

IEA roadmap to net zero emissions by 2050

Selected indicators

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Global energy system, 2019-2050

IEA net-zero emissions by 2050 pathway (Table 1)

	Exajoules					CAGR %			
	2019	2020	2030	2040	2050	2019-2030	2030-2040	2040-2050	2019-2050
Total energy supply	612	587	547	535	543	-1.0	-0.2	0.1	-0.4
Renewables	67	69	167	295	362	8.7	5.9	2.1	5.6
Solar	4	5	32	78	109	20.8	9.3	3.4	11.3
Wind	5	6	29	67	89	17.3	8.7	2.9	9.7
Hydro	15	16	21	27	30	3.1	2.5	1.1	2.3
Other	43	42	85	123	134	6.4	3.8	0.9	3.7
Traditional use of biomass	25	25	0	0	0				
Nuclear	30	29	41	54	61	2.9	2.8	1.2	2.3
Gas	139	137	129	75	60	-0.7	-5.3	-2.2	-2.7
Unabated	139	136	116	44	17	-1.6	-9.2	-9.1	-6.6
CCUS	0	1	13	31	43				
Oil products	190	173	137	79	42	-2.9	-5.4	-6.1	-4.8
Coal	160	154	72	32	17	-7.0	-7.8	-6.1	-7.0
Unabated	160	154	68	16	3	-7.5	-13.5	-15.4	-12.0
CCUS	0	0	4	16	14				
(Oil products, non-energy use)	28	27	32	31	29	1.2	-0.3	-0.7	0.1
<i>Memo items:</i>									
Population (million)	7,672	7,753	8,505	9,155	9,692	0.9	0.7	0.6	0.8
GDP (PPP US\$ billion)	134,710	128,276	184,037	246,960	316,411	2.9	3.0	2.5	2.8
GDP per capita (PPP US\$1000)	17,558	16,545	21,638	26,975	32,648	1.9	2.2	1.9	2.0
Total energy supply per GDP (GJ per US\$1000 PPP)	4.543	4.578	2.973	2.164	1.716	-3.8	-3.1	-2.3	-3.1
Total final consumption per GDP (GJ per US\$1000 PPP)	3.231	3.208	2.139	1.468	1.086	-3.7	-3.7	-3.0	-3.5
Total energy supply per capita (GJ per capita)	79.774	75.739	64.326	58.385	56.027	-1.9	-1.0	-0.4	-1.1

Source: "Net Zero by 2050: A Roadmap for the Global Energy Sector", IEA, 2021

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Global energy system, 2019-2050

IEA net-zero emissions by 2050 pathway (Table 2)

	Exajoules					CAGR %			
	2019	2020	2030	2040	2050	2019-2030	2030-2040	2040-2050	2019-2050
Total final energy consumption	435	412	394	363	344	-0.9	-0.8	-0.5	-0.8
Industry	162	157	170	169	160	0.4	-0.1	-0.5	0.0
Iron and Steel	36	33	37	36	32	0.2	-0.3	-1.2	-0.4
Chemical and petrochemicals	22	20	26	26	25	1.5	0.0	-0.4	0.4
Cement	12	16	11	11	10	-0.8	0.0	-0.9	-0.6
Transport	122	105	102	85	80	-1.6	-1.8	-0.6	-1.4
Road	90	81	73	57	50	-1.9	-2.4	-1.3	-1.9
Passenger cars	47	41	30	19	17	-4.0	-4.5	-1.1	-3.2
Trucks	27	25	28	24	22	0.3	-1.5	-0.9	-0.7
Aviation	14	8	13	13	14	-0.7	0.0	0.7	0.0
Navigation	12	11	11	10	10	-0.8	-0.9	0.0	-0.6
Buildings	129	127	99	89	86	-2.4	-1.1	-0.3	-1.3
Residential	91	90	67	59	58	-2.7	-1.3	-0.2	-1.4
Services	38	36	32	30	28	-1.6	-0.6	-0.7	-1.0
Other	22	23	22	20	18	0.0	-0.9	-1.0	-0.6
<i>Memo items:</i>									
Population (million)	7,672	7,753	8,505	9,155	9,692	0.9	0.7	0.6	0.8
GDP (PPP US\$ billion)	134,710	128,276	184,037	246,960	316,411	2.9	3.0	2.5	2.8
GDP per capita (PPP US\$1000)	17,558	16,545	21,638	26,975	32,648	1.9	2.2	1.9	2.0
Total energy supply per GDP (GJ per US\$1000 PPP)	4.543	4.578	2.973	2.164	1.716	-3.8	-3.1	-2.3	-3.1
Total final consumption per GDP (GJ per US\$1000 PPP)	3.231	3.208	2.139	1.468	1.086	-3.7	-3.7	-3.0	-3.5
Total energy supply per capita (GJ per capita)	79.774	75.739	64.326	58.385	56.027	-1.9	-1.0	-0.4	-1.1

Global electricity system, 2019-2050

IEA net-zero emissions by 2050 pathway (Table 3)

	Electricity generation (Terawatt-hours)					CAGR %			
	2019	2020	2030	2040	2050	2019-2030	2030-2040	2040-2050	2019-2050
Total electricity generation	26,922	26,778	37,316	56,553	71,164	3.0	4.2	2.3	3.2
Renewables	7,153	7,660	22,817	47,521	62,333	11.1	7.6	2.8	7.2
Solar PV	665	821	6,970	17,031	23,468	23.8	9.3	3.3	12.2
Wind	1,423	1,592	8,008	18,787	24,785	17.0	8.9	2.8	9.7
Hydro	4,294	4,418	5,870	7,445	8,461	2.9	2.4	1.3	2.2
Bio-energy and waste	665	718	1,407	2,676	3,279	7.1	6.6	2.1	5.3
Bio-energy with CCUS	0	0	129	673	842		18.0	2.3	
Concentrating solar power	14	14	204	880	1,386	27.6	15.7	4.6	16.0
Geothermal	92	94	330	625	821	12.3	6.6	2.8	7.3
Tidal and wave	1	2	27	77	132	34.9	11.0	5.5	17.1
Nuclear	2,792	2,698	3,777	4,855	5,497	2.8	2.5	1.2	2.2
Hydrogen-based energy	0	0	875	1,857	1,713		7.8	-0.8	
Fossil fuels with CCUS	1	4	459	1,659	1,332	74.6	13.7	-2.2	26.1
Coal with CCUS	1	4	289	966	663	67.4	12.8	-3.7	23.3
Gas with CCUS	0	0	170	694	669		15.1	-0.4	
Unabated fossil fuels	16,941	16,382	9,358	632	259	-5.3	-23.6	-8.5	-12.6
Unabated coal	9,832	9,426	2,947	0	0	-10.4	-100.0		-100.0
Unabated gas	6,314	6,200	6,222	626	253	-0.1	-20.5	-8.7	-9.9
Oil products	795	756	189	6	6	-12.2	-29.2	0.0	-14.6

Source: "Net Zero by 2050: A Roadmap for the Global Energy Sector", IEA, 2021

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Global electricity system, 2019-2050

IEA net-zero emissions by 2050 pathway (Table 4)

	Installed generation capacity (Gigawatts)					CAGR %			
	2019	2020	2030	2040	2050	2019-2030	2030-2040	2040-2050	2019-2050
Total electricity generation	7,484	7,795	14,933	26,384	33,415	6.5	5.9	2.4	4.9
Renewables	2,707	2,994	10,293	20,732	26,568	12.9	7.3	2.5	7.6
Solar PV	603	737	4,956	10,980	14,458	21.1	8.3	2.8	10.8
Wind	623	737	3,101	6,525	8,265	15.7	7.7	2.4	8.7
Hydro	1,306	1,327	1,804	2,282	2,599	3.0	2.4	1.3	2.2
Bio-energy and waste	153	171	297	534	640	6.2	6.0	1.8	4.7
Bio-energy with CCUS	0	0	28	125	152		16.1	2.0	
Concentrating solar power	6	6	73	281	426	25.5	14.4	4.2	14.7
Geothermal	15	15	52	98	126	12.0	6.5	2.5	7.1
Tidal and wave	1	1	11	32	55	24.4	11.3	5.6	13.8
Nuclear	415	415	515	730	812	2.0	3.6	1.1	2.2
Hydrogen-based energy	0	0	139	1,455	1,867		26.5	2.5	
Fossil fuels with CCUS	0	1	81	312	394		14.4	2.4	
Coal with CCUS	0	1	53	182	222		13.1	2.0	
Gas with CCUS	0	0	28	130	171		16.6	2.8	
Unabated fossil fuels	4,351	4,368	3,320	1,151	677	-2.4	-10.1	-5.2	-5.8
Unabated coal	2,124	2,117	1,192	432	158	-5.1	-9.7	-9.6	-8.0
Unabated gas	1,788	1,829	1,950	679	495	0.8	-10.0	-3.1	-4.1
Oil products	440	422	178	39	25	-7.9	-14.1	-4.3	-8.8
Battery storage	11	18	585	2,005	3,097	43.5	13.1	4.4	20.0

Source: "Net Zero by 2050: A Roadmap for the Global Energy Sector", IEA, 2021

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