75%	-4,92%	-32,80%
2012	8,07%	8,57%	35,46%
2013	5,42%	3,25%	1,90%
2014	4,51%	-3,85%	9,00%
2015	5,25%	4,48%	2,17%
2016	2,65%	2,58%	6,01%
2017	3,99%	2,52%	9,29%
2018	3,22%	3,85%	9,82%
2019	4,62%	2,39%	3,99%
2020	5,66%	0,43%	1,25%

Source: own study based on <https://ec.europa.eu/eurostat/web/energy/data/shares>.

6. Summary

Based on the presented data, the countries of the European Union are increasingly using renewable sources from year to year. A constant level of obtained energy is in the case of hydropower. Its share is significantly increased by getting energy from wind power, which reduces the percentage share of hydropower. Other sources (solid biofuels, solar, and all other renewables) also record an increase in their claim, but it is not as significant as wind and water power. In terms of the use of electricity obtained from renewable sources in the case of Transport, compliant biofuels have the largest share, which dominates other sources. Another,

but with a much smaller percentage, is renewable electricity in rail transport. Other factors do not have a significant share in Transport. In the case of heating and cooling, final Energy consumption has the largest share, which recorded a slight increase in subsequent years. Derived heat and heat pumps have a much smaller percentage. Summing up the presented analyses, it can be assumed that individual EU Member States with more minor or significant problems have a chance to achieve the supposed goals regarding acquiring and using electricity from renewable sources. Indeed, this process will be supported by various initiatives and directives, which are developed in case of problems with implementing the plans.

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