GLOBAL BIOENERGY STATISTICS 2022

World Bioenergy Association

DISCLAIMER

WBA publishes the Global Bioenergy Statistics reports annually to increase awareness of the role of bioenergy in the global energy mix. The reports are prepared with the extreme care and due diligence. Even though every effort is made to ensure the highest quality in data presented in the report, WBA cannot be held liable for the accuracy of the information presented.

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SUMMARY

Fossil fuels dominate the global energy supply. 80% of the total primary energy supply was from coal, crude oil and natural gas. Renewable energy technologies of solar, wind, hydro, biomass, geothermal etc. had a share of 15% in the primary energy supply in 2020 – a 0.9% increase over the previous year.

Coal is a significant contributor to the global electricity mix. In 2020, 35% of electricity produced globally was from coal-based sources with a total production of 9 452 TWh. In 2020, 26 833 TWh of electricity was generated globally with renewables having a share of 29%, mainly driven by the increasing use of solar and wind as well as significant contribution from hydropower and biomass. In 2020, 7 669 TWh of renewable electricity was produced globally. Hydropower was the largest renewable electricity generating source with a share of 58% followed by wind at 21%. Bioenergy was the 4th largest renewable electricity generating source with 685 TWh of production.

In 2020, 15.7 EJ of heat was produced globally via heat only and combined heat and power plants. Coal and natural gas have a combined share of more than 85% in the global heat production. Renewable energy technologies including biomass, geothermal and solar thermal have doubled their share in the global heat production over the past 20 years. 96% of all renewable heat produced was from biomass with minor contribution from geothermal and solar thermal technologies.

In the transport sector, crude oil and oil products contribute 91% of the energy needs. Liquid biofuels and biogas are a sustainable option for the sector right now.

Gross final energy consumption includes the total final consumption of all energy sources including the electricity and heat consumption at all end use sectors. In 2019, gross final energy consumption of all energy sources was 379 EJ. The share of renewables has remained constant at 17%.

In 2020, domestic supply of biomass was 57,5 EJ globally. 86% of the domestic supply was from solid biomass sources including wood chips, wood pellets and traditional biomass sources. Liquid biofuels accounted for 7%, municipal and industrial waste sectors accounted for 6% followed by biogas at 2%.

In 2021, 1.9 billion m3 of wood fuel was produced globally. Africa and Asia had the highest share of wood fuel production with a contribution of 37% and 36% respectively. Wood pellets are one of the fastest growing bioenergy sectors worldwide. In 2021, 44,3 million tonnes of pellets were estimated to be produced globally. In 2021, 54 million tonnes of wood charcoal were produced globally with Africa accounting for 67% of the global production.

Agriculture is a key sector for increased potential for bioenergy utilization in the future. In terms of yields of major crops, there is significant potential to increase the yields in various regions to the global average. This will enable increased production of both food and fuel with the agriculture sector playing a key enabler for increased bioenergy use around the world. Energy generation from municipal and industrial waste represents the 3rd feedstock sector after forestry and agriculture. In 2020, domestic supply of energy from municipal and industrial waste was 2.65 EJ with 55% from municipal waste and remaining from industrial waste.

In 2020, 685 TWh of electricity was generated from biomass globally. 69% of all biopower generated was from solid biomass sources followed by 17% from municipal and industrial waste. Asia accounted for 39% of all biopower generated globally with 255 TWh of production in 2019 followed by Europe at 35%. Electricity only plants are designed to produce electricity only. In 2020, 5.3 EJ of biomass was used in electricity only plants for power generation.

CHP or Combined Heat and Power plants refer to those plants that are designed to produce both heat and electricity. In 2020, 3.4 EJ of biomass was used in CHP plants. Solid biofuels account for 66% of all biopower produced in CHP facilities followed by municipal waste at 17%. In 2020, 1.2 EJ of heat was produced from biomass-based sources – 52% from solid biomass sources and 25% from municipal solid waste. Europe is the world leader in producing heat from biomass in power plants with a share of 88% globally. In 2020, 0.57 EJ of bioheat was produced in heat only plants.

In 2020, 146 billion litres of biofuels were produced globally. This was the first time that the production of biofuels decreased year on year, mainly due to the COVID pandemic. North and South America together produce 70% of all biofuels globally with Europe having a share of 15%. In 2020, 38,1 billion m3 of biogas was produced globally with an equivalent energy content of 1.46 EJ.

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INTRODUCTION

The WBA Global Bioenergy Statistics report is the flagship publications of World Bioenergy Association.

First published in 2014, the annually published report is one of the only reports focussing solely on the developments in the bioenergy sector. The 2022 report is the 9th in the series.

Bioenergy is a versatile energy system. A multitude of feedstock, technology pathways and end products encompass the biomass to energy conversion. Currently, bioenergy is the largest renewable energy source globally. Considering the prominence of bioenergy in the overall energy mix, the sector has not received attention due to lack of awareness about the potential benefits of bioenergy. Secondly, it is important to note that there is a lack of reliable and updated data on bioenergy globally and locally. Due to the informal and local nature of most of the feedstock and technology used for bioenergy production, it is very challenging to gather, analyse and report accurate and updated information on bioenergy developments.

As readers go through the report, it is important to understand certain key terminologies and definitions used regularly in the report:

Total primary energy supply or TPES is a combination of: Indigenous production + Imports – Exports- International bunkers +/- Stock changes. The indigenous production of a particular fuel is the energy content of the fuel, for e.g. the lower heating value of charcoal. However, for fuels like solar and wind, the electricity generated is considered as TPES.

Gross final energy consumption or GFEC is a combination of: Total Final Consumption (TFC) – Non-energy use of fuels + Electricity consumption + Derived Heat consumption. TFC is the consumption of energy commodities in end use sectors, for e.g. residential, commercial, agriculture etc. and is calculated using the energy content of the fuel. The non-energy use of fossil fuels (e.g. in chemical industry) is eliminated. The electricity and heat consumption are derived from 'generation' data after eliminating their use within the industry and losses occurring during transmission and distribution.

Bioenergy refers to the use of biological commodity (or biomass) used specifically for energy purposes. The energy use implies the use of biomass for electricity and heat generation and the conversion of biomass to secondary products such as biofuels to be used in the transportation sector. For bioenergy, the energy content of the fuel is considered as primary energy.

Derived heat. If the heat is generated in power plants (combined heat and power and heat only plants), then the heat is termed as derived heat. This is then transported via district heating grids for consumption in end sectors.

Units: Throughout the report, an effort is made to ensure consistent units for reporting. For all energy related values, Exa Joule (10^18 Joule) is considered the standard unit. For electricity, TWh is used as reporting unit while for energy commodities, various units like million tonnes, million m3 and billion litres are used.

Geography: The data in the report is classified into a 2-tier system – global and continental. The continental classification is available in the Appendix. Data sources: Most of the data is obtained from the IEA Key World Energy Statistics and their online publication. Biomass supply data is obtained from FAOSTAT. Other data sources used in the report include publications from IRENA (e.g. Jobs) and WBA member network.

Base year: An attempt is made to obtain the most recent available data for each section. Most of the information available is from 2020 and some from the year 2021 as well.

For getting in touch with WBA, please send an email to info@worldbioenergy.org.

World Bioenergy Association

GLOBAL ENERGY SYSTEM

SUPPLY

Fossil fuels dominate the global energy supply. In 2020, Total Primary Energy Supply globally was 585 EJ – fossil fuels had a share of 80% (Coal 27%, Oil 29% and Gas 24%) TPES of nuclear power was 29,2 EJ, accounting for 5% of the overall energy mix

Renewable energy technologies of solar, wind, hydro, biomass, geothermal etc. had a share of 15% in the primary energy supply in 2020 which is an increase of 0.9% over the previous year.

Table 1 Total primary energy supply globally

	Total	Coal	Oil	Gas	Nuclear	Renewables	Renewables (%)
2000	420	96,9	154	86,5	28,3	53,7	13%
2005	481	125	168	98,6	30,2	58,3	12%
2010	537	153	173	114	30,1	66,3	12%
2015	569	161	182	122	28,1	75,1	13%
2020	585	157	172	138	29,2	88,0	15%

All values in EJ

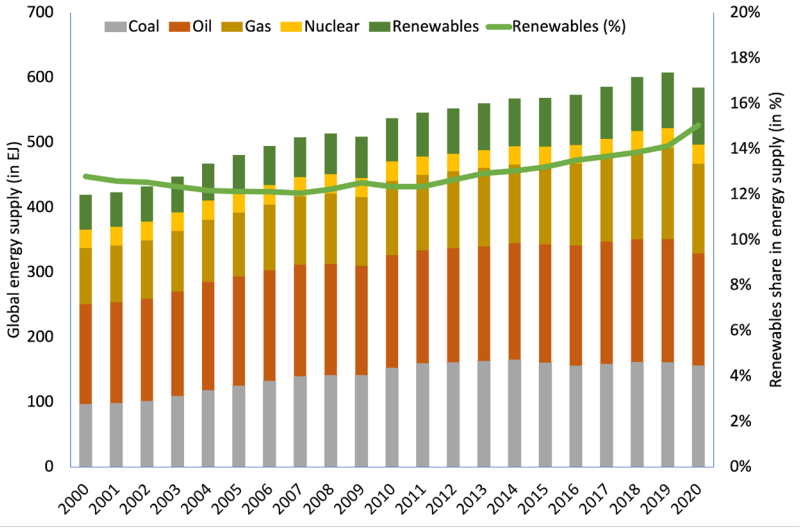

Figure 1 Total primary energy supply globally

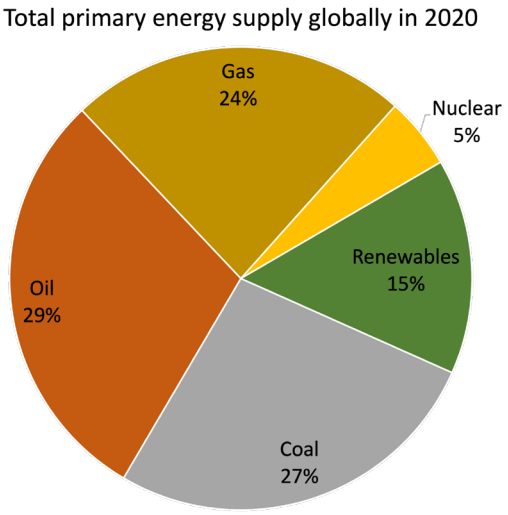

Figure 2 Total primary energy supply globally in 2020

In 2019, among continents, total primary energy supply of all energy sources is highest in Asia. The continent is heavily dependent on coal as a major energy source. Americas including North, Central and South America are more dependent on crude oil and oil products. Among renewable energy sources, African continent has the highest renewable energy share (47%) due to hydropower and traditional biomass use for heating and cooking.

Table 2 Total primary energy supply in continents in 2019

	Coal	Oil	Gas	Nuclear	Renewables	Total	Renewables (%)
Africa	4.97	8.28	5.66	0.14	16.8	35.9	47%
Americas	13.9	51.7	44.7	10.7	19.2	140	14%
Asia	125	63.7	29.9	7.06	34.9	261	13%
Europe	16.2	31.6	40.7	12.5	13.6	115	12%
Oceania	1.81	2.09	1.60	0.00	0.75	6.25	12%
EU - 28	7.56	21.7	16.8	8.97	10.6	65.9	16%

All values in EJ

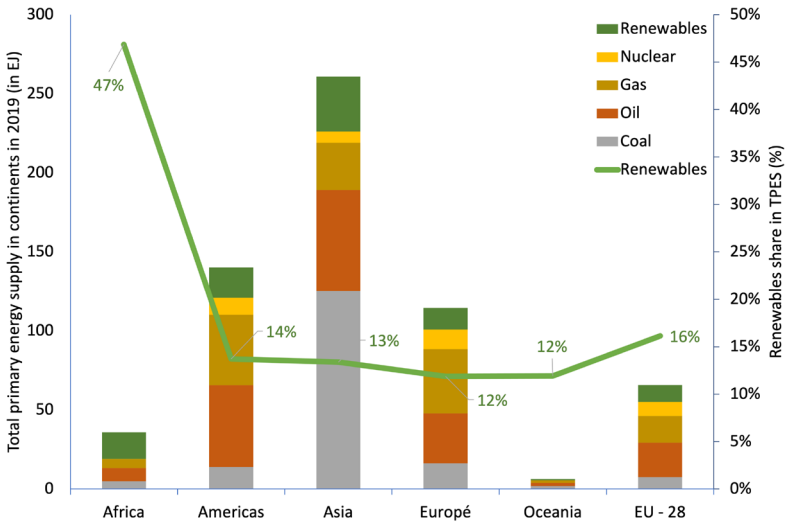

Figure 3 Total primary energy supply in continents in 2019

ELECTRICITY

Coal is a major energy source to the global electricity mix. In 2020, 35% of electricity produced globally was from coal-based sources. In recent years, natural gas is emerging as a major electricity producing energy source. During 2000 – 2020, the share of natural gas in electricity mix increased from 18% to 24%.

In 2020, 26 833 TWh of electricity was generated globally with renewables having a share of 29%, mainly driven by the increasing use of solar and wind as well as significant contribution from hydropower and biomass.

Table 3 Electricity generation globally

	Total	Coal	Oil	Gas	Nuclear	Renewables	Renewables (%)
2000	15 510	5 995	1 188	2 771	2 591	2 943	19%
2005	18 369	7 326	1 129	3 701	2 768	3 413	19%
2010	21 626	8 670	969	4 856	2 756	4 342	20%
2015	24 375	9 536	1 021	5 550	2 570	5 661	23%
2020	26 833	9 452	668	6 335	2 674	7 669	29%

All values in TWh

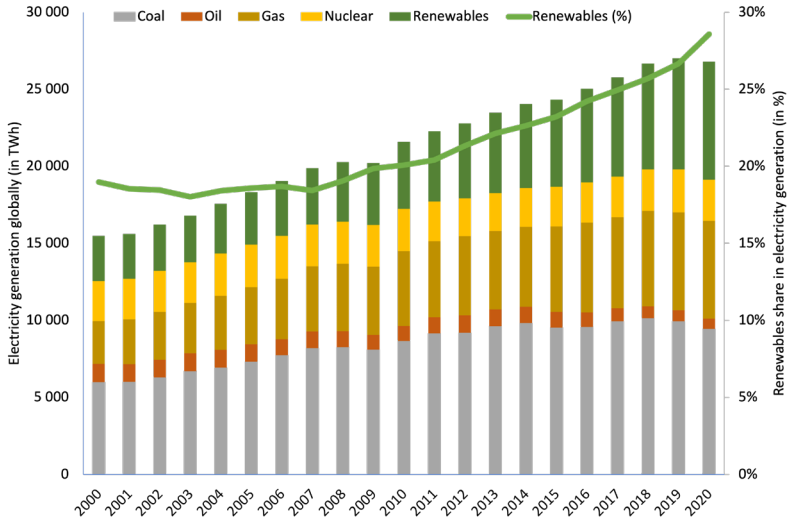

Figure 4 Electricity generation globally

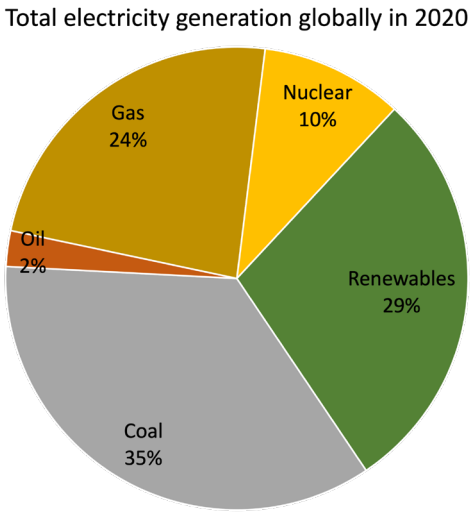

Figure 5 Electricity generation globally in 2020

Among continents, Asia is heavily dependent on electricity from coal. In 2019, 7 434 TWh of coal power was produced in Asia – accounting for 75% of all coal electricity generated globally. Among other continents, Americas and Europe have a major dependence on natural gas – accounting for 32% and 27% respectively.

Europe has a high share of renewables in the electricity mix at 33.7% while at the same time, Americas had a share of 32.5% in 2019. Overall, 7 311 TWh of renewable power was produced in 2019.

Table 4 Electricity generation in continents in 2019

	Coal	Oil	Gas	Nuclear	Renewables	Total	Renewables (%)
Africa	260	71.1	334	13.3	176	856	20.5%
Americas	1 205	181	2 153	980	2 175	6 690	32.5%
Asia	7 434	426	2 397	654	3 140	14 057	22.3%
Europe	859	64.2	1 403	1 142	1 732	5 132	33.7%
Oceania	157	4.93	58.7	0.00	88.6	309	28.7%
EU - 28	498	53.4	700	822	1 222	3 232	37.8%

All values in TWh

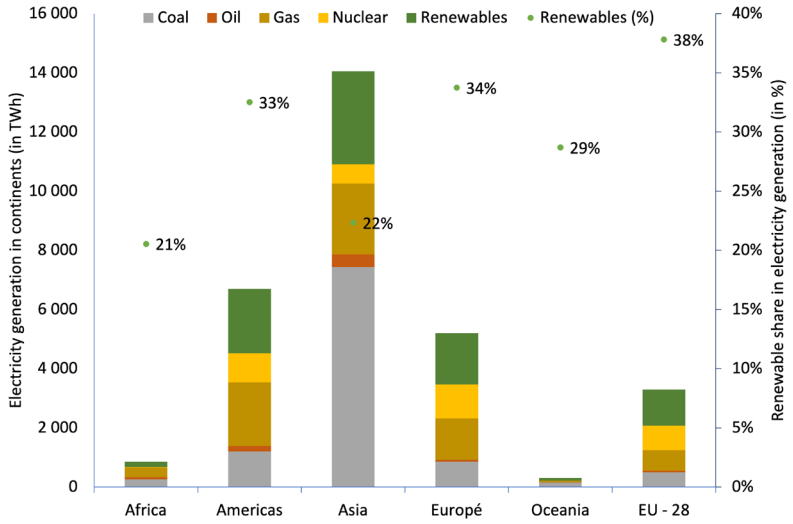

Figure 6 Electricity generation in continents in 2019

HEAT

In 2020, 15.7 EJ of heat was produced globally via heat only and combined heat and power plants. Coal and natural gas have a combined share of more than 85% in the global heat production which has remained the same since the start of the century.

Renewable energy technologies including biomass, geothermal and solar thermal have increased by 3 times in the global heat production over the past 20 years. However, share of renewables in heat production is currently at 8%. It is important to note that the heat production only includes the heat generated in power plants and supplied to customers via district heating networks.

Table 5 Heat production globally

	Total	Coal	Oil	Gas	Nuclear	Renewables	Renewables (%)
2000	12,3	4,33	1,16	6,24	0,02	0,43	3,5%
2005	13,4	4,79	0,97	6,62	0,02	0,55	4,1%
2010	14,3	5,37	0,85	6,78	0,03	0,81	5,7%
2015	13,8	5,77	0,59	5,90	0,03	0,99	7,2%
2020	15,7	7,04	0,54	6,24	0,03	1,26	8,0%

All values in EJ

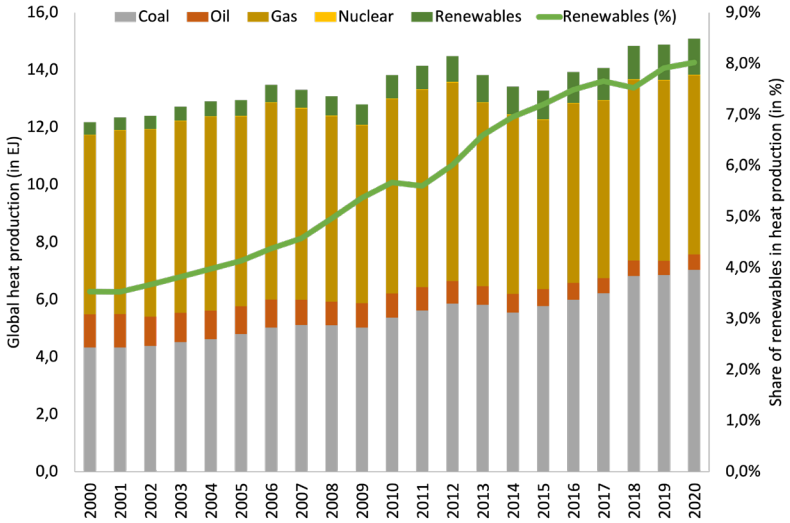

Figure 7 Heat production globally

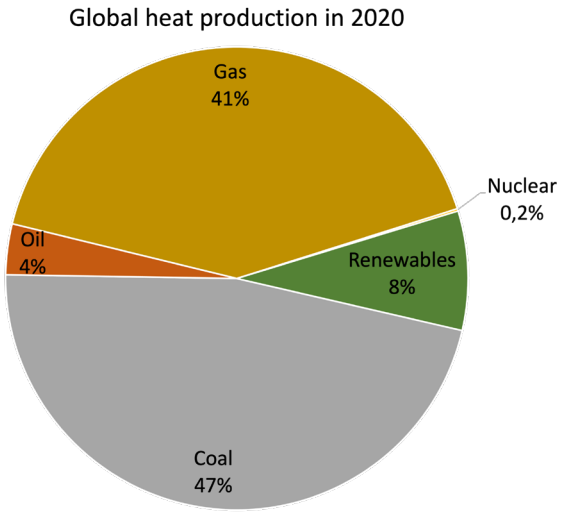

Figure 8 Heat production globally in 2020

In 2019, derived heat production globally was concentrated in Asia and Europe with both accounting for a share of 90% in the global heat production. Coal accounts for 82% of the heat production in Asia while natural gas accounts for 74% and 57% of the heat production in Americas and Europe respectively.

Europe is the leader in commercial production of renewable heat, mainly due to the increased use of biomass in power plants. In 2019, Europe accounted for 89% of all renewable heat produced with EU – 28 countries accounting for 69%.

Table 6 Heat production in continents in 2019

	Coal	Oil	Gas	Nuclear	Renewables	Total	Renewables (%)
Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00%
Americas	0.03	0.03	0.36	0.00	0.09	0.49	18.0%
Asia	4.88	0.21	0.77	0.00	0.10	5.97	1.64%
Europe	1.94	0.26	5.16	0.03	1.48	9.01	16.4%
Oceania	0.00	0.00	0.00	0.00	0.00	0.00	0.00%
EU - 28	0.56	0.07	0.87	0.00	1.15	2.40	48.0%

All values in EJ

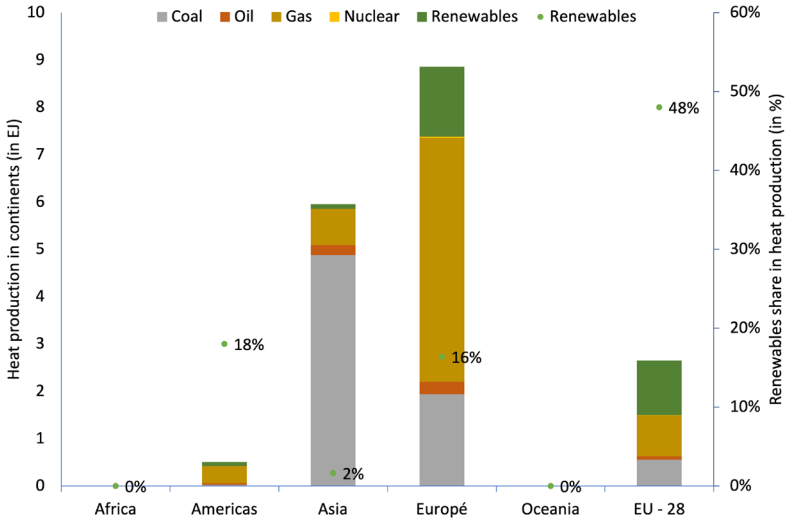

Figure 9 Heat production in continents in 2019

TRANSPORT

In 2020, 105 EJ of energy was consumed in the transport sector. Crude oil and oil products contribute 90% of the energy needs for the transport sector. The energy consumption in transport is more than the energy use for electricity globally.

Electrification is an important option for decarbonizing the transport sector, but the contribution to the overall share in transport is 1.4%. It is important to note that the share of renewables in the electricity is only about 30% and hence, the overall share of renewable electricity is much lower. At the same time, liquid biofuels and biogas currently offer commercial and renewable fuel for the sector right now. Biofuels have a share of 3.6% in the overall energy use in the transport sector.

Table 7 Energy use in transport

	Total	Coal	Oil	Gas	Nuclear	Renewables	Renewables (%)
2000	82,2	0,03	78,6	2,42	0,42	0,79	0,7%
2005	92,9	0,01	88,1	3,10	0,81	0,93	1,1%
2010	102	0,01	94,5	3,74	2,37	1,06	2,5%
2015	113	0,00	104	4,12	3,29	1,21	3,2%
2020	105	0,04	95,0	4,67	3,81	1,47	4,0%

All values in EJ

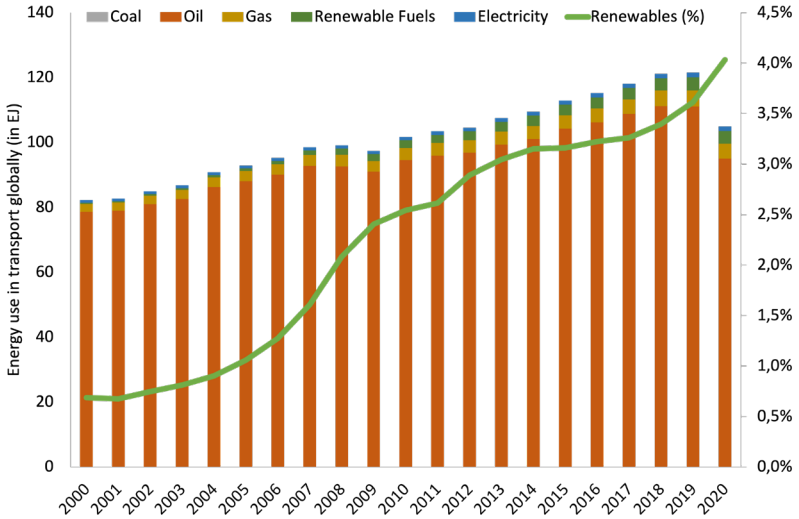

Figure 10 Energy use in transport globally

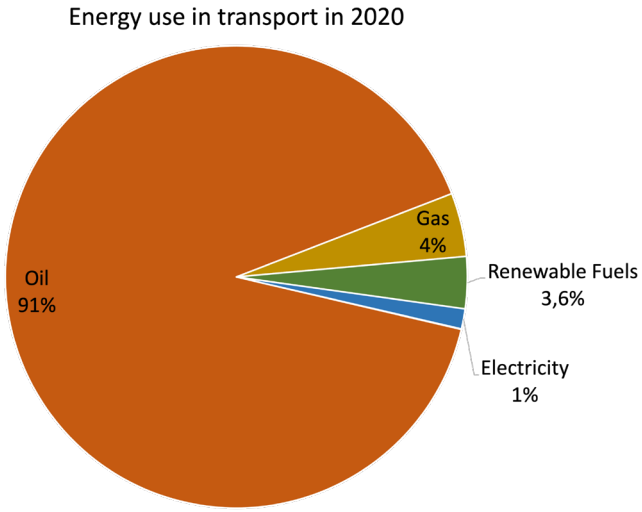

Figure 11 Energy use in transport in 2019

Crude oil and oil products are the dominant source of energy for the transport sector across all continents with its contribution ranging from 85% in Europe to 99% in Africa. The contribution of natural gas varies from 1% to 8%. In 2019, biofuels share in Americas was 7%. The dominance of Americas (USA and Brazil) in the renewable fuels sector is quite evident as more than 67% of all biofuels consumed in transport sector occurs in that region.

Table 6 Heat production in continents in 2019

	Coal	Oil	Gas	Biofuels	Electricity	Total	Biofuels (%)
Africa	0.00	5.00	0.04	0.00	0.02	5.07	0.0%
Americas	0.00	34.8	1.48	2.68	0.10	39.0	6.9%
Asia	0.04	34.3	1.74	0.52	0.77	37.4	1.4%
Europe	0.00	17.2	1.67	0.77	0.60	20.2	3.8%
Oceania	0.00	1.60	0.02	0.01	0.02	1.64	0.3%
EU - 28	0.00	12.7	0.16	0.73	0.23	13.8	5.3%

All values in EJ

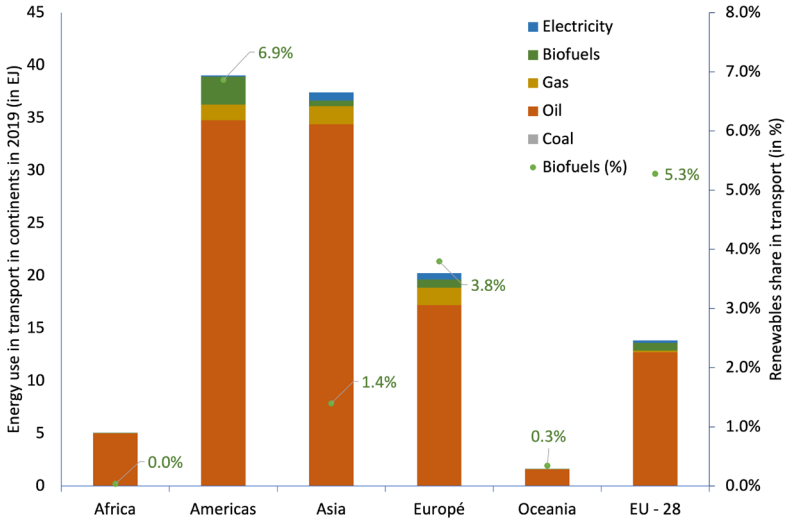

Figure 12 Energy use in transport in continents in 2019

GROSS FINAL ENERGY CONSUMPTION

Gross final energy consumption includes the total final consumption of all energy sources including the electricity and heat consumption at all end use sectors. In 2019, gross final energy consumption of all energy sources was 379 EJ.

Fossil fuels account for more than 79% of the total energy consumption while the share of renewables has remained constant at 17% since the start of the century.

Table 9 Gross final energy consumption

	Coal	Oil	Gas	Nuclear	Renewables	Total	Renewables (%)
2000	42.1	115	55.4	7.27	45.3	268	16.9%
2005	57.7	125	60.6	7.84	48.4	304	16.0%
2010	71.7	129	69.5	7.90	53.6	336	15.9%
2015	75.8	138	73.4	7.41	59.0	359	16.4%
2016	73.7	140	75.7	7.53	60.1	362	16.6%
2017	73.8	142	77.6	7.63	61.9	369	16.8%
2018	73.2	143	81.9	7.86	63.6	377	16.9%
2019	71.9	143	83.6	8.11	65.3	379	17.2%

All values in EJ

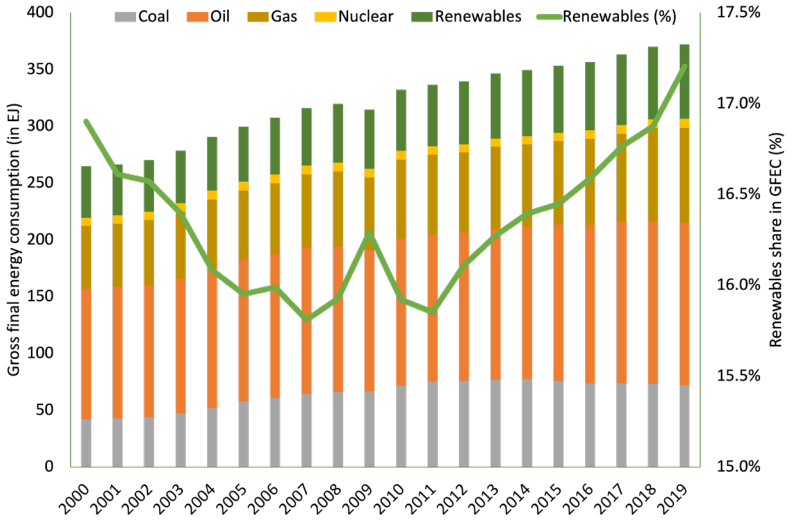

Figure 13 Gross final energy consumption

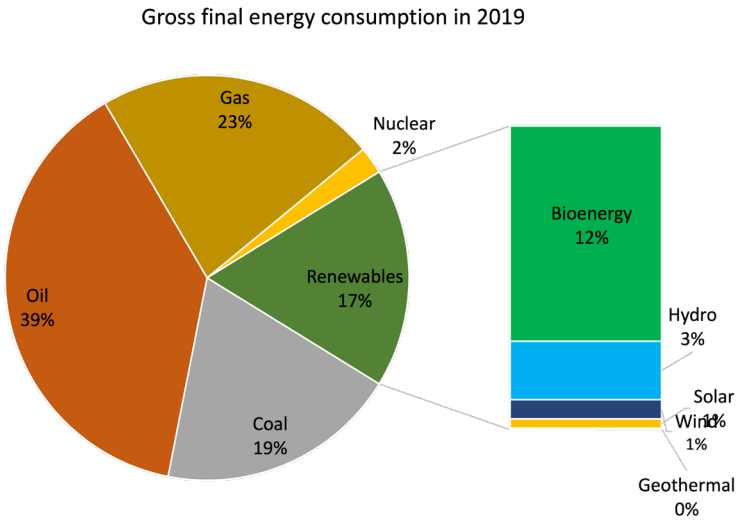

Figure 14 Gross final energy consumption in continents in 2019

RENEWABLE ENERGY

RENEWABLE ELECTRICITY

In 2020, 7 669 TWh of renewable electricity was produced globally. Hydropower was the largest renewable electricity generating source with a share of 58% followed by wind at 21%. Bioenergy was the 4th largest renewable electricity generating source with production of 685 TWh in 2020.

Table 10 Renewable electricity generation globally

	Total	Bioen-ergy	Hydro	Solar	Wind	Geo-thermal	Tide	Biopower (%)
2000	2 943	162	2 696	1,30	31,4	52,2	0,55	6%
2005	3 413	228	3 018	4,29	104	58,3	0,52	7%
2010	4 342	362	3 536	33,7	342	67,7	0,51	8%
2015	5 661	509	3 981	254	834	81,0	1,01	9%
2020	7 669	685	4 453	837	1 598	94,9	0,99	9%

All values in TWh

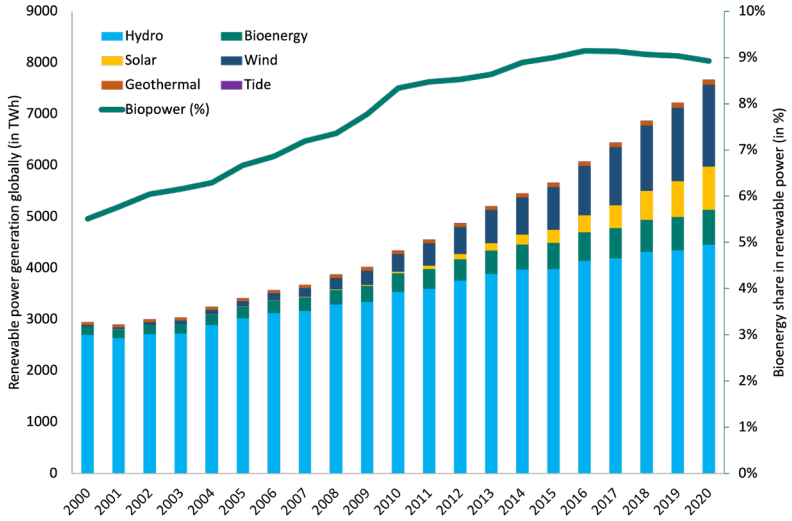

Figure 15 Renewable electricity generation

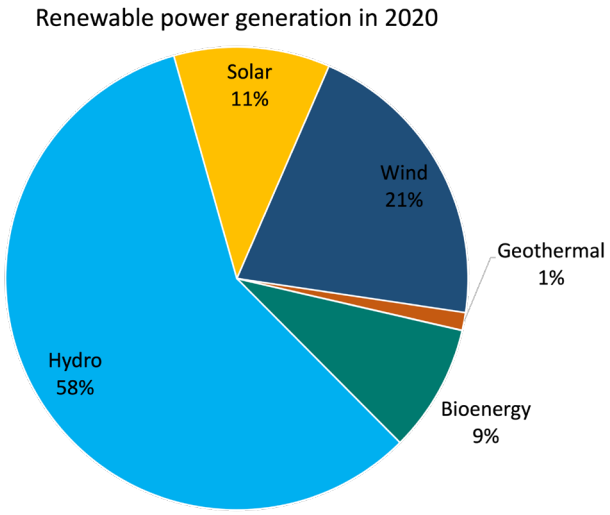

Figure 16 Renewable electricity generation in 2020

Asia leads in terms of renewable electricity generation globally. In 2019, 43% of all renewable electricity generated was in Asia followed by Americas (30%) and Europe (24%). Africa had a share of 2.4% - mainly due to hydropower which had a share of 80% in the Africa renewable electricity mix.

Europe is also the largest producer of biopower with an estimated generation of 304 TWh, accounting for 40% of all bioelectricity generation globally.

Table 11 Renewable power generation in continents in 2019

	Hydro	Wind	Biomass	Solar	Geothermal	Tide	Total	Biomass (%)
Africa	141	17.5	1.97	10.17	4.89	0.00	176	1.12%
Americas	1 408	426	186	127	28.3	0.00	2 175	8.57%
Asia	1 913	522	272	396	36.7	0.49	3 140	8.67%
Europe	826	442	304	146	13.2	0.51	1 732	17.5%
Oceania	41.5	20.0	4.11	14.98	8.04	0.00	88.6	4.64%
EU - 28	353	431	292	139	6.73	0.51	1 222	23.9%

All values in TWh

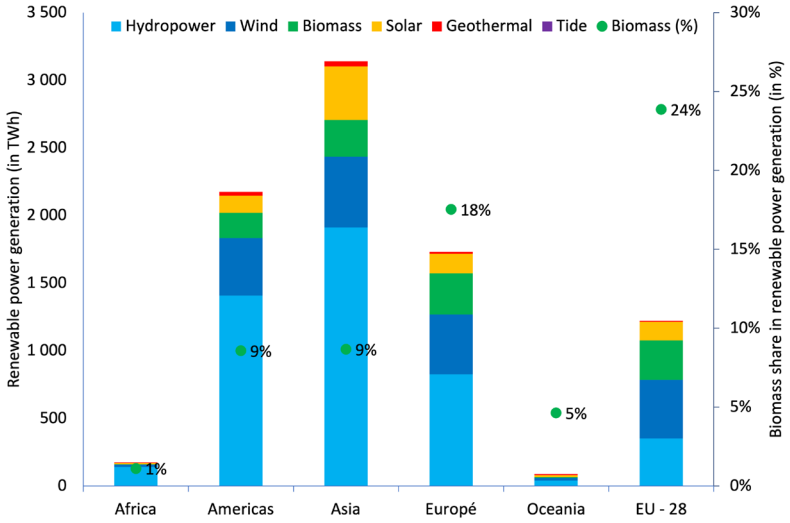

Figure 17 Renewable power generation in continents in 2019

RENEWABLE HEAT

In 2020, 1.26 EJ of renewable heat was produced in both heat-only plants as well as combined heat and power plants. 96% of all renewable heat produced was from biomass with minor contribution from geothermal and solar thermal technologies.

Table 12 Renewable heat production globally

	Total	Bioenergy	Geothermal	Solar Thermal	Bioenergy (in %)
2000	0,43	0,41	0,02	0,000	96%
2005	0,55	0,53	0,02	0,000	96%
2010	0,81	0,78	0,03	0,000	96%
2015	0,99	0,95	0,04	0,001	96%
2020	1,26	1,20	0,05	0,003	96%

All values in EJ

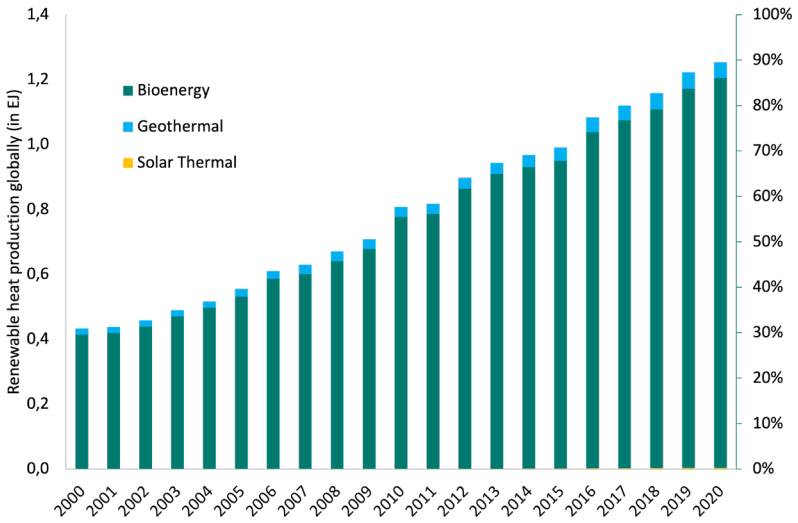

Figure 18 Renewable heat production globally

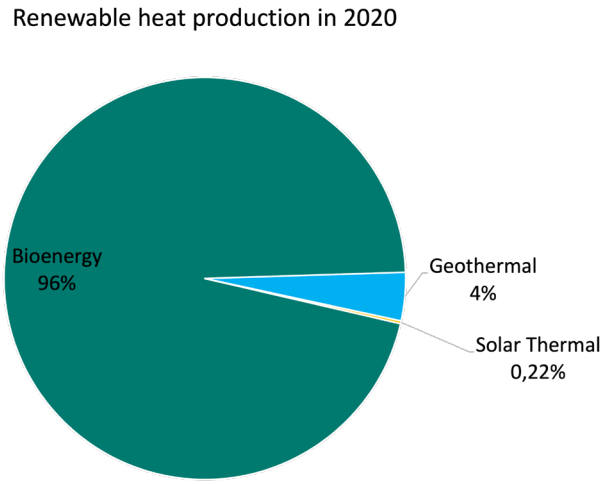

Figure 19 Renewable heat production globally in 2019

In 2019, almost all the heat production from solar thermal and geothermal facilities occurred in Europe – mainly EU 28 countries. Europe also leads the way in terms of use of biomass for heat as close to 88% of bioheat produced globally occurred in Europe.

Table 13 Renewable heat production in continents in 2019

	Biomass	Solar	Geothermal	Total	Biomass (%)
Africa	0.00	0.000	0.00	0.00	0%
Americas	0.09	0.000	0.00	0.09	100%
Asia	0.10	0.000	0.00	0.10	100%
Europe	1.43	0.002	0.05	1.48	97%
Oceania	0.00	0.000	0.00	0.00	0%
EU - 28	1.14	0.002	0.01	1.15	99%

All values in EJ

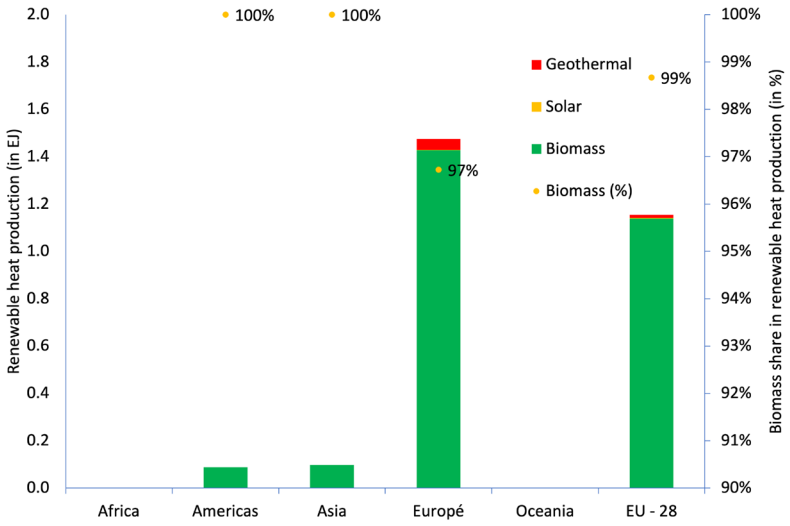

Figure 20 Renewable heat production in continents in 2019

RENEWABLE TRANSPORT

In 2020, 4,23 EJ of renewable energy was used in the transport sector globally and liquid and gaseous biofuels accounted for 90% of all renewable energy used in the sector. Share of renewable electricity (calculated based on the share of renewables in overall electricity sector) had a share of 10%.

Table 14 Renewable energy use in transport globally

	Total	Biofuels	Renewable Electricity	Biofuels (%)
2000	0,56	0,42	0,15	74%
2005	0,98	0,81	0,17	82%
2010	2,59	2,37	0,21	92%
2015	3,57	3,29	0,28	92%
2020	4,23	3,81	0,42	90%

All values in EJ

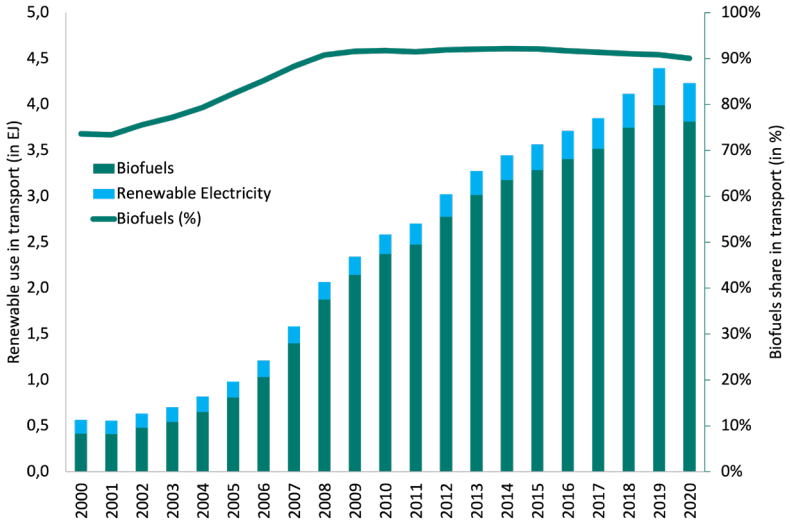

Figure 21 Renewable energy use in transport globally

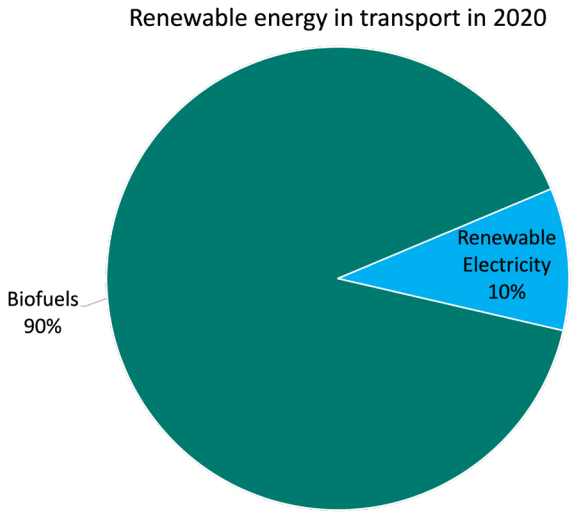

Figure 22 Renewable energy use in transport globally in 2020

In 2019, biofuels accounted for 99% of all renewable energy use in transport in Americas, while

both Asia and Europe had higher shares as well at 75% and 79% respectively.

Table 15 Renewables use in transport in continents in 2019

	Biomass	RE Electricity	Total	Biofuels (%)
Africa	0.00	0.00	0.03	7.2%
Americas	2.68	0.03	2.81	95%
Asia	0.52	0.17	1.46	36%
Europe	0.77	0.20	1.57	49%
Oceania	0.01	0.01	0.04	16%
EU - 28	0.73	0.09	1.05	70%

All values in EJ

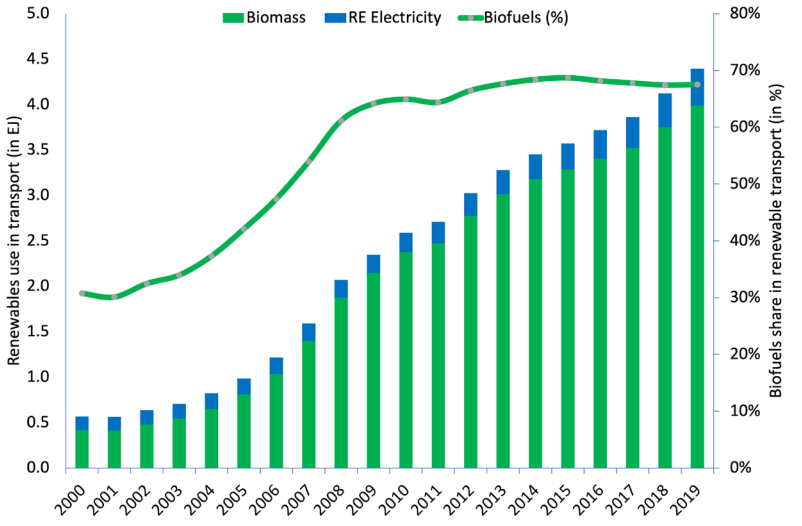

Figure 23 Renewables use in transport in continents in 2019

BIOMASS SUPPLY

SUPPLY

In 2020, domestic supply of biomass was 57,5 EJ globally. 86% of the domestic supply was from solid biomass sources including wood chips, wood pellets and traditional biomass sources. Liquid biofuels accounted for 7%, municipal and industrial waste sectors accounted for 2 - 3% followed by biogas at 2%.

Table 16 Domestic biomass supply globally

	Total	Municipal Waste	Industrial Waste	Solid Biomass	Biogas	Liquid biofuels
2000	41,7	0,74	0,50	39,8	0,29	0,44
2005	44,8	0,96	0,45	42,0	0,54	0,88
2010	49,3	1,17	0,79	43,9	0,89	2,54
2015	52,6	1,38	0,92	45,5	1,34	3,46
2020	57,5	1,47	1,19	49,3	1,46	4,06

All values in EJ

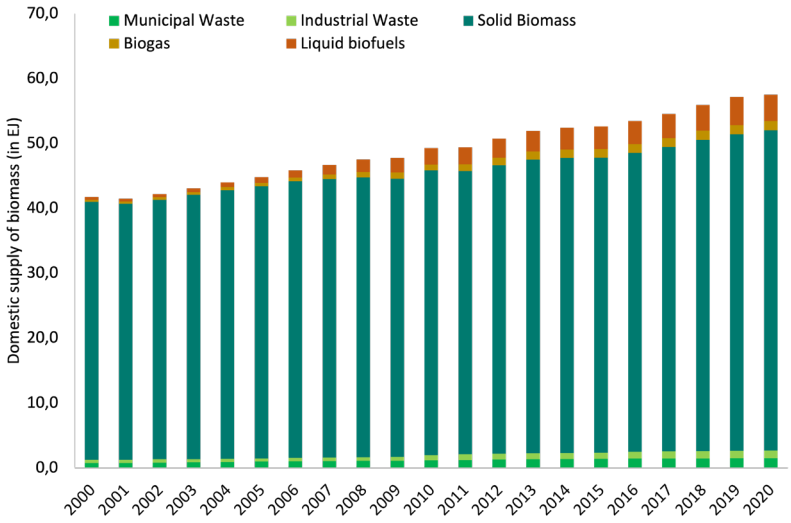

Figure 24 Domestic supply of biomass globally

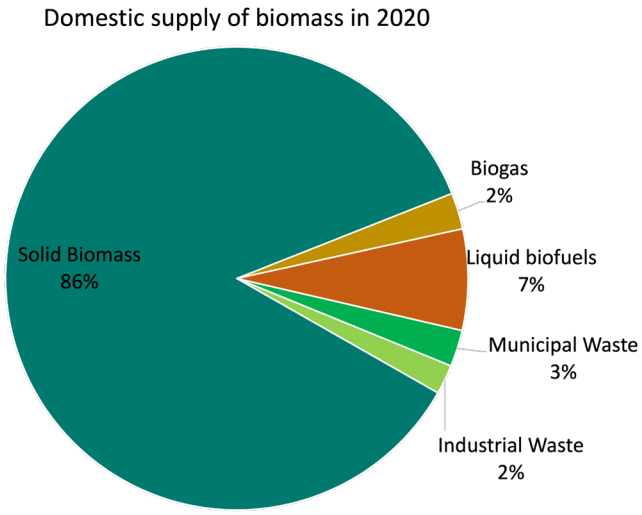

Figure 25 Domestic supply of biomass in 2020

In 2019, solid biomass, predominantly from the forestry sector made up the majority of biomass supply in all continents. Europe accounted for 64% of all energy from municipal waste. Europe was also the leader in biogas supply accounting for more than half of the global biogas supply. Americas (mainly USA and Brazil) had significant supply of liquid biofuels accounting for 70% of the global supply.

Table 17 Domestic supply of biomass in continents in 2019

	Municipal Waste	Industrial Waste	Solid Biomass	Biogas	Liquid Biofuels	Total
Africa	0.00	0.00	16.0	0.00	0.00	16.0
Americas	0.29	0.07	8.05	0.19	3.00	11.6
Asia	0.20	0.55	19.3	0.50	0.62	21.2
Europe	0.92	0.52	4.70	0.72	0.63	7.49
Oceania	0.00	0.00	0.22	0.02	0.01	0.25
EU - 28	0.85	0.19	4.07	0.70	0.63	6.45

All values in EJ

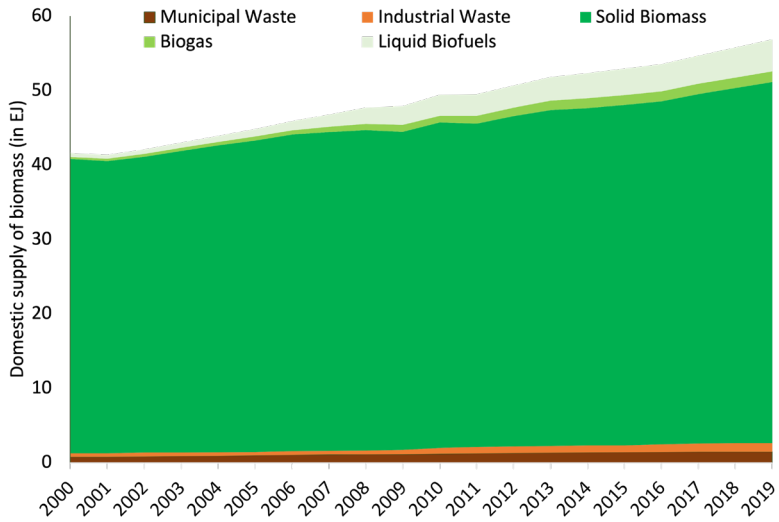

Figure 26 Domestic supply of biomass in continents in 2019

WOODFUEL

In 2021, 1.9 billion m3 of wood fuel were produced globally. Africa and Asia accounted for most of the production with shares of 37% each.

Table 18 Production of woodfuel globally

	World	Africa	Americas	Asia	Europe	Oceania
2000	1 795	551	314	808	109	13
2005	1 825	600	300	792	123	11
2010	1 864	644	290	764	155	11
2015	1 901	679	307	735	169	10
2020	1 928	713	328	708	169	10
2021	1 948	720	340	705	174	10

All values in million m3

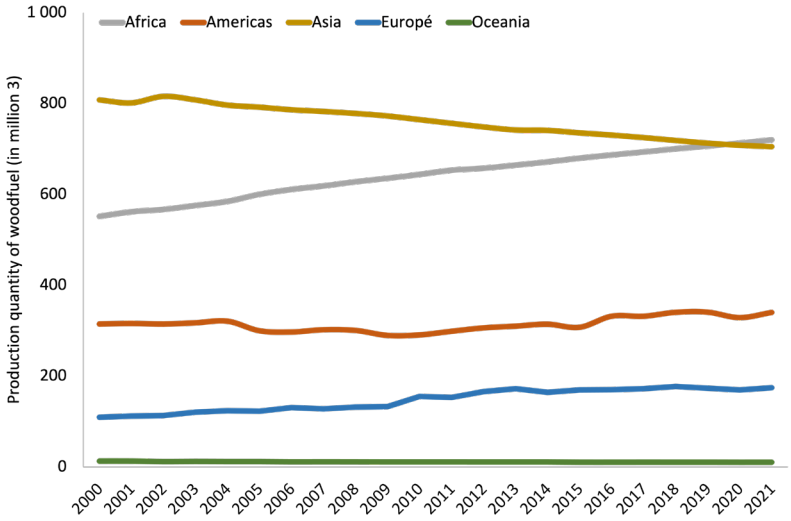

Figure 27 Woodfuel production globally

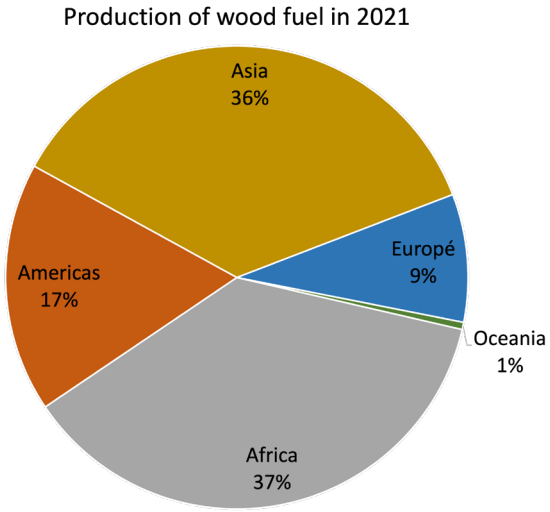

Figure 28 Woodfuel production globally in 2021

WOOD PELLETS

In 2021, 44,3 million tonnes of pellets were estimated to be produced globally. Europe accounts for the majority of wood pellets production with a share of 56% globally followed by Americas at 30%.

Table 19 Wood pellets production globallyv

	World	Africa	Americas	Asia	Europe	Oceania
2012	18,1	0,09	5,10	0,30	12,5	0,03
2013	21,2	0,04	6,65	0,62	13,9	0,03
2014	25,1	0,04	7,96	1,72	15,2	0,14
2015	27,4	0,03	8,76	2,04	16,4	0,15
2016	29,3	0,04	9,49	2,59	17,0	0,16
2017	33,4	0,06	10,4	3,52	19,2	0,25
2018	37,6	0,07	11,3	5,58	20,5	0,21
2019	42,0	0,07	12,5	5,52	23,7	0,14
2020	43,2	0,07	13,0	5,67	24,3	0,15
2021	44,3	0,07	13,2	5,97	25,0	0,17

All values in million tonnes

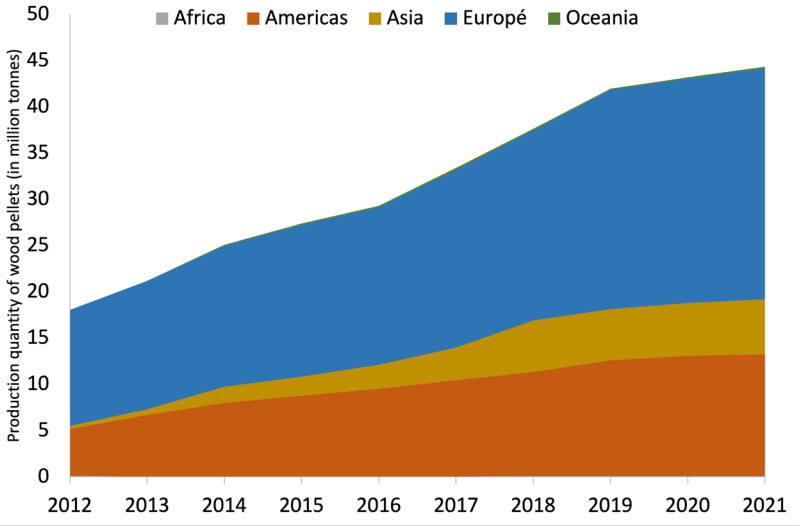

Figure 29 Wood pellets production globally

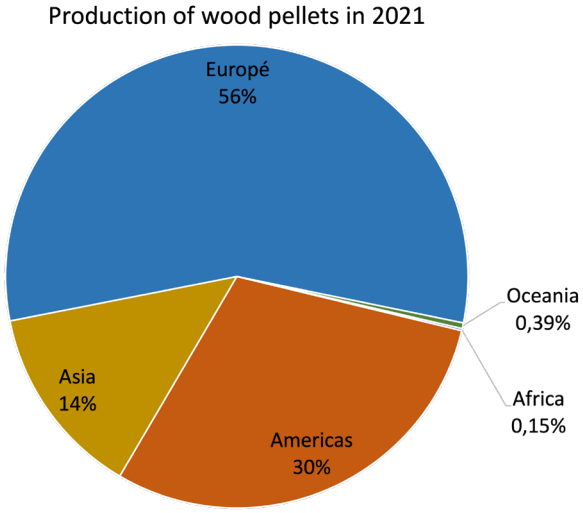

Figure 30 Wood pellet production globally in 2021

WOOD CHARCOAL

Wood charcoal is another key bioenergy sector with significant volumes being produced globally. In 2021, 54 million tonnes of wood charcoal were produced globally with Africa accounting for 67% of the global production.

Table 20 Wood charcoal production globally

	World	Africa	Americas	Asia	Europe	Oceania
2000	36,7	20,2	9,7	6,54	0,30	0,04
2005	43,9	24,4	10,9	8,01	0,51	0,03
2010	46,5	28,5	8,9	8,54	0,57	0,04
2015	51,2	32,1	9,4	9,05	0,58	0,04
2020	52,9	35,1	9,2	8,02	0,62	0,04
2021	54,0	36,1	9,2	8,04	0,64	0,04

All values in million tonnes

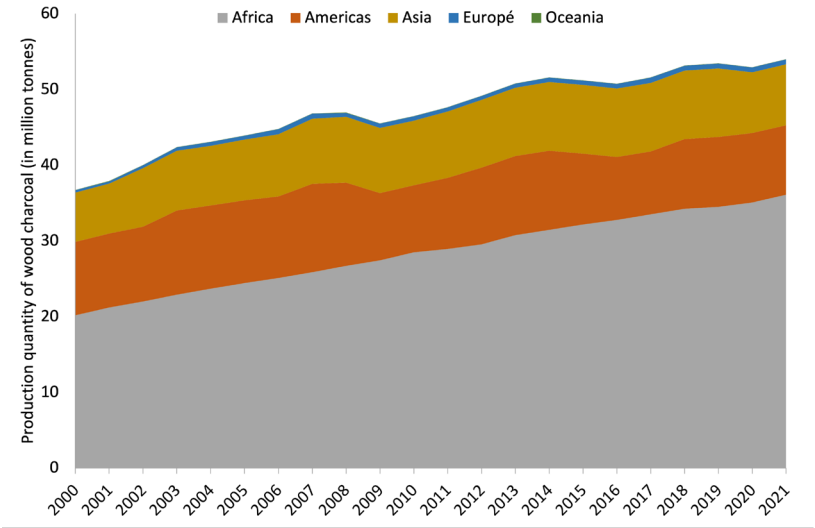

Figure 31 Wood charcoal production globally

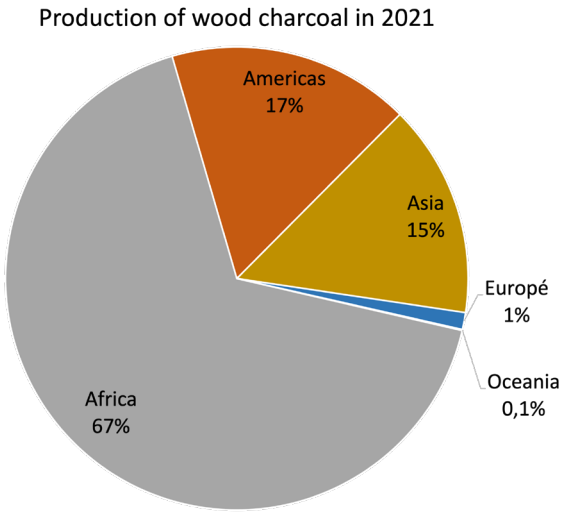

Figure 32 Wood charcoal production globally in 2021

CROPS

Agriculture is a key sector for increased potential for bioenergy utilization in the future. Although the sector accounts for about 10% of the global biomass supply, there is significant potential for increasing its contribution.

In terms of yields of major crops, there is significant potential to increase the yields in various regions to the global average.

Table 21 Production quantity of major agricultural crops

	World	Africa	Americas	Asia	Europe	Oceania
Barley	157	5,53	21,1	25,5	94,4	10,5
Cassava, fresh	303	194	26,9	81,9	0,0	0,25
Maize (corn)	1 162	90,5	582	365	124	0,48
Oats	25,2	0,18	7,66	1,12	15,1	1,17

	World	Africa	Americas	Asia	Europe	Oceania
Olives	23,6	5,59	0,80	3,12	14,1	0,05
Rice	757	37,9	38,1	677	4,07	0,06
Rye	15,0	0,10	1,01	0,92	13,0	0,03
Sorghum	58,7	27,5	20,3	9,20	1,31	0,40
Soya beans	353	3,44	306	33,6	10,6	0,02
Sugar beet	253	16,8	32,9	46,2	157	0,00
Sugar cane	1 870	95,7	1 009	732	0,00	32,4
Sunflower seed	50,2	2,47	4,98	6,09	36,7	0,01
Wheat	761	25,2	118	348	255	14,9
Wheat	216	9.77	34.7	98.6	62.4	10.4

All values in million tonnes

Table 22 Yield of major crops

	World	Africa	Americas	Asia	Europe	Oceania
Barley	3,0	1,3	3,8	2,0	4,0	2,1
Cassava, fresh	11	8,6	13	22	-	12
Maize (corn)	5,8	2,1	7,9	5,5	6,4	8,2
Oats	2,6	1,3	2,8	2,1	2,7	1,4
Olives	1,9	1,0	3,7	1,7	2,7	2,4
Rice	4,6	2,2	6,5	4,8	6,4	6,7
Rye	3,4	1,9	2,5	2,6	3,6	0,7
Sorghum	1,5	1,0	3,7	1,3	4,1	2,0
Soya beans	2,8	1,3	3,2	1,4	2,0	1,8
Sugar beet	57	52	67	63	54	-
Sugar cane	71	61	74	68	-	77
Sunflower seed	1,8	1,1	2,0	1,9	1,8	1,3
Wheat	3,5	2,5	3,3	3,4	4,1	1,5
Wheat	3.55	2.76	3.37	3.43	4.27	1.72

All values in tons/ha

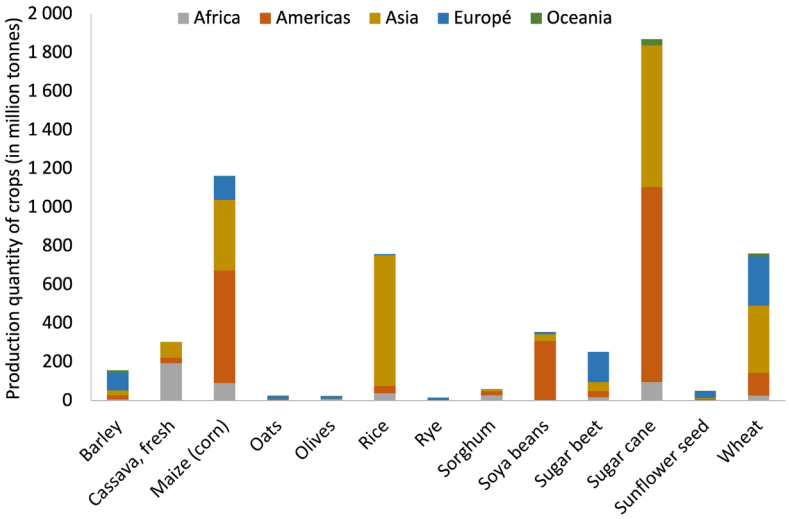

Figure 33 Production quantity of major crops

WASTE TO ENERGY

In 2020, domestic supply of energy from municipal and industrial waste was 2,65EJ with 55% from municipal waste and remaining from industrial waste.

Table 23 Energy from waste globally

	Total	Municipal Waste	Industrial Waste
2000	1,24	0,74	0,50
2005	1,41	0,96	0,45
2010	1,96	1,17	0,79
2015	2,30	1,38	0,92
2020	2,65	1,47	1,19

All values in EJ

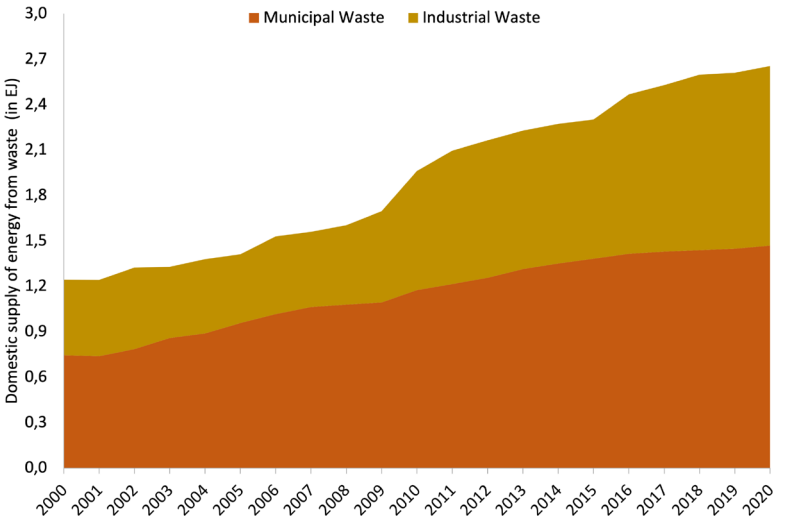

Figure 34 Energy from waste globally

Europe is the world leader in the production of energy from waste. In 2019, domestic supply of municipal and industrial waste was 1.44 EJ. Europe accounted for 54% of all global domestic supply of energy from waste followed by Americas at 32%.

Table 24 Energy from waste in continents in 2019

	Total	Municipal Waste	Industrial Waste
Africa	0.00	0.00	0.00
Americas	0.36	0.29	0.07
Asia	0.75	0.20	0.55
Europe	1.44	0.92	0.52
Oceania	0.00	0.00	0.00
EU - 28	1.05	0.85	0.19

All values in EJ

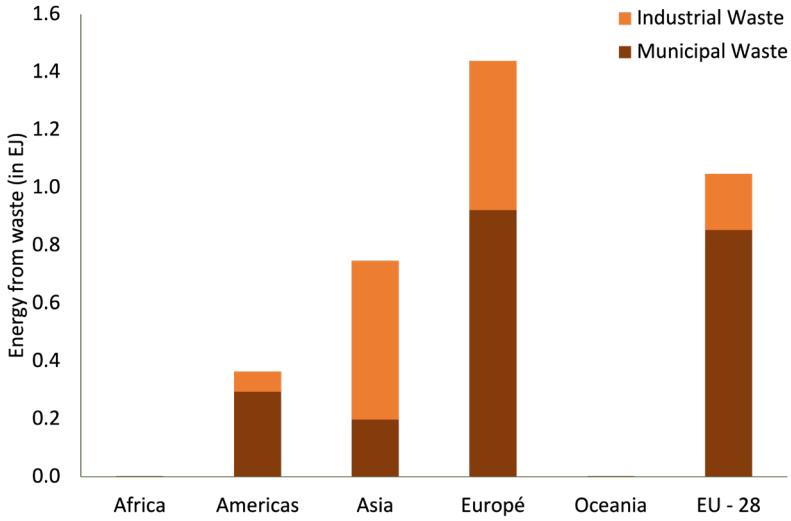

Figure 35 Energy from waste in continents in 2019

BIOMASS TO POWER

In 2020, 685 TWh of electricity was generated from biomass globally. 69% of all biopower generated was from solid biomass sources followed by 17% from municipal and industrial waste. Biogas share was 13%.

Table 25 Electricity generation from biomass

	Total	Municipalwaste	Industrialwaste	SolidBiomass	Biogas	LiquidBiofuels
2000	162	34,5	15,3	99	13,2	0,00
2005	228	46,5	11,7	146	21,1	1,98
2010	362	62,6	24,3	223	46,8	4,99
2015	509	73,2	26,1	318	83,8	8,25
2020	685	76,7	36,6	471	89,7	10,4

All values in TWh

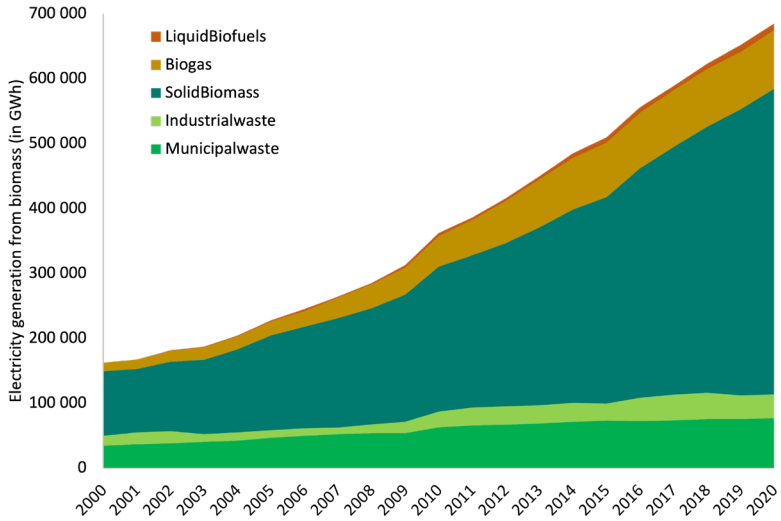

Figure 36 Biopower generation globally

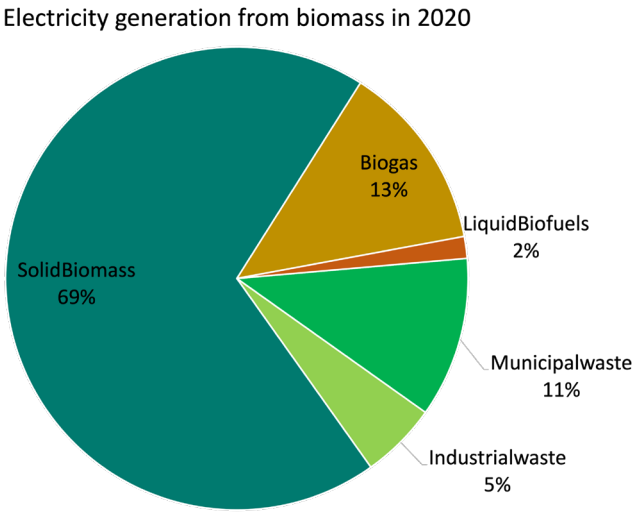

Figure 37 Biopower generation in 2020

Asia accounted for 39% of all biopower generated globally with 255 TWh of production in 2019 followed by Europe at 35%. Europe leads the world in biopower produced from Municipal waste accounting for 64% of the production while Asia leads in using industrial waste for electricity with a global share of 71%. Biopower from biogas is dominant in Europe with a global share of 72%.

Table 26 Biopower generation in continents in 2019

	Municipal Waste	Industrial Waste	Solid Bio-mass	Biogas	Liquid biofuels
Africa	0.00	0.00	1.94	0.02	0.00
Americas	16.2	4.19	125.7	16.1	0.80
Asia	11.2	26.2	206	7.67	4.73
Europe	48.3	6.66	107	63.4	5.20
Oceania	0.00	0.00	2.50	1.61	0.00
EU - 28	45.4	3.68	107	62.5	5.20

All values in TWh

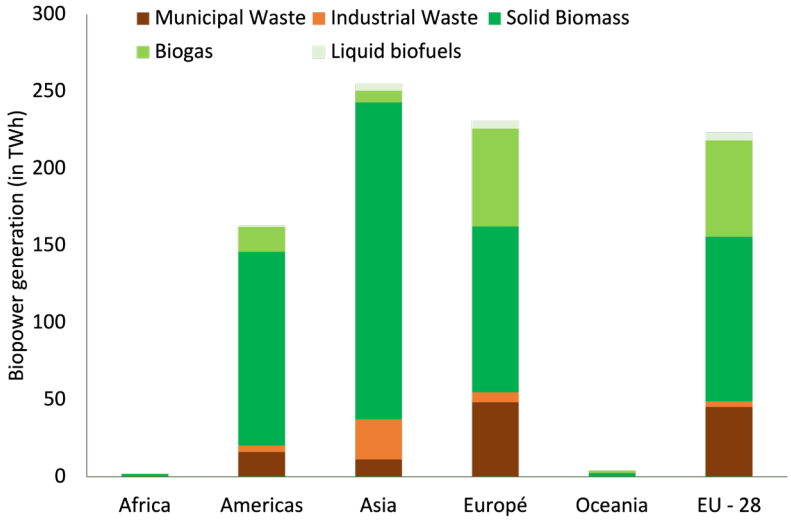

Figure 38 Biopower generation in continents in 2019

Electricity only plants are designed to produce electricity only. They do not produce any heat from biomass and have an average conversion efficiency of about 30%. In 2020, 5.3 EJ of biomass was used in electricity only plants for power generation.

Table 27 Biomass use in electricity only plants

	Total	Municipalwaste	Industrialwaste	SolidBiomass	Biogas	Liquid Biofuels
2000	1 025 027	359 887	59 784	483 278	122 078	
2005	1 543 923	467 835	27 946	861 936	185 795	411
2010	2 547 634	573 334	232 521	1 431 531	309 724	524
2015	3 551 290	624 963	271 959	2 200 308	452 644	1 416
2020	5 321 800	650 077	293 505	3 934 861	441 355	2 002

All values in TJ

CHP or Combined Heat and Power plants refer to those plants that are designed to produce both heat and electricity. These are also referred to as cogeneration facilities. The conversion efficiency varies widely among CHP facilities.

In 2020, 3.4 EJ of biomass was used in CHP plants. Solid biofuels account for 66% of all biopower produced in CHP facilities followed by municipal waste at 17%.

Table 28 Biomass use in CHP plants

	Total	Municipalwaste	Industrialwaste	SolidBiomass	Biogas	LiquidBiofuels
2000	1 094 469	211 830	141 361	710 147	31 131	
2005	1 467 145	331 348	121 075	961 730	52 806	186
2010	1 937 656	411 790	135 304	1 238 415	151 578	569
2015	2 699 208	540 519	137 234	1 697 662	323 207	586
2020	3 433 600	580 006	160 508	2 291 101	401 360	625

All values in TJ

BIOMASS TO HEAT

In 2020, 1.2 EJ of heat was produced from biomass-based sources – 52% from solid biomass sources and 25% from municipal solid waste.

Table 29 Heat generation from biomass

	Total	Municipal waste	Industrial waste	Solid Biomass	Biogas	Liquid Biofuels
2000	414 093	125 142	74 987	208 994	4 931	39
2005	530 683	152 968	82 712	284 689	6 616	3 698
2010	776 943	206 718	125 941	421 571	12 393	10 320
2015	949 134	263 338	138 693	509 620	33 032	4 451
2020	1 204 293	298 228	229 650	620 192	52 173	4 050

All values in EJ

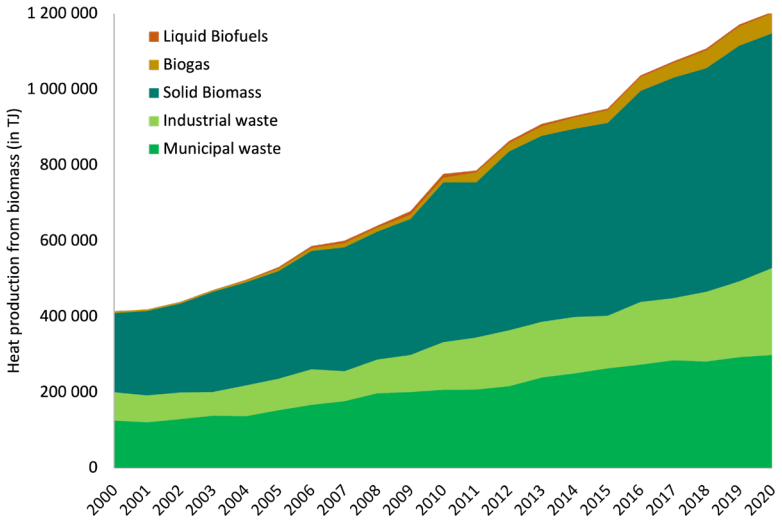

Figure 39 Bioheat production globally

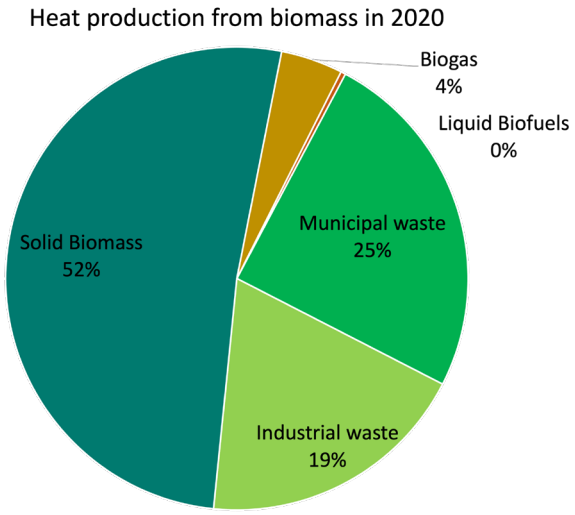

Figure 40 Bioheat production in 2020

Europe is the world leader in producing heat from biomass in power plants with a share of 88% globally followed by Asia at 8%. It is important to note that the bioheat only includes heat production in heat only and CHP plants which is transmitted and distributed to end consumers predominantly via district heating networks. It does not include the use of biomass for heat in end use sectors.

Table 30 Bioheat production in continents in 2019

	Municipal Waste	Industrial Waste	Solid Biomass	Biogas	Liquid biofuels
Africa	0.00	0.00	0.00	0.00	0.00
Americas	0.02	0.01	0.04	0.00	0.00
Asia	0.01	0.05	0.02	0.00	0.00
Europe	0.26	0.15	0.57	0.04	0.01
Oceania	0.00	0.00	0.00	0.00	0.00
EU - 28	0.24	0.01	0.48	0.04	0.01

All values in EJ

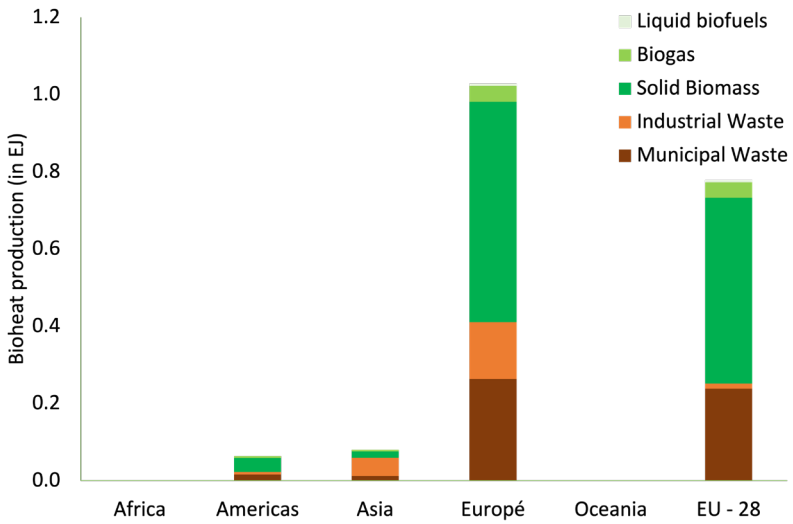

Figure 41 Bioheat production in continents in 2019

Bioheat is produced either via heat only plants or CHP plants. Heat only plants are specifically designed to produce heat only and sold to a third party – e.g., residential, commercial or industrial consumers. In 2020, 0.57 EJ of biomass was used to produce heat in heat only plants.

Table 31 Use of biomass in heat only plants

	Total	Municipal-waste	Industrial-waste	Solid Bio-mass	Biogas	Liquid Biofuels
2000	243 253	47 896	41 604	152 498	1 255	
2005	310 495	65 562	50 205	192 148	2 505	75
2010	439 785	96 303	102 260	234 656	6 320	246
2015	477 561	84 485	116 811	270 499	5 702	64
2020	573 501	76 480	167 964	323 497	5 521	39

All values in TJ

CHP (Combined Heat and Power) plants or cogeneration plants are designed to produce both heat and electricity. In 2020, 3.43 EJ of biomass was used for heat production in CHP plants. As is the case with heat only plants, solid biofuels are the largest contributor to heat production from biomass globally in CHP plants.

Table 32 Heat generation from biomass in CHP plants

	Total	Municipalwaste	Industrialwaste	SolidBiomass	Biogas	LiquidBiofuels
2000	1 094 469	211 830	141 361	710 147	31 131	
2005	1 467 145	331 348	121 075	961 730	52 806	186
2010	1 937 656	411 790	135 304	1 238 415	151 578	569
2015	2 699 208	540 519	137 234	1 697 662	323 207	586
2020	3 433 600	580 006	160 508	2 291 101	401 360	625

All values in TJ

BIOFUELS

LIQUID BIOFUELS

In 2020, 146 billion litres of biofuels were produced globally. This was the first time that the production of biofuels decreased year on year, mainly due to the COVID pandemic.

Table 33 Liquid biofuels production

	Production (kt)	Production (bl)
2000	14 397	17,1
2005	31 193	37,1
2010	87 070	104
2015	106 629	127
2020	122 547	146

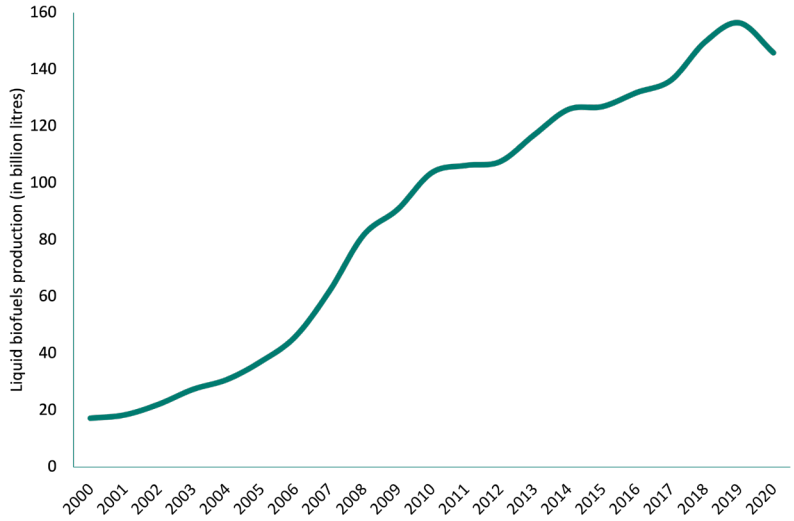

Figure 42 Liquid Biofuels Production

Americas dominate the biofuel production globally. North and South America together produce 70% of all biofuels globally with Europe having a share of 15%.

Table 34 Liquid biofuels production in continents in 2019

	Liquid Biofuels (kt)	Liquid Biofuels (Billion litres)
Africa	70	0.08
Americas	92 238	111
Asia	19 207	23.1
Europe	19 508	23.5
Oceania	200	0.24
EU - 28	19 323	23.3

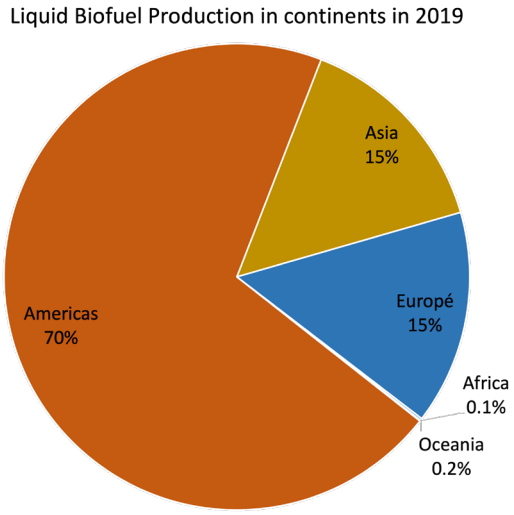

Figure 43 Liquid biofuels production in continents in 2019

BIOGAS

Biogas is produced by anaerobic fermentation of different forms of organic matter and is composed mainly of methane (CH4) and carbon dioxide (CO2). In 2020, 38,1 billion m3 of biogas was produced globally with an equivalent energy content of 1.46 EJ.

Table 35 Biogas Supply globally

	Production (TJ)	Production (bcm)
2000	285 631	7,46
2005	538 590	14,1
2010	891 701	23,3
2020	1 458 785	38,1

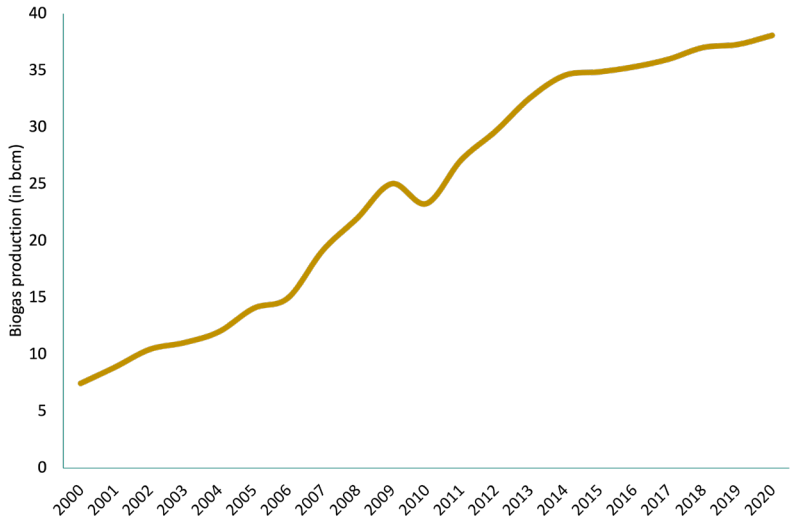

Figure 44 Domestic supply of biogas

Europe is the world leader in biogas production. In 2019, Europe produced 30.6 billion m3 of biogas with an energy equivalent of 0.70 EJ. The production accounted for more than half of the global biogas production with Asia coming 2nd with a share of 32%.

Table 36 Biogas supply in continents in 2019

	Biogas Supply (EJ)	Biogas Supply (in Bm3)
Africa	0.00	0,00
Americas	0.19	5,0
Asia	0.50	13,1
Europe	0.72	18,8
Oceania	0.02	0,50
EU - 28	0.70	18,3

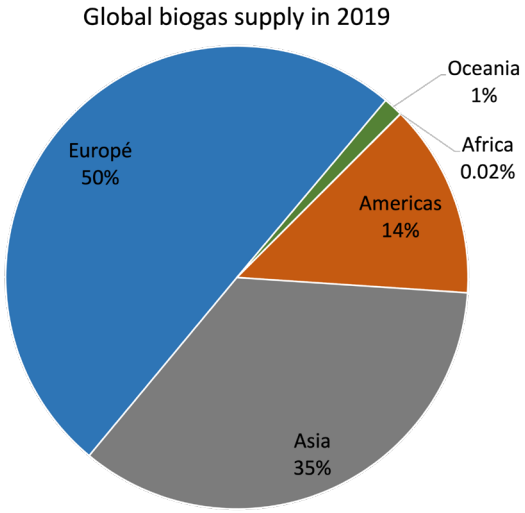

Figure 45 Domestic supply of biogas in continents in 2019

APPENDIX

GEOGRAPHICAL INFORMATION

Africa: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Guinea – Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Sao Tome and Principe, Senegal , Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swazi-land, Togo, Tunisia, Uganda, United Republic of Tanzania, Western Sahara, Zambia, Zimbabwe.

Americas: Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, British Virgin Islands, Canada, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Falklands Islands , French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Pierre and Miquelon, Saint Vincent and the Grenadines, Suriname, Turks and Caicos Islands, United States of America, Uruguay, Venezuela.

Asia: Afghanistan, Bahrain, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, China, Hong Kong SAR, China, Macao SAR, Democratic People's Republic of Korea, India, Indonesia, Iran (Islamic Republic of), Iraq, Israel, Japan, Jordan, Korea Democratic Republic, Kuwait, Lao People's Democratic Republic, Lebanon, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, Sri Lanka, Syrian Arab Republic, Thailand, Turkey, United Arab Emirates, Viet Nam, Yemen.

Europe: Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Gibraltar, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Ukraine, United Kingdom.

Oceania: Australia, New Zealand

GLOSSARY

Bioenergy: Bioenergy is equal to sum of industrial waste, municipal waste, primary solid biofuels, biogas, bioethanol, biodiesel, other liquid biofuels and charcoal etc.

Geothermal: Geothermal energy is the energy available as heat emitted from within the earth's crust, usually in the form of hot water or steam.

Municipal Waste: Municipal waste consists of products that are combusted directly to produce heat and/or power and comprises wastes produced by households, industry, hospitals and the tertiary sector that are collected by local authorities for incineration at specific installations. Municipal waste is split into renewable and non-renewable.

Industrial Waste: Industrial waste of non-renewable origin consists of solid and liquid products (e.g. tyres) combusted directly, usually in specialised plants, to produce heat and/or power. Renewable industrial waste is not included here, but with solid biofuels, biogases or liquid biofuels.

Solid Biofuels: Primary solid biofuels are defined as any plant matter used directly as fuel or converted into other forms before combustion. This covers a multitude of woody materials generated by industrial process or provided directly by forestry and agriculture (firewood, wood chips, bark, sawdust, shavings, chips, sulphite lye also known as black liquor, animal materials/wastes and other solid biofuels).

Biogases: Biogases are gases arising from the anaerobic fermentation of biomass and the gasification of solid biomass (including biomass in wastes). The biogases from anaerobic fermentation are composed principally of methane and carbon dioxide and comprise landfill gas, sewage sludge gas and other biogases from anaerobic fermentation.

Liquid Biofuels: Liquid biofuels is sum of Biogasoline, biodiesel and other liquid biofuels.

Wood Fuel: Roundwood that will be used as fuel for purposes such as cooking, heating or power production. It includes wood harvested from main stems, branches and other parts of trees (where these are harvested for fuel) and wood that will be used for the production of charcoal (e.g. in pit kilns and portable ovens), wood pellets and other agglomerates. The volume of roundwood used in charcoal production is estimated by using a factor of 6.0 to convert from the weight (mt) of charcoal produced to the solid volume (m3) of roundwood used in production. It also includes wood chips to be used for fuel that are made directly (i.e. in the forest) from round-wood. It excludes wood charcoal, pellets and other agglomerates. It is reported in cubic metres solid volume underbark (i.e. excluding bark)

Wood Pellets: Agglomerates produced either directly by compression or by the addition of a binder in a proportion not exceeding 3% by weight. Such pellets are cylindrica, with a diameter not ex-ceeding 25 mm and a length not exceeding 100 mm. It is reported in metric tonnes.

Wood Charcoal: It covers the solid residue of the destructive distillation and pyrolysis of wood and other vegetal material.

Electricity Only: Refers to plants which are designed to produce electricity only. If one or more units of the plant is a CHP unit (and the inputs and outputs cannot be distinguished on a unit basis) then the whole plant is designated as a CHP plant.

Heat Only: Refers to plants (including heat pumps and electric boilers) designed to produce heat only and who sell heat to a third party (e.g. residential, commercial or industrial consumers) under the provisions of a contract.

CHP: Refers to plants which are designed to produce both heat and electricity (sometimes referred to as co-generation power stations). If possible, fuel inputs and electricity/heat outputs are on a unit basis rather than on a plant basis.

GENERAL REGIONAL DATA

Table 49 Some general regional data on energy, emissions and population

Country Name	Population	GDP (Current USD)	Emissions (kt)
Central Europe and the Baltics	**102 378 579**	**1 656 928 913 108**	**656 859**
East Asia & Pacific	**2 340 628 292**	**26 979 805 534 123**	**13 955 922**
Europe & Central Asia	**921 140 092**	**22 748 788 538 190**	**6 269 012**
European Union	**447 512 041**	**15 592 795 166 700**	**2 881 621**
Latin America & Caribbean	**646 430 841**	**5 719 252 824 663**	**1 836 828**
Middle East & North Africa	**456 707 404**	**3 701 386 017 856**	**2 608 737**
Pacific island small states	**2 493 696**	**10 456 001 897**	**3 370**
Sub-Saharan Africa	**1 106 957 898**	**1 755 011 419 751**	**853 107**
South Asia	**1 835 776 742**	**3 597 970 348 648**	**2 736 913**
World	**7 673 533 972**	**87 697 518 999 809**	**35 999**

(World Bank, 2019)

USEFUL CONVERSIONS

Table 50 Average energy content of fuels

Fuel	Value	Unit
Biogas	23.0	MJ/m3
Bioethanol	21.1	MJ/l
Biodiesel	34.5	MJ/l
Other Biofuels	27.8	MJ/l

Table 51 Standard energy unit conversions

To:	TJ	Gcal	Mtoe	Mbtu	GWh
From:					
TJ	1	238.8	2.388E-05	947.8	0.2778
Gcal	4.1868E-03	1	1E-06	3.968	1.163E-03
Mtoe	4.1868E+04	1E+08	1	3.97E+07	11 630
Mbtu	1.0551E-03	0.252	2.52E-08	1	2.931E-04
GWh	3.6	860	8.6E-05	3 412	1

Table 52 Standard unit conversions

To:	Exa	Peta	Tera	Giga	Mega	Kilo	Joule
From:	Multiply by						
Exa	1	1E+03	1E+06	1E+09	1E+12	1E+15	1E+18
Peta	1E-03	1	1E+03	1E+06	1E+09	1E+12	1E+15
Tera	1E-06	1E-03	1	1E+03	1E+06	1E+09	1E+12
Giga	1E-09	1E-06	1E-03	1	1E+03	1E+06	1E+09
Mega	1E-12	1E-09	1E-06	1E-03	1	1E+03	1E+06
Kilo	1E-15	1E-12	1E-09	1E-06	1E-03	1	1E+03
Joule	1E-18	1E-15	1E-12	1E-09	1E-06	1E-03	1

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SILVER SUPPORTERS OF WBA