

IEEJ Outlook 2019

Energy transition and a thorny path for 3E challenges

Energy, Environment and Economy



The Institute of
Energy Economics, Japan

Table A20 | World [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	7,208	8,774	10,036	13,761	16,554	18,164	19,275	100	100	100	1.7	1.3	0.8	1.0
Coal	1,783	2,220	2,316	3,731	4,167	4,352	4,323	25	27	22	2.0	0.8	0.2	0.4
Oil	3,105	3,234	3,663	4,390	5,052	5,416	5,628	37	32	29	1.2	1.0	0.5	0.7
Natural gas	1,232	1,664	2,072	3,035	3,978	4,628	5,183	19	22	27	2.3	2.0	1.3	1.6
Nuclear	186	526	675	680	814	856	911	6.0	4.9	4.7	1.0	1.3	0.6	0.9
Hydro	148	184	225	349	425	466	501	2.1	2.5	2.6	2.5	1.4	0.8	1.1
Geothermal	12	34	52	81	183	234	283	0.4	0.6	1.5	3.4	6.0	2.2	3.8
Solar, wind, etc.	0.1	2.5	8.0	145	389	572	762	-	1.1	4.0	17.0	7.3	3.4	5.0
Biomass and waste	742	909	1,022	1,349	1,545	1,640	1,683	10	9.8	8.7	1.5	1.0	0.4	0.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	5,368	6,271	7,035	9,555	11,357	12,446	13,277	100	100	100	1.6	1.2	0.8	1.0
Industry	1,766	1,804	1,868	2,753	3,214	3,535	3,771	29	29	28	1.6	1.1	0.8	0.9
Transport	1,246	1,570	1,958	2,748	3,238	3,497	3,691	25	29	28	2.2	1.2	0.7	0.9
Buildings, etc.	2,002	2,417	2,596	3,185	3,807	4,158	4,436	39	33	33	1.1	1.3	0.8	1.0
Non-energy use	354	480	614	870	1,098	1,256	1,379	7.6	9.1	10	2.3	1.7	1.1	1.4
Coal	703	752	542	1,036	1,050	1,050	1,020	12	11	7.7	1.2	0.1	-0.1	0.0
Oil	2,446	2,605	3,122	3,908	4,536	4,874	5,094	42	41	38	1.6	1.1	0.6	0.8
Natural gas	815	945	1,118	1,440	1,798	2,007	2,163	15	15	16	1.6	1.6	0.9	1.2
Electricity	586	834	1,089	1,794	2,488	2,990	3,481	13	19	26	3.0	2.4	1.7	2.0
Heat	121	336	248	283	293	297	298	5.4	3.0	2.2	-0.7	0.2	0.1	0.2
Hydrogen	-	-	-	-	0.7	1.2	1.3	-	-	-	n.a.	n.a.	3.1	n.a.
Renewables	698	799	916	1,095	1,191	1,228	1,220	13	11	9.2	1.2	0.6	0.1	0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	8,283	11,852	15,441	24,973	34,470	40,912	46,915	100	100	100	2.9	2.3	1.6	1.9
Coal	3,137	4,430	6,001	9,594	11,873	13,096	13,912	37	38	30	3.0	1.5	0.8	1.1
Oil	1,659	1,323	1,212	931	981	992	893	11	3.7	1.9	-1.3	0.4	-0.5	-0.1
Natural gas	999	1,750	2,747	5,794	8,587	11,012	13,538	15	23	29	4.7	2.9	2.3	2.5
Nuclear	713	2,013	2,591	2,606	3,122	3,287	3,496	17	10	7.5	1.0	1.3	0.6	0.9
Hydro	1,717	2,144	2,618	4,061	4,940	5,415	5,824	18	16	12	2.5	1.4	0.8	1.1
Geothermal	14	36	52	82	195	254	307	0.3	0.3	0.7	3.2	6.4	2.3	4.0
Solar PV	-	0.1	1.0	328	1,229	1,923	2,653	-	1.3	5.7	37.3	9.9	3.9	6.3
Wind	-	3.9	31	958	2,446	3,501	4,506	-	3.8	9.6	23.6	6.9	3.1	4.7
CSP and marine	0.5	1.2	1.1	12	119	214	351	-	-	0.7	9.1	18.1	5.6	10.6
Biomass and waste	44	130	164	571	942	1,182	1,399	1.1	2.3	3.0	5.9	3.6	2.0	2.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	22	37	37	37	37	0.2	0.1	0.1	2.3	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	28,090	37,882	49,957	77,321	116,562	153,030	191,975	2.8	3.0	2.5	2.7
Population (million)	4,437	5,281	6,113	7,433	8,514	9,172	9,733	1.3	1.0	0.7	0.8
CO ₂ emissions (Mt)	17,808	20,479	23,113	32,353	37,521	40,407	41,909	1.8	1.1	0.6	0.8
GDP per capita (\$2010 thousand)	6.3	7.2	8.2	10	14	17	20	1.4	2.0	1.8	1.9
Primary energy consump. per capita (toe)	1.6	1.7	1.6	1.9	1.9	2.0	2.0	0.4	0.4	0.1	0.2
Primary energy consumption per GDP ^{*2}	257	232	201	178	142	119	100	-1.0	-1.6	-1.7	-1.7
CO ₂ emissions per GDP ^{*3}	634	541	463	418	322	264	218	-1.0	-1.9	-1.9	-1.9
CO ₂ per primary energy consumption ^{*4}	2.5	2.3	2.3	2.4	2.3	2.2	2.2	0.0	-0.3	-0.2	-0.2

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A21 | Asia [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,439	2,110	2,887	5,497	7,327	8,336	8,987	100	100	100	3.8	2.1	1.0	1.5
Coal	466	787	1,036	2,685	3,238	3,505	3,557	37	49	40	4.8	1.3	0.5	0.8
Oil	477	618	916	1,367	1,819	2,052	2,207	29	25	25	3.1	2.1	1.0	1.4
Natural gas	51	116	233	567	988	1,274	1,524	5.5	10	17	6.3	4.1	2.2	3.0
Nuclear	25	77	132	122	271	338	404	3.6	2.2	4.5	1.8	5.9	2.0	3.6
Hydro	20	32	41	138	182	205	221	1.5	2.5	2.5	5.8	2.0	1.0	1.4
Geothermal	2.6	8.2	23	40	93	119	145	0.4	0.7	1.6	6.3	6.3	2.2	3.9
Solar, wind, etc.	-	1.2	2.1	62	180	264	344	0.1	1.1	3.8	16.2	7.9	3.3	5.2
Biomass and waste	397	471	503	517	554	579	584	22	9.4	6.5	0.4	0.5	0.3	0.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,129	1,556	1,991	3,709	4,783	5,412	5,887	100	100	100	3.4	1.8	1.0	1.4
Industry	383	514	647	1,511	1,789	1,959	2,086	33	41	35	4.2	1.2	0.8	1.0
Transport	124	184	318	661	969	1,120	1,226	12	18	21	5.1	2.8	1.2	1.8
Buildings, etc.	569	741	842	1,162	1,525	1,750	1,935	48	31	33	1.7	2.0	1.2	1.5
Non-energy use	54	117	185	375	499	583	640	7.5	10	11	4.6	2.1	1.3	1.6
Coal	301	424	373	899	906	901	873	27	24	15	2.9	0.1	-0.2	-0.1
Oil	326	459	734	1,204	1,634	1,859	2,017	29	32	34	3.8	2.2	1.1	1.5
Natural gas	21	47	88	266	463	574	653	3.0	7.2	11	6.9	4.0	1.7	2.7
Electricity	88	156	278	784	1,217	1,512	1,793	10	21	30	6.4	3.2	2.0	2.5
Heat	7.5	14	30	96	110	118	120	0.9	2.6	2.0	7.6	1.0	0.4	0.7
Hydrogen	-	-	-	-	0.2	0.5	0.5	-	-	-	n.a.	n.a.	3.7	n.a.
Renewables	386	456	488	459	452	447	431	29	12	7.3	0.0	-0.1	-0.2	-0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,196	2,240	3,983	10,768	16,728	20,542	23,994	100	100	100	6.2	3.2	1.8	2.4
Coal	298	869	1,990	6,443	8,928	10,379	11,496	39	60	48	8.0	2.4	1.3	1.7
Oil	476	434	390	233	209	183	140	19	2.2	0.6	-2.4	-0.8	-2.0	-1.5
Natural gas	90	237	559	1,340	2,299	3,156	4,119	11	12	17	6.9	3.9	3.0	3.4
Nuclear	97	294	505	468	1,041	1,296	1,552	13	4.3	6.5	1.8	5.9	2.0	3.6
Hydro	232	369	478	1,603	2,118	2,382	2,565	16	15	11	5.8	2.0	1.0	1.4
Geothermal	3.0	8.4	20	24	60	77	94	0.4	0.2	0.4	4.2	6.7	2.2	4.1
Solar PV	-	0.1	0.6	152	708	1,123	1,533	-	1.4	6.4	34.4	11.6	3.9	7.0
Wind	-	-	2.4	294	993	1,458	1,892	-	2.7	7.9	41.7	9.1	3.3	5.6
CSP and marine	-	-	-	0.5	7.5	14	26	-	-	0.1	18.2	20.8	6.4	12.1
Biomass and waste	-	9.5	17	187	341	452	554	0.4	1.7	2.3	12.1	4.4	2.5	3.2
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	20	23	23	23	23	0.9	0.2	0.1	0.6	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	4,441	7,560	11,025	23,349	42,947	61,820	81,967	4.4	4.4	3.3	3.8
Population (million)	2,440	2,933	3,410	4,035	4,439	4,601	4,665	1.2	0.7	0.2	0.4
CO ₂ emissions (Mt)	3,105	4,632	6,720	14,795	18,891	21,064	22,176	4.6	1.8	0.8	1.2
GDP per capita (\$2010 thousand)	1.8	2.6	3.2	5.8	9.7	13	18	3.2	3.7	3.0	3.3
Primary energy consump. per capita (toe)	0.6	0.7	0.8	1.4	1.7	1.8	1.9	2.5	1.4	0.8	1.0
Primary energy consumption per GDP ^{*2}	324	279	262	235	171	135	110	-0.7	-2.3	-2.2	-2.2
CO ₂ emissions per GDP ^{*3}	699	613	609	634	440	341	271	0.1	-2.6	-2.4	-2.5
CO ₂ per primary energy consumption ^{*4}	2.2	2.2	2.3	2.7	2.6	2.5	2.5	0.8	-0.3	-0.2	-0.3

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A22 | China [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	598	874	1,130	2,958	3,658	3,915	3,873	100	100	100	4.8	1.5	0.3	0.8
Coal	313	531	665	1,916	2,035	2,014	1,817	61	65	47	5.1	0.4	-0.6	-0.2
Oil	89	119	221	545	732	774	743	14	18	19	6.0	2.1	0.1	0.9
Natural gas	12	13	21	171	370	476	554	1.5	5.8	14	10.5	5.7	2.0	3.5
Nuclear	-	-	4.4	56	149	200	249	-	1.9	6.4	n.a.	7.3	2.6	4.5
Hydro	5.0	11	19	100	122	132	135	1.2	3.4	3.5	8.9	1.4	0.5	0.9
Geothermal	-	-	1.7	9.4	12	15	16	-	0.3	0.4	n.a.	2.0	1.2	1.5
Solar, wind, etc.	-	-	1.0	49	133	186	231	-	1.7	6.0	32.4	7.3	2.8	4.7
Biomass and waste	180	200	198	113	106	121	130	23	3.8	3.3	-2.2	-0.5	1.0	0.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	487	658	781	1,969	2,365	2,517	2,536	100	100	100	4.3	1.3	0.3	0.7
Industry	181	234	302	994	998	986	967	36	50	38	5.7	0.0	-0.2	-0.1
Transport	22	30	84	297	465	501	484	4.6	15	19	9.2	3.3	0.2	1.4
Buildings, etc.	274	351	338	516	686	778	816	53	26	32	1.5	2.1	0.9	1.4
Non-energy use	10	43	57	162	215	252	269	6.5	8.2	11	5.3	2.0	1.1	1.5
Coal	214	311	274	710	620	558	488	47	36	19	3.2	-1.0	-1.2	-1.1
Oil	59	85	180	495	673	712	685	13	25	27	7.0	2.2	0.1	1.0
Natural gas	6.4	8.9	12	113	214	264	294	1.3	5.7	12	10.3	4.7	1.6	2.8
Electricity	21	39	89	445	655	769	848	5.9	23	33	9.8	2.8	1.3	1.9
Heat	7.4	13	26	90	103	111	113	2.0	4.6	4.5	7.7	1.0	0.4	0.7
Hydrogen	-	-	-	-	0.2	0.3	0.3	-	-	-	n.a.	n.a.	3.1	n.a.
Renewables	180	200	199	117	99	103	107	30	5.9	4.2	-2.1	-1.2	0.4	-0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	301	621	1,356	6,187	9,019	10,463	11,388	100	100	100	9.2	2.7	1.2	1.8
Coal	159	441	1,060	4,242	5,157	5,444	5,374	71	69	47	9.1	1.4	0.2	0.7
Oil	82	50	47	10	10.0	8.2	5.7	8.1	0.2	0.1	-5.9	-0.3	-2.8	-1.7
Natural gas	0.7	2.8	5.8	170	535	773	1,020	0.4	2.8	9.0	17.2	8.5	3.3	5.4
Nuclear	-	-	17	213	573	766	955	-	3.4	8.4	n.a.	7.3	2.6	4.5
Hydro	58	127	222	1,163	1,414	1,531	1,574	20	19	14	8.9	1.4	0.5	0.9
Geothermal	-	0.1	0.1	0.1	0.4	0.4	0.5	-	-	-	3.1	8.2	1.3	4.1
Solar PV	-	-	-	75	388	573	734	-	1.2	6.4	50.0	12.4	3.2	6.9
Wind	-	-	0.6	237	802	1,169	1,474	-	3.8	13	56.7	9.1	3.1	5.5
CSP and marine	-	-	-	-	1.0	3.7	8.0	-	-	0.1	6.9	26.2	10.7	16.9
Biomass and waste	-	-	2.4	76	139	195	244	-	1.2	2.1	n.a.	4.4	2.8	3.5
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	341	830	2,237	9,504	20,603	31,022	40,505	9.8	5.7	3.4	4.4
Population (million)	981	1,135	1,263	1,379	1,416	1,393	1,341	0.8	0.2	-0.3	-0.1
CO ₂ emissions (Mt)	1,392	2,136	3,126	9,015	10,267	10,433	9,706	5.7	0.9	-0.3	0.2
GDP per capita (\$2010 thousand)	0.3	0.7	1.8	6.9	15	22	30	9.0	5.5	3.7	4.4
Primary energy consump. per capita (toe)	0.6	0.8	0.9	2.1	2.6	2.8	2.9	4.0	1.3	0.6	0.9
Primary energy consumption per GDP ^{*2}	1,752	1,053	505	311	178	126	96	-4.6	-3.9	-3.0	-3.4
CO ₂ emissions per GDP ^{*3}	4,079	2,575	1,398	949	498	336	240	-3.8	-4.5	-3.6	-4.0
CO ₂ per primary energy consumption ^{*4}	2.3	2.4	2.8	3.0	2.8	2.7	2.5	0.9	-0.6	-0.6	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A23 | India [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	200	306	441	862	1,499	1,943	2,357	100	100	100	4.1	4.0	2.3	3.0
Coal	44	93	146	380	694	892	1,068	30	44	45	5.6	4.4	2.2	3.1
Oil	33	61	112	217	390	516	633	20	25	27	5.0	4.3	2.5	3.2
Natural gas	1.3	11	23	47	127	197	270	3.5	5.5	11	5.9	7.4	3.8	5.3
Nuclear	0.8	1.6	4.4	9.9	30	47	63	0.5	1.1	2.7	7.3	8.4	3.7	5.6
Hydro	4.0	6.2	6.4	12	24	31	38	2.0	1.4	1.6	2.5	5.2	2.4	3.5
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	0.2	5.8	31	51	74	-	0.7	3.1	27.5	12.8	4.4	7.8
Biomass and waste	116	133	149	192	203	209	210	44	22	8.9	1.4	0.4	0.2	0.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	174	243	314	572	971	1,261	1,538	100	100	100	3.4	3.9	2.3	2.9
Industry	41	67	83	193	364	473	557	27	34	36	4.2	4.7	2.1	3.2
Transport	17	21	32	90	168	234	299	8.5	16	19	5.8	4.6	2.9	3.6
Buildings, etc.	110	142	172	243	351	440	545	59	43	35	2.1	2.7	2.2	2.4
Non-energy use	5.7	13	27	46	88	115	137	5.5	8.1	8.9	4.9	4.7	2.3	3.2
Coal	25	38	33	99	177	222	252	16	17	16	3.7	4.3	1.8	2.8
Oil	27	50	94	182	342	461	575	21	32	37	5.1	4.6	2.6	3.4
Natural gas	0.7	5.6	9.7	32	74	105	128	2.3	5.6	8.3	6.9	6.2	2.8	4.1
Electricity	7.8	18	32	95	219	321	439	7.6	17	29	6.5	6.1	3.5	4.6
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	0.1	0.1	-	-	-	n.a.	n.a.	7.0	n.a.
Renewables	114	130	144	164	158	153	144	54	29	9.4	0.9	-0.2	-0.5	-0.4

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	120	293	570	1,478	3,285	4,628	6,086	100	100	100	6.4	5.9	3.1	4.3
Coal	61	192	390	1,105	2,184	2,936	3,710	65	75	61	7.0	5.0	2.7	3.6
Oil	8.8	13	29	23	31	29	18	4.5	1.6	0.3	2.2	2.1	-2.6	-0.7
Natural gas	0.6	10.0	56	71	256	462	744	3.4	4.8	12	7.9	9.6	5.5	7.1
Nuclear	3.0	6.1	17	38	117	182	241	2.1	2.6	4.0	7.3	8.4	3.7	5.6
Hydro	47	72	74	138	280	364	448	24	9.3	7.4	2.5	5.2	2.4	3.5
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar PV	-	-	-	14	176	307	440	-	1.0	7.2	n.a.	19.7	4.7	10.6
Wind	-	-	1.7	45	151	228	330	-	3.0	5.4	32.1	9.1	4.0	6.0
CSP and marine	-	-	-	-	3.2	5.9	9.5	-	-	0.2	n.a.	n.a.	5.6	n.a.
Biomass and waste	-	-	1.3	44	86	115	145	-	3.0	2.4	n.a.	5.0	2.6	3.6
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	271	465	800	2,456	6,243	10,407	16,104	6.6	6.9	4.9	5.7
Population (million)	697	870	1,053	1,324	1,513	1,605	1,659	1.6	1.0	0.5	0.7
CO ₂ emissions (Mt)	258	529	885	2,078	3,921	5,180	6,343	5.4	4.6	2.4	3.3
GDP per capita (\$2010 thousand)	0.4	0.5	0.8	1.9	4.1	6.5	9.7	4.9	5.9	4.4	5.0
Primary energy consump. per capita (toe)	0.3	0.4	0.4	0.7	1.0	1.2	1.4	2.4	3.0	1.8	2.3
Primary energy consumption per GDP ^{*2}	739	658	551	351	240	187	146	-2.4	-2.7	-2.4	-2.5
CO ₂ emissions per GDP ^{*3}	953	1,138	1,106	846	628	498	394	-1.1	-2.1	-2.3	-2.2
CO ₂ per primary energy consumption ^{*4}	1.3	1.7	2.0	2.4	2.6	2.7	2.7	1.3	0.6	0.1	0.3

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A24 | Japan [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	345	438	518	426	420	394	367	100	100	100	-0.1	-0.1	-0.7	-0.4
Coal	60	76	97	114	103	99	89	17	27	24	1.6	-0.8	-0.7	-0.7
Oil	234	250	255	177	144	126	110	57	42	30	-1.3	-1.4	-1.4	-1.4
Natural gas	21	44	66	102	96	91	83	10	24	23	3.3	-0.4	-0.7	-0.6
Nuclear	22	53	84	4.7	40	35	34	12	1.1	9.4	-8.9	16.4	-0.7	6.0
Hydro	7.6	7.6	7.3	6.8	7.7	7.8	7.9	1.7	1.6	2.1	-0.4	0.9	0.1	0.4
Geothermal	0.8	1.6	3.1	2.3	5.2	8.2	11	0.4	0.5	2.9	1.5	5.8	3.6	4.5
Solar, wind, etc.	-	1.2	0.8	5.1	7.7	11	14	0.3	1.2	3.8	5.8	2.9	3.0	3.0
Biomass and waste	-	4.6	4.9	14	17	18	18	1.0	3.2	4.9	4.4	1.3	0.5	0.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	232	288	331	294	277	261	245	100	100	100	0.1	-0.4	-0.6	-0.5
Industry	91	106	97	82	79	77	75	37	28	30	-1.0	-0.3	-0.3	-0.3
Transport	54	68	86	72	58	51	46	24	24	19	0.2	-1.4	-1.2	-1.3
Buildings, etc.	58	78	106	104	104	97	91	27	35	37	1.1	0.0	-0.7	-0.4
Non-energy use	28	36	41	37	36	35	34	12	13	14	0.2	-0.2	-0.4	-0.3
Coal	25	27	21	21	19	18	17	9.5	7.3	6.8	-0.9	-0.7	-0.8	-0.7
Oil	157	177	202	150	126	112	100	61	51	41	-0.6	-1.2	-1.1	-1.2
Natural gas	5.8	15	22	32	36	34	33	5.1	11	13	3.0	0.8	-0.4	0.0
Electricity	44	65	81	83	89	90	89	23	28	36	1.0	0.5	0.0	0.2
Heat	0.1	0.2	0.5	0.5	0.4	0.4	0.3	0.1	0.2	0.1	3.7	-1.2	-1.3	-1.3
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	-1.4	n.a.
Renewables	-	3.9	3.8	6.7	6.7	6.4	6.1	1.4	2.3	2.5	2.1	0.0	-0.4	-0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	573	861	1,058	1,052	1,125	1,130	1,112	100	100	100	0.8	0.5	-0.1	0.2
Coal	55	123	230	349	315	314	295	14	33	26	4.1	-0.7	-0.3	-0.5
Oil	265	248	140	84	47	27	8.2	29	8.0	0.7	-4.1	-4.2	-8.3	-6.6
Natural gas	81	168	248	406	360	355	330	20	39	30	3.5	-0.9	-0.4	-0.6
Nuclear	83	202	322	18	152	133	132	24	1.7	12	-8.9	16.4	-0.7	6.0
Hydro	88	88	84	79	89	91	91	10	7.5	8.2	-0.4	0.9	0.1	0.4
Geothermal	0.9	1.7	3.3	2.5	5.8	9.4	12	0.2	0.2	1.1	1.4	6.2	3.7	4.7
Solar PV	-	0.1	0.4	51	72	102	131	-	4.8	12	29.1	2.5	3.1	2.8
Wind	-	-	0.1	6.0	16	22	31	-	0.6	2.7	n.a.	7.1	3.4	4.9
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	8.9	10	34	47	55	61	1.0	3.2	5.5	5.2	2.4	1.3	1.8
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	20	21	21	21	21	2.3	2.0	1.9	0.3	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	2,977	4,683	5,349	6,053	6,808	7,353	7,885	1.0	0.8	0.7	0.8
Population (million)	117	124	127	127	121	115	108	0.1	-0.4	-0.6	-0.5
CO ₂ emissions (Mt)	908	1,046	1,145	1,138	984	902	802	0.3	-1.0	-1.0	-1.0
GDP per capita (\$2010 thousand)	25	38	42	48	56	64	73	0.9	1.2	1.3	1.3
Primary energy consump. per capita (toe)	3.0	3.5	4.1	3.4	3.5	3.4	3.4	-0.2	0.3	-0.1	0.0
Primary energy consumption per GDP ^{*2}	116	94	97	70	62	54	46	-1.1	-0.9	-1.4	-1.2
CO ₂ emissions per GDP ^{*3}	305	223	214	188	144	123	102	-0.7	-1.9	-1.7	-1.8
CO ₂ per primary energy consumption ^{*4}	2.6	2.4	2.2	2.7	2.3	2.3	2.2	0.4	-0.9	-0.3	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A25 | Korea [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	41	93	188	282	307	304	287	100	100	100	4.4	0.6	-0.3	0.0
Coal	14	25	42	81	89	88	81	27	29	28	4.6	0.6	-0.4	0.0
Oil	27	50	99	110	113	109	100	54	39	35	3.1	0.2	-0.6	-0.3
Natural gas	-	2.7	17	41	55	63	67	2.9	15	24	11.0	2.1	1.0	1.5
Nuclear	0.9	14	28	42	38	31	23	15	15	8.0	4.4	-0.8	-2.5	-1.8
Hydro	0.2	0.5	0.3	0.2	0.3	0.3	0.3	0.6	0.1	0.1	-3.0	2.0	0.0	0.8
Geothermal	-	-	-	0.2	0.2	0.2	0.2	-	0.1	0.1	n.a.	1.6	0.4	0.9
Solar, wind, etc.	-	-	-	0.8	2.6	3.9	5.7	-	0.3	2.0	18.1	9.2	4.1	6.1
Biomass and waste	-	0.7	1.4	6.4	8.7	8.8	8.4	0.8	2.3	2.9	8.7	2.2	-0.2	0.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	31	65	127	179	196	197	189	100	100	100	4.0	0.7	-0.2	0.2
Industry	10	19	38	48	52	52	50	30	27	26	3.6	0.6	-0.2	0.1
Transport	4.8	15	26	35	37	35	31	22	20	16	3.4	0.4	-0.9	-0.3
Buildings, etc.	13	24	37	46	52	53	53	38	26	28	2.5	0.8	0.1	0.4
Non-energy use	3.1	6.7	25	50	55	56	56	10	28	29	8.0	0.7	0.0	0.3
Coal	9.7	12	9.1	9.4	8.4	7.5	6.4	18	5.3	3.4	-0.8	-0.8	-1.4	-1.1
Oil	19	44	80	94	98	93	86	67	53	46	3.0	0.3	-0.6	-0.2
Natural gas	-	0.7	11	22	26	27	27	1.0	12	14	14.3	1.4	0.2	0.7
Electricity	2.8	8.1	23	44	54	58	60	13	25	32	6.8	1.4	0.6	0.9
Heat	-	-	3.3	4.8	4.8	4.8	4.5	-	2.7	2.4	n.a.	0.1	-0.4	-0.2
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	2.6	n.a.
Renewables	-	0.7	1.3	4.4	5.2	5.1	4.7	1.1	2.5	2.5	7.1	1.2	-0.6	0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	37	105	289	559	677	736	761	100	100	100	6.6	1.4	0.6	0.9
Coal	2.5	18	111	235	275	293	288	17	42	38	10.5	1.1	0.2	0.6
Oil	29	19	35	18	16	13	7.9	18	3.2	1.0	-0.2	-0.7	-3.5	-2.4
Natural gas	-	9.6	29	127	194	248	291	9.1	23	38	10.4	3.1	2.0	2.5
Nuclear	3.5	53	109	162	146	117	88	50	29	12	4.4	-0.8	-2.5	-1.8
Hydro	2.0	6.4	4.0	2.8	3.7	3.7	3.7	6.0	0.5	0.5	-3.0	2.0	0.0	0.8
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar PV	-	-	-	5.1	22	32	45	-	0.9	5.9	38.9	10.8	3.7	6.6
Wind	-	-	-	1.7	4.9	8.3	14	-	0.3	1.8	n.a.	8.0	5.2	6.4
CSP and marine	-	-	-	0.5	3.2	4.7	8.0	-	0.1	1.1	n.a.	14.2	4.7	8.5
Biomass and waste	-	-	0.1	6.4	12	13	14	-	1.1	1.9	n.a.	4.5	0.9	2.4
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	1.3	1.3	1.3	1.3	-	0.2	0.2	n.a.	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	141	363	710	1,305	1,873	2,278	2,624	5.0	2.6	1.7	2.1
Population (million)	38	43	47	51	53	53	51	0.7	0.3	-0.2	0.0
CO ₂ emissions (Mt)	112	215	414	601	659	660	621	4.0	0.7	-0.3	0.1
GDP per capita (\$2010 thousand)	3.7	8.5	15	25	35	43	52	4.3	2.3	1.9	2.1
Primary energy consump. per capita (toe)	1.1	2.2	4.0	5.5	5.8	5.8	5.6	3.7	0.3	-0.1	0.1
Primary energy consumption per GDP ^{*2}	292	256	265	216	164	134	109	-0.6	-2.0	-2.0	-2.0
CO ₂ emissions per GDP ^{*3}	793	593	583	461	352	290	237	-1.0	-1.9	-2.0	-1.9
CO ₂ per primary energy consumption ^{*4}	2.7	2.3	2.2	2.1	2.1	2.2	2.2	-0.3	0.0	0.1	0.1

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A26 | Chinese Taipei [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	28	48	85	110	111	110	105	100	100	100	3.3	0.1	-0.3	-0.1
Coal	3.9	11	30	41	42	39	33	24	37	32	5.0	0.2	-1.2	-0.6
Oil	20	26	38	43	41	39	36	54	39	35	2.0	-0.2	-0.7	-0.5
Natural gas	1.6	1.4	5.6	15	22	25	28	2.9	14	27	9.7	2.6	1.1	1.7
Nuclear	2.1	8.6	10	8.2	-	-	-	18	7.5	-	-0.1	-100	n.a.	-100
Hydro	0.3	0.5	0.4	0.6	0.4	0.4	0.4	1.1	0.5	0.4	0.1	-2.2	0.0	-0.9
Geothermal	-	-	-	-	-	-	-	-	-	-	-100	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	0.1	0.3	1.3	2.2	3.1	-	0.3	3.0	11.8	10.6	4.3	6.8
Biomass and waste	-	-	0.6	1.5	3.3	3.7	3.7	-	1.4	3.5	n.a.	6.0	0.5	2.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	19	29	49	70	72	72	71	100	100	100	3.4	0.2	-0.1	0.0
Industry	10	12	19	23	24	24	24	42	33	33	2.5	0.2	-0.1	0.0
Transport	2.9	6.6	12	13	12	11	8.9	22	18	13	2.6	-0.5	-1.5	-1.1
Buildings, etc.	3.6	6.5	10	12	14	14	15	22	17	21	2.5	0.7	0.6	0.6
Non-energy use	2.0	4.0	7.8	22	23	23	23	14	31	33	6.8	0.3	0.1	0.2
Coal	2.2	3.6	5.0	8.5	8.1	7.5	6.8	12	12	9.6	3.4	-0.4	-0.8	-0.7
Oil	12	18	28	38	37	35	33	62	54	46	2.9	-0.2	-0.6	-0.4
Natural gas	1.4	0.9	1.6	3.0	3.9	4.2	4.2	3.0	4.3	5.9	4.9	1.9	0.3	1.0
Electricity	3.2	6.6	14	20	23	25	26	22	29	37	4.4	0.9	0.7	0.8
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	0.5	n.a.
Renewables	-	-	0.1	0.2	0.4	0.5	0.5	0.1	0.3	0.7	9.8	4.4	1.8	2.8

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	43	88	181	261	295	319	338	100	100	100	4.2	0.9	0.7	0.8
Coal	6.0	24	88	122	134	128	118	28	47	35	6.4	0.7	-0.6	-0.1
Oil	26	23	30	11	11	8.5	6.1	26	4.3	1.8	-2.8	-0.5	-2.7	-1.8
Natural gas	-	1.2	17	83	124	146	166	1.4	32	49	17.5	2.9	1.5	2.0
Nuclear	8.2	33	39	32	-	-	-	37	12	-	-0.1	-100	n.a.	-100
Hydro	2.9	6.4	4.6	6.6	4.8	4.8	4.8	7.2	2.5	1.4	0.1	-2.2	0.0	-0.9
Geothermal	-	-	-	-	-	-	-	-	-	-	-100	n.a.	n.a.	n.a.
Solar PV	-	-	-	1.1	6.1	10	14	-	0.4	4.3	n.a.	12.7	4.4	7.8
Wind	-	-	-	1.5	8.3	14	20	-	0.6	5.9	n.a.	13.2	4.5	8.0
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	-	1.7	3.5	7.3	8.3	8.8	-	1.4	2.6	n.a.	5.4	0.9	2.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	70	155	297	514	684	814	929	4.7	2.1	1.5	1.8
Population (million)	18	20	22	24	24	24	23	0.6	0.2	-0.3	-0.1
CO ₂ emissions (Mt)	71	110	214	261	276	263	239	3.4	0.4	-0.7	-0.3
GDP per capita (\$2010 thousand)	3.9	7.6	13	22	28	34	41	4.1	1.9	1.8	1.9
Primary energy consump. per capita (toe)	1.6	2.3	3.8	4.7	4.6	4.6	4.6	2.7	-0.1	0.0	0.0
Primary energy consumption per GDP ^{*2}	396	308	286	213	162	135	112	-1.4	-1.9	-1.8	-1.9
CO ₂ emissions per GDP ^{*3}	1,008	706	722	508	404	323	257	-1.3	-1.6	-2.2	-2.0
CO ₂ per primary energy consumption ^{*4}	2.5	2.3	2.5	2.4	2.5	2.4	2.3	0.1	0.3	-0.4	-0.1

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A27 | ASEAN [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	142	233	379	643	1,011	1,270	1,514	100	100	100	4.0	3.3	2.0	2.6
Coal	3.6	13	32	120	233	316	395	5.4	19	26	9.1	4.8	2.7	3.6
Oil	58	89	153	220	314	386	461	38	34	30	3.6	2.6	1.9	2.2
Natural gas	8.6	30	74	139	225	285	339	13	22	22	6.1	3.5	2.1	2.7
Nuclear	-	-	-	-	-	12	21	-	-	1.4	n.a.	n.a.	n.a.	n.a.
Hydro	0.8	2.3	4.1	11	18	20	22	1.0	1.7	1.5	6.1	3.5	1.1	2.1
Geothermal	1.8	6.6	18	28	75	96	117	2.8	4.3	7.8	5.7	7.3	2.3	4.3
Solar, wind, etc.	-	-	-	0.6	3.8	8.1	13	-	0.1	0.9	n.a.	14.8	6.3	9.8
Biomass and waste	70	93	98	123	140	144	141	40	19	9.3	1.1	1.0	0.0	0.4

Final energy consumption

	Mtoe							Shares (%)			1990/2016/2030/2050			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	112	173	270	451	659	812	960	100	100	100	3.7	2.7	1.9	2.2
Industry	22	43	75	129	208	267	317	25	29	33	4.3	3.5	2.1	2.7
Transport	17	32	61	122	176	220	273	19	27	28	5.2	2.7	2.2	2.4
Buildings, etc.	71	87	113	148	199	230	257	50	33	27	2.1	2.1	1.3	1.6
Non-energy use	2.4	11	21	52	76	95	114	6.3	12	12	6.2	2.7	2.1	2.3
Coal	2.1	6.1	13	35	53	64	72	3.5	7.8	7.5	7.0	3.0	1.6	2.1
Oil	41	67	123	204	292	362	435	38	45	45	4.4	2.6	2.0	2.3
Natural gas	2.5	7.5	17	37	66	85	100	4.4	8.2	10	6.3	4.2	2.1	3.0
Electricity	4.7	11	28	73	139	194	253	6.4	16	26	7.5	4.7	3.1	3.7
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	0.1	-	-	-	n.a.	n.a.	5.8	n.a.
Renewables	61	82	89	102	109	107	99	47	23	10	0.8	0.5	-0.5	-0.1

Electricity generation

	(TWh)							Shares (%)			1990/2016/2030/2050			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	62	154	370	926	1,780	2,493	3,251	100	100	100	7.1	4.8	3.1	3.8
Coal	3.0	28	79	339	785	1,157	1,566	18	37	48	10.1	6.2	3.5	4.6
Oil	47	66	72	25	23	22	14	43	2.7	0.4	-3.7	-0.5	-2.4	-1.6
Natural gas	0.7	26	154	383	617	808	1,019	17	41	31	10.9	3.5	2.5	2.9
Nuclear	-	-	-	-	-	44	81	-	-	2.5	n.a.	n.a.	n.a.	n.a.
Hydro	9.8	27	47	128	208	238	259	18	14	8.0	6.1	3.5	1.1	2.1
Geothermal	2.1	6.6	16	22	54	67	81	4.3	2.3	2.5	4.7	6.7	2.1	3.9
Solar PV	-	-	-	4.9	38	83	136	-	0.5	4.2	n.a.	15.7	6.6	10.2
Wind	-	-	-	1.5	6.3	11	16	-	0.2	0.5	n.a.	10.7	4.8	7.2
CSP and marine	-	-	-	-	0.1	0.2	0.3	-	-	-	n.a.	n.a.	8.3	n.a.
Biomass and waste	-	0.6	1.0	23	47	63	78	0.4	2.5	2.4	15.1	5.3	2.5	3.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	440	741	1,180	2,607	5,042	7,503	10,546	5.0	4.8	3.8	4.2
Population (million)	346	430	506	618	700	740	765	1.4	0.9	0.4	0.6
CO ₂ emissions (Mt)	188	348	676	1,298	2,158	2,793	3,403	5.2	3.7	2.3	2.9
GDP per capita (\$2010 thousand)	1.3	1.7	2.3	4.2	7.2	10	14	3.5	3.9	3.3	3.5
Primary energy consump. per capita (toe)	0.4	0.5	0.7	1.0	1.4	1.7	2.0	2.5	2.4	1.6	1.9
Primary energy consumption per GDP ^{*2}	323	314	322	247	201	169	144	-0.9	-1.5	-1.7	-1.6
CO ₂ emissions per GDP ^{*3}	426	469	573	498	428	372	323	0.2	-1.1	-1.4	-1.3
CO ₂ per primary energy consumption ^{*4}	1.3	1.5	1.8	2.0	2.1	2.2	2.2	1.2	0.4	0.3	0.3

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A28 | Indonesia [Reference Scenario]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	56	99	156	230	390	497	591	100	100	100	3.3	3.8	2.1	2.8
Coal	0.2	3.5	12	43	88	124	158	3.6	19	27	10.1	5.2	3.0	3.9
Oil	20	33	58	70	104	127	147	34	31	25	2.9	2.8	1.8	2.2
Natural gas	5.0	16	27	39	77	108	134	16	17	23	3.5	5.0	2.8	3.7
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	0.1	0.5	0.9	1.7	1.7	1.8	2.0	0.5	0.7	0.3	4.8	-0.1	1.0	0.6
Geothermal	-	1.9	8.4	18	58	76	96	2.0	8.0	16	9.0	8.6	2.6	5.0
Solar, wind, etc.	-	-	-	-	-	0.1	0.2	-	-	-	n.a.	24.2	8.0	14.4
Biomass and waste	30	44	50	58	62	59	54	44	25	9.1	1.1	0.5	-0.7	-0.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	50	80	120	165	241	295	342	100	100	100	2.8	2.8	1.8	2.2
Industry	6.7	18	30	39	65	85	103	23	24	30	3.0	3.7	2.4	2.9
Transport	6.0	11	21	47	70	89	109	13	29	32	5.9	2.9	2.2	2.5
Buildings, etc.	36	44	59	71	95	106	114	55	43	33	1.9	2.1	0.9	1.4
Non-energy use	1.2	7.4	9.8	7.4	11	14	16	9.2	4.5	4.8	0.0	3.1	1.9	2.4
Coal	0.1	2.3	4.7	9.5	15	19	23	2.8	5.8	6.8	5.7	3.3	2.2	2.7
Oil	17	27	48	67	98	121	142	34	41	41	3.5	2.8	1.8	2.2
Natural gas	2.4	6.0	12	13	28	40	48	7.5	8.2	14	3.2	5.4	2.7	3.8
Electricity	0.6	2.4	6.8	19	39	58	78	3.0	11	23	8.1	5.5	3.5	4.3
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	5.4	n.a.
Renewables	29	42	49	56	60	57	52	53	34	15	1.1	0.5	-0.7	-0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	7.5	33	93	249	525	773	1,026	100	100	100	8.1	5.5	3.4	4.3
Coal	-	9.8	34	135	309	465	627	30	54	61	10.6	6.1	3.6	4.6
Oil	6.2	15	18	16	14	14	9.4	47	6.3	0.9	0.1	-0.8	-2.0	-1.5
Natural gas	-	0.7	26	66	146	222	302	2.2	26	29	18.9	5.9	3.7	4.6
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	1.3	5.7	10	19	19	21	24	17	7.8	2.3	4.8	-0.1	1.0	0.6
Geothermal	-	1.1	4.9	11	34	44	56	3.4	4.3	5.4	9.0	8.6	2.6	5.0
Solar PV	-	-	-	-	0.5	1.5	2.5	-	-	0.2	n.a.	26.0	8.0	15.1
Wind	-	-	-	-	-	0.1	0.1	-	-	-	n.a.	11.6	6.4	8.5
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	-	-	1.8	3.4	4.6	5.8	-	0.7	0.6	n.a.	4.7	2.6	3.5
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	182	310	453	1,038	2,138	3,351	4,849	4.8	5.3	4.2	4.6
Population (million)	147	181	212	261	296	313	322	1.4	0.9	0.4	0.6
CO ₂ emissions (Mt)	64	133	255	455	811	1,089	1,339	4.8	4.2	2.5	3.2
GDP per capita (\$2010 thousand)	1.2	1.7	2.1	4.0	7.2	11	15	3.3	4.4	3.7	4.0
Primary energy consump. per capita (toe)	0.4	0.5	0.7	0.9	1.3	1.6	1.8	1.9	2.9	1.7	2.2
Primary energy consumption per GDP ^{*2}	307	318	343	222	182	148	122	-1.4	-1.4	-2.0	-1.7
CO ₂ emissions per GDP ^{*3}	352	431	563	439	379	325	276	0.1	-1.0	-1.6	-1.4
CO ₂ per primary energy consumption ^{*4}	1.1	1.4	1.6	2.0	2.1	2.2	2.3	1.5	0.4	0.4	0.4

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A29 | Malaysia [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	12	22	49	89	125	146	161	100	100	100	5.5	2.4	1.3	1.8
Coal	0.1	1.4	2.3	19	33	39	43	6.2	21	27	10.6	4.2	1.3	2.5
Oil	7.9	11	19	31	37	40	42	53	35	26	3.9	1.3	0.6	0.9
Natural gas	2.2	6.8	25	36	49	57	66	31	40	41	6.6	2.3	1.5	1.8
Nuclear	-	-	-	-	-	3.7	3.7	-	-	2.3	n.a.	n.a.	n.a.	n.a.
Hydro	0.1	0.3	0.6	1.7	2.4	2.8	3.1	1.6	1.9	1.9	6.4	2.4	1.3	1.7
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	-	0.2	0.4	0.6	-	-	0.3	n.a.	14.9	5.7	9.4
Biomass and waste	1.6	1.9	1.9	1.9	2.6	2.9	3.2	8.5	2.2	2.0	0.2	2.2	0.9	1.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	7.2	14	30	56	76	87	96	100	100	100	5.5	2.2	1.2	1.6
Industry	3.1	5.6	12	16	26	32	37	40	29	38	4.2	3.4	1.7	2.4
Transport	2.1	4.9	11	22	24	25	25	35	39	26	5.9	0.8	0.2	0.4
Buildings, etc.	1.7	2.6	5.0	9.3	13	15	17	19	17	18	5.0	2.3	1.6	1.9
Non-energy use	0.3	0.8	2.2	8.7	12	15	17	6.0	16	18	9.4	2.5	1.6	2.0
Coal	0.1	0.5	1.0	1.8	2.4	2.8	3.0	3.7	3.2	3.1	4.9	2.2	1.1	1.5
Oil	5.3	9.3	18	28	34	36	38	67	50	40	4.4	1.3	0.6	0.9
Natural gas	-	1.1	3.9	12	18	21	23	7.9	22	24	9.8	2.8	1.2	1.8
Electricity	0.7	1.7	5.3	12	20	26	31	12	22	32	7.9	3.5	2.2	2.7
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	3.5	n.a.
Renewables	1.0	1.3	1.3	1.2	1.2	1.2	1.1	9.1	2.2	1.2	-0.1	-0.4	-0.2	-0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	10	23	69	157	257	330	398	100	100	100	7.7	3.6	2.2	2.8
Coal	-	2.9	7.7	69	141	173	198	13	44	50	12.9	5.2	1.7	3.1
Oil	8.5	11	3.6	1.2	1.1	0.7	-	46	0.8	-	-8.1	-0.3	-100	-100
Natural gas	0.1	5.5	51	65	82	101	138	24	42	35	9.9	1.7	2.6	2.2
Nuclear	-	-	-	-	-	14	14	-	-	3.5	n.a.	n.a.	n.a.	n.a.
Hydro	1.4	4.0	7.0	20	28	32	36	17	13	9.1	6.4	2.4	1.3	1.7
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar PV	-	-	-	0.3	2.2	4.3	6.5	-	0.2	1.6	n.a.	14.9	5.7	9.4
Wind	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	-	-	0.8	3.4	4.5	5.7	-	0.5	1.4	n.a.	11.3	2.6	6.1
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	46	82	163	344	646	917	1,236	5.7	4.6	3.3	3.8
Population (million)	14	18	23	31	37	40	42	2.1	1.2	0.6	0.9
CO ₂ emissions (Mt)	28	54	115	223	318	362	394	5.6	2.6	1.1	1.7
GDP per capita (\$2010 thousand)	3.3	4.5	7.0	11	18	23	30	3.5	3.4	2.7	2.9
Primary energy consump. per capita (toe)	0.9	1.2	2.1	2.9	3.4	3.7	3.9	3.3	1.2	0.7	0.9
Primary energy consumption per GDP ^{*2}	260	267	301	258	193	159	130	-0.1	-2.1	-1.9	-2.0
CO ₂ emissions per GDP ^{*3}	608	658	708	647	493	394	319	-0.1	-1.9	-2.1	-2.1
CO ₂ per primary energy consumption ^{*4}	2.3	2.5	2.4	2.5	2.6	2.5	2.4	0.1	0.1	-0.2	-0.1

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A30 | Myanmar [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	9.4	11	13	19	29	38	47	100	100	100	2.3	3.0	2.3	2.6
Coal	0.2	0.1	0.3	0.4	3.6	6.5	10	0.6	2.0	22	6.9	17.5	5.4	10.2
Oil	1.3	0.7	2.0	4.4	8.5	12	15	6.8	23	32	7.2	4.9	2.8	3.7
Natural gas	0.3	0.8	1.2	3.5	5.2	7.6	10	7.1	18	22	6.1	2.7	3.5	3.2
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	0.1	0.1	0.2	0.8	3.2	4.2	5.1	1.0	4.3	11	8.4	9.9	2.4	5.4
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	-	0.1	0.1	0.2	-	-	0.5	n.a.	n.a.	6.8	n.a.
Biomass and waste	7.6	9.0	9.2	10	10	9.8	8.7	84	53	19	0.5	0.1	-0.8	-0.5

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	8.4	9.4	11	16	24	29	35	100	100	100	2.2	2.7	1.9	2.2
Industry	0.6	0.4	1.1	1.8	3.8	5.5	6.9	4.2	11	20	5.9	5.7	3.0	4.1
Transport	0.6	0.4	1.2	1.5	3.7	5.4	7.5	4.7	9.3	21	4.9	6.5	3.6	4.8
Buildings, etc.	7.0	8.5	9.1	13	15	17	19	90	77	55	1.6	1.4	1.1	1.2
Non-energy use	0.1	0.1	0.1	0.6	0.9	1.2	1.5	1.0	3.4	4.3	7.1	3.8	2.4	3.0
Coal	0.1	0.1	0.3	0.4	0.7	0.9	1.1	0.5	2.3	3.1	7.9	4.3	2.4	3.2
Oil	1.2	0.6	1.5	4.1	8.2	11	15	6.2	25	42	7.8	5.0	2.9	3.8
Natural gas	0.1	0.2	0.3	0.6	1.0	1.3	1.7	2.4	3.4	4.7	3.5	4.0	2.8	3.3
Electricity	0.1	0.1	0.3	1.3	3.9	6.2	9.1	1.6	8.0	26	8.7	8.0	4.4	5.8
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	6.0	n.a.
Renewables	6.9	8.4	9.0	10	10	9.7	8.6	89	61	25	0.7	0.1	-0.8	-0.5

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1.5	2.5	5.1	18	72	112	160	100	100	100	7.9	10.5	4.1	6.7
Coal	-	-	-	-	15	29	52	1.6	0.1	32	-5.2	68.4	6.5	28.6
Oil	0.5	0.3	0.7	0.1	0.2	0.2	0.2	11	0.3	0.1	-5.6	7.9	-0.5	2.8
Natural gas	0.2	1.0	2.5	8.1	20	32	47	39	45	29	8.5	6.6	4.4	5.3
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	0.8	1.2	1.9	9.7	37	49	59	48	55	37	8.4	9.9	2.4	5.4
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar PV	-	-	-	-	0.3	0.8	1.8	-	-	1.1	n.a.	n.a.	10.1	n.a.
Wind	-	-	-	-	0.5	0.7	1.0	-	-	0.6	n.a.	n.a.	3.7	n.a.
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	5.9	6.7	13	62	150	246	375	9.0	6.5	4.7	5.4
Population (million)	33	41	46	53	59	61	62	1.0	0.8	0.3	0.5
CO ₂ emissions (Mt)	5.1	4.0	9.4	21	49	75	106	6.6	6.3	3.9	4.9
GDP per capita (\$2010 thousand)	0.2	0.2	0.3	1.2	2.5	4.0	6.0	7.9	5.6	4.4	4.9
Primary energy consump. per capita (toe)	0.3	0.3	0.3	0.4	0.5	0.6	0.7	1.3	2.2	2.1	2.1
Primary energy consumption per GDP ^{*2}	1,597	1,594	960	310	196	153	124	-6.1	-3.2	-2.2	-2.7
CO ₂ emissions per GDP ^{*3}	868	597	705	336	328	305	283	-2.2	-0.2	-0.7	-0.5
CO ₂ per primary energy consumption ^{*4}	0.5	0.4	0.7	1.1	1.7	2.0	2.3	4.2	3.2	1.5	2.2

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A31 | Philippines [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	22	29	40	55	97	127	161	100	100	100	2.5	4.2	2.5	3.2
Coal	0.5	1.5	5.2	14	25	33	40	5.3	26	25	9.0	4.1	2.4	3.1
Oil	10	11	16	19	36	51	69	38	34	43	2.1	4.9	3.3	4.0
Natural gas	-	-	-	3.3	7.6	12	16	-	6.0	10	n.a.	6.2	3.9	4.8
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	0.3	0.5	0.7	0.7	0.9	0.9	1.0	1.8	1.3	0.6	1.1	2.1	0.1	0.9
Geothermal	1.8	4.7	10	9.5	17	19	21	16	17	13	2.8	4.3	1.1	2.4
Solar, wind, etc.	-	-	-	0.2	0.6	1.2	2.0	-	0.3	1.2	n.a.	9.0	6.3	7.4
Biomass and waste	9.4	11	8.1	8.3	9.6	10	10	39	15	6.4	-1.1	1.1	0.4	0.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	16	20	24	32	59	81	108	100	100	100	1.8	4.5	3.1	3.7
Industry	3.4	4.7	5.3	7.6	14	18	23	24	24	21	1.9	4.2	2.7	3.3
Transport	3.3	4.5	8.1	11	26	38	53	23	36	50	3.6	5.9	3.7	4.6
Buildings, etc.	9.4	10	10	11	17	22	26	52	36	24	0.4	3.1	2.0	2.4
Non-energy use	0.3	0.2	0.3	1.1	2.2	3.5	5.6	1.2	3.6	5.2	6.3	4.9	4.8	4.8
Coal	0.2	0.6	0.8	2.8	4.7	5.9	7.0	3.1	9.0	6.5	6.1	3.7	2.0	2.7
Oil	6.8	8.1	13	17	34	49	67	41	52	62	2.8	5.3	3.4	4.2
Natural gas	-	-	-	0.1	0.1	0.2	0.2	-	0.2	0.2	n.a.	4.9	2.8	3.7
Electricity	1.5	1.8	3.1	6.4	13	19	26	9.3	20	24	4.9	5.3	3.5	4.2
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	6.0	n.a.
Renewables	7.8	9.1	6.9	5.8	7.0	7.3	7.5	46	18	7.0	-1.7	1.4	0.4	0.8

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	18	26	45	91	184	260	351	100	100	100	4.9	5.2	3.3	4.1
Coal	0.2	1.9	17	43	92	130	175	7.3	48	50	12.7	5.5	3.3	4.2
Oil	12	12	9.2	5.7	4.6	3.6	0.7	47	6.2	0.2	-3.0	-1.4	-9.3	-6.1
Natural gas	-	-	-	20	48	76	114	-	22	32	n.a.	6.5	4.4	5.3
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	3.5	6.1	7.8	8.1	11	11	11	23	8.9	3.2	1.1	2.1	0.1	0.9
Geothermal	2.1	5.5	12	11	20	23	25	21	12	7.1	2.8	4.3	1.1	2.4
Solar PV	-	-	-	1.1	3.6	8.7	15	-	1.2	4.3	n.a.	8.8	7.5	8.0
Wind	-	-	-	1.0	3.4	5.3	8.1	-	1.1	2.3	n.a.	9.2	4.5	6.4
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	0.4	-	0.7	1.3	1.8	2.2	1.6	0.8	0.6	2.0	4.4	2.6	3.4
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	80	95	125	284	620	915	1,305	4.3	5.7	3.8	4.6
Population (million)	47	62	78	103	125	139	151	2.0	1.4	0.9	1.1
CO ₂ emissions (Mt)	31	36	67	115	218	297	386	4.5	4.7	2.9	3.6
GDP per capita (\$2010 thousand)	1.7	1.5	1.6	2.8	4.9	6.6	8.6	2.3	4.3	2.8	3.4
Primary energy consump. per capita (toe)	0.5	0.5	0.5	0.5	0.8	0.9	1.1	0.5	2.8	1.6	2.1
Primary energy consumption per GDP ^{*2}	280	304	319	193	157	139	123	-1.7	-1.4	-1.2	-1.3
CO ₂ emissions per GDP ^{*3}	393	383	533	404	352	324	296	0.2	-1.0	-0.9	-0.9
CO ₂ per primary energy consumption ^{*4}	1.4	1.3	1.7	2.1	2.2	2.3	2.4	2.0	0.5	0.4	0.4

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A32 | Thailand [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	22	42	72	139	182	215	246	100	100	100	4.7	2.0	1.5	1.7
Coal	0.5	3.8	7.7	15	20	23	25	9.1	11	10	5.5	2.0	1.0	1.4
Oil	11	18	32	55	67	78	88	43	40	36	4.4	1.4	1.4	1.4
Natural gas	-	5.0	17	37	49	54	58	12	27	24	8.0	2.0	0.9	1.4
Nuclear	-	-	-	-	-	3.7	8.8	-	-	3.6	n.a.	n.a.	n.a.	n.a.
Hydro	0.1	0.4	0.5	0.6	0.6	0.7	0.7	1.0	0.4	0.3	1.3	0.5	0.1	0.3
Geothermal	-	-	-	-	-	-	-	-	-	-	0.0	11.1	1.1	5.1
Solar, wind, etc.	-	-	-	0.3	2.7	5.7	9.1	-	0.2	3.7	n.a.	16.3	6.3	10.4
Biomass and waste	11	15	15	28	39	46	51	35	20	21	2.5	2.3	1.3	1.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	15	29	51	98	125	147	168	100	100	100	4.8	1.8	1.5	1.6
Industry	4.0	8.7	17	31	41	50	57	30	32	34	5.1	2.0	1.6	1.8
Transport	3.2	9.0	15	25	29	31	33	31	26	20	4.0	1.0	0.7	0.8
Buildings, etc.	7.8	11	14	18	22	26	29	37	18	17	2.0	1.5	1.3	1.4
Non-energy use	0.2	0.4	5.6	23	32	40	49	1.5	23	29	16.5	2.5	2.1	2.3
Coal	0.1	1.3	3.5	6.1	6.2	6.5	6.9	4.5	6.2	4.1	6.1	0.2	0.5	0.4
Oil	7.3	15	29	54	65	75	85	52	55	51	5.1	1.4	1.3	1.4
Natural gas	-	0.1	1.1	7.2	12	15	19	0.5	7.4	11	16.4	3.7	2.3	2.8
Electricity	1.1	3.3	7.6	17	25	32	38	11	17	23	6.4	3.0	2.1	2.5
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	4.7	n.a.
Renewables	6.7	9.2	9.4	14	16	18	19	32	14	11	1.6	1.3	0.8	1.0

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	14	44	96	191	273	342	413	100	100	100	5.8	2.6	2.1	2.3
Coal	1.4	11	18	37	60	74	84	25	19	20	4.7	3.5	1.7	2.5
Oil	12	10	10	0.6	0.1	-	-	23	0.3	-	-10.6	-15.6	-100	-100
Natural gas	-	18	62	125	139	134	122	40	65	30	7.8	0.8	-0.6	-0.1
Nuclear	-	-	-	-	-	14	34	-	-	8.1	n.a.	n.a.	n.a.	n.a.
Hydro	1.3	5.0	6.0	7.0	7.5	7.6	7.7	11	3.6	1.9	1.3	0.5	0.1	0.3
Geothermal	-	-	-	-	-	-	-	-	-	-	0.0	11.1	1.1	5.1
Solar PV	-	-	-	3.4	30	63	102	-	1.8	25	n.a.	16.8	6.4	10.5
Wind	-	-	-	0.3	1.1	1.9	2.7	-	0.2	0.7	n.a.	8.8	4.5	6.3
CSP and marine	-	-	-	-	0.1	0.2	0.3	-	-	0.1	n.a.	n.a.	8.3	n.a.
Biomass and waste	-	-	0.5	18	36	48	60	-	9.6	15	n.a.	4.9	2.6	3.6
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	67	142	218	406	669	921	1,204	4.1	3.6	3.0	3.2
Population (million)	47	57	63	69	70	68	65	0.8	0.1	-0.3	-0.2
CO ₂ emissions (Mt)	31	78	147	245	300	332	355	4.5	1.5	0.8	1.1
GDP per capita (\$2010 thousand)	1.4	2.5	3.5	5.9	9.6	13	18	3.4	3.5	3.3	3.4
Primary energy consump. per capita (toe)	0.5	0.7	1.1	2.0	2.6	3.1	3.8	3.9	1.9	1.8	1.9
Primary energy consumption per GDP ^{*2}	331	296	332	341	272	233	204	0.5	-1.6	-1.4	-1.5
CO ₂ emissions per GDP ^{*3}	468	548	675	603	449	361	295	0.4	-2.1	-2.1	-2.1
CO ₂ per primary energy consumption ^{*4}	1.4	1.8	2.0	1.8	1.6	1.5	1.4	-0.2	-0.5	-0.7	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A33 | Viet Nam [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	14	18	29	81	150	207	266	100	100	100	6.0	4.5	2.9	3.6
Coal	2.3	2.2	4.4	28	62	90	118	12	34	44	10.2	5.9	3.3	4.4
Oil	1.8	2.7	7.8	22	39	54	73	15	28	28	8.5	4.0	3.2	3.5
Natural gas	-	-	1.1	9.5	24	34	42	-	12	16	36.9	6.9	2.8	4.5
Nuclear	-	-	-	-	-	4.2	8.6	-	-	3.2	n.a.	n.a.	n.a.	n.a.
Hydro	0.1	0.5	1.3	5.5	9.1	10	11	2.6	6.8	3.9	10.0	3.7	0.7	1.9
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	-	0.2	0.4	0.8	-	-	0.3	n.a.	20.3	6.1	11.7
Biomass and waste	10	12	14	16	16	14	12	70	19	4.5	0.9	-0.1	-1.3	-0.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	13	16	25	65	110	146	183	100	100	100	5.5	3.9	2.6	3.1
Industry	3.8	4.5	7.9	27	51	68	82	28	41	45	7.0	4.7	2.4	3.4
Transport	0.6	1.4	3.5	12	21	30	43	8.6	19	23	8.8	3.8	3.7	3.8
Buildings, etc.	8.6	10	14	23	33	40	48	63	35	26	3.1	2.7	1.9	2.2
Non-energy use	-	-	0.1	3.6	6.2	8.3	11	0.2	5.5	5.8	20.5	4.0	2.8	3.3
Coal	1.5	1.3	3.2	14	24	29	31	8.3	22	17	9.6	3.6	1.3	2.2
Oil	1.7	2.3	6.5	20	36	50	70	15	32	38	8.7	4.1	3.4	3.7
Natural gas	-	-	-	1.6	4.5	6.1	7.2	-	2.5	3.9	n.a.	7.6	2.4	4.5
Electricity	0.2	0.5	1.9	14	32	47	65	3.3	21	35	13.3	6.2	3.7	4.7
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	10.1	n.a.
Renewables	9.7	12	13	15	15	13	11	74	23	6.0	0.8	-0.1	-1.4	-0.9

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	3.6	8.7	27	165	398	601	825	100	100	100	12.0	6.5	3.7	4.9
Coal	1.4	2.0	3.1	54	168	285	429	23	33	52	13.5	8.5	4.8	6.3
Oil	0.7	1.3	4.5	1.1	2.5	3.3	3.6	15	0.7	0.4	-0.6	6.0	1.8	3.5
Natural gas	-	-	4.4	46	118	175	228	0.1	28	28	41.0	7.0	3.3	4.9
Nuclear	-	-	-	-	-	16	33	-	-	4.0	n.a.	n.a.	n.a.	n.a.
Hydro	1.5	5.4	15	64	106	117	122	62	39	15	10.0	3.7	0.7	1.9
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar PV	-	-	-	-	1.4	2.7	4.7	-	-	0.6	n.a.	n.a.	6.4	n.a.
Wind	-	-	-	0.2	1.3	2.5	4.1	-	0.1	0.5	n.a.	14.3	5.8	9.2
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	-	-	0.1	0.2	0.2	0.3	-	-	-	n.a.	7.6	2.6	4.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	17	29	61	164	377	622	980	6.8	6.1	4.9	5.4
Population (million)	54	68	80	95	106	111	115	1.3	0.8	0.4	0.6
CO ₂ emissions (Mt)	15	17	43	187	402	576	760	9.7	5.6	3.2	4.2
GDP per capita (\$2010 thousand)	0.3	0.4	0.8	1.7	3.5	5.6	8.5	5.5	5.2	4.5	4.8
Primary energy consump. per capita (toe)	0.3	0.3	0.4	0.9	1.4	1.9	2.3	4.7	3.7	2.5	3.0
Primary energy consumption per GDP ^{*2}	851	607	470	494	399	333	272	-0.8	-1.5	-1.9	-1.7
CO ₂ emissions per GDP ^{*3}	859	572	698	1,140	1,067	925	776	2.7	-0.5	-1.6	-1.1
CO ₂ per primary energy consumption ^{*4}	1.0	0.9	1.5	2.3	2.7	2.8	2.9	3.5	1.0	0.3	0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A34 | North America [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,997	2,126	2,527	2,447	2,426	2,357	2,272	100	100	100	0.5	-0.1	-0.3	-0.2
Coal	397	484	566	359	275	207	144	23	15	6.3	-1.2	-1.9	-3.2	-2.6
Oil	885	833	958	886	806	736	666	39	36	29	0.2	-0.7	-0.9	-0.8
Natural gas	522	493	622	748	842	874	882	23	31	39	1.6	0.9	0.2	0.5
Nuclear	80	179	227	245	207	192	177	8.4	10	7.8	1.2	-1.2	-0.8	-1.0
Hydro	46	49	53	56	61	62	62	2.3	2.3	2.7	0.5	0.6	0.1	0.3
Geothermal	4.6	14	13	9.2	21	28	34	0.7	0.4	1.5	-1.6	6.2	2.3	3.9
Solar, wind, etc.	-	0.3	2.1	29	80	122	167	-	1.2	7.3	18.9	7.4	3.7	5.2
Biomass and waste	62	73	87	115	133	137	141	3.4	4.7	6.2	1.7	1.1	0.3	0.6

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,466	1,455	1,738	1,706	1,705	1,669	1,619	100	100	100	0.6	0.0	-0.3	-0.2
Industry	437	331	388	306	313	314	304	23	18	19	-0.3	0.2	-0.1	0.0
Transport	470	531	640	683	637	593	558	36	40	34	1.0	-0.5	-0.7	-0.6
Buildings, etc.	446	460	537	557	578	577	574	32	33	35	0.7	0.3	0.0	0.1
Non-energy use	114	134	173	160	178	184	182	9.2	9.4	11	0.7	0.7	0.1	0.4
Coal	60	59	36	20	18	17	15	4.0	1.2	0.9	-4.1	-0.7	-0.9	-0.8
Oil	769	752	874	837	767	704	643	52	49	40	0.4	-0.6	-0.9	-0.8
Natural gas	374	346	413	382	385	381	371	24	22	23	0.4	0.1	-0.2	-0.1
Electricity	200	262	342	368	435	470	496	18	22	31	1.3	1.2	0.7	0.9
Heat	1.0	2.8	6.1	7.2	6.3	5.8	5.2	0.2	0.4	0.3	3.7	-1.0	-0.9	-0.9
Hydrogen	-	-	-	-	0.2	0.2	0.2	-	-	-	n.a.	n.a.	1.5	n.a.
Renewables	62	33	66	93	94	91	89	2.3	5.4	5.5	4.1	0.1	-0.3	-0.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	2,801	3,685	4,631	4,967	5,831	6,256	6,554	100	100	100	1.2	1.2	0.6	0.8
Coal	1,303	1,782	2,247	1,416	1,143	882	606	48	29	9.2	-0.9	-1.5	-3.1	-2.5
Oil	277	147	133	43	35	25	14	4.0	0.9	0.2	-4.6	-1.5	-4.4	-3.2
Natural gas	380	391	668	1,480	2,134	2,442	2,672	11	30	41	5.2	2.6	1.1	1.8
Nuclear	304	685	871	941	795	738	679	19	19	10	1.2	-1.2	-0.8	-1.0
Hydro	530	570	612	657	712	721	725	15	13	11	0.5	0.6	0.1	0.3
Geothermal	5.4	16	15	19	44	58	70	0.4	0.4	1.1	0.6	6.3	2.4	4.0
Solar PV	-	-	0.2	50	168	258	337	-	1.0	5.1	45.3	9.1	3.6	5.8
Wind	-	3.1	5.9	260	581	829	1,042	0.1	5.2	16	18.6	5.9	3.0	4.2
CSP and marine	-	0.7	0.6	3.7	52	100	174	-	0.1	2.7	6.7	20.7	6.3	12.0
Biomass and waste	1.8	90	80	92	162	196	228	2.5	1.9	3.5	0.1	4.1	1.7	2.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	5.7	5.7	5.7	5.7	-	0.1	0.1	n.a.	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	7,310	10,078	14,056	18,748	25,056	30,555	36,229	2.4	2.1	1.9	2.0
Population (million)	252	277	313	359	396	418	436	1.0	0.7	0.5	0.6
CO ₂ emissions (Mt)	5,033	5,226	6,203	5,409	5,008	4,585	4,153	0.1	-0.5	-0.9	-0.8
GDP per capita (\$2010 thousand)	29	36	45	52	63	73	83	1.4	1.4	1.4	1.4
Primary energy consump. per capita (toe)	7.9	7.7	8.1	6.8	6.1	5.6	5.2	-0.5	-0.8	-0.8	-0.8
Primary energy consumption per GDP ^{*2}	273	211	180	131	97	77	63	-1.8	-2.1	-2.1	-2.1
CO ₂ emissions per GDP ^{*3}	688	519	441	289	200	150	115	-2.2	-2.6	-2.7	-2.7
CO ₂ per primary energy consumption ^{*4}	2.5	2.5	2.5	2.2	2.1	1.9	1.8	-0.4	-0.5	-0.6	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A35 | United States [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,805	1,915	2,274	2,167	2,135	2,074	1,999	100	100	100	0.5	-0.1	-0.3	-0.2
Coal	376	460	534	342	273	205	142	24	16	7.1	-1.1	-1.6	-3.2	-2.5
Oil	797	757	871	787	712	652	592	40	36	30	0.2	-0.7	-0.9	-0.8
Natural gas	477	438	548	653	718	742	747	23	30	37	1.5	0.7	0.2	0.4
Nuclear	69	159	208	219	186	179	169	8.3	10	8.5	1.2	-1.1	-0.5	-0.7
Hydro	24	23	22	23	25	26	26	1.2	1.1	1.3	0.0	0.7	0.1	0.3
Geothermal	4.6	14	13	9.2	21	28	34	0.7	0.4	1.7	-1.6	6.2	2.3	3.9
Solar, wind, etc.	-	0.3	2.1	26	74	114	156	-	1.2	7.8	18.5	7.6	3.8	5.4
Biomass and waste	54	62	73	102	120	124	128	3.3	4.7	6.4	1.9	1.2	0.3	0.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,311	1,294	1,546	1,515	1,508	1,476	1,432	100	100	100	0.6	0.0	-0.3	-0.2
Industry	387	284	332	264	271	273	265	22	17	18	-0.3	0.2	-0.1	0.0
Transport	425	488	588	622	577	538	507	38	41	35	0.9	-0.5	-0.6	-0.6
Buildings, etc.	397	403	473	493	508	509	506	31	33	35	0.8	0.2	0.0	0.1
Non-energy use	102	119	153	136	152	157	154	9.2	9.0	11	0.5	0.8	0.1	0.4
Coal	56	56	33	18	16	15	13	4.3	1.2	0.9	-4.4	-0.8	-0.9	-0.8
Oil	689	683	793	744	678	622	568	53	49	40	0.3	-0.7	-0.9	-0.8
Natural gas	338	303	360	336	338	335	325	23	22	23	0.4	0.0	-0.2	-0.1
Electricity	174	226	301	327	386	417	439	18	22	31	1.4	1.2	0.7	0.9
Heat	-	2.2	5.3	6.6	5.7	5.3	4.7	0.2	0.4	0.3	4.4	-1.1	-0.9	-1.0
Hydrogen	-	-	-	-	0.2	0.2	0.2	-	-	-	n.a.	n.a.	1.4	n.a.
Renewables	54	23	54	83	85	83	82	1.8	5.5	5.7	5.1	0.2	-0.2	0.0

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	2,427	3,203	4,026	4,300	5,060	5,439	5,703	100	100	100	1.1	1.2	0.6	0.8
Coal	1,243	1,700	2,129	1,354	1,143	882	606	53	31	11	-0.9	-1.2	-3.1	-2.3
Oil	263	131	118	35	26	17	8.3	4.1	0.8	0.1	-5.0	-2.0	-5.6	-4.1
Natural gas	370	382	634	1,418	1,956	2,223	2,426	12	33	43	5.2	2.3	1.1	1.6
Nuclear	266	612	798	840	715	685	650	19	20	11	1.2	-1.1	-0.5	-0.7
Hydro	279	273	253	270	295	298	300	8.5	6.3	5.3	0.0	0.7	0.1	0.3
Geothermal	5.4	16	15	19	44	58	70	0.5	0.4	1.2	0.6	6.3	2.4	4.0
Solar PV	-	-	0.2	47	161	248	325	-	1.1	5.7	44.9	9.2	3.6	5.9
Wind	-	3.1	5.7	229	518	747	936	0.1	5.3	16	18.1	6.0	3.0	4.2
CSP and marine	-	0.7	0.5	3.7	52	100	174	-	0.1	3.0	6.8	20.7	6.3	12.0
Biomass and waste	0.5	86	72	79	144	175	203	2.7	1.8	3.6	-0.3	4.4	1.7	2.8
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	5.6	5.6	5.6	5.6	-	0.1	0.1	n.a.	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	6,529	9,064	12,713	16,920	22,637	27,647	32,825	2.4	2.1	1.9	2.0
Population (million)	227	250	282	323	356	375	391	1.0	0.7	0.5	0.6
CO ₂ emissions (Mt)	4,620	4,817	5,700	4,870	4,482	4,075	3,668	0.0	-0.6	-1.0	-0.8
GDP per capita (\$2010 thousand)	29	36	45	52	64	74	84	1.4	1.4	1.4	1.4
Primary energy consump. per capita (toe)	7.9	7.7	8.1	6.7	6.0	5.5	5.1	-0.5	-0.8	-0.8	-0.8
Primary energy consumption per GDP ^{*2}	276	211	179	128	94	75	61	-1.9	-2.2	-2.2	-2.2
CO ₂ emissions per GDP ^{*3}	708	531	448	288	198	147	112	-2.3	-2.6	-2.8	-2.7
CO ₂ per primary energy consumption ^{*4}	2.6	2.5	2.5	2.2	2.1	2.0	1.8	-0.4	-0.5	-0.7	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A36 | Latin America [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	382	464	600	840	1,068	1,230	1,325	100	100	100	2.3	1.7	1.1	1.3
Coal	13	21	27	45	55	68	74	4.6	5.4	5.6	2.9	1.5	1.4	1.5
Oil	223	238	303	361	427	456	452	51	43	34	1.6	1.2	0.3	0.7
Natural gas	48	72	119	208	278	359	426	16	25	32	4.2	2.1	2.1	2.1
Nuclear	0.6	3.2	5.3	9.0	17	18	15	0.7	1.1	1.2	4.0	4.7	-0.6	1.6
Hydro	19	33	50	63	77	82	88	7.2	7.5	6.7	2.5	1.5	0.7	1.0
Geothermal	1.2	5.1	6.4	6.6	21	30	37	1.1	0.8	2.8	1.0	8.8	2.8	5.2
Solar, wind, etc.	-	-	0.2	6.3	21	29	39	-	0.8	2.9	25.4	8.8	3.2	5.5
Biomass and waste	78	92	89	141	170	186	193	20	17	15	1.7	1.4	0.6	0.9

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	288	343	447	610	768	876	947	100	100	100	2.2	1.7	1.1	1.3
Industry	98	114	148	187	237	283	315	33	31	33	1.9	1.7	1.4	1.5
Transport	85	103	141	223	284	311	322	30	37	34	3.0	1.7	0.6	1.1
Buildings, etc.	88	100	120	162	201	230	251	29	27	27	1.9	1.6	1.1	1.3
Non-energy use	16	26	38	37	46	53	58	7.5	6.1	6.1	1.4	1.5	1.2	1.3
Coal	6.1	7.8	11	13	17	20	21	2.3	2.1	2.3	1.9	2.0	1.2	1.5
Oil	159	179	240	304	371	404	416	52	50	44	2.1	1.4	0.6	0.9
Natural gas	27	38	53	75	97	114	129	11	12	14	2.7	1.8	1.5	1.6
Electricity	27	44	69	113	162	207	248	13	19	26	3.6	2.6	2.2	2.3
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	0.1	0.2	0.2	-	-	-	n.a.	n.a.	3.4	n.a.
Renewables	68	74	74	104	121	130	133	22	17	14	1.3	1.0	0.5	0.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	380	623	1,009	1,628	2,299	2,893	3,386	100	100	100	3.8	2.5	2.0	2.2
Coal	7.8	23	43	107	139	191	220	3.8	6.6	6.5	6.0	1.8	2.3	2.1
Oil	111	128	198	178	153	131	63	21	11	1.9	1.3	-1.1	-4.4	-3.0
Natural gas	35	60	141	436	679	1,039	1,373	9.6	27	41	8.0	3.2	3.6	3.4
Nuclear	2.3	12	20	35	66	71	59	2.0	2.1	1.7	4.0	4.7	-0.6	1.6
Hydro	218	386	584	729	899	959	1,027	62	45	30	2.5	1.5	0.7	1.0
Geothermal	1.4	5.9	7.8	10	34	49	61	1.0	0.6	1.8	2.1	9.0	3.0	5.4
Solar PV	-	-	-	5.2	38	66	99	-	0.3	2.9	39.0	15.2	4.9	9.1
Wind	-	-	0.3	56	179	249	324	-	3.4	9.6	52.3	8.7	3.0	5.3
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	3.9	7.6	14	71	113	140	160	1.2	4.3	4.7	9.0	3.4	1.7	2.4
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	0.4	0.4	0.4	0.4	0.4	-	-	-	n.a.	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	2,418	2,787	3,778	5,704	8,559	11,723	14,928	2.8	2.9	2.8	2.9
Population (million)	360	441	521	634	713	752	775	1.4	0.8	0.4	0.6
CO ₂ emissions (Mt)	749	853	1,169	1,603	1,977	2,280	2,433	2.5	1.5	1.0	1.2
GDP per capita (\$2010 thousand)	6.7	6.3	7.3	9.0	12	16	19	1.4	2.1	2.4	2.3
Primary energy consump. per capita (toe)	1.1	1.1	1.2	1.3	1.5	1.6	1.7	0.9	0.9	0.7	0.8
Primary energy consumption per GDP ^{*2}	158	167	159	147	125	105	89	-0.5	-1.2	-1.7	-1.5
CO ₂ emissions per GDP ^{*3}	310	306	309	281	231	194	163	-0.3	-1.4	-1.7	-1.6
CO ₂ per primary energy consumption ^{*4}	2.0	1.8	1.9	1.9	1.9	1.9	1.8	0.1	-0.2	0.0	-0.1

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A37 | OECD Europe [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,494	1,627	1,753	1,723	1,676	1,593	1,519	100	100	100	0.2	-0.2	-0.5	-0.4
Coal	464	448	331	269	219	177	146	28	16	9.6	-1.9	-1.5	-2.0	-1.8
Oil	688	611	653	560	499	446	402	38	33	26	-0.3	-0.8	-1.1	-1.0
Natural gas	206	262	394	414	452	453	437	16	24	29	1.8	0.6	-0.2	0.2
Nuclear	60	205	245	217	184	166	159	13	13	10	0.2	-1.2	-0.7	-0.9
Hydro	36	39	47	50	51	52	54	2.4	2.9	3.5	1.0	0.2	0.2	0.2
Geothermal	3.0	4.9	7.2	16	25	28	30	0.3	1.0	1.9	4.7	3.1	0.8	1.7
Solar, wind, etc.	0.1	0.3	2.7	41	78	103	126	-	2.4	8.3	20.4	4.7	2.4	3.3
Biomass and waste	36	55	72	155	166	166	165	3.4	9.0	11	4.0	0.5	0.0	0.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,081	1,133	1,231	1,230	1,217	1,166	1,119	100	100	100	0.3	-0.1	-0.4	-0.3
Industry	356	327	324	284	287	282	275	29	23	25	-0.5	0.1	-0.2	-0.1
Transport	209	267	317	343	305	274	250	24	28	22	1.0	-0.8	-1.0	-0.9
Buildings, etc.	425	438	475	499	515	498	482	39	41	43	0.5	0.2	-0.3	-0.1
Non-energy use	90	101	115	105	111	112	112	8.9	8.5	10	0.1	0.4	0.1	0.2
Coal	156	123	62	47	44	41	38	11	3.8	3.4	-3.7	-0.4	-0.7	-0.6
Oil	551	524	572	509	453	405	365	46	41	33	-0.1	-0.8	-1.1	-1.0
Natural gas	161	203	268	267	276	269	261	18	22	23	1.1	0.2	-0.3	-0.1
Electricity	147	192	233	266	300	315	324	17	22	29	1.3	0.9	0.4	0.6
Heat	35	43	41	47	45	41	37	3.8	3.9	3.3	0.4	-0.4	-0.9	-0.7
Hydrogen	-	-	-	-	0.1	0.1	0.1	-	-	-	n.a.	n.a.	2.6	n.a.
Renewables	31	47	55	94	98	95	93	4.2	7.7	8.3	2.7	0.3	-0.3	0.0

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	2,049	2,668	3,227	3,599	4,037	4,201	4,287	100	100	100	1.2	0.8	0.3	0.5
Coal	887	1,030	968	790	694	558	443	39	22	10	-1.0	-0.9	-2.2	-1.7
Oil	364	206	179	55	42	29	15	7.7	1.5	0.4	-5.0	-1.9	-4.9	-3.7
Natural gas	138	169	513	689	893	970	953	6.3	19	22	5.6	1.9	0.3	1.0
Nuclear	230	787	939	834	707	638	609	29	23	14	0.2	-1.2	-0.7	-0.9
Hydro	416	451	549	579	596	610	623	17	16	15	1.0	0.2	0.2	0.2
Geothermal	2.7	3.6	6.2	17	28	31	33	0.1	0.5	0.8	6.0	3.7	0.9	2.1
Solar PV	-	-	0.1	104	199	258	309	-	2.9	7.2	41.3	4.7	2.2	3.3
Wind	-	0.8	22	310	565	749	904	-	8.6	21	25.9	4.4	2.4	3.2
CSP and marine	0.5	0.5	0.5	6.1	34	47	65	-	0.2	1.5	10.1	13.0	3.3	7.2
Biomass and waste	11	21	48	210	274	306	327	0.8	5.8	7.6	9.3	1.9	0.9	1.3
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	0.3	1.4	5.7	5.7	5.7	5.7	-	0.2	0.1	11.8	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	9,927	12,691	15,934	20,165	25,706	29,301	32,707	1.8	1.7	1.2	1.4
Population (million)	475	502	524	569	587	591	590	0.5	0.2	0.0	0.1
CO ₂ emissions (Mt)	4,110	3,908	3,902	3,466	3,162	2,837	2,544	-0.5	-0.7	-1.1	-0.9
GDP per capita (\$2010 thousand)	21	25	30	35	44	50	55	1.3	1.5	1.2	1.3
Primary energy consump. per capita (toe)	3.1	3.2	3.3	3.0	2.9	2.7	2.6	-0.3	-0.4	-0.5	-0.5
Primary energy consumption per GDP ^{*2}	151	128	110	85	65	54	46	-1.5	-1.9	-1.7	-1.8
CO ₂ emissions per GDP ^{*3}	414	308	245	172	123	97	78	-2.2	-2.4	-2.3	-2.3
CO ₂ per primary energy consumption ^{*4}	2.8	2.4	2.2	2.0	1.9	1.8	1.7	-0.7	-0.5	-0.6	-0.5

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A38 | Non-OECD Europe [Reference Scenario]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,241	1,530	1,000	1,130	1,252	1,321	1,403	100	100	100	-1.2	0.7	0.6	0.6
Coal	362	367	209	212	200	198	193	24	19	14	-2.1	-0.4	-0.2	-0.3
Oil	464	465	202	257	265	272	283	30	23	20	-2.3	0.2	0.3	0.3
Natural gas	355	600	488	529	609	665	713	39	47	51	-0.5	1.0	0.8	0.9
Nuclear	21	59	64	81	106	98	107	3.9	7.1	7.6	1.2	2.0	0.1	0.8
Hydro	20	23	23	27	28	29	30	1.5	2.4	2.1	0.7	0.3	0.3	0.3
Geothermal	-	-	0.1	0.2	0.5	0.6	0.6	-	-	-	9.0	6.2	0.7	2.9
Solar, wind, etc.	-	-	-	1.6	5.2	9.3	15	-	0.1	1.1	n.a.	8.9	5.4	6.8
Biomass and waste	21	17	16	24	39	49	63	1.1	2.2	4.5	1.4	3.4	2.3	2.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	869	1,067	651	713	780	824	876	100	100	100	-1.5	0.6	0.6	0.6
Industry	395	394	205	198	223	243	262	37	28	30	-2.6	0.8	0.8	0.8
Transport	107	171	110	145	149	148	148	16	20	17	-0.6	0.2	-0.1	0.1
Buildings, etc.	301	436	287	275	292	298	309	41	39	35	-1.8	0.4	0.3	0.3
Non-energy use	67	66	49	95	116	136	158	6.2	13	18	1.4	1.5	1.5	1.5
Coal	152	113	36	33	37	38	39	11	4.6	4.4	-4.7	0.8	0.3	0.5
Oil	310	278	145	205	216	221	229	26	29	26	-1.2	0.4	0.3	0.3
Natural gas	215	261	201	220	242	259	277	24	31	32	-0.6	0.7	0.7	0.7
Electricity	95	126	87	106	135	156	180	12	15	21	-0.6	1.7	1.5	1.6
Heat	78	277	171	132	132	133	135	26	19	15	-2.8	0.0	0.1	0.1
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	3.3	n.a.
Renewables	21	13	12	17	18	17	16	1.2	2.4	1.8	1.1	0.4	-0.6	-0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,461	1,888	1,428	1,764	2,147	2,390	2,625	100	100	100	-0.3	1.4	1.0	1.2
Coal	471	429	338	395	438	474	469	23	22	18	-0.3	0.7	0.3	0.5
Oil	357	256	70	25	24	24	21	14	1.4	0.8	-8.6	-0.2	-0.8	-0.5
Natural gas	295	714	503	699	854	1,003	1,106	38	40	42	-0.1	1.4	1.3	1.4
Nuclear	79	226	242	307	408	378	412	12	17	16	1.2	2.0	0.1	0.9
Hydro	232	262	272	315	329	340	347	14	18	13	0.7	0.3	0.3	0.3
Geothermal	-	-	0.1	0.4	1.7	2.0	2.2	-	-	0.1	11.2	10.2	1.1	4.8
Solar PV	-	-	-	4.8	18	32	48	-	0.3	1.8	n.a.	9.7	5.2	7.0
Wind	-	-	-	12	40	75	121	-	0.7	4.6	n.a.	9.1	5.7	7.0
CSP and marine	-	-	-	-	-	0.1	0.2	-	-	-	n.a.	n.a.	12.7	n.a.
Biomass and waste	27	-	2.6	5.0	35	63	99	-	0.3	3.8	19.5	14.9	5.4	9.2
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	0.1	0.4	0.4	0.4	0.4	-	-	-	9.3	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	1,779	2,143	1,497	2,727	3,815	4,817	6,023	0.9	2.4	2.3	2.4
Population (million)	321	341	339	342	345	341	338	0.0	0.1	-0.1	0.0
CO ₂ emissions (Mt)	3,319	3,840	2,296	2,425	2,525	2,618	2,683	-1.8	0.3	0.3	0.3
GDP per capita (\$2010 thousand)	5.5	6.3	4.4	8.0	11	14	18	0.9	2.4	2.4	2.4
Primary energy consump. per capita (toe)	3.9	4.5	3.0	3.3	3.6	3.9	4.2	-1.2	0.7	0.7	0.7
Primary energy consumption per GDP ^{*2}	698	714	668	414	328	274	233	-2.1	-1.7	-1.7	-1.7
CO ₂ emissions per GDP ^{*3}	1,865	1,792	1,533	889	662	543	446	-2.7	-2.1	-2.0	-2.0
CO ₂ per primary energy consumption ^{*4}	2.7	2.5	2.3	2.1	2.0	2.0	1.9	-0.6	-0.4	-0.3	-0.3

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A39 | European Union [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	n.a.	1,646	1,695	1,599	1,553	1,475	1,407	100	100	100	-0.1	-0.2	-0.5	-0.4
Coal	n.a.	454	321	241	196	159	131	28	15	9.3	-2.4	-1.5	-2.0	-1.8
Oil	n.a.	608	625	522	464	414	371	37	33	26	-0.6	-0.8	-1.1	-1.0
Natural gas	n.a.	297	396	383	420	422	406	18	24	29	1.0	0.7	-0.2	0.2
Nuclear	n.a.	207	246	219	186	167	161	13	14	11	0.2	-1.2	-0.7	-0.9
Hydro	n.a.	25	31	30	31	32	32	1.5	1.9	2.3	0.7	0.2	0.2	0.2
Geothermal	n.a.	3.2	4.6	6.7	8.6	9.4	10	0.2	0.4	0.7	2.9	1.9	0.8	1.2
Solar, wind, etc.	n.a.	0.3	2.4	40	76	101	124	-	2.5	8.8	20.6	4.8	2.5	3.4
Biomass and waste	n.a.	48	67	155	168	168	169	2.9	9.7	12	4.7	0.5	0.0	0.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	n.a.	1,134	1,179	1,138	1,127	1,078	1,032	100	100	100	0.0	-0.1	-0.4	-0.3
Industry	n.a.	345	308	257	262	257	250	30	23	24	-1.1	0.1	-0.2	-0.1
Transport	n.a.	259	303	319	284	254	231	23	28	22	0.8	-0.8	-1.0	-1.0
Buildings, etc.	n.a.	430	454	463	480	463	448	38	41	43	0.3	0.2	-0.3	-0.1
Non-energy use	n.a.	100	113	98	102	103	103	8.8	8.6	10	-0.1	0.3	0.1	0.2
Coal	n.a.	120	51	34	33	31	28	11	3.0	2.8	-4.7	-0.3	-0.7	-0.6
Oil	n.a.	506	543	471	420	374	335	45	41	32	-0.3	-0.8	-1.1	-1.0
Natural gas	n.a.	227	272	252	262	254	247	20	22	24	0.4	0.3	-0.3	-0.1
Electricity	n.a.	186	217	239	271	285	294	16	21	29	1.0	0.9	0.4	0.6
Heat	n.a.	55	45	48	46	43	39	4.9	4.2	3.8	-0.5	-0.2	-0.8	-0.6
Hydrogen	n.a.	-	-	-	0.1	0.1	0.1	-	-	-	n.a.	n.a.	2.6	n.a.
Renewables	n.a.	40	50	93	96	92	88	3.5	8.2	8.6	3.3	0.2	-0.4	-0.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	n.a.	2,577	3,006	3,228	3,654	3,839	3,950	100	100	100	0.9	0.9	0.4	0.6
Coal	n.a.	1,050	968	736	649	527	422	41	23	11	-1.4	-0.9	-2.1	-1.6
Oil	n.a.	224	181	60	46	32	18	8.7	1.8	0.5	-5.0	-1.8	-4.6	-3.5
Natural gas	n.a.	193	480	611	792	868	849	7.5	19	21	4.5	1.9	0.3	1.0
Nuclear	n.a.	795	945	840	713	643	616	31	26	16	0.2	-1.2	-0.7	-0.9
Hydro	n.a.	290	357	350	360	367	374	11	11	9.5	0.7	0.2	0.2	0.2
Geothermal	n.a.	3.2	4.8	6.6	8.7	9.6	10	0.1	0.2	0.3	2.8	1.9	0.9	1.3
Solar PV	n.a.	-	0.1	105	205	269	326	-	3.3	8.2	41.8	4.9	2.3	3.4
Wind	n.a.	0.8	22	303	564	752	910	-	9.4	23	25.8	4.5	2.4	3.3
CSP and marine	n.a.	0.5	0.5	6.1	35	52	78	-	0.2	2.0	10.1	13.2	4.1	7.8
Biomass and waste	n.a.	20	46	206	276	315	344	0.8	6.4	8.7	9.5	2.1	1.1	1.5
Hydrogen	n.a.	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	n.a.	0.2	1.4	5.0	4.3	4.3	4.3	-	0.2	0.1	12.9	-1.0	0.0	-0.4

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	n.a.	11,895	14,789	18,309	23,323	26,643	29,798	1.7	1.7	1.2	1.4
Population (million)	n.a.	478	488	511	524	526	523	0.3	0.2	0.0	0.1
CO ₂ emissions (Mt)	n.a.	4,018	3,798	3,195	2,859	2,560	2,286	-0.9	-0.8	-1.1	-1.0
GDP per capita (\$2010 thousand)	n.a.	25	30	36	45	51	57	1.4	1.6	1.2	1.4
Primary energy consump. per capita (toe)	n.a.	3.4	3.5	3.1	3.0	2.8	2.7	-0.4	-0.4	-0.5	-0.4
Primary energy consumption per GDP ^{*2}	n.a.	138	115	87	67	55	47	-1.8	-1.9	-1.7	-1.8
CO ₂ emissions per GDP ^{*3}	n.a.	338	257	175	123	96	77	-2.5	-2.5	-2.3	-2.4
CO ₂ per primary energy consumption ^{*4}	n.a.	2.4	2.2	2.0	1.8	1.7	1.6	-0.8	-0.6	-0.6	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A40 | Africa [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	276	392	498	818	1,116	1,390	1,644	100	100	100	2.9	2.2	2.0	2.1
Coal	52	74	90	108	128	149	166	19	13	10	1.5	1.2	1.3	1.3
Oil	64	85	100	184	275	373	459	22	23	28	3.0	2.9	2.6	2.7
Natural gas	12	30	47	115	194	283	395	7.5	14	24	5.4	3.8	3.6	3.7
Nuclear	-	2.2	3.4	3.9	5.8	10	8.8	0.6	0.5	0.5	2.2	2.9	2.1	2.4
Hydro	4.1	4.8	6.4	10.0	19	29	40	1.2	1.2	2.4	2.8	4.7	3.8	4.2
Geothermal	-	0.3	0.4	3.6	13	21	29	0.1	0.4	1.8	10.3	9.8	4.0	6.4
Solar, wind, etc.	-	-	-	1.5	11	23	39	-	0.2	2.3	35.9	15.8	6.3	10.1
Biomass and waste	143	196	249	390	468	502	507	50	48	31	2.7	1.3	0.4	0.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	218	292	368	594	816	1,012	1,193	100	100	100	2.8	2.3	1.9	2.1
Industry	46	55	58	87	132	183	229	19	15	19	1.8	3.0	2.8	2.9
Transport	27	38	54	117	165	219	279	13	20	23	4.5	2.5	2.6	2.6
Buildings, etc.	139	188	241	370	488	569	631	64	62	53	2.6	2.0	1.3	1.6
Non-energy use	5.4	11	15	20	29	41	54	3.8	3.3	4.6	2.2	3.0	3.1	3.1
Coal	22	20	19	19	22	25	27	6.7	3.1	2.3	-0.2	1.1	1.0	1.1
Oil	54	71	89	165	246	329	407	24	28	34	3.3	2.9	2.6	2.7
Natural gas	2.8	8.6	14	36	58	79	99	2.9	6.0	8.3	5.6	3.6	2.7	3.1
Electricity	14	22	31	55	96	153	229	7.6	9.2	19	3.5	4.1	4.5	4.3
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	0.1	0.1	-	-	-	n.a.	n.a.	5.6	n.a.
Renewables	126	171	215	320	394	426	431	59	54	36	2.4	1.5	0.4	0.9

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	184	316	442	801	1,372	2,139	3,141	100	100	100	3.6	3.9	4.2	4.1
Coal	100	165	209	254	334	418	503	52	32	16	1.7	2.0	2.1	2.0
Oil	22	41	51	86	130	187	217	13	11	6.9	2.9	3.0	2.6	2.8
Natural gas	14	45	92	308	550	938	1,559	14	38	50	7.7	4.2	5.3	4.9
Nuclear	-	8.4	13	15	22	39	34	2.7	1.9	1.1	2.2	2.9	2.1	2.4
Hydro	47	56	75	116	220	336	465	18	15	15	2.8	4.7	3.8	4.2
Geothermal	-	0.3	0.4	4.2	16	24	34	0.1	0.5	1.1	10.3	9.8	4.0	6.4
Solar PV	-	-	-	3.3	33	76	142	-	0.4	4.5	n.a.	17.8	7.6	11.7
Wind	-	-	0.2	10	37	61	102	-	1.3	3.2	n.a.	9.6	5.2	7.0
CSP and marine	-	-	-	0.9	20	42	66	-	0.1	2.1	n.a.	24.7	6.2	13.5
Biomass and waste	0.2	0.5	1.1	1.9	9.5	14	18	0.1	0.2	0.6	5.7	12.0	3.2	6.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	0.1	1.6	1.6	1.6	1.6	-	0.2	0.1	n.a.	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	717	876	1,146	2,307	4,168	6,725	9,996	3.8	4.3	4.5	4.4
Population (million)	479	634	816	1,223	1,701	2,097	2,524	2.6	2.4	2.0	2.2
CO ₂ emissions (Mt)	396	538	661	1,155	1,644	2,191	2,743	3.0	2.6	2.6	2.6
GDP per capita (\$2010 thousand)	1.5	1.4	1.4	1.9	2.5	3.2	4.0	1.2	1.9	2.4	2.2
Primary energy consump. per capita (toe)	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.3	-0.1	0.0	-0.1
Primary energy consumption per GDP ^{*2}	384	447	434	354	268	207	164	-0.9	-2.0	-2.4	-2.2
CO ₂ emissions per GDP ^{*3}	552	614	576	501	394	326	274	-0.8	-1.7	-1.8	-1.8
CO ₂ per primary energy consumption ^{*4}	1.4	1.4	1.3	1.4	1.5	1.6	1.7	0.1	0.3	0.6	0.5

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A41 | Middle East [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	121	223	372	757	1,019	1,184	1,313	100	100	100	4.8	2.1	1.3	1.6
Coal	1.2	3.0	8.1	8.7	13	14	14	1.3	1.2	1.1	4.2	2.9	0.4	1.4
Oil	90	146	217	327	421	481	526	66	43	40	3.1	1.8	1.1	1.4
Natural gas	29	72	145	415	553	640	708	32	55	54	7.0	2.1	1.2	1.6
Nuclear	-	-	-	1.7	22	33	39	-	0.2	3.0	n.a.	19.8	3.0	9.6
Hydro	0.8	1.0	0.7	1.8	2.1	2.3	2.5	0.5	0.2	0.2	2.2	1.0	1.0	1.0
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.4	0.7	0.9	6.7	12	21	0.2	0.1	1.6	3.2	15.0	5.9	9.6
Biomass and waste	0.3	0.4	0.4	0.9	1.1	1.0	1.0	0.2	0.1	0.1	2.9	0.8	-0.3	0.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	84	157	253	498	672	782	870	100	100	100	4.5	2.2	1.3	1.7
Industry	30	47	71	152	204	241	270	30	30	31	4.6	2.1	1.4	1.7
Transport	26	51	75	139	174	193	207	32	28	24	3.9	1.6	0.9	1.2
Buildings, etc.	22	40	75	136	181	207	226	25	27	26	4.8	2.1	1.1	1.5
Non-energy use	5.6	20	32	72	112	141	167	12	14	19	5.1	3.2	2.0	2.5
Coal	0.3	0.2	0.5	2.9	3.7	4.0	4.2	0.1	0.6	0.5	11.2	1.6	0.7	1.0
Oil	67	108	153	236	307	351	383	69	47	44	3.1	1.9	1.1	1.4
Natural gas	9.8	31	65	178	242	277	301	20	36	35	6.9	2.2	1.1	1.6
Electricity	6.5	17	33	80	118	148	180	11	16	21	6.1	2.9	2.1	2.4
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	0.1	0.1	-	-	-	n.a.	n.a.	4.1	n.a.
Renewables	0.2	0.7	1.0	1.4	1.6	1.7	1.7	0.5	0.3	0.2	2.5	1.0	0.3	0.6

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	95	244	472	1,147	1,694	2,096	2,510	100	100	100	6.1	2.8	2.0	2.3
Coal	0.1	11	30	25	40	44	45	4.3	2.2	1.8	3.3	3.5	0.6	1.8
Oil	47	108	188	306	383	409	419	44	27	17	4.1	1.6	0.4	0.9
Natural gas	39	114	246	785	1,106	1,384	1,673	47	68	67	7.7	2.5	2.1	2.3
Nuclear	-	-	-	6.6	83	127	151	-	0.6	6.0	n.a.	19.8	3.0	9.6
Hydro	9.7	12	8.0	21	24	27	30	4.9	1.8	1.2	2.2	1.0	1.0	1.0
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar PV	-	-	-	2.9	44	78	138	-	0.3	5.5	n.a.	21.5	5.9	12.1
Wind	-	-	-	0.6	7.1	16	33	-	0.1	1.3	28.2	18.7	8.0	12.3
CSP and marine	-	-	-	0.3	6.0	10	20	-	-	0.8	n.a.	25.1	6.2	13.6
Biomass and waste	-	-	-	0.1	0.3	0.4	0.6	-	-	-	n.a.	6.2	2.9	4.3
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	972	1,024	1,525	2,749	4,118	5,467	7,075	3.9	2.9	2.7	2.8
Population (million)	92	132	168	242	299	335	367	2.3	1.5	1.0	1.2
CO ₂ emissions (Mt)	313	571	948	1,837	2,341	2,649	2,870	4.6	1.7	1.0	1.3
GDP per capita (\$2010 thousand)	11	7.7	9.1	11	14	16	19	1.5	1.4	1.7	1.6
Primary energy consump. per capita (toe)	1.3	1.7	2.2	3.1	3.4	3.5	3.6	2.4	0.6	0.2	0.4
Primary energy consumption per GDP ^{*2}	125	217	244	275	247	217	186	0.9	-0.8	-1.4	-1.2
CO ₂ emissions per GDP ^{*3}	322	557	622	668	568	485	406	0.7	-1.2	-1.7	-1.5
CO ₂ per primary energy consumption ^{*4}	2.6	2.6	2.6	2.4	2.3	2.2	2.2	-0.2	-0.4	-0.3	-0.3

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A42 | Oceania [Reference Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	79	99	125	151	154	151	145	100	100	100	1.6	0.2	-0.3	-0.1
Coal	28	36	49	45	38	33	28	36	30	20	0.8	-1.2	-1.4	-1.3
Oil	34	35	40	50	49	46	42	35	33	29	1.4	-0.2	-0.7	-0.5
Natural gas	8.3	19	24	39	43	44	43	19	26	30	2.9	0.7	0.0	0.3
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	2.7	3.2	3.5	3.5	3.5	3.6	3.6	3.2	2.3	2.5	0.3	0.1	0.1	0.1
Geothermal	1.0	1.5	1.9	4.8	7.6	8.0	8.4	1.5	3.2	5.8	4.7	3.3	0.5	1.6
Solar, wind, etc.	-	0.1	0.1	2.2	6.1	8.8	12	0.1	1.5	8.4	11.6	7.6	3.5	5.2
Biomass and waste	4.1	4.7	6.2	6.6	7.3	7.5	7.5	4.8	4.4	5.2	1.3	0.7	0.1	0.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	54	66	83	96	101	102	100	100	100	100	1.4	0.4	-0.1	0.1
Industry	20	23	28	27	30	30	29	35	29	29	0.7	0.6	-0.2	0.1
Transport	19	24	30	38	38	37	36	36	39	35	1.8	0.0	-0.3	-0.2
Buildings, etc.	11	15	19	24	27	29	30	22	25	29	1.9	0.8	0.4	0.6
Non-energy use	3.1	4.6	6.1	6.2	6.4	6.4	6.4	6.9	6.5	6.4	1.2	0.3	0.0	0.1
Coal	5.3	5.2	4.7	3.0	3.1	3.0	2.8	7.9	3.1	2.8	-2.1	0.3	-0.6	-0.2
Oil	31	33	40	49	48	46	43	50	51	43	1.5	-0.1	-0.6	-0.4
Natural gas	5.4	10	14	16	17	17	17	16	17	17	1.7	0.5	0.0	0.2
Electricity	8.5	14	18	22	26	29	31	20	22	31	1.8	1.4	0.9	1.1
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	3.3	n.a.
Renewables	4.0	4.1	5.6	6.1	6.4	6.2	5.8	6.2	6.3	5.8	1.5	0.4	-0.5	-0.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	118	187	249	299	361	395	420	100	100	100	1.8	1.4	0.8	1.0
Coal	70	122	176	164	158	150	132	65	55	32	1.1	-0.3	-0.9	-0.6
Oil	5.2	3.6	1.8	5.6	4.9	4.3	3.5	1.9	1.9	0.8	1.7	-0.9	-1.7	-1.4
Natural gas	8.7	20	26	56	73	81	82	11	19	20	4.0	1.8	0.6	1.1
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydro	32	37	41	41	41	41	42	20	14	9.9	0.3	0.1	0.1	0.1
Geothermal	1.2	2.1	2.9	7.4	12	13	13	1.1	2.5	3.1	4.9	3.4	0.5	1.7
Solar PV	-	-	-	6.3	22	32	47	-	2.1	11	n.a.	9.4	3.8	6.1
Wind	-	-	0.2	15	43	64	87	-	4.8	21	n.a.	8.1	3.6	5.4
CSP and marine	-	-	-	-	-	0.1	0.2	-	-	-	n.a.	19.2	6.5	11.5
Biomass and waste	0.7	1.3	1.7	4.3	7.4	10	13	0.7	1.4	3.1	4.9	3.9	2.8	3.3
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-0.5	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	526	721	996	1,570	2,193	2,621	3,050	3.0	2.4	1.7	2.0
Population (million)	18	20	23	29	34	36	39	1.4	1.1	0.8	0.9
CO ₂ emissions (Mt)	230	282	363	423	402	376	343	1.6	-0.4	-0.8	-0.6
GDP per capita (\$2010 thousand)	30	35	43	54	65	72	78	1.7	1.3	0.9	1.1
Primary energy consump. per capita (toe)	4.4	4.9	5.4	5.2	4.6	4.1	3.7	0.3	-0.9	-1.1	-1.0
Primary energy consumption per GDP ^{*2}	150	137	126	96	70	58	48	-1.4	-2.2	-1.9	-2.0
CO ₂ emissions per GDP ^{*3}	437	391	365	269	183	143	112	-1.4	-2.7	-2.4	-2.5
CO ₂ per primary energy consumption ^{*4}	2.9	2.8	2.9	2.8	2.6	2.5	2.4	-0.1	-0.5	-0.5	-0.5

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A43 | OECD [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	4,060	4,522	5,287	5,252	5,258	5,108	4,918	100	100	100	0.6	0.0	-0.3	-0.2
Coal	966	1,076	1,094	887	747	631	517	24	17	11	-0.7	-1.2	-1.8	-1.6
Oil	1,938	1,867	2,105	1,887	1,727	1,581	1,437	41	36	29	0.0	-0.6	-0.9	-0.8
Natural gas	778	845	1,164	1,414	1,578	1,632	1,632	19	27	33	2.0	0.8	0.2	0.4
Nuclear	162	451	586	512	474	429	397	10.0	9.8	8.1	0.5	-0.6	-0.9	-0.7
Hydro	94	102	115	121	130	132	134	2.3	2.3	2.7	0.7	0.5	0.2	0.3
Geothermal	10	27	30	36	71	89	105	0.6	0.7	2.1	1.2	4.9	2.0	3.2
Solar, wind, etc.	0.1	2.0	5.9	80	179	255	332	-	1.5	6.8	15.3	5.9	3.1	4.3
Biomass and waste	111	150	185	313	351	358	363	3.3	6.0	7.4	2.9	0.8	0.2	0.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	2,937	3,102	3,625	3,654	3,674	3,589	3,479	100	100	100	0.6	0.0	-0.3	-0.1
Industry	940	835	910	792	818	825	810	27	22	23	-0.2	0.2	-0.1	0.1
Transport	781	936	1,140	1,232	1,146	1,063	994	30	34	29	1.1	-0.5	-0.7	-0.6
Buildings, etc.	972	1,038	1,205	1,265	1,317	1,300	1,277	33	35	37	0.8	0.3	-0.2	0.0
Non-energy use	243	292	370	365	393	401	398	9.4	10.0	11	0.9	0.5	0.1	0.3
Coal	259	228	134	103	96	89	82	7.4	2.8	2.4	-3.0	-0.5	-0.8	-0.7
Oil	1,570	1,586	1,838	1,729	1,594	1,466	1,343	51	47	39	0.3	-0.6	-0.9	-0.7
Natural gas	559	590	745	735	761	752	733	19	20	21	0.8	0.2	-0.2	0.0
Electricity	408	551	713	813	947	1,016	1,066	18	22	31	1.5	1.1	0.6	0.8
Heat	36	46	51	60	56	52	48	1.5	1.6	1.4	1.0	-0.5	-0.8	-0.7
Hydrogen	-	-	-	-	0.3	0.5	0.5	-	-	-	n.a.	n.a.	1.9	n.a.
Renewables	105	100	144	215	221	214	208	3.2	5.9	6.0	3.0	0.2	-0.3	-0.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	5,656	7,640	9,700	10,876	12,608	13,453	14,006	100	100	100	1.4	1.1	0.5	0.7
Coal	2,319	3,089	3,760	3,020	2,668	2,299	1,881	40	28	13	-0.1	-0.9	-1.7	-1.4
Oil	980	688	584	243	180	131	72	9.0	2.2	0.5	-3.9	-2.1	-4.5	-3.5
Natural gas	618	773	1,538	2,963	3,948	4,492	4,822	10	27	34	5.3	2.1	1.0	1.4
Nuclear	621	1,729	2,249	1,965	1,818	1,648	1,524	23	18	11	0.5	-0.6	-0.9	-0.7
Hydro	1,093	1,185	1,341	1,412	1,508	1,535	1,555	16	13	11	0.7	0.5	0.2	0.3
Geothermal	11	29	33	51	111	145	173	0.4	0.5	1.2	2.3	5.7	2.2	3.6
Solar PV	-	0.1	0.7	219	496	705	901	-	2.0	6.4	35.3	6.0	3.0	4.2
Wind	-	3.8	29	605	1,240	1,714	2,133	0.1	5.6	15	21.5	5.3	2.7	3.8
CSP and marine	0.5	1.2	1.1	10	88	152	247	-	0.1	1.8	8.6	16.6	5.3	9.8
Biomass and waste	13	122	143	353	517	599	665	1.6	3.2	4.7	4.2	2.8	1.3	1.9
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	22	34	34	34	34	0.3	0.3	0.2	2.1	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	21,458	29,234	38,070	49,348	63,980	75,356	86,697	2.0	1.9	1.5	1.7
Population (million)	980	1,064	1,150	1,281	1,358	1,391	1,409	0.7	0.4	0.2	0.3
CO ₂ emissions (Mt)	10,616	10,962	12,421	11,549	10,815	10,023	9,157	0.2	-0.5	-0.8	-0.7
GDP per capita (\$2010 thousand)	22	27	33	39	47	54	62	1.3	1.5	1.3	1.4
Primary energy consump. per capita (toe)	4.1	4.2	4.6	4.1	3.9	3.7	3.5	-0.1	-0.4	-0.5	-0.5
Primary energy consumption per GDP ^{*2}	189	155	139	106	82	68	57	-1.4	-1.8	-1.8	-1.8
CO ₂ emissions per GDP ^{*3}	495	375	326	234	169	133	106	-1.8	-2.3	-2.3	-2.3
CO ₂ per primary energy consumption ^{*4}	2.6	2.4	2.3	2.2	2.1	2.0	1.9	-0.4	-0.5	-0.5	-0.5

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A44 | Non-OECD [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	2,969	4,050	4,475	8,111	10,779	12,454	13,692	100	100	100	2.7	2.1	1.2	1.6
Coal	817	1,144	1,222	2,843	3,420	3,721	3,806	28	35	28	3.6	1.3	0.5	0.9
Oil	988	1,165	1,284	2,105	2,833	3,281	3,600	29	26	26	2.3	2.1	1.2	1.6
Natural gas	454	818	908	1,621	2,382	2,960	3,497	20	20	26	2.7	2.8	1.9	2.3
Nuclear	24	74	89	167	340	427	514	1.8	2.1	3.8	3.2	5.2	2.1	3.4
Hydro	54	82	110	228	295	334	367	2.0	2.8	2.7	4.0	1.9	1.1	1.4
Geothermal	2.2	7.6	22	45	112	145	178	0.2	0.5	1.3	7.0	6.8	2.4	4.2
Solar, wind, etc.	-	0.5	2.1	65	209	317	429	-	0.8	3.1	20.8	8.8	3.7	5.7
Biomass and waste	631	759	837	1,036	1,187	1,269	1,300	19	13	9.5	1.2	1.0	0.5	0.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	2,252	2,967	3,136	5,503	7,168	8,254	9,133	100	100	100	2.4	1.9	1.2	1.5
Industry	825	968	957	1,960	2,396	2,710	2,961	33	36	32	2.7	1.4	1.1	1.2
Transport	286	432	544	1,117	1,577	1,832	2,032	15	20	22	3.7	2.5	1.3	1.8
Buildings, etc.	1,030	1,379	1,392	1,920	2,490	2,857	3,160	46	35	35	1.3	1.9	1.2	1.5
Non-energy use	111	187	243	505	705	855	981	6.3	9.2	11	3.9	2.4	1.7	2.0
Coal	444	524	408	933	954	960	938	18	17	10	2.2	0.2	-0.1	0.0
Oil	697	817	1,010	1,781	2,449	2,854	3,160	28	32	35	3.0	2.3	1.3	1.7
Natural gas	256	354	372	706	1,020	1,219	1,376	12	13	15	2.7	2.7	1.5	2.0
Electricity	177	283	377	981	1,542	1,974	2,415	9.5	18	26	4.9	3.3	2.3	2.7
Heat	85	291	197	223	237	245	251	9.8	4.1	2.7	-1.0	0.4	0.3	0.3
Hydrogen	-	-	-	-	0.4	0.7	0.8	-	-	-	n.a.	n.a.	4.0	n.a.
Renewables	593	698	772	880	964	1,001	992	24	16	11	0.9	0.7	0.1	0.4

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	2,628	4,212	5,741	14,097	21,861	27,459	32,909	100	100	100	4.8	3.2	2.1	2.5
Coal	817	1,342	2,242	6,575	9,206	10,796	12,031	32	47	37	6.3	2.4	1.3	1.8
Oil	678	635	628	689	802	861	821	15	4.9	2.5	0.3	1.1	0.1	0.5
Natural gas	381	977	1,209	2,831	4,638	6,521	8,716	23	20	26	4.2	3.6	3.2	3.4
Nuclear	93	283	341	641	1,305	1,639	1,972	6.7	4.5	6.0	3.2	5.2	2.1	3.4
Hydro	624	959	1,277	2,649	3,432	3,881	4,269	23	19	13	4.0	1.9	1.1	1.4
Geothermal	2.6	7.8	19	30	84	109	135	0.2	0.2	0.4	5.4	7.5	2.4	4.5
Solar PV	-	-	0.3	109	733	1,218	1,752	-	0.8	5.3	52.1	14.6	4.5	8.5
Wind	-	-	2.8	352	1,205	1,786	2,373	-	2.5	7.2	42.5	9.2	3.4	5.8
CSP and marine	-	-	-	1.2	30	63	104	-	-	0.3	21.9	25.9	6.4	14.0
Biomass and waste	31	7.7	21	217	425	583	734	0.2	1.5	2.2	13.7	4.9	2.8	3.6
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	0.6	2.3	2.3	2.3	2.3	-	-	-	17.2	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	6,632	8,648	11,887	27,973	52,582	77,674	105,279	4.6	4.6	3.5	4.0
Population (million)	3,457	4,216	4,963	6,152	7,156	7,781	8,324	1.5	1.1	0.8	0.9
CO ₂ emissions (Mt)	6,637	8,888	9,841	19,564	25,134	28,577	30,788	3.1	1.8	1.0	1.3
GDP per capita (\$2010 thousand)	1.9	2.1	2.4	4.5	7.3	10.0	13	3.1	3.5	2.8	3.1
Primary energy consump. per capita (toe)	0.9	1.0	0.9	1.3	1.5	1.6	1.6	1.2	1.0	0.4	0.7
Primary energy consumption per GDP ^{*2}	448	468	376	290	205	160	130	-1.8	-2.4	-2.2	-2.3
CO ₂ emissions per GDP ^{*3}	1,001	1,028	828	699	478	368	292	-1.5	-2.7	-2.4	-2.5
CO ₂ per primary energy consumption ^{*4}	2.2	2.2	2.2	2.4	2.3	2.3	2.2	0.4	-0.2	-0.2	-0.2

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A45 | World [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	7,208	8,774	10,036	13,761	15,834	16,650	16,994	100	100	100	1.7	1.0	0.4	0.6
Coal	1,783	2,220	2,316	3,731	3,646	3,391	2,968	25	27	17	2.0	-0.2	-1.0	-0.7
Oil	3,105	3,234	3,663	4,390	4,681	4,662	4,543	37	32	27	1.2	0.5	-0.1	0.1
Natural gas	1,232	1,664	2,072	3,035	3,761	4,140	4,274	19	22	25	2.3	1.5	0.6	1.0
Nuclear	186	526	675	680	1,008	1,246	1,481	6.0	4.9	8.7	1.0	2.9	1.9	2.3
Hydro	148	184	225	349	425	466	501	2.1	2.5	2.9	2.5	1.4	0.8	1.1
Geothermal	12	34	52	81	242	339	430	0.4	0.6	2.5	3.4	8.2	2.9	5.1
Solar, wind, etc.	0.1	2.5	8.0	145	508	810	1,175	-	1.1	6.9	17.0	9.4	4.3	6.3
Biomass and waste	742	909	1,022	1,349	1,562	1,595	1,620	10	9.8	9.5	1.5	1.0	0.2	0.5

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	5,368	6,271	7,035	9,555	10,863	11,333	11,546	100	100	100	1.6	0.9	0.3	0.6
Industry	1,766	1,804	1,868	2,753	3,106	3,258	3,278	29	29	28	1.6	0.9	0.3	0.5
Transport	1,246	1,570	1,958	2,748	2,997	3,001	2,985	25	29	26	2.2	0.6	0.0	0.2
Buildings, etc.	2,002	2,417	2,596	3,185	3,663	3,817	3,904	39	33	34	1.1	1.0	0.3	0.6
Non-energy use	354	480	614	870	1,098	1,256	1,379	7.6	9.1	12	2.3	1.7	1.1	1.4
Coal	703	752	542	1,036	1,020	980	907	12	11	7.9	1.2	-0.1	-0.6	-0.4
Oil	2,446	2,605	3,122	3,908	4,235	4,250	4,186	42	41	36	1.6	0.6	-0.1	0.2
Natural gas	815	945	1,118	1,440	1,747	1,857	1,889	15	15	16	1.6	1.4	0.4	0.8
Electricity	586	834	1,089	1,794	2,446	2,889	3,278	13	19	28	3.0	2.2	1.5	1.8
Heat	121	336	248	283	285	276	261	5.4	3.0	2.3	-0.7	0.0	-0.4	-0.2
Hydrogen	-	-	-	-	0.6	2.2	6.2	-	-	0.1	n.a.	n.a.	12.9	n.a.
Renewables	698	799	916	1,095	1,130	1,080	1,018	13	11	8.8	1.2	0.2	-0.5	-0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	8,283	11,852	15,441	24,973	33,592	38,835	43,245	100	100	100	2.9	2.1	1.3	1.6
Coal	3,137	4,430	6,001	9,594	9,665	8,869	7,577	37	38	18	3.0	0.1	-1.2	-0.7
Oil	1,659	1,323	1,212	931	796	689	512	11	3.7	1.2	-1.3	-1.1	-2.2	-1.7
Natural gas	999	1,750	2,747	5,794	7,825	9,188	9,929	15	23	23	4.7	2.2	1.2	1.6
Nuclear	713	2,013	2,591	2,606	3,868	4,783	5,685	17	10	13	1.0	2.9	1.9	2.3
Hydro	1,717	2,144	2,618	4,061	4,940	5,415	5,824	18	16	13	2.5	1.4	0.8	1.1
Geothermal	14	36	52	82	268	371	468	0.3	0.3	1.1	3.2	8.8	2.8	5.3
Solar PV	-	0.1	1.0	328	1,677	2,750	3,884	-	1.3	9.0	37.3	12.4	4.3	7.5
Wind	-	3.9	31	958	3,186	4,864	6,762	-	3.8	16	23.6	9.0	3.8	5.9
CSP and marine	0.5	1.2	1.1	12	190	422	814	-	-	1.9	9.1	22.2	7.5	13.3
Biomass and waste	44	130	164	571	1,141	1,448	1,755	1.1	2.3	4.1	5.9	5.1	2.2	3.4
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	22	37	37	37	37	0.2	0.1	0.1	2.3	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	28,090	37,882	49,957	77,321	116,562	153,030	191,975	2.8	3.0	2.5	2.7
Population (million)	4,437	5,281	6,113	7,433	8,514	9,172	9,733	1.3	1.0	0.7	0.8
CO ₂ emissions (Mt)	17,808	20,479	23,113	32,353	33,335	31,513	28,714	1.8	0.2	-0.7	-0.4
GDP per capita (\$2010 thousand)	6.3	7.2	8.2	10	14	17	20	1.4	2.0	1.8	1.9
Primary energy consump. per capita (toe)	1.6	1.7	1.6	1.9	1.9	1.8	1.7	0.4	0.0	-0.3	-0.2
Primary energy consumption per GDP ^{*2}	257	232	201	178	136	109	89	-1.0	-1.9	-2.1	-2.0
CO ₂ emissions per GDP ^{*3}	634	541	463	418	286	206	150	-1.0	-2.7	-3.2	-3.0
CO ₂ per primary energy consumption ^{*4}	2.5	2.3	2.3	2.4	2.1	1.9	1.7	0.0	-0.8	-1.1	-1.0

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A46 | Asia [Advanced Technologies Scenario]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,439	2,110	2,887	5,497	6,997	7,622	7,917	100	100	100	3.8	1.7	0.6	1.1
Coal	466	787	1,036	2,685	2,851	2,761	2,502	37	49	32	4.8	0.4	-0.6	-0.2
Oil	477	618	916	1,367	1,711	1,807	1,815	29	25	23	3.1	1.6	0.3	0.8
Natural gas	51	116	233	567	941	1,167	1,316	5.5	10	17	6.3	3.7	1.7	2.5
Nuclear	25	77	132	122	398	583	765	3.6	2.2	9.7	1.8	8.8	3.3	5.6
Hydro	20	32	41	138	182	205	221	1.5	2.5	2.8	5.8	2.0	1.0	1.4
Geothermal	2.6	8.2	23	40	122	179	231	0.4	0.7	2.9	6.3	8.4	3.2	5.3
Solar, wind, etc.	-	1.2	2.1	62	229	351	484	0.1	1.1	6.1	16.2	9.8	3.8	6.2
Biomass and waste	397	471	503	517	563	569	582	22	9.4	7.3	0.4	0.6	0.2	0.4

Final energy consumption

	Mtoe							Shares (%)			1990/2016/2030/2050			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,129	1,556	1,991	3,709	4,592	4,950	5,123	100	100	100	3.4	1.5	0.5	1.0
Industry	383	514	647	1,511	1,726	1,796	1,800	33	41	35	4.2	1.0	0.2	0.5
Transport	124	184	318	661	892	947	968	12	18	19	5.1	2.2	0.4	1.1
Buildings, etc.	569	741	842	1,162	1,475	1,624	1,715	48	31	33	1.7	1.7	0.8	1.2
Non-energy use	54	117	185	375	499	583	640	7.5	10	12	4.6	2.1	1.3	1.6
Coal	301	424	373	899	879	841	778	27	24	15	2.9	-0.2	-0.6	-0.4
Oil	326	459	734	1,204	1,547	1,647	1,670	29	32	33	3.8	1.8	0.4	1.0
Natural gas	21	47	88	266	440	511	544	3.0	7.2	11	6.9	3.6	1.1	2.1
Electricity	88	156	278	784	1,193	1,450	1,668	10	21	33	6.4	3.0	1.7	2.2
Heat	7.5	14	30	96	106	109	104	0.9	2.6	2.0	7.6	0.7	-0.1	0.2
Hydrogen	-	-	-	-	0.3	1.1	3.0	-	-	0.1	n.a.	n.a.	13.0	n.a.
Renewables	386	456	488	459	427	391	356	29	12	7.0	0.0	-0.5	-0.9	-0.7

Electricity generation

	(TWh)							Shares (%)			1990/2016/2030/2050			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,196	2,240	3,983	10,768	16,250	19,345	21,851	100	100	100	6.2	3.0	1.5	2.1
Coal	298	869	1,990	6,443	7,393	7,257	6,617	39	60	30	8.0	1.0	-0.6	0.1
Oil	476	434	390	233	169	135	89	19	2.2	0.4	-2.4	-2.3	-3.2	-2.8
Natural gas	90	237	559	1,340	2,242	3,023	3,705	11	12	17	6.9	3.7	2.5	3.0
Nuclear	97	294	505	468	1,529	2,236	2,935	13	4.3	13	1.8	8.8	3.3	5.6
Hydro	232	369	478	1,603	2,118	2,382	2,565	16	15	12	5.8	2.0	1.0	1.4
Geothermal	3.0	8.4	20	24	80	116	151	0.4	0.2	0.7	4.2	8.8	3.2	5.5
Solar PV	-	0.1	0.6	152	974	1,602	2,187	-	1.4	10	34.4	14.2	4.1	8.2
Wind	-	-	2.4	294	1,285	1,985	2,812	-	2.7	13	41.7	11.1	4.0	6.9
CSP and marine	-	-	-	0.5	12	28	62	-	-	0.3	18.2	25.2	8.4	15.0
Biomass and waste	-	9.5	17	187	425	559	705	0.4	1.7	3.2	12.1	6.0	2.6	4.0
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	20	23	23	23	23	0.9	0.2	0.1	0.6	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	4,441	7,560	11,025	23,349	42,947	61,820	81,967	4.4	4.4	3.3	3.8
Population (million)	2,440	2,933	3,410	4,035	4,439	4,601	4,665	1.2	0.7	0.2	0.4
CO ₂ emissions (Mt)	3,105	4,632	6,720	14,795	16,704	16,369	15,090	4.6	0.9	-0.5	0.1
GDP per capita (\$2010 thousand)	1.8	2.6	3.2	5.8	9.7	13	18	3.2	3.7	3.0	3.3
Primary energy consump. per capita (toe)	0.6	0.7	0.8	1.4	1.6	1.7	1.7	2.5	1.0	0.4	0.6
Primary energy consumption per GDP ^{*2}	324	279	262	235	163	123	97	-0.7	-2.6	-2.6	-2.6
CO ₂ emissions per GDP ^{*3}	699	613	609	634	389	265	184	0.1	-3.4	-3.7	-3.6
CO ₂ per primary energy consumption ^{*4}	2.2	2.2	2.3	2.7	2.4	2.1	1.9	0.8	-0.9	-1.1	-1.0

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A47 | China [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	598	874	1,130	2,958	3,427	3,503	3,343	100	100	100	4.8	1.1	-0.1	0.4
Coal	313	531	665	1,916	1,791	1,578	1,240	61	65	37	5.1	-0.5	-1.8	-1.3
Oil	89	119	221	545	678	657	587	14	18	18	6.0	1.6	-0.7	0.2
Natural gas	12	13	21	171	365	455	490	1.5	5.8	15	10.5	5.6	1.5	3.1
Nuclear	-	-	4.4	56	188	308	427	-	1.9	13	n.a.	9.1	4.2	6.2
Hydro	5.0	11	19	100	122	132	135	1.2	3.4	4.0	8.9	1.4	0.5	0.9
Geothermal	-	-	1.7	9.4	12	14	14	-	0.3	0.4	n.a.	1.9	0.7	1.2
Solar, wind, etc.	-	-	1.0	49	156	223	295	-	1.7	8.8	32.4	8.6	3.2	5.4
Biomass and waste	180	200	198	113	117	137	156	23	3.8	4.7	-2.2	0.2	1.4	0.9

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	487	658	781	1,969	2,260	2,301	2,212	100	100	100	4.3	1.0	-0.1	0.3
Industry	181	234	302	994	950	898	833	36	50	38	5.7	-0.3	-0.7	-0.5
Transport	22	30	84	297	424	416	375	4.6	15	17	9.2	2.6	-0.6	0.7
Buildings, etc.	274	351	338	516	670	736	736	53	26	33	1.5	1.9	0.5	1.0
Non-energy use	10	43	57	162	215	252	269	6.5	8.2	12	5.3	2.0	1.1	1.5
Coal	214	311	274	710	601	525	445	47	36	20	3.2	-1.2	-1.5	-1.4
Oil	59	85	180	495	626	609	546	13	25	25	7.0	1.7	-0.7	0.3
Natural gas	6.4	8.9	12	113	198	226	233	1.3	5.7	11	10.3	4.1	0.8	2.2
Electricity	21	39	89	445	635	733	782	5.9	23	35	9.8	2.6	1.0	1.7
Heat	7.4	13	26	90	99	102	97	2.0	4.6	4.4	7.7	0.7	-0.1	0.2
Hydrogen	-	-	-	-	0.2	0.9	2.6	-	-	0.1	n.a.	n.a.	14.3	n.a.
Renewables	180	200	199	117	100	106	106	30	5.9	4.8	-2.1	-1.1	0.3	-0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	301	621	1,356	6,187	8,687	9,833	10,313	100	100	100	9.2	2.5	0.9	1.5
Coal	159	441	1,060	4,242	4,277	3,809	2,830	71	69	27	9.1	0.1	-2.0	-1.2
Oil	82	50	47	10	8.6	6.2	3.4	8.1	0.2	-	-5.9	-1.3	-4.5	-3.2
Natural gas	0.7	2.8	5.8	170	634	890	1,002	0.4	2.8	9.7	17.2	9.8	2.3	5.3
Nuclear	-	-	17	213	721	1,183	1,639	-	3.4	16	n.a.	9.1	4.2	6.2
Hydro	58	127	222	1,163	1,414	1,531	1,574	20	19	15	8.9	1.4	0.5	0.9
Geothermal	-	0.1	0.1	0.1	0.5	0.6	0.7	-	-	-	3.1	10.1	2.1	5.3
Solar PV	-	-	-	75	469	698	886	-	1.2	8.6	50.0	14.0	3.2	7.5
Wind	-	-	0.6	237	992	1,479	2,061	-	3.8	20	56.7	10.8	3.7	6.6
CSP and marine	-	-	-	-	3.5	11	29	-	-	0.3	6.9	37.5	11.2	21.4
Biomass and waste	-	-	2.4	76	168	225	288	-	1.2	2.8	n.a.	5.8	2.7	4.0
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	341	830	2,237	9,504	20,603	31,022	40,505	9.8	5.7	3.4	4.4
Population (million)	981	1,135	1,263	1,379	1,416	1,393	1,341	0.8	0.2	-0.3	-0.1
CO ₂ emissions (Mt)	1,392	2,136	3,126	9,015	9,042	8,113	6,574	5.7	0.0	-1.6	-0.9
GDP per capita (\$2010 thousand)	0.3	0.7	1.8	6.9	15	22	30	9.0	5.5	3.7	4.4
Primary energy consump. per capita (toe)	0.6	0.8	0.9	2.1	2.4	2.5	2.5	4.0	0.9	0.1	0.4
Primary energy consumption per GDP ^{*2}	1,752	1,053	505	311	166	113	83	-4.6	-4.4	-3.4	-3.8
CO ₂ emissions per GDP ^{*3}	4,079	2,575	1,398	949	439	262	162	-3.8	-5.4	-4.9	-5.1
CO ₂ per primary energy consumption ^{*4}	2.3	2.4	2.8	3.0	2.6	2.3	2.0	0.9	-1.0	-1.5	-1.3

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A48 | India [Advanced Technologies Scenario]
Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	200	306	441	862	1,436	1,732	1,984	100	100	100	4.1	3.7	1.6	2.5
Coal	44	93	146	380	603	676	735	30	44	37	5.6	3.4	1.0	2.0
Oil	33	61	112	217	375	466	524	20	25	26	5.0	4.0	1.7	2.6
Natural gas	1.3	11	23	47	123	178	226	3.5	5.5	11	5.9	7.1	3.1	4.7
Nuclear	0.8	1.6	4.4	9.9	53	92	130	0.5	1.1	6.6	7.3	12.7	4.6	7.9
Hydro	4.0	6.2	6.4	12	24	31	38	2.0	1.4	1.9	2.5	5.2	2.4	3.5
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	0.2	5.8	51	88	128	-	0.7	6.4	27.5	16.8	4.7	9.5
Biomass and waste	116	133	149	192	207	200	203	44	22	10	1.4	0.5	-0.1	0.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	174	243	314	572	940	1,141	1,306	100	100	100	3.4	3.6	1.7	2.5
Industry	41	67	83	193	361	430	468	27	34	36	4.2	4.6	1.3	2.6
Transport	17	21	32	90	156	198	228	8.5	16	17	5.8	4.0	1.9	2.8
Buildings, etc.	110	142	172	243	335	399	472	59	43	36	2.1	2.3	1.7	2.0
Non-energy use	5.7	13	27	46	88	115	137	5.5	8.1	10	4.9	4.7	2.3	3.2
Coal	25	38	33	99	173	204	216	16	17	17	3.7	4.1	1.1	2.3
Oil	27	50	94	182	330	416	473	21	32	36	5.1	4.3	1.8	2.8
Natural gas	0.7	5.6	9.7	32	72	94	107	2.3	5.6	8.2	6.9	5.9	2.0	3.6
Electricity	7.8	18	32	95	217	304	402	7.6	17	31	6.5	6.1	3.1	4.3
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	0.1	0.2	-	-	-	n.a.	n.a.	12.4	n.a.
Renewables	114	130	144	164	147	124	108	54	29	8.2	0.9	-0.8	-1.6	-1.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	120	293	570	1,478	3,187	4,210	5,351	100	100	100	6.4	5.6	2.6	3.9
Coal	61	192	390	1,105	1,756	1,913	2,135	65	75	40	7.0	3.4	1.0	2.0
Oil	8.8	13	29	23	26	20	12	4.5	1.6	0.2	2.2	0.7	-3.9	-2.1
Natural gas	0.6	10.0	56	71	251	439	665	3.4	4.8	12	7.9	9.4	5.0	6.8
Nuclear	3.0	6.1	17	38	203	352	500	2.1	2.6	9.3	7.3	12.7	4.6	7.9
Hydro	47	72	74	138	280	364	448	24	9.3	8.4	2.5	5.2	2.4	3.5
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Solar PV	-	-	-	14	311	550	762	-	1.0	14	n.a.	24.7	4.6	12.4
Wind	-	-	1.7	45	240	408	604	-	3.0	11	32.1	12.7	4.7	7.9
CSP and marine	-	-	-	-	5.1	11	22	-	-	0.4	n.a.	n.a.	7.6	n.a.
Biomass and waste	-	-	1.3	44	115	154	204	-	3.0	3.8	n.a.	7.2	2.9	4.6
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	271	465	800	2,456	6,243	10,407	16,104	6.6	6.9	4.9	5.7
Population (million)	697	870	1,053	1,324	1,513	1,605	1,659	1.6	1.0	0.5	0.7
CO ₂ emissions (Mt)	258	529	885	2,078	3,470	3,972	4,283	5.4	3.7	1.1	2.1
GDP per capita (\$2010 thousand)	0.4	0.5	0.8	1.9	4.1	6.5	9.7	4.9	5.9	4.4	5.0
Primary energy consump. per capita (toe)	0.3	0.4	0.4	0.7	0.9	1.1	1.2	2.4	2.7	1.2	1.8
Primary energy consumption per GDP ^{*2}	739	658	551	351	230	166	123	-2.4	-3.0	-3.1	-3.0
CO ₂ emissions per GDP ^{*3}	953	1,138	1,106	846	556	382	266	-1.1	-3.0	-3.6	-3.3
CO ₂ per primary energy consumption ^{*4}	1.3	1.7	2.0	2.4	2.4	2.3	2.2	1.3	0.0	-0.6	-0.3

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A49 | Japan [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	345	438	518	426	418	385	352	100	100	100	-0.1	-0.1	-0.9	-0.6
Coal	60	76	97	114	97	84	66	17	27	19	1.6	-1.2	-1.9	-1.6
Oil	234	250	255	177	135	114	96	57	42	27	-1.3	-1.9	-1.7	-1.8
Natural gas	21	44	66	102	83	77	69	10	24	19	3.3	-1.4	-1.0	-1.2
Nuclear	22	53	84	4.7	60	56	56	12	1.1	16	-8.9	20.0	-0.4	7.6
Hydro	7.6	7.6	7.3	6.8	7.7	7.8	7.9	1.7	1.6	2.2	-0.4	0.9	0.1	0.4
Geothermal	0.8	1.6	3.1	2.3	6.4	11	15	0.4	0.5	4.3	1.5	7.4	4.5	5.7
Solar, wind, etc.	-	1.2	0.8	5.1	9.1	14	19	0.3	1.2	5.3	5.8	4.2	3.7	3.9
Biomass and waste	-	4.6	4.9	14	19	21	24	1.0	3.2	6.8	4.4	2.3	1.1	1.6

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	232	288	331	294	271	249	230	100	100	100	0.1	-0.6	-0.8	-0.7
Industry	91	106	97	82	78	76	73	37	28	32	-1.0	-0.3	-0.3	-0.3
Transport	54	68	86	72	53	44	37	24	24	16	0.2	-2.1	-1.7	-1.9
Buildings, etc.	58	78	106	104	103	95	85	27	35	37	1.1	0.0	-1.0	-0.6
Non-energy use	28	36	41	37	36	35	34	12	13	15	0.2	-0.2	-0.4	-0.3
Coal	25	27	21	21	19	18	16	9.5	7.3	7.0	-0.9	-0.7	-0.9	-0.8
Oil	157	177	202	150	121	103	88	61	51	38	-0.6	-1.5	-1.6	-1.6
Natural gas	5.8	15	22	32	35	33	30	5.1	11	13	3.0	0.7	-0.8	-0.2
Electricity	44	65	81	83	89	89	87	23	28	38	1.0	0.5	-0.1	0.1
Heat	0.1	0.2	0.5	0.5	0.4	0.4	0.3	0.1	0.2	0.1	3.7	-1.0	-1.5	-1.3
Hydrogen	-	-	-	-	0.1	0.1	0.2	-	-	0.1	n.a.	n.a.	7.0	n.a.
Renewables	-	3.9	3.8	6.7	6.5	6.4	7.4	1.4	2.3	3.2	2.1	-0.2	0.6	0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	573	861	1,058	1,052	1,119	1,121	1,098	100	100	100	0.8	0.4	-0.1	0.1
Coal	55	123	230	349	286	241	181	14	33	16	4.1	-1.4	-2.3	-1.9
Oil	265	248	140	84	31	18	5.9	29	8.0	0.5	-4.1	-6.8	-8.0	-7.5
Natural gas	81	168	248	406	290	286	270	20	39	25	3.5	-2.4	-0.4	-1.2
Nuclear	83	202	322	18	232	215	215	24	1.7	20	-8.9	20.0	-0.4	7.6
Hydro	88	88	84	79	89	91	91	10	7.5	8.3	-0.4	0.9	0.1	0.4
Geothermal	0.9	1.7	3.3	2.5	7.2	12	18	0.2	0.2	1.6	1.4	7.8	4.5	5.9
Solar PV	-	0.1	0.4	51	84	130	168	-	4.8	15	29.1	3.6	3.5	3.6
Wind	-	-	0.1	6.0	20	35	50	-	0.6	4.5	n.a.	9.1	4.6	6.4
CSP and marine	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	8.9	10	34	58	71	79	1.0	3.2	7.2	5.2	4.0	1.5	2.5
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	20	21	21	21	21	2.3	2.0	2.0	0.3	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	2,977	4,683	5,349	6,053	6,808	7,353	7,885	1.0	0.8	0.7	0.8
Population (million)	117	124	127	127	121	115	108	0.1	-0.4	-0.6	-0.5
CO ₂ emissions (Mt)	908	1,046	1,145	1,138	904	778	642	0.3	-1.6	-1.7	-1.7
GDP per capita (\$2010 thousand)	25	38	42	48	56	64	73	0.9	1.2	1.3	1.3
Primary energy consump. per capita (toe)	3.0	3.5	4.1	3.4	3.5	3.4	3.3	-0.2	0.2	-0.3	-0.1
Primary energy consumption per GDP ^{*2}	116	94	97	70	61	52	45	-1.1	-1.0	-1.6	-1.3
CO ₂ emissions per GDP ^{*3}	305	223	214	188	133	106	81	-0.7	-2.4	-2.4	-2.4
CO ₂ per primary energy consumption ^{*4}	2.6	2.4	2.2	2.7	2.2	2.0	1.8	0.4	-1.5	-0.8	-1.1

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A50 | ASEAN [Advanced Technologies Scenario]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	142	233	379	643	998	1,247	1,460	100	100	100	4.0	3.2	1.9	2.4
Coal	3.6	13	32	120	209	269	316	5.4	19	22	9.1	4.0	2.1	2.9
Oil	58	89	153	220	294	343	389	38	34	27	3.6	2.1	1.4	1.7
Natural gas	8.6	30	74	139	212	259	298	13	22	20	6.1	3.1	1.7	2.3
Nuclear	-	-	-	-	14	49	76	-	-	5.2	n.a.	n.a.	9.0	n.a.
Hydro	0.8	2.3	4.1	11	18	20	22	1.0	1.7	1.5	6.1	3.5	1.1	2.1
Geothermal	1.8	6.6	18	28	103	153	200	2.8	4.3	14	5.7	9.8	3.4	6.0
Solar, wind, etc.	-	-	-	0.6	6.4	13	22	-	0.1	1.5	n.a.	19.1	6.5	11.5
Biomass and waste	70	93	98	123	139	137	132	40	19	9.0	1.1	0.9	-0.3	0.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	112	173	270	451	629	739	835	100	100	100	3.7	2.4	1.4	1.8
Industry	22	43	75	129	201	246	275	25	29	33	4.3	3.2	1.6	2.3
Transport	17	32	61	122	164	192	226	19	27	27	5.2	2.1	1.6	1.8
Buildings, etc.	71	87	113	148	189	207	221	50	33	26	2.1	1.8	0.8	1.2
Non-energy use	2.4	11	21	52	76	95	114	6.3	12	14	6.2	2.7	2.1	2.3
Coal	2.1	6.1	13	35	51	58	61	3.5	7.8	7.3	7.0	2.6	0.9	1.6
Oil	41	67	123	204	276	325	371	38	45	44	4.4	2.2	1.5	1.8
Natural gas	2.5	7.5	17	37	62	76	83	4.4	8.2	10.0	6.3	3.8	1.5	2.4
Electricity	4.7	11	28	73	137	188	239	6.4	16	29	7.5	4.6	2.8	3.5
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Hydrogen	-	-	-	-	-	-	0.1	-	-	-	n.a.	n.a.	7.9	n.a.
Renewables	61	82	89	102	102	92	80	47	23	9.6	0.8	0.0	-1.2	-0.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	62	154	370	926	1,753	2,400	3,040	100	100	100	7.1	4.7	2.8	3.6
Coal	3.0	28	79	339	679	893	1,098	18	37	36	10.1	5.1	2.4	3.5
Oil	47	66	72	25	21	19	11	43	2.7	0.4	-3.7	-1.2	-3.0	-2.2
Natural gas	0.7	26	154	383	588	725	889	17	41	29	10.9	3.1	2.1	2.5
Nuclear	-	-	-	-	52	187	292	-	-	9.6	n.a.	n.a.	9.0	n.a.
Hydro	9.8	27	47	128	208	238	259	18	14	8.5	6.1	3.5	1.1	2.1
Geothermal	2.1	6.6	16	22	71	102	131	4.3	2.3	4.3	4.7	8.8	3.1	5.4
Solar PV	-	-	-	4.9	63	135	226	-	0.5	7.4	n.a.	20.0	6.6	11.9
Wind	-	-	-	1.5	11	22	33	-	0.2	1.1	n.a.	15.2	5.7	9.5
CSP and marine	-	-	-	-	0.1	0.2	0.5	-	-	-	n.a.	n.a.	9.9	n.a.
Biomass and waste	-	0.6	1.0	23	60	79	100	0.4	2.5	3.3	15.1	7.0	2.6	4.4
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	440	741	1,180	2,607	5,042	7,503	10,546	5.0	4.8	3.8	4.2
Population (million)	346	430	506	618	700	740	765	1.4	0.9	0.4	0.6
CO ₂ emissions (Mt)	188	348	676	1,298	1,886	2,037	2,112	5.2	2.7	0.6	1.4
GDP per capita (\$2010 thousand)	1.3	1.7	2.3	4.2	7.2	10	14	3.5	3.9	3.3	3.5
Primary energy consump. per capita (toe)	0.4	0.5	0.7	1.0	1.4	1.7	1.9	2.5	2.3	1.5	1.8
Primary energy consumption per GDP ^{*2}	323	314	322	247	198	166	138	-0.9	-1.6	-1.8	-1.7
CO ₂ emissions per GDP ^{*3}	426	469	573	498	374	271	200	0.2	-2.0	-3.1	-2.6
CO ₂ per primary energy consumption ^{*4}	1.3	1.5	1.8	2.0	1.9	1.6	1.4	1.2	-0.5	-1.3	-1.0

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A51 | United States [Advanced Technologies Scenario]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,805	1,915	2,274	2,167	2,056	1,914	1,764	100	100	100	0.5	-0.4	-0.8	-0.6
Coal	376	460	534	342	227	140	66	24	16	3.7	-1.1	-2.9	-6.0	-4.7
Oil	797	757	871	787	652	542	452	40	36	26	0.2	-1.3	-1.8	-1.6
Natural gas	477	438	548	653	675	641	546	23	30	31	1.5	0.2	-1.1	-0.5
Nuclear	69	159	208	219	193	187	178	8.3	10	10	1.2	-0.9	-0.4	-0.6
Hydro	24	23	22	23	25	26	26	1.2	1.1	1.5	0.0	0.7	0.1	0.3
Geothermal	4.6	14	13	9.2	34	44	52	0.7	0.4	2.9	-1.6	9.8	2.1	5.2
Solar, wind, etc.	-	0.3	2.1	26	108	183	279	-	1.2	16	18.5	10.6	4.8	7.2
Biomass and waste	54	62	73	102	136	148	160	3.3	4.7	9.1	1.9	2.1	0.8	1.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,311	1,294	1,546	1,515	1,444	1,347	1,248	100	100	100	0.6	-0.3	-0.7	-0.6
Industry	387	284	332	264	264	253	228	22	17	18	-0.3	0.0	-0.7	-0.4
Transport	425	488	588	622	536	465	418	38	41	34	0.9	-1.1	-1.2	-1.2
Buildings, etc.	397	403	473	493	493	472	447	31	33	36	0.8	0.0	-0.5	-0.3
Non-energy use	102	119	153	136	152	157	154	9.2	9.0	12	0.5	0.8	0.1	0.4
Coal	56	56	33	18	15	13	11	4.3	1.2	0.9	-4.4	-0.9	-1.6	-1.3
Oil	689	683	793	744	622	521	438	53	49	35	0.3	-1.3	-1.7	-1.5
Natural gas	338	303	360	336	325	304	274	23	22	22	0.4	-0.2	-0.8	-0.6
Electricity	174	226	301	327	379	401	410	18	22	33	1.4	1.1	0.4	0.7
Heat	-	2.2	5.3	6.6	5.5	4.8	4.0	0.2	0.4	0.3	4.4	-1.3	-1.5	-1.4
Hydrogen	-	-	-	-	0.1	0.7	2.4	-	-	0.2	n.a.	n.a.	15.9	n.a.
Renewables	54	23	54	83	97	101	107	1.8	5.5	8.6	5.1	1.1	0.5	0.8

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	2,427	3,203	4,026	4,300	4,958	5,207	5,285	100	100	100	1.1	1.0	0.3	0.6
Coal	1,243	1,700	2,129	1,354	893	518	196	53	31	3.7	-0.9	-2.9	-7.3	-5.5
Oil	263	131	118	35	22	12	4.1	4.1	0.8	0.1	-5.0	-3.1	-8.1	-6.1
Natural gas	370	382	634	1,418	1,744	1,697	1,315	12	33	25	5.2	1.5	-1.4	-0.2
Nuclear	266	612	798	840	742	717	683	19	20	13	1.2	-0.9	-0.4	-0.6
Hydro	279	273	253	270	295	298	300	8.5	6.3	5.7	0.0	0.7	0.1	0.3
Geothermal	5.4	16	15	19	70	91	108	0.5	0.4	2.0	0.6	10.0	2.2	5.3
Solar PV	-	-	0.2	47	214	353	510	-	1.1	9.7	44.9	11.5	4.4	7.3
Wind	-	3.1	5.7	229	714	1,114	1,564	0.1	5.3	30	18.1	8.4	4.0	5.8
CSP and marine	-	0.7	0.5	3.7	101	208	376	-	0.1	7.1	6.8	26.6	6.8	14.6
Biomass and waste	0.5	86	72	79	158	192	224	2.7	1.8	4.2	-0.3	5.1	1.8	3.1
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	-	-	5.6	5.6	5.6	5.6	-	0.1	0.1	n.a.	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	6,529	9,064	12,713	16,920	22,637	27,647	32,825	2.4	2.1	1.9	2.0
Population (million)	227	250	282	323	356	375	391	1.0	0.7	0.5	0.6
CO ₂ emissions (Mt)	4,620	4,817	5,700	4,870	3,902	3,035	2,276	0.0	-1.6	-2.7	-2.2
GDP per capita (\$2010 thousand)	29	36	45	52	64	74	84	1.4	1.4	1.4	1.4
Primary energy consump. per capita (toe)	7.9	7.7	8.1	6.7	5.8	5.1	4.5	-0.5	-1.1	-1.2	-1.2
Primary energy consumption per GDP ^{*2}	276	211	179	128	91	69	54	-1.9	-2.4	-2.6	-2.5
CO ₂ emissions per GDP ^{*3}	708	531	448	288	172	110	69	-2.3	-3.6	-4.5	-4.1
CO ₂ per primary energy consumption ^{*4}	2.6	2.5	2.5	2.2	1.9	1.6	1.3	-0.4	-1.2	-1.9	-1.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A52 | European Union [Advanced Technologies Scenario]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	n.a.	1,646	1,695	1,599	1,507	1,385	1,280	100	100	100	-0.1	-0.4	-0.8	-0.7
Coal	n.a.	454	321	241	161	110	72	28	15	5.6	-2.4	-2.9	-3.9	-3.5
Oil	n.a.	608	625	522	431	350	287	37	33	22	-0.6	-1.4	-2.0	-1.7
Natural gas	n.a.	297	396	383	375	331	270	18	24	21	1.0	-0.2	-1.6	-1.0
Nuclear	n.a.	207	246	219	220	228	244	13	14	19	0.2	0.0	0.5	0.3
Hydro	n.a.	25	31	30	31	32	32	1.5	1.9	2.5	0.7	0.2	0.2	0.2
Geothermal	n.a.	3.2	4.6	6.7	11	12	12	0.2	0.4	1.0	2.9	3.4	0.8	1.9
Solar, wind, etc.	n.a.	0.3	2.4	40	93	131	168	-	2.5	13	20.6	6.3	3.0	4.4
Biomass and waste	n.a.	48	67	155	184	188	192	2.9	9.7	15	4.7	1.2	0.2	0.6

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	n.a.	1,134	1,179	1,138	1,085	990	905	100	100	100	0.0	-0.3	-0.9	-0.7
Industry	n.a.	345	308	257	252	239	221	30	23	24	-1.1	-0.1	-0.6	-0.4
Transport	n.a.	259	303	319	262	213	180	23	28	20	0.8	-1.4	-1.9	-1.7
Buildings, etc.	n.a.	430	454	463	469	437	406	38	41	45	0.3	0.1	-0.7	-0.4
Non-energy use	n.a.	100	113	98	102	101	97	8.8	8.6	11	-0.1	0.3	-0.2	0.0
Coal	n.a.	120	51	34	33	29	26	11	3.0	2.8	-4.7	-0.4	-1.2	-0.9
Oil	n.a.	506	543	471	392	319	261	45	41	29	-0.3	-1.3	-2.0	-1.7
Natural gas	n.a.	227	272	252	252	232	211	20	22	23	0.4	0.0	-0.9	-0.5
Electricity	n.a.	186	217	239	266	279	287	16	21	32	1.0	0.8	0.4	0.5
Heat	n.a.	55	45	48	45	39	34	4.9	4.2	3.8	-0.5	-0.5	-1.4	-1.0
Hydrogen	n.a.	-	-	-	-	0.1	0.2	-	-	-	n.a.	n.a.	9.1	n.a.
Renewables	n.a.	40	50	93	98	92	86	3.5	8.2	9.5	3.3	0.4	-0.7	-0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	n.a.	2,577	3,006	3,228	3,618	3,787	3,907	100	100	100	0.9	0.8	0.4	0.6
Coal	n.a.	1,050	968	736	466	280	131	41	23	3.4	-1.4	-3.2	-6.1	-4.9
Oil	n.a.	224	181	60	33	17	5.5	8.7	1.8	0.1	-5.0	-4.1	-8.6	-6.8
Natural gas	n.a.	193	480	611	582	463	244	7.5	19	6.2	4.5	-0.3	-4.3	-2.7
Nuclear	n.a.	795	945	840	844	875	936	31	26	24	0.2	0.0	0.5	0.3
Hydro	n.a.	290	357	350	360	367	374	11	11	9.6	0.7	0.2	0.2	0.2
Geothermal	n.a.	3.2	4.8	6.6	11	12	13	0.1	0.2	0.3	2.8	3.7	0.8	2.0
Solar PV	n.a.	-	0.1	105	254	339	421	-	3.3	11	41.8	6.5	2.6	4.2
Wind	n.a.	0.8	22	303	703	980	1,251	-	9.4	32	25.8	6.2	2.9	4.3
CSP and marine	n.a.	0.5	0.5	6.1	39	73	110	-	0.2	2.8	10.1	14.1	5.3	8.9
Biomass and waste	n.a.	20	46	206	322	375	417	0.8	6.4	11	9.5	3.2	1.3	2.1
Hydrogen	n.a.	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	n.a.	0.2	1.4	5.0	4.3	4.3	4.3	-	0.2	0.1	12.9	-1.0	0.0	-0.4

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	n.a.	11,895	14,789	18,309	23,323	26,643	29,798	1.7	1.7	1.2	1.4
Population (million)	n.a.	478	488	511	524	526	523	0.3	0.2	0.0	0.1
CO ₂ emissions (Mt)	n.a.	4,018	3,798	3,195	2,510	1,967	1,497	-0.9	-1.7	-2.6	-2.2
GDP per capita (\$2010 thousand)	n.a.	25	30	36	45	51	57	1.4	1.6	1.2	1.4
Primary energy consump. per capita (toe)	n.a.	3.4	3.5	3.1	2.9	2.6	2.4	-0.4	-0.6	-0.8	-0.7
Primary energy consumption per GDP ^{*2}	n.a.	138	115	87	65	52	43	-1.8	-2.1	-2.0	-2.1
CO ₂ emissions per GDP ^{*3}	n.a.	338	257	175	108	74	50	-2.5	-3.4	-3.7	-3.6
CO ₂ per primary energy consumption ^{*4}	n.a.	2.4	2.2	2.0	1.7	1.4	1.2	-0.8	-1.3	-1.8	-1.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A53 | World [No New Coal-fired Power Plant (Natural Gas Substitution) Case]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/2016	2016/2030	2030/2050	2016/2050
Total ¹	7,208	8,774	10,036	13,761	16,377	17,835	18,879	100	100	100	1.7	1.3	0.7	0.9
Coal	1,783	2,220	2,316	3,731	3,502	3,150	2,693	25	27	14	2.0	-0.5	-1.3	-1.0
Oil	3,105	3,234	3,663	4,390	5,121	5,496	5,715	37	32	30	1.2	1.1	0.6	0.8
Natural gas	1,232	1,664	2,072	3,035	4,403	5,429	6,344	19	22	34	2.3	2.7	1.8	2.2
Nuclear	186	526	675	680	814	856	911	6.0	4.9	4.8	1.0	1.3	0.6	0.9
Hydro	148	184	225	349	425	466	501	2.1	2.5	2.7	2.5	1.4	0.8	1.1
Geothermal	12	34	52	81	182	233	281	0.4	0.6	1.5	3.4	6.0	2.2	3.7
Solar, wind, etc.	0.1	2.5	8.0	145	387	568	757	-	1.1	4.0	17.0	7.3	3.4	5.0
Biomass and waste	742	909	1,022	1,349	1,541	1,634	1,676	10	9.8	8.9	1.5	1.0	0.4	0.6

Final energy consumption

	Mtoe							Shares (%)			1990/	2016/	2030/	2016/
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	2016	2030	2050	2050
Total	5,368	6,271	7,035	9,555	11,307	12,350	13,145	100	100	100	1.6	1.2	0.8	0.9
Industry	1,766	1,804	1,868	2,753	3,214	3,535	3,771	29	29	29	1.6	1.1	0.8	0.9
Transport	1,246	1,570	1,958	2,748	3,245	3,507	3,705	25	29	28	2.2	1.2	0.7	0.9
Buildings, etc.	2,002	2,417	2,596	3,185	3,750	4,052	4,290	39	33	33	1.1	1.2	0.7	0.9
Non-energy use	354	480	614	870	1,098	1,256	1,379	7.6	9.1	10	2.3	1.7	1.1	1.4
Coal	703	752	542	1,036	1,098	1,125	1,110	12	11	8.4	1.2	0.4	0.1	0.2
Oil	2,446	2,605	3,122	3,908	4,599	4,948	5,175	42	41	39	1.6	1.2	0.6	0.8
Natural gas	815	945	1,118	1,440	1,670	1,827	1,955	15	15	15	1.6	1.1	0.8	0.9
Electricity	586	834	1,089	1,794	2,465	2,942	3,410	13	19	26	3.0	2.3	1.6	1.9
Heat	121	336	248	283	288	288	286	5.4	3.0	2.2	-0.7	0.1	0.0	0.0
Hydrogen	-	-	-	-	0.7	1.2	1.3	-	-	-	n.a.	n.a.	3.1	n.a.
Renewables	698	799	916	1,095	1,186	1,218	1,208	13	11	9.2	1.2	0.6	0.1	0.3

Electricity generation

	(TWh)							Shares (%)			1990/	2016/	2030/	2016/
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	2016	2030	2050	2050
Total	8,283	11,852	15,441	24,973	34,152	40,269	45,964	100	100	100	2.9	2.3	1.5	1.8
Coal	3,137	4,430	6,001	9,594	8,524	7,006	5,217	37	38	11	3.0	-0.8	-2.4	-1.8
Oil	1,659	1,323	1,212	931	981	991	891	11	3.7	1.9	-1.3	0.4	-0.5	-0.1
Natural gas	999	1,750	2,747	5,794	11,619	16,460	21,285	15	23	46	4.7	5.1	3.1	3.9
Nuclear	713	2,013	2,591	2,606	3,122	3,287	3,496	17	10	7.6	1.0	1.3	0.6	0.9
Hydro	1,717	2,144	2,618	4,061	4,940	5,415	5,824	18	16	13	2.5	1.4	0.8	1.1
Geothermal	14	36	52	82	195	254	307	0.3	0.3	0.7	3.2	6.4	2.3	4.0
Solar PV	-	0.1	1.0	328	1,229	1,923	2,653	-	1.3	5.8	37.3	9.9	3.9	6.3
Wind	-	3.9	31	958	2,446	3,501	4,506	-	3.8	9.8	23.6	6.9	3.1	4.7
CSP and marine	0.5	1.2	1.1	12	119	214	351	-	-	0.8	9.1	18.1	5.6	10.6
Biomass and waste	44	130	164	571	942	1,182	1,399	1.1	2.3	3.0	5.9	3.6	2.0	2.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	22	37	37	37	37	0.2	0.1	0.1	2.3	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	28,090	37,882	49,957	77,321	116,562	153,030	191,975	2.8	3.0	2.5	2.7
Population (million)	4,437	5,281	6,113	7,433	8,514	9,172	9,733	1.3	1.0	0.7	0.8
CO ₂ emissions (Mt)	17,808	20,479	23,113	32,353	36,095	37,784	38,452	1.8	0.8	0.3	0.5
GDP per capita (\$2010 thousand)	6.3	7.2	8.2	10	14	17	20	1.4	2.0	1.8	1.9
Primary energy consump. per capita (toe)	1.6	1.7	1.6	1.9	1.9	1.9	1.9	0.4	0.3	0.0	0.1
Primary energy consumption per GDP ^{*2}	257	232	201	178	140	117	98	-1.0	-1.7	-1.8	-1.7
CO ₂ emissions per GDP ^{*3}	634	541	463	418	310	247	200	-1.0	-2.1	-2.2	-2.1
CO ₂ per primary energy consumption ^{*4}	2.5	2.3	2.3	2.4	2.2	2.1	2.0	0.0	-0.5	-0.4	-0.4

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A54 | Asia [No New Coal-fired Power Plant (Natural Gas Substitution) Case]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,439	2,110	2,887	5,497	7,215	8,116	8,721	100	100	100	3.8	2.0	1.0	1.4
Coal	466	787	1,036	2,685	2,729	2,573	2,230	37	49	26	4.8	0.1	-1.0	-0.5
Oil	477	618	916	1,367	1,830	2,063	2,217	29	25	25	3.1	2.1	1.0	1.4
Natural gas	51	116	233	567	1,379	1,982	2,586	5.5	10	30	6.3	6.6	3.2	4.6
Nuclear	25	77	132	122	271	338	404	3.6	2.2	4.6	1.8	5.9	2.0	3.6
Hydro	20	32	41	138	182	205	221	1.5	2.5	2.5	5.8	2.0	1.0	1.4
Geothermal	2.6	8.2	23	40	93	118	143	0.4	0.7	1.6	6.3	6.3	2.2	3.8
Solar, wind, etc.	-	1.2	2.1	62	179	261	340	0.1	1.1	3.9	16.2	7.9	3.3	5.1
Biomass and waste	397	471	503	517	551	575	580	22	9.4	6.6	0.4	0.5	0.3	0.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,129	1,556	1,991	3,709	4,754	5,352	5,797	100	100	100	3.4	1.8	1.0	1.3
Industry	383	514	647	1,511	1,789	1,959	2,086	33	41	36	4.2	1.2	0.8	1.0
Transport	124	184	318	661	969	1,120	1,226	12	18	21	5.1	2.8	1.2	1.8
Buildings, etc.	569	741	842	1,162	1,496	1,690	1,846	48	31	32	1.7	1.8	1.1	1.4
Non-energy use	54	117	185	375	499	583	640	7.5	10	11	4.6	2.1	1.3	1.6
Coal	301	424	373	899	930	942	922	27	24	16	2.9	0.2	0.0	0.1
Oil	326	459	734	1,204	1,645	1,870	2,027	29	32	35	3.8	2.3	1.0	1.5
Natural gas	21	47	88	266	417	502	565	3.0	7.2	9.7	6.9	3.3	1.5	2.2
Electricity	88	156	278	784	1,205	1,484	1,748	10	21	30	6.4	3.1	1.9	2.4
Heat	7.5	14	30	96	109	114	114	0.9	2.6	2.0	7.6	0.9	0.2	0.5
Hydrogen	-	-	-	-	0.2	0.5	0.5	-	-	-	n.a.	n.a.	3.7	n.a.
Renewables	386	456	488	459	447	439	421	29	12	7.3	0.0	-0.2	-0.3	-0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,196	2,240	3,983	10,768	16,566	20,173	23,404	100	100	100	6.2	3.1	1.7	2.3
Coal	298	869	1,990	6,443	6,524	5,868	4,571	39	60	20	8.0	0.1	-1.8	-1.0
Oil	476	434	390	233	209	183	140	19	2.2	0.6	-2.4	-0.8	-2.0	-1.5
Natural gas	90	237	559	1,340	4,540	7,297	10,455	11	12	45	6.9	9.1	4.3	6.2
Nuclear	97	294	505	468	1,041	1,296	1,552	13	4.3	6.6	1.8	5.9	2.0	3.6
Hydro	232	369	478	1,603	2,118	2,382	2,565	16	15	11	5.8	2.0	1.0	1.4
Geothermal	3.0	8.4	20	24	60	77	94	0.4	0.2	0.4	4.2	6.7	2.2	4.1
Solar PV	-	0.1	0.6	152	708	1,123	1,533	-	1.4	6.5	34.4	11.6	3.9	7.0
Wind	-	-	2.4	294	993	1,458	1,892	-	2.7	8.1	41.7	9.1	3.3	5.6
CSP and marine	-	-	-	0.5	7.5	14	26	-	-	0.1	18.2	20.8	6.4	12.1
Biomass and waste	-	9.5	17	187	341	452	554	0.4	1.7	2.4	12.1	4.4	2.5	3.2
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	20	23	23	23	23	0.9	0.2	0.1	0.6	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	4,441	7,560	11,025	23,349	42,947	61,820	81,967	4.4	4.4	3.3	3.8
Population (million)	2,440	2,933	3,410	4,035	4,439	4,601	4,665	1.2	0.7	0.2	0.4
CO ₂ emissions (Mt)	3,105	4,632	6,720	14,795	17,833	19,080	19,449	4.6	1.3	0.4	0.8
GDP per capita (\$2010 thousand)	1.8	2.6	3.2	5.8	9.7	13	18	3.2	3.7	3.0	3.3
Primary energy consump. per capita (toe)	0.6	0.7	0.8	1.4	1.6	1.8	1.9	2.5	1.3	0.7	0.9
Primary energy consumption per GDP ^{*2}	324	279	262	235	168	131	106	-0.7	-2.4	-2.3	-2.3
CO ₂ emissions per GDP ^{*3}	699	613	609	634	415	309	237	0.1	-3.0	-2.8	-2.8
CO ₂ per primary energy consumption ^{*4}	2.2	2.2	2.3	2.7	2.5	2.4	2.2	0.8	-0.6	-0.5	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A55 | World [No New Coal-fired Power Plant (Renewables Substitution) Case]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	7,208	8,774	10,036	13,761	16,106	17,377	18,257	100	100	100	1.7	1.1	0.6	0.8
Coal	1,783	2,220	2,316	3,731	3,460	3,096	2,632	25	27	14	2.0	-0.5	-1.4	-1.0
Oil	3,105	3,234	3,663	4,390	5,043	5,397	5,603	37	32	31	1.2	1.0	0.5	0.7
Natural gas	1,232	1,664	2,072	3,035	3,967	4,603	5,153	19	22	28	2.3	1.9	1.3	1.6
Nuclear	186	526	675	680	814	856	911	6.0	4.9	5.0	1.0	1.3	0.6	0.9
Hydro	148	184	225	349	425	466	501	2.1	2.5	2.7	2.5	1.4	0.8	1.1
Geothermal	12	34	52	81	183	234	283	0.4	0.6	1.5	3.4	6.0	2.2	3.8
Solar, wind, etc.	0.1	2.5	8.0	145	672	1,086	1,493	-	1.1	8.2	17.0	11.6	4.1	7.1
Biomass and waste	742	909	1,022	1,349	1,542	1,637	1,679	10	9.8	9.2	1.5	1.0	0.4	0.6

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	5,368	6,271	7,035	9,555	11,346	12,427	13,248	100	100	100	1.6	1.2	0.8	1.0
Industry	1,766	1,804	1,868	2,753	3,214	3,535	3,771	29	29	28	1.6	1.1	0.8	0.9
Transport	1,246	1,570	1,958	2,748	3,238	3,497	3,691	25	29	28	2.2	1.2	0.7	0.9
Buildings, etc.	2,002	2,417	2,596	3,185	3,796	4,139	4,407	39	33	33	1.1	1.3	0.7	1.0
Non-energy use	354	480	614	870	1,098	1,256	1,379	7.6	9.1	10	2.3	1.7	1.1	1.4
Coal	703	752	542	1,036	1,064	1,081	1,060	12	11	8.0	1.2	0.2	0.0	0.1
Oil	2,446	2,605	3,122	3,908	4,527	4,857	5,072	42	41	38	1.6	1.1	0.6	0.8
Natural gas	815	945	1,118	1,440	1,789	1,987	2,137	15	15	16	1.6	1.6	0.9	1.2
Electricity	586	834	1,089	1,794	2,485	2,983	3,468	13	19	26	3.0	2.4	1.7	2.0
Heat	121	336	248	283	292	295	295	5.4	3.0	2.2	-0.7	0.2	0.1	0.1
Hydrogen	-	-	-	-	0.7	1.2	1.3	-	-	-	n.a.	n.a.	3.1	n.a.
Renewables	698	799	916	1,095	1,188	1,224	1,215	13	11	9.2	1.2	0.6	0.1	0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	8,283	11,852	15,441	24,973	34,417	40,815	46,737	100	100	100	2.9	2.3	1.5	1.9
Coal	3,137	4,430	6,001	9,594	8,524	7,006	5,217	37	38	11	3.0	-0.8	-2.4	-1.8
Oil	1,659	1,323	1,212	931	981	992	893	11	3.7	1.9	-1.3	0.4	-0.5	-0.1
Natural gas	999	1,750	2,747	5,794	8,587	11,012	13,538	15	23	29	4.7	2.9	2.3	2.5
Nuclear	713	2,013	2,591	2,606	3,122	3,287	3,496	17	10	7.5	1.0	1.3	0.6	0.9
Hydro	1,717	2,144	2,618	4,061	4,940	5,415	5,824	18	16	12	2.5	1.4	0.8	1.1
Geothermal	14	36	52	82	195	254	307	0.3	0.3	0.7	3.2	6.4	2.3	4.0
Solar PV	-	0.1	1.0	328	2,684	4,802	6,959	-	1.3	15	37.3	16.2	4.9	9.4
Wind	-	3.9	31	958	4,287	6,614	8,717	-	3.8	19	23.6	11.3	3.6	6.7
CSP and marine	0.5	1.2	1.1	12	119	214	351	-	-	0.8	9.1	18.1	5.6	10.6
Biomass and waste	44	130	164	571	942	1,182	1,399	1.1	2.3	3.0	5.9	3.6	2.0	2.7
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	22	37	37	37	37	0.2	0.1	0.1	2.3	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	28,090	37,882	49,957	77,321	116,562	153,030	191,975	2.8	3.0	2.5	2.7
Population (million)	4,437	5,281	6,113	7,433	8,514	9,172	9,733	1.3	1.0	0.7	0.8
CO ₂ emissions (Mt)	17,808	20,479	23,113	32,353	34,696	35,373	35,133	1.8	0.5	0.1	0.2
GDP per capita (\$2010 thousand)	6.3	7.2	8.2	10	14	17	20	1.4	2.0	1.8	1.9
Primary energy consump. per capita (toe)	1.6	1.7	1.6	1.9	1.9	1.9	1.9	0.4	0.2	0.0	0.0
Primary energy consumption per GDP ^{*2}	257	232	201	178	138	114	95	-1.0	-1.8	-1.9	-1.8
CO ₂ emissions per GDP ^{*3}	634	541	463	418	298	231	183	-1.0	-2.4	-2.4	-2.4
CO ₂ per primary energy consumption ^{*4}	2.5	2.3	2.3	2.4	2.2	2.0	1.9	0.0	-0.6	-0.6	-0.6

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe

Table A56 | Asia [No New Coal-fired Power Plant (Renewables Substitution) Case]**Primary energy consumption**

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total ¹	1,439	2,110	2,887	5,497	6,987	7,732	8,176	100	100	100	3.8	1.7	0.8	1.2
Coal	466	787	1,036	2,685	2,712	2,551	2,204	37	49	27	4.8	0.1	-1.0	-0.6
Oil	477	618	916	1,367	1,812	2,038	2,188	29	25	27	3.1	2.0	0.9	1.4
Natural gas	51	116	233	567	982	1,261	1,507	5.5	10	18	6.3	4.0	2.2	2.9
Nuclear	25	77	132	122	271	338	404	3.6	2.2	4.9	1.8	5.9	2.0	3.6
Hydro	20	32	41	138	182	205	221	1.5	2.5	2.7	5.8	2.0	1.0	1.4
Geothermal	2.6	8.2	23	40	93	119	144	0.4	0.7	1.8	6.3	6.3	2.2	3.9
Solar, wind, etc.	-	1.2	2.1	62	383	644	925	0.1	1.1	11	16.2	13.9	4.5	8.3
Biomass and waste	397	471	503	517	552	577	582	22	9.4	7.1	0.4	0.5	0.3	0.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,129	1,556	1,991	3,709	4,774	5,398	5,863	100	100	100	3.4	1.8	1.0	1.4
Industry	383	514	647	1,511	1,789	1,959	2,086	33	41	36	4.2	1.2	0.8	1.0
Transport	124	184	318	661	969	1,120	1,226	12	18	21	5.1	2.8	1.2	1.8
Buildings, etc.	569	741	842	1,162	1,517	1,736	1,911	48	31	33	1.7	1.9	1.2	1.5
Non-energy use	54	117	185	375	499	583	640	7.5	10	11	4.6	2.1	1.3	1.6
Coal	301	424	373	899	915	922	899	27	24	15	2.9	0.1	-0.1	0.0
Oil	326	459	734	1,204	1,628	1,846	2,000	29	32	34	3.8	2.2	1.0	1.5
Natural gas	21	47	88	266	458	563	637	3.0	7.2	11	6.9	3.9	1.7	2.6
Electricity	88	156	278	784	1,214	1,506	1,781	10	21	30	6.4	3.2	1.9	2.4
Heat	7.5	14	30	96	110	117	119	0.9	2.6	2.0	7.6	1.0	0.4	0.6
Hydrogen	-	-	-	-	0.2	0.5	0.5	-	-	-	n.a.	n.a.	3.7	n.a.
Renewables	386	456	488	459	449	444	427	29	12	7.3	0.0	-0.2	-0.3	-0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)			
	1980	1990	2000	2016	2030	2040	2050	1990	2016	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
Total	1,196	2,240	3,983	10,768	16,683	20,459	23,832	100	100	100	6.2	3.2	1.8	2.4
Coal	298	869	1,990	6,443	6,524	5,868	4,571	39	60	19	8.0	0.1	-1.8	-1.0
Oil	476	434	390	233	209	183	140	19	2.2	0.6	-2.4	-0.8	-2.0	-1.5
Natural gas	90	237	559	1,340	2,299	3,156	4,119	11	12	17	6.9	3.9	3.0	3.4
Nuclear	97	294	505	468	1,041	1,296	1,552	13	4.3	6.5	1.8	5.9	2.0	3.6
Hydro	232	369	478	1,603	2,118	2,382	2,565	16	15	11	5.8	2.0	1.0	1.4
Geothermal	3.0	8.4	20	24	60	77	94	0.4	0.2	0.4	4.2	6.7	2.2	4.1
Solar PV	-	0.1	0.6	152	1,888	3,492	5,201	-	1.4	22	34.4	19.7	5.2	10.9
Wind	-	-	2.4	294	2,172	3,516	4,988	-	2.7	21	41.7	15.4	4.2	8.7
CSP and marine	-	-	-	0.5	7.5	14	26	-	-	0.1	18.2	20.8	6.4	12.1
Biomass and waste	-	9.5	17	187	341	452	554	0.4	1.7	2.3	12.1	4.4	2.5	3.2
Hydrogen	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.
Others	-	20	20	23	23	23	23	0.9	0.2	0.1	0.6	0.0	0.0	0.0

Energy and economic indicators

	1980	1990	2000	2016	2030	2040	2050	1990/ 2016	2016/ 2030	2030/ 2050	2016/ 2050
GDP (\$2010 billion)	4,441	7,560	11,025	23,349	42,947	61,820	81,967	4.4	4.4	3.3	3.8
Population (million)	2,440	2,933	3,410	4,035	4,439	4,601	4,665	1.2	0.7	0.2	0.4
CO ₂ emissions (Mt)	3,105	4,632	6,720	14,795	16,787	17,238	16,753	4.6	0.9	0.0	0.4
GDP per capita (\$2010 thousand)	1.8	2.6	3.2	5.8	9.7	13	18	3.2	3.7	3.0	3.3
Primary energy consump. per capita (toe)	0.6	0.7	0.8	1.4	1.6	1.7	1.8	2.5	1.0	0.5	0.7
Primary energy consumption per GDP ^{*2}	324	279	262	235	163	125	100	-0.7	-2.6	-2.4	-2.5
CO ₂ emissions per GDP ^{*3}	699	613	609	634	391	279	204	0.1	-3.4	-3.2	-3.3
CO ₂ per primary energy consumption ^{*4}	2.2	2.2	2.3	2.7	2.4	2.2	2.0	0.8	-0.8	-0.8	-0.8

*1 Trade of electricity, heat and hydrogen are not shown, *2 toe/\$2010 million,

*3 t/\$2010 million, *4 t/toe