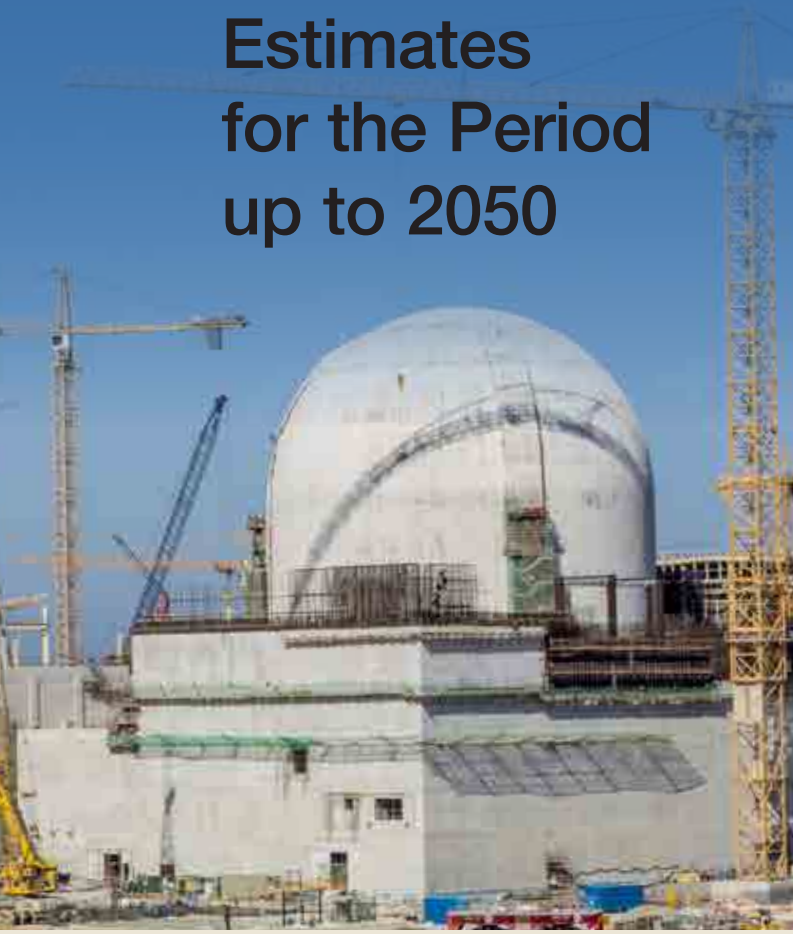
REFERENCE DATA SERIES No. 1
2015 Edition

Energy, Electricity and Nuclear Power Estimates for the Period up to 2050



IAEA
International Atomic Energy Agency

REFERENCE DATA SERIES No. 1

ENERGY, ELECTRICITY AND NUCLEAR POWER ESTIMATES FOR THE PERIOD UP TO 2050

2015 Edition

INTERNATIONAL ATOMIC ENERGY AGENCY
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Introduction

Reference Data Series No. 1 (RDS-1) is an annual publication — currently in its thirty-fifth edition — containing estimates of energy, electricity and nuclear power trends up to the year 2050.

RDS-1 starts with a summary of the situation of nuclear power in IAEA Member States as of the end of 2014. The data on nuclear power presented in Tables 1 and 2 are based on actual statistical data collected by the IAEA's Power Reactor Information System (PRIS). However, energy and electricity data for 2014 are estimated, as the latest information available from the United Nations Department of Economic and Social Affairs is for 2012. Population data originate from the World Population Prospects (2012 revision), published by the Population Division of the United Nations Department of Economic and Social Affairs. The 2014 values again are estimates.

As in previous editions, projections of future energy and electricity demand and the role of nuclear power are presented as low and high estimates encompassing the inherent uncertainties involved in projecting trends. The RDS-1 estimates should be viewed as very general growth trends whose validity must be constantly subjected to critical review.

Many international, national and private organizations routinely engage in energy demand and supply projections, including nuclear power. These projections are based on a multitude of different assumptions and aggregating procedures, making a straightforward comparison and synthesis very difficult. The basic differences relate to such fundamental input assumptions as:

- Economic growth;
- Correlation of economic growth and energy use;
- Technology performance and costs;
- Energy resource availability and future fuel prices;
- Energy policy and physical, environmental and economic constraints.

The projections presented in this publication are based on a compromise between:

- National projections supplied by each country for a recent OECD Nuclear Energy Agency study;

- Global and regional energy, electricity and nuclear power projections made by other international organizations.

More specifically, the estimates of future nuclear generating capacity presented in Table 3 are derived using a country by country 'bottom up' approach. They are established by a group of experts participating in the IAEA's yearly consultancy on Nuclear Capacity Projections and are based upon a review of nuclear power projects and programmes in Member States. The experts consider all the operating reactors, possible licence renewals, planned shutdowns and plausible construction projects foreseen for the next several decades. They build the projections project by project by assessing the plausibility of each in light of, first, the low projection's assumptions and, second, the high projection's assumptions.

The low and high estimates reflect contrasting, but not extreme, underlying assumptions on the different driving factors that have an impact on nuclear power deployment. These factors, and the ways they might evolve, vary from country to country. The estimates presented provide a plausible range of nuclear capacity growth by region and worldwide. They are not intended to be predictive nor to reflect the whole range of possible futures from the lowest to the highest feasible.

The low case represents expectations about the future assuming that current market, technology and resource trends continue and there are few additional changes in explicit laws, policies and regulations affecting nuclear power. Policy responses to the accident at the Fukushima Daiichi nuclear power plant, as understood in April 2015, are included in the projections. This case was explicitly designed to produce a 'conservative but plausible' set of projections. Additionally, the low case does not automatically assume that targets for nuclear power growth in a particular country will necessarily be achieved. These assumptions are relaxed in the high case.

The high case assumes that current rates of economic and electricity demand growth, especially in the Far East, will continue. Changes in country policies toward climate change are also included in the high case.

Over the short term, the low price of natural gas and the impact of increasing capacities of subsidized

intermittent renewable energy sources on electricity prices are expected to continue to impact nuclear growth prospects in some regions of the developed world. These low natural gas prices are partly due to low demand as a result of macroeconomic conditions as well as technological advances. Moreover, the ongoing financial crisis continues to present challenges for capital intensive projects such as nuclear power. The assumption adopted by the expert group is that the above mentioned challenges, in addition to the Fukushima Daiichi accident, continue to temporarily delay deployment of some nuclear power plants. Heightened safety requirements as a result of stress tests, deployment of advanced technologies and other factors have increased construction times and costs, contributing to deployment delays. In the longer run, the underlying fundamentals of population growth and demand for electricity in the developing world, as well as climate change and air quality concerns, security of energy supply and price volatility for other fuels continue to point to nuclear generating capacity playing an important role in the energy mix.

Most countries have finalized their nuclear safety reviews, undertaken after the Fukushima Daiichi accident, providing greater clarity with respect to nuclear power development. Nevertheless, challenges remain, given that policy responses to the Fukushima Daiichi accident are still evolving in some key regions. Once greater certainty about the policy and regulatory responses is established, these projections will be further refined.

Compared with the 2014 projections to 2030, the 2015 projections were reduced by 67 GW(e)[1] in the high case and 15 GW(e) in the low case. These reductions continue to reflect responses to the Fukushima Daiichi accident and the factors noted above, although the decline this year is slightly more than in 2014. Some of the effects of the Fukushima Daiichi accident include earlier than anticipated retirements, delayed or possibly cancelled new construction, and increased costs owing to changing regulatory requirements, mainly in the high case projection. In addition, political and economic uncertainties

[1] The projections consist of both available capacity (currently supplying electricity to the grid) and installed nominal capacity (available, but not currently supplying electricity to the grid).

have reduced low case projections in some regions. Adding to these uncertainties is the fact that there will be a considerable number of reactor retirements in some regions before and after 2030. Nevertheless, interest in nuclear power remains strong in some regions, particularly in the developing world.

With respect to projections from 2030 to 2050, assumptions were made about the general rate of development and retirements. Given all the uncertainties, these estimates should be considered as suggestive of the potential outcomes.

The data on electricity produced by nuclear power plants are converted to joules based on the average efficiency of a nuclear power plant (i.e. 33%); data on electricity generated by geothermal heat are converted to joules based on the average efficiency of a geothermal power plant (i.e. 10%).

The conversion to joules of electricity generated by hydropower or by other non-thermal sources such as wind, tide and solar is based on the energy content of the electricity generated (the equivalent of assuming 100% efficiency).

The total energy requirement has been calculated by summing the primary energy production, the net energy trade minus changes in international bunkers and domestic stocks.

The values shown in Table 9 refer to primary energy used for the generation of electricity. Owing to differences in conversion efficiencies, the percentage values are different from the shares of electricity generation presented in Tables 1 and 5.

Due to rounding, numbers presented throughout this publication may not add up precisely to the totals provided, and percentages may not precisely reflect the absolute figures.

Energy Units

1 MW(e) = 10^6 watts (electrical)
1 GW(e) = 1000 MW(e) = 10^9 watts (electrical)
1 GJ = 1 gigajoule = 10^9 joules
1 EJ = 1 exajoule = 10^{18} joules
1 EJ = 23.9 megatonnes of oil equivalent (Mtoe)
1 TW·h = 1 terawatt-hour = 10^9 kW·h = 3.6×10^{-3} EJ

GROUPING OF COUNTRIES AND AREAS

The countries and geographical areas included in each grouping are listed below
(IAEA Member States are denoted by an asterisk)

North America

Canada*
United States of America*

Latin America

Anguilla
Antigua and Barbuda
Argentina*
Aruba
Bahamas*
Barbados
Belize*
Bermuda
Bolivia*
Brazil*
Cayman Islands
Chile*
Colombia*
Costa Rica*
Cuba*
Dominica*
Dominican Republic*
Ecuador*
El Salvador*
Grenada
Guadeloupe
Guatemala*
Guyana*
Haiti*
Honduras*
Jamaica*
Martinique
Mexico*
Montserrat
Netherlands Antilles
Nicaragua*
Panama*
Paraguay*
Peru*
Puerto Rico
S. Georgia & S. Sandwich Islands
Saint Kitts and Nevis
Saint Lucia
Saint Pierre and Miquelon
Saint Vincent & the Grenadines
Suriname
Trinidad and Tobago*
Turks and Caicos Islands
Uruguay*
Venezuela, Bolivarian Republic of*

Western Europe

Andorra
Austria*
Belgium*
Cyprus*
Denmark*
Finland*
France*
Germany*
Gibraltar
Greece*
Greenland
Holy See*
Iceland*
Ireland*
Italy*
Liechtenstein*
Luxembourg*
Malta*
Monaco*
Netherlands*
Norway*
Portugal*
San Marino*
Spain*
Svalbard and Jan Mayen Islands
Sweden*
Switzerland*
Turkey*
United Kingdom*

Eastern Europe

Albania*
Armenia*
Azerbaijan*
Belarus*
Bosnia and Herzegovina*
Bulgaria*
Croatia*
Czech Republic*
Estonia*
Georgia*
Hungary*
Kazakhstan*
Kyrgyzstan*
Latvia*
Lithuania*
Montenegro*
Poland*
Republic of Moldova*
Romania*
Russian Federation*
Serbia*
Slovakia*
Slovenia*
Tajikistan*
The former Yugolav Republic of Macedonia*
Turkmenistan
Ukraine*
Uzbekistan*

Africa

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

Middle East and South Asia

Afghanistan*
Bahrain*
Bangladesh*
Bhutan
British Indian Ocean Territory
Cocos (Keeling) Islands
French Southern Territories
Heard Island & McDonald Islands
India*
Iran, Islamic Republic of*
Iraq*
Israel*
Jordan*
Kuwait*
Lebanon*
Nepal*
Oman*
Pakistan*
Qatar*
Saudi Arabia*
Sri Lanka*
Syrian Arab Republic*
T.T.U.T.J of T. Palestinian A.
United Arab Emirates*
Yemen*

South East Asia and the Pacific

Australia*
Brunei Darussalam*
Cook Islands
Fiji*
Indonesia*
Kiribati
Malaysia*
Maldives
Marshall Islands*
Micronesia, Federated States of
Myanmar*
New Zealand*
Niue
Norfolk Island
Northern Mariana Islands
Palau*
Papua New Guinea*
Pitcairn Islands
Samoa
Singapore*
Solomon Islands
Thailand*
Timor-Leste
Tokelau
Tonga
Tuvalu
US Minor Outlying Islands
Vanuatu
Wallis and Futuna Islands

Far East

Cambodia*
China*
Japan*
Korea, Democratic People's Republic of
Korea, Republic of*
Lao People's Democratic Republic
Macau, China
Mongolia*
Philippines*
Taiwan, China
Viet Nam*

TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2014)

Group and Country	In Operation		Long-term Shut Down Reactors		Under Construction		Electricity Supplied by Nuclear Power Reactors in 2014	
	Number of Units	Total MW(e)	Number of Units	Total MW(e)	Number of Units	Total MW(e)	TW·h	Percent of Total Electricity
North America								
Canada	19	13500					98.6	16.8
United States of America	99	98639			5	5633	798.6	19.5
Latin America								
Argentina	3	1627			1	25	5.3	4.1
Brazil	2	1884			1	1245	14.5	2.9
Mexico	2	1330					9.3	5.6
Western Europe								
Belgium	7	5927					32.1	47.5
Finland	4	2752			1	1600	22.6	34.8
France	58	63130			1	1630	418.0	76.9
Germany	9	12074					91.8	15.8
Netherlands	1	482					3.9	4.0
Spain	7	7121	1	446			54.9	20.4
Sweden	10	9470					62.3	41.5
Switzerland	5	3333					26.5	37.9
United Kingdom	16	9373					57.9	17.2
Eastern Europe								
Armenia	1	375					2.3	30.2
Belarus					2	2218		
Bulgaria	2	1926					15.0	33.6
Czech Republic	6	3904					28.6	35.8

TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2014)

Group and Country	In Operation		Long-term Shut Down Reactors		Under Construction		Electricity Supplied by Nuclear Power Reactors in 2014	
	Number of Units	Total MW(e)	Number of Units	Total MW(e)	Number of Units	Total MW(e)	TW·h	Percent of Total Electricity
Hungary	4	1889					14.8	53.5
Romania	2	1300					10.8	18.4
Russian Federation	34	24654			9	7371	169.1	18.6
Slovakia	4	1814			2	880	14.4	56.9
Slovenia	1	688					6.1	37.1
Ukraine	15	13107			2	1900	83.1	49.4
Africa								
South Africa	2	1860					14.8	6.2
Middle East and South Asia								
India	21	5308			6	3907	33.2	3.5
Iran, Islamic Republic of	1	915					3.7	1.5
Pakistan	3	690			2	630	4.6	4.3
United Arab Emirates					3	4035		
Far East								
China	23	19007			26	25756	123.8	2.4
Japan	48	42388	1	246	2	2650	0.0	0.0
Korea, Republic of	23	20717			5	6370	149.2	30.4
World Total (*)	438	376216	2	692	70	68450	2410.4	11.1

Notes:

(*) Including the following data in Taiwan, China:

— 6 units in operation with total capacity of 5032 MW(e); 2 units under construction with total capacity of 2600 MW(e);

— 40.8 TWh of nuclear electricity generation, representing 18.9% of the total electricity generated.

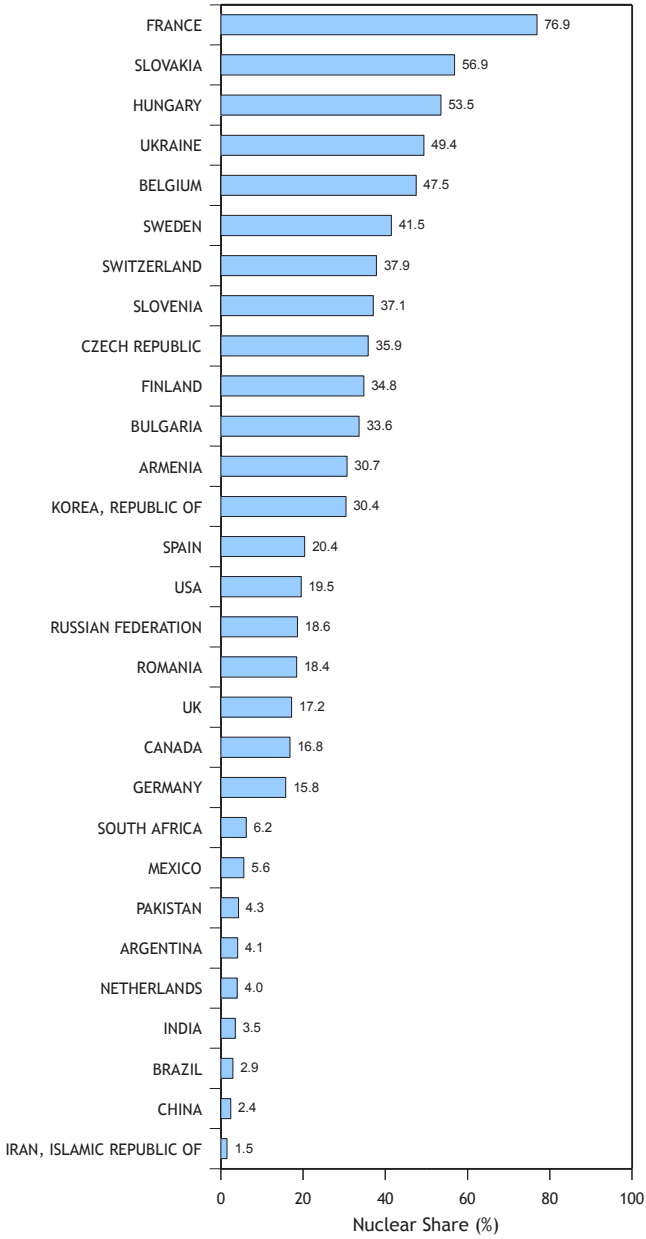


FIGURE 1. NUCLEAR SHARE OF TOTAL ELECTRICITY GENERATION IN 2014

Note: The nuclear share of electricity generation in Taiwan, China was 18.9%.

TABLE 2. NUMBER OF COUNTRIES WITH NUCLEAR POWER REACTORS IN OPERATION OR UNDER CONSTRUCTION (end of 2014)

Country Group	Number of Countries in Group	Countries with Nuclear Power Reactors			
		In Operation	Long-term Shut Down	Under Construction (1)	Total (2)
North America	2	2		1	2
Latin America	45	3		2	3
Western Europe	29	9	1	2	9
Eastern Europe	27	9		4	10
Africa	57	1			1
Middle East and South Asia	25	3		3	4
South East Asia and the Pacific	29				
Far East	11	3	1	3	3
World Total	225	30	2	15	32

Notes:
(1) May include countries having reactors already in operation.
(2) Total number of countries in each group that have nuclear power reactors in operation, or under construction.

TABLE 3. ESTIMATES OF TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY

Country Group	2014			2020 (a)			2030 (a)			2050 (a)(b)		
	Total Elect. GW(e)	Nuclear		Total Elect. GW(e)	Nuclear		Total Elect. GW(e)	Nuclear		Total Elect. GW(e)	Nuclear	
		GW(e)	%		GW(e)	%		GW(e)	%		GW(e)	%
North America	1229	112.1	9.1	1296	108.3	8.4	1370	92.0	6.7	1419	60	4.2
				1318	118.2	9.0	1535	139.7	9.1		157	11.0
								0.0				
Latin America	365	4.8	1.3	453	4.5	1.0	975	6.8	0.7	1840	13	0.7
				518	5.8	1.1	1239	13.4	1.1		55	3.0
								0.0				
Western Europe	1002	113.7	11.3	1113	99.0	8.9	1189	62.7	5.3	1647	27	1.6
				1145	111.9	9.8	1504	112.0	7.4		121	7.3
								0.0				
Eastern Europe	530	49.7	9.4	650	55.2	8.5	675	64.1	9.5	963	63	6.6
				650	62.7	9.7	898	93.5	10.4		126	13.0
								0.0				
Africa	181	1.9	1.0	321	1.9	0.6	654	1.9	0.3	2055	7	0.3
				335	1.9	0.6	867	6.5	0.7		38	1.9
								0.0				
Middle East and South Asia	621	6.9	1.1	720	12.0	1.7	1797	25.9	1.4	5871	48	0.8
				974	17.4	1.8	2215	43.8	2.0		94	1.6
								0.0				
South East Asia and the Pacific	229			308			473	0.0	0.0	1286	5	0.4
				319			591	4.0	0.7		18	1.4
								0.0				
Far East	1932	87.1	4.5	2367	98.7	4.2	3001	131.8	4.4	5150	149	2.9
				2473	122.9	5.0	3474	219.0	6.3		355	6.9
World Total Low Estimate	6090	376.2	6.2	7228	379.5	5.3	10134	385.3	3.8	20230	371	1.8
World Total High Estimate				7732	440.9	5.7	12323	631.8	5.1		964	4.8

Notes:
(a) Nuclear capacity estimates take into account the scheduled retirement of the older units at the end of their lifetime.
(b) Projection figures for total electric generating capacities are the arithmetic average between low and high estimates.

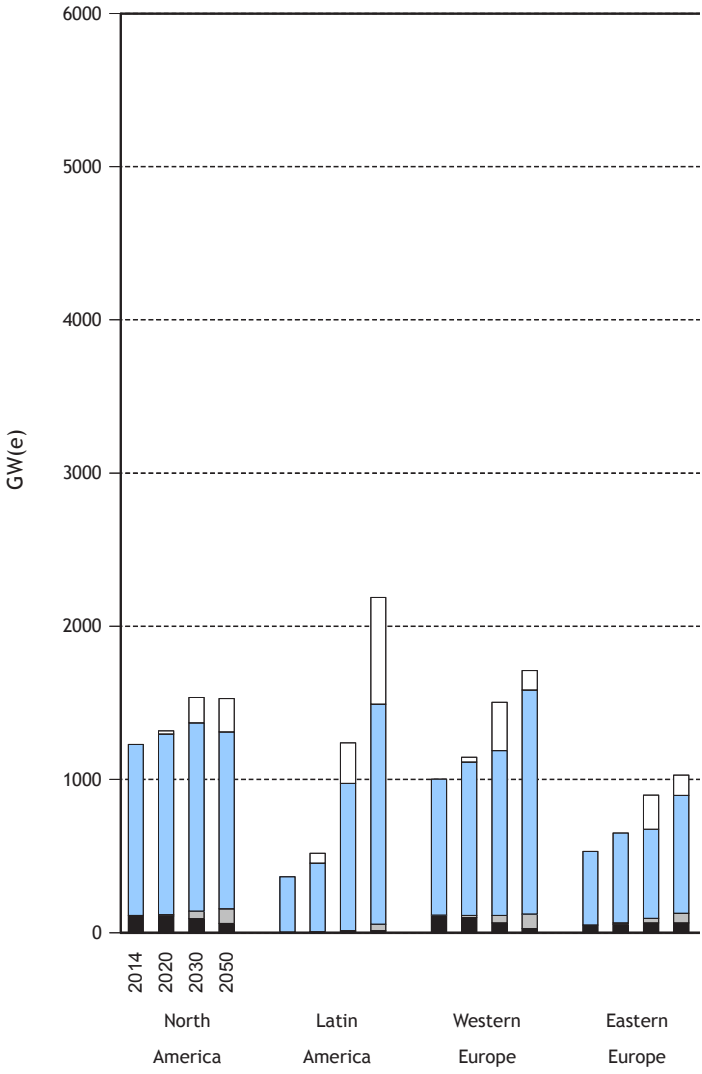


FIGURE 2. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY

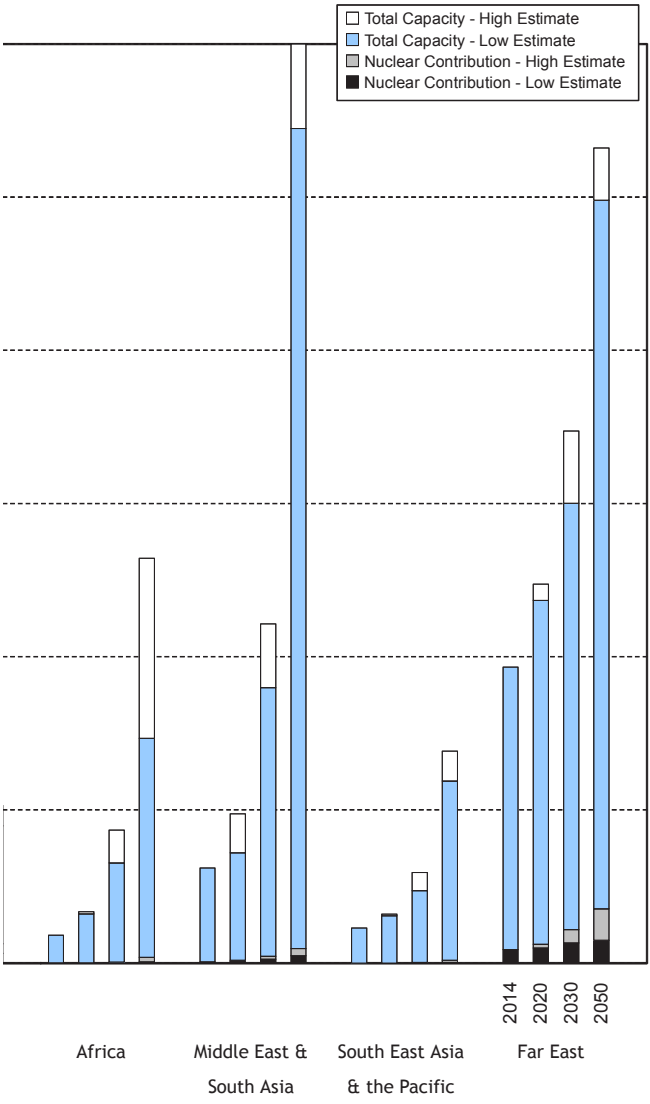

Total Capacity - High Estimate
Total Capacity - Low Estimate
Nuclear Contribution - High Estimate
Nuclear Contribution - Low Estimate
2014
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

TABLE 4. ESTIMATES OF TOTAL ELECTRICITY GENERATION AND CONTRIBUTION BY NUCLEAR POWER (*)

Country Group	2014			2020			2030			2050 (a)		
	Total Elect. TW·h	Nuclear		Total Elect. TW·h	Nuclear		Total Elect. TW·h	Nuclear		Total Elect. TW·h	Nuclear	
		TW·h	%		TW·h	%		TW·h	%		TW·h	%
North America	4682	897.2	19.2	4894 4906	854 932	17.4 19.0	5133 5224	726 1101	14.1 21.1	5376	484 1262	9.0 23.5
Latin America	1435	29.0	2.0	1919 1990	34 43	1.7 2.2	3198 4501	54 106	1.7 2.4	6514	105 446	1.6 6.8
Western Europe	3105	769.9	24.8	3408 3512	737 833	21.6 23.7	3672 4505	495 883	13.5 19.6	5288	216 975	4.1 18.4
Eastern Europe	1867	344.1	18.4	2092 2149	411 467	19.7 21.7	2348 2961	505 737	21.5 24.9	3374	510 1012	15.1 30.0
Africa	702	14.8	2.1	1000 1104	14 14	1.4 1.3	1955 2585	15 51	0.8 2.0	6648	56 309	0.8 4.7
Middle East and South Asia	2119	41.5	2.0	2843 3178	84 122	2.9 3.8	5950 7547	204 345	3.4 4.6	20386	383 760	1.9 3.7
South East Asia and the Pacific	889			1098 1123			1659 2178	0 32	0.0 1.4	4563	40 147	0.9 3.2
									0.0			0.0
Far East	6886	313.8	4.6	8037 8901	642 769	8.0 8.6	10597 13154	982 1568	9.3 11.9	19843	1198 2860	6.0 14.4
World Total Low Estimate	21685	2410.4	11.1	25290	2775	11.0	34511	2980	8.6	71991	2992	4.2
World Total High Estimate				26863	3181	11.8	42655	4823	11.3		7771	10.8

Notes:

(*) The nuclear generation data presented in this table and the nuclear capacity data presented in Table 3 cannot be used to calculate average annual capacity factors for nuclear plants, as Table 3 presents year-end capacity and not the effective capacity average over the year.

(a) Projection figures for total electricity generation are the arithmetic average between low and high estimates.

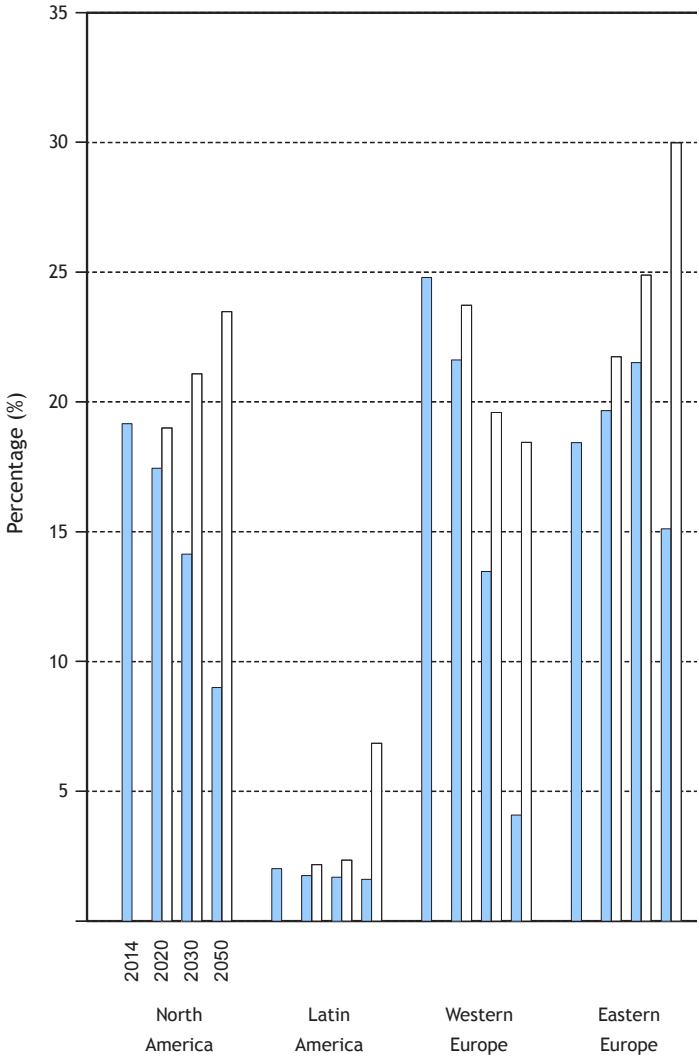


FIGURE 3. PERCENTAGE OF ELECTRICITY SUPPLIED BY NUCLEAR POWER

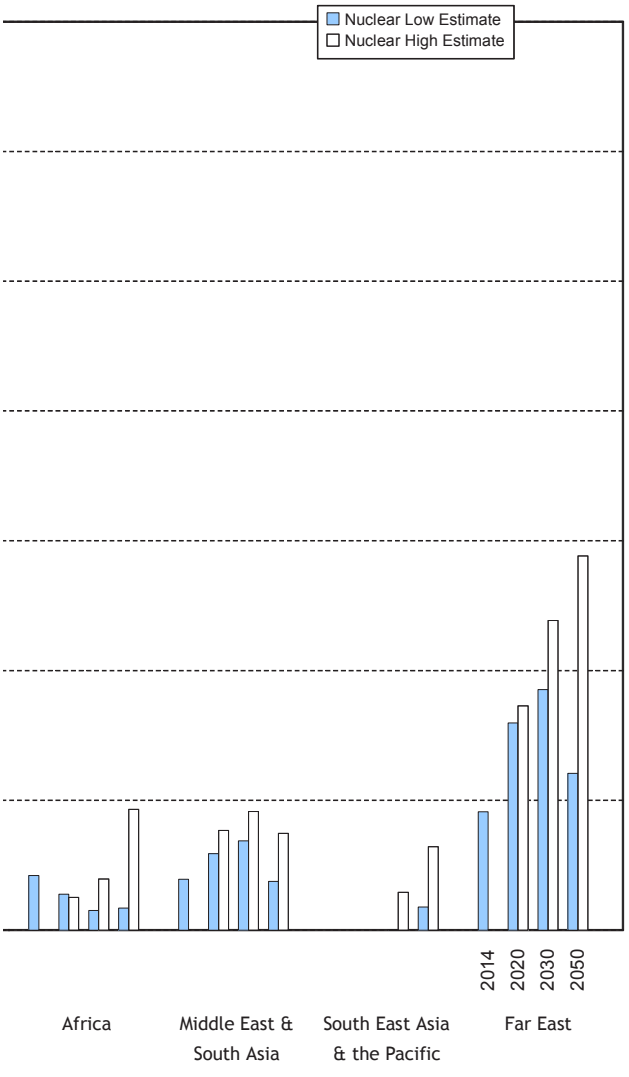

Nuclear Low Estimate
Nuclear High Estimate
2014
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

TABLE 5. ESTIMATES OF TOTAL ENERGY REQUIREMENT (EJ), PERCENTAGE USED FOR ELECTRICITY GENERATION, AND PERCENTAGE SUPPLIED BY NUCLEAR ENERGY (*)

Country Group	2014			2020			2030			2050 (a)		
	Total Energy Requirement	% Used for Elect. Gen.	% Supplied by Nuclear	Total Energy Requirement	% Used for Elect. Gen.	% Supplied by Nuclear	Total Energy Requirement	% Used for Elect. Gen.	% Supplied by Nuclear	Total Energy Requirement	% Used for Elect. Gen.	% Supplied by Nuclear
North America	103.0	42.1	9.5	104 109	44 42	9.0 9.3	103 108	46 45	7.7 11.1	101	49	5.5 13.0
Latin America	35.1	27.0	0.9	46 48	27 27	0.8 1.0	58 79	36 38	1.0 1.5	99	44	1.4 4.2
Western Europe	62.4	40.5	13.5	67 69	41 41	12.0 13.2	72 82	39 44	7.5 11.8	89	45	2.8 11.4
Eastern Europe	56.4	41.1	6.7	62 64	42 42	7.3 8.0	60 72	48 51	9.1 11.2	81	52	7.7 12.4
Africa	30.0	23.7	0.5	35 38	29 30	0.4 0.4	54 91	37 29	0.3 0.6	176	38	0.5 1.5
Middle East and South Asia	75.5	36.6	0.6	93 105	40 39	1.0 1.3	150 191	51 51	1.5 2.0	478	52	1.0 1.6
South East Asia and the Pacific	27.3	33.7		31 32	37 36		37 46	46 49	0.0 0.7	101	47	0.5 1.4
Far East	169.0	39.4	2.0	187 199	42 43	3.7 4.2	237 295	44 44	4.5 5.8	404	48	3.6 6.9
World Total (b) Low Estimate	567.4	37.3	4.6	644	38	4.7	799	43	4.1	1589	47	2.3
World Total (b) High Estimate				684	39	5.1	997	43	5.3			4.8

Notes:

(*) Total energy requirement is estimated as production of primary energy plus net trade (import—export) minus international bunkers and stock changes.

(a) Projection figures for total energy requirement and percentage used for electricity generation are the arithmetic average between low and high estimates.

(b) World Total energy requirement includes international bunkers.

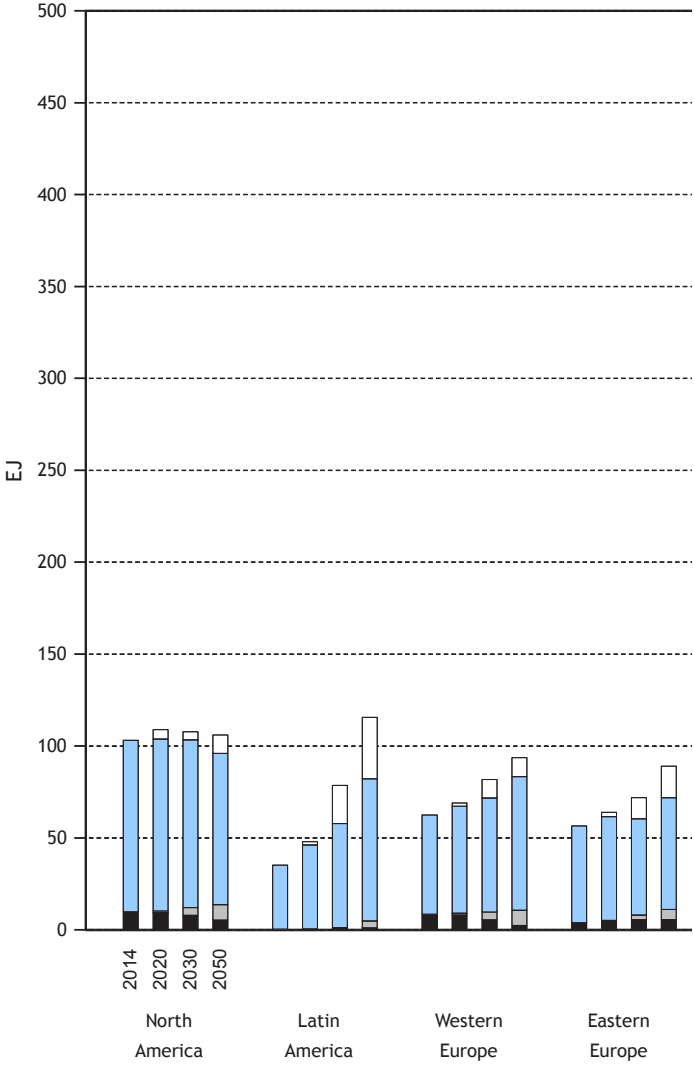


FIGURE 4. ESTIMATES OF TOTAL ENERGY REQUIREMENT

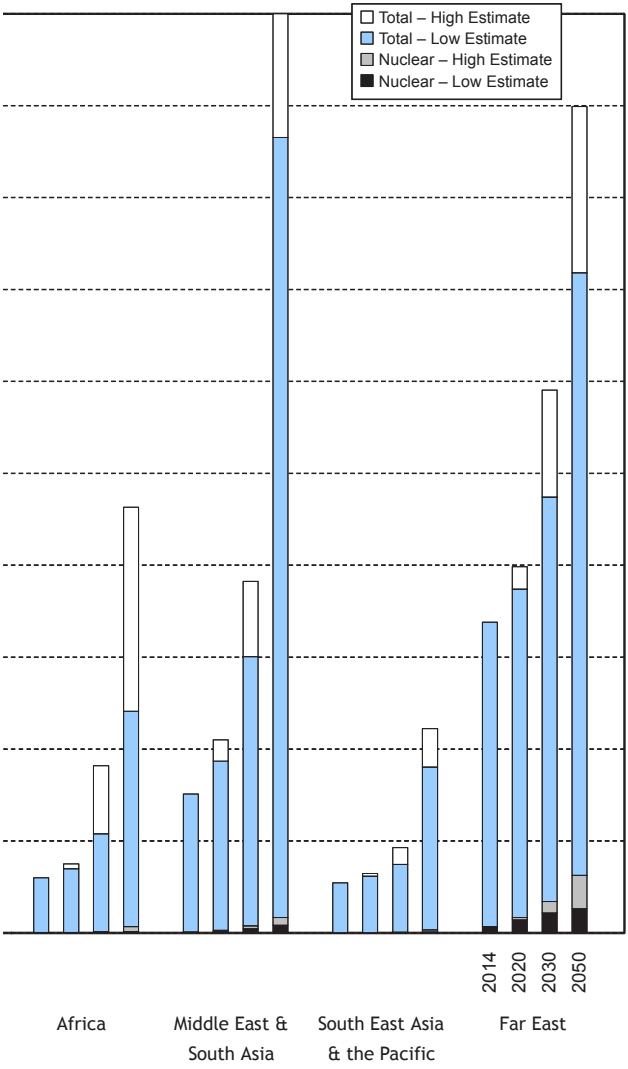

Total – High Estimate
Total – Low Estimate
Nuclear – High Estimate
Nuclear – Low Estimate
2014
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

TABLE 6. TOTAL ENERGY REQUIREMENT (EJ) BY TYPE OF FUEL IN 2014 (*)

Country Group	Coal (a)	Oil (b)	Natural Gas (c)	Biofuels (d)	Hydro	Nuclear	Renewables (e)	Total
North America	19.10	36.17	29.76	4.62	2.28	9.79	1.31	103.03
Latin America	1.86	15.78	8.78	5.20	2.54	0.32	0.63	35.11
Western Europe	8.98	20.88	14.39	5.68	2.00	8.40	2.09	62.42
Eastern Europe	12.60	12.72	24.34	1.81	1.15	3.75	0.06	56.43
Africa	5.38	6.63	4.01	13.24	0.42	0.16	0.11	29.95
Middle East and South Asia	18.62	24.44	20.05	10.91	0.77	0.45	0.26	75.50
South East Asia and the Pacific	5.04	9.81	6.35	4.65	0.30		1.12	27.27
Far East	95.20	36.73	13.88	12.84	4.45	3.42	2.44	168.96
World Total (f)	166.78	178.16	121.56	58.95	13.91	26.29	8.02	573.67

Notes:

(*) Total energy requirement is estimated as production of primary energy plus net trade (import—export) minus international bunkers and stock changes.

(a) The column headed 'Coal' includes coal, coal products, peat and peat products.

(b) The column headed 'Oil' includes crude oil, natural gas liquids (NGL), oil products, oil shale and oil sands.

(c) The column headed 'Natural Gas' includes natural gas in all its forms including liquid natural gas (LNG).

(d) The column headed 'Biofuels' includes commercial wood, charcoal, combustible renewables, waste and other energy products derived directly or indirectly from biomass.

(e) The column headed 'Renewables' includes geothermal, wind, solar, tide energy and net electricity trade.

(f) World Total energy requirement includes international bunkers.

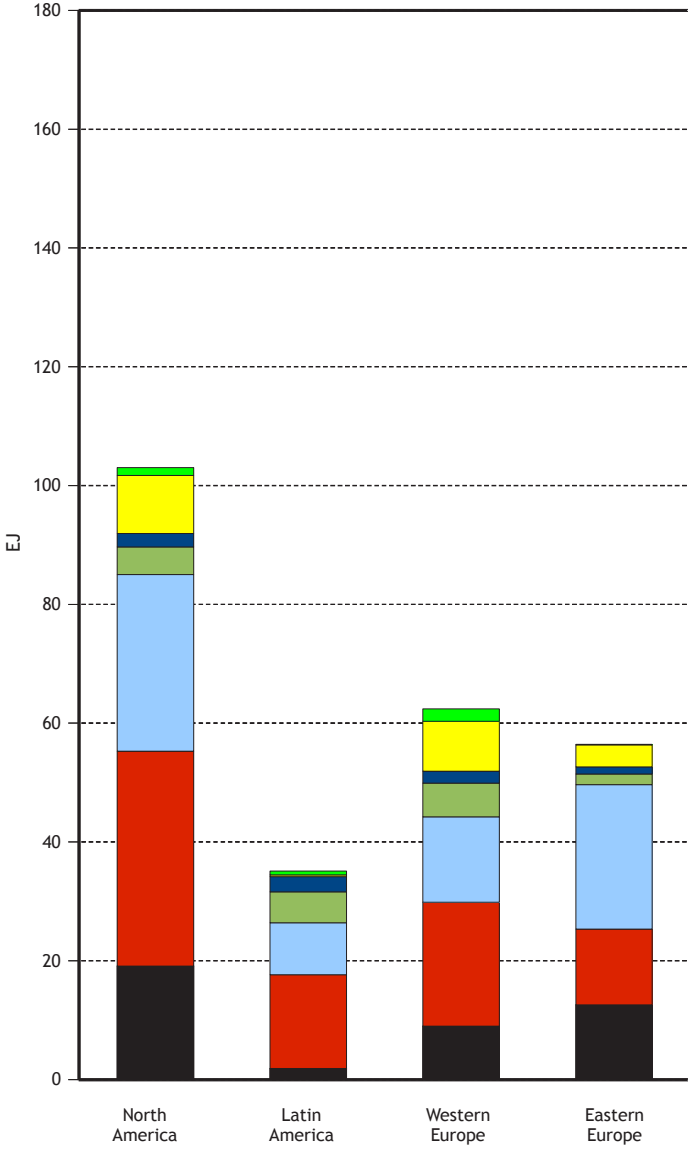
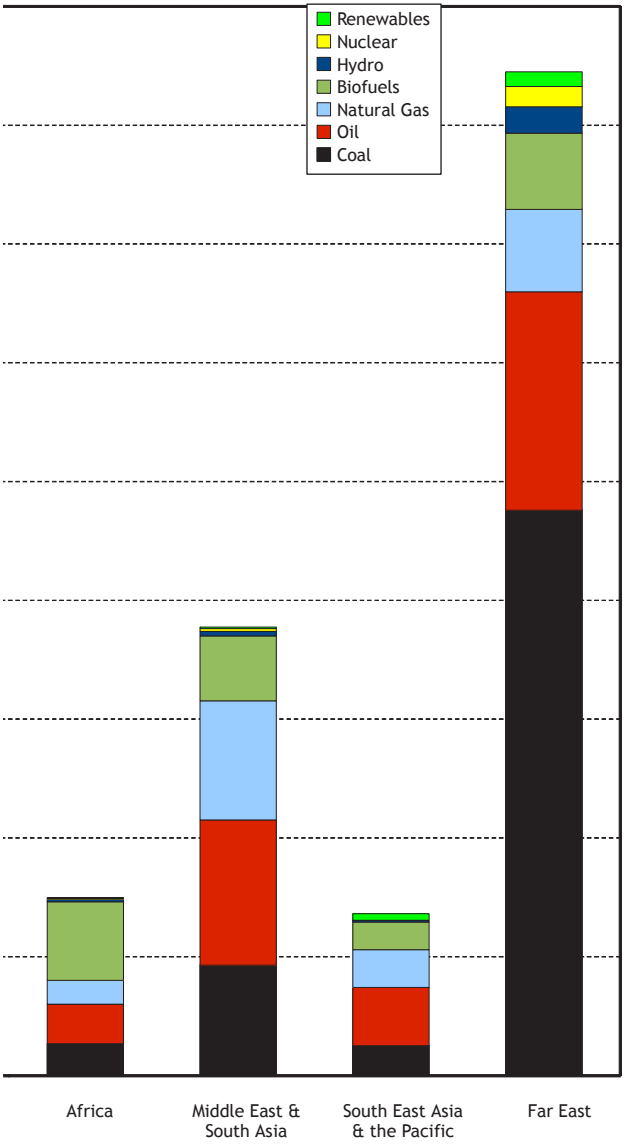


FIGURE 5. TOTAL ENERGY REQUIREMENT BY TYPE OF FUEL IN 2014


Renewables
Nuclear
Hydro
Biofuels
Natural Gas
Oil
Coal
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

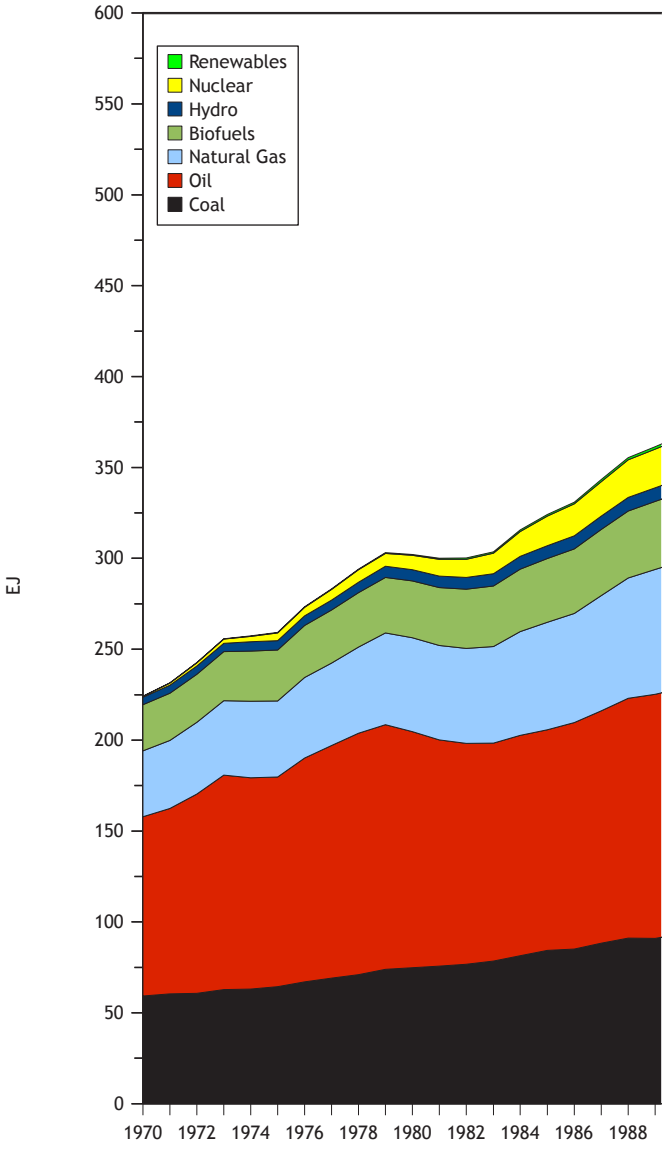


FIGURE 6. BREAKDOWN OF WORLD TOTAL ENERGY REQUIREMENT DURING THE PERIOD 1970 — 2014

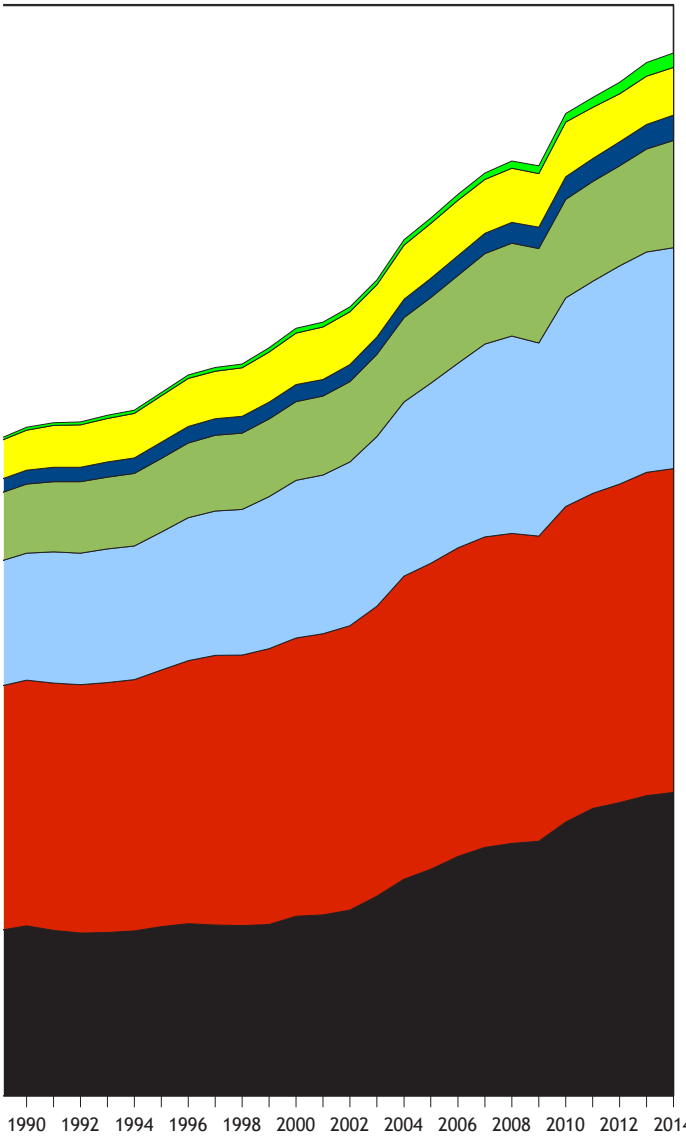

1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Year

TABLE 7. FUEL SHARES (%) OF TOTAL ENERGY REQUIREMENT IN 2014 (*)

Country Group	Coal (a)	Oil (b)	Natural Gas (c)	Biofuels (d)	Hydro	Nuclear	Renewables (e)	Total
North America	18.5	35.1	28.9	4.5	2.2	9.5	1.3	100.0
Latin America	5.3	44.9	25.0	14.8	7.2	0.9	1.8	100.0
Western Europe	14.4	33.5	23.1	9.1	3.2	13.5	3.3	100.0
Eastern Europe	22.3	22.5	43.1	3.2	2.0	6.6	0.1	100.0
Africa	18.0	22.1	13.4	44.2	1.4	0.5	0.4	100.0
Middle East and South Asia	24.7	32.4	26.6	14.5	1.0	0.6	0.3	100.0
South East Asia and the Pacific	18.5	36.0	23.3	17.1	1.1		4.1	100.0
Far East	56.3	21.7	8.2	7.6	2.6	2.0	1.4	100.0
World Total (f)	29.1	31.1	21.2	10.3	2.4	4.6	1.4	100.0

Notes:

(*) Total energy requirement is estimated as production of primary energy plus net trade (import—export) minus international bunkers and stock changes.

(a) The column headed 'Coal' includes coal, coal products, peat and peat products.

(b) The column headed 'Oil' includes crude oil, natural gas liquids (NGL), oil products, oil shale and oil sands.

(c) The column headed 'Natural Gas' includes natural gas in all its forms including liquid natural gas (LNG).

(d) The column headed 'Biofuels' includes commercial wood, charcoal, combustible renewables, waste and other energy products derived directly or indirectly from biomass.

(e) The column headed 'Renewables' includes geothermal, wind, solar, tide energy and net electricity trade.

(f) World Total energy requirement includes international bunkers.

TABLE 8. FUEL USE (EJ) FOR ELECTRICITY GENERATION BY TYPE OF FUEL IN 2014

Country Group	Thermal (a)	Hydro	Nuclear	Renewables (b)	Total
North America	28.66	2.28	9.79	1.20	41.93
Latin America	6.61	2.54	0.32	0.57	10.04
Western Europe	12.25	2.00	8.40	1.88	24.53
Eastern Europe	16.94	1.15	3.75	0.06	21.90
Africa	5.64	0.42	0.16	0.10	6.32
Middle East and South Asia	25.27	0.77	0.45	0.23	26.72
South East Asia and the Pacific	8.34	0.30		1.07	9.71
Far East	57.47	4.45	3.42	2.25	67.59
World Total	161.18	13.91	26.29	7.36	208.74

Notes:
(a) The column headed 'Thermal' is the total for solids, liquids, gases, biomass and waste.
(b) The column headed 'Renewables' includes geothermal, wind, solar and tide energy.

TABLE 9. PERCENTAGE CONTRIBUTION OF EACH FUEL TYPE TO ELECTRICITY GENERATION IN 2014

Country Group	Thermal (a)	Hydro	Nuclear	Renewables (b)	Total
North America	64.2	13.5	19.2	3.1	100.0
Latin America	47.5	49.2	2.0	1.3	100.0
Western Europe	46.8	17.9	24.8	10.5	100.0
Eastern Europe	64.0	17.2	18.4	0.4	100.0
Africa	80.2	16.8	2.1	0.9	100.0
Middle East and South Asia	85.5	10.1	2.0	2.4	100.0
South East Asia and the Pacific	85.4	9.3		5.3	100.0
Far East	74.2	17.9	4.6	3.3	100.0
World Total	67.3	17.8	11.1	3.8	100.0

Notes:
(a) The column headed 'Thermal' is the total for solids, liquids, gases, biomass and waste.
(b) The column headed 'Renewables' includes geothermal, wind, solar and tide energy.

TABLE 10. ESTIMATES OF POPULATION GROWTH BY REGION (*)

Country Group	2014		2020		2030		2050	
	Million Inhabitants	Growth Rate (%/a) 2000 — 2014	Million Inhabitants	Growth Rate (%/a) 2014 — 2020	Million Inhabitants	Growth Rate (%/a) 2020 — 2030	Million Inhabitants	Growth Rate (%/a) 2030 — 2050
North America	358	0.97	376	0.80	403	0.71	446	0.51
Latin America	623	1.33	662	1.00	717	0.80	782	0.43
Western Europe	494	0.53	506	0.38	519	0.27	531	0.12
Eastern Europe	397	-0.21	397	0.00	390	-0.17	369	-0.28
Africa	1139	2.69	1312	2.38	1634	2.22	2393	1.93
Middle East and South Asia	1936	1.78	2085	1.24	2301	0.99	2578	0.57
South East Asia and the Pacific	451	1.24	478	0.96	514	0.74	553	0.36
Far East	1844	0.75	1902	0.52	1946	0.23	1899	-0.12
World Total	7243	1.67	7717	1.06	8425	0.88	9551	0.63

(*) Projection figures are the arithmetic average between low and high estimates.

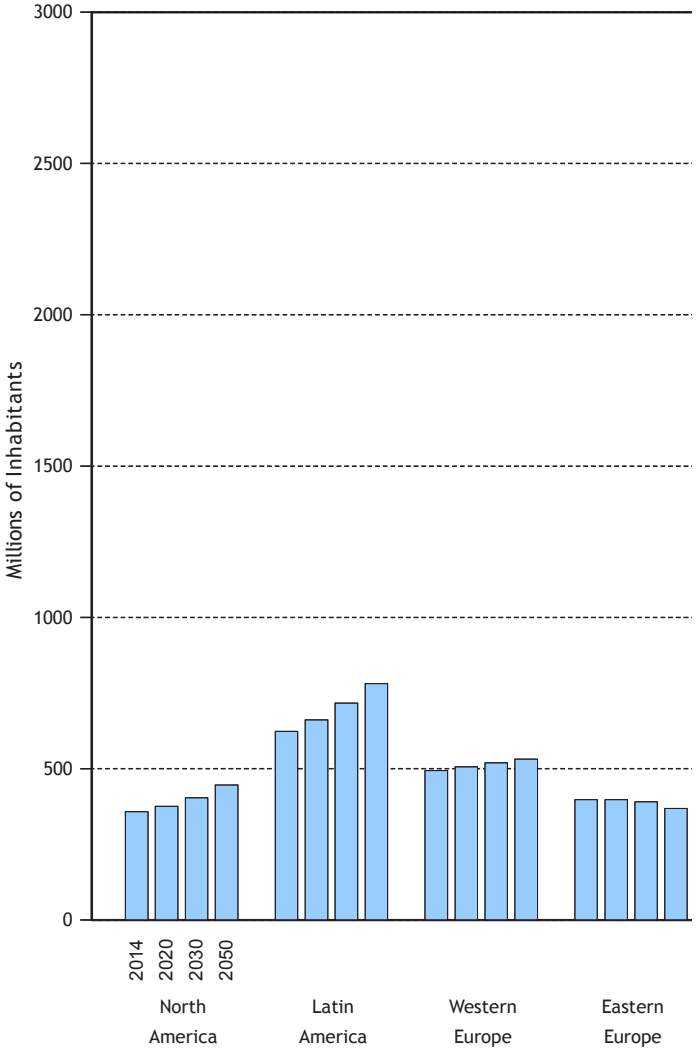


FIGURE 7. POPULATION ESTIMATES

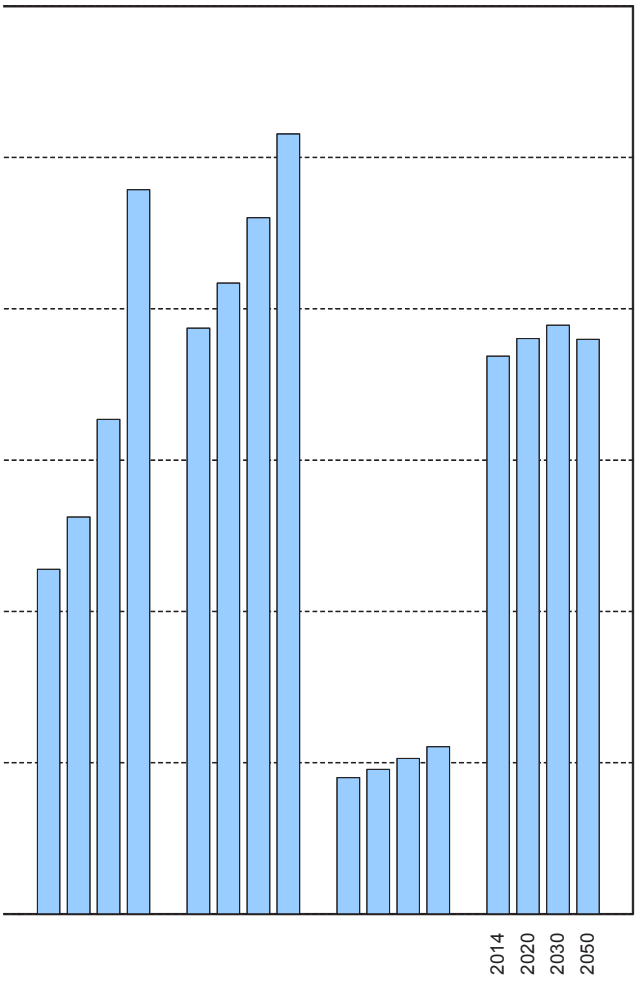

2014
2020
2030
2050
Africa
Middle East &
South Asia
South East Asia
& the Pacific
Far East

TABLE 11. ESTIMATES OF TOTAL ENERGY AND ELECTRICITY REQUIREMENT PER CAPITA

Country Group	2014		2020		2030		2050 (*)	
	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW·h/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW·h/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW·h/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW·h/cap)
North America	288	13.1	276 – 290	13.0 – 13.1	256 – 267	12.7 – 13.0	226 ± 11	12.0 ± 0.9
Latin America	56	2.3	70 – 72	2.9 – 3.0	81 – 110	4.5 – 6.3	126 ± 21	8.3 ± 1.6
Western Europe	126	6.3	133 – 136	6.7 – 6.9	138 – 157	7.1 – 8.7	167 ± 10	10.0 ± 0.9
Eastern Europe	142	4.7	155 – 161	5.3 – 5.4	155 – 184	6.0 – 7.6	218 ± 23	9.1 ± 1.0
Africa	26	0.6	27 – 29	0.8 – 0.8	33 – 56	1.2 – 1.6	74 ± 23	2.8 ± 0.9
Middle East and South Asia	39	1.1	45 – 50	1.4 – 1.5	65 – 83	2.6 – 3.3	185 ± 17	7.9 ± 0.7
South East Asia and the Pacific	60	2.0	64 – 68	2.3 – 2.4	72 – 90	3.2 – 4.2	182 ± 19	8.3 ± 0.8
Far East	92	3.7	98 – 105	4.2 – 4.7	122 – 152	5.4 – 6.8	213 ± 24	10.4 ± 0.8
World Average	77	3.0	81 – 86	3.3 – 3.5	92 – 114	4.1 – 5.1	160 ± 20	7.5 ± 0.9

Note:
(*) Projection figures are the arithmetic average between low and high estimates with indicated range.

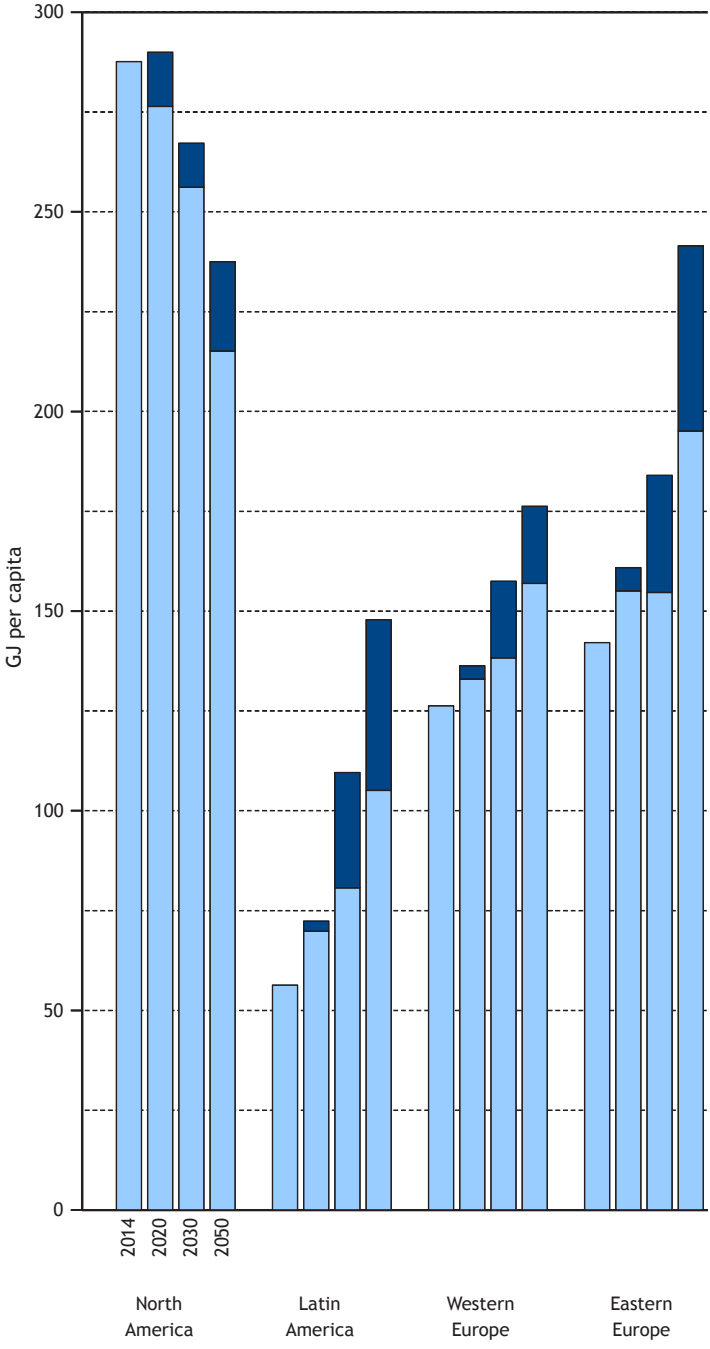
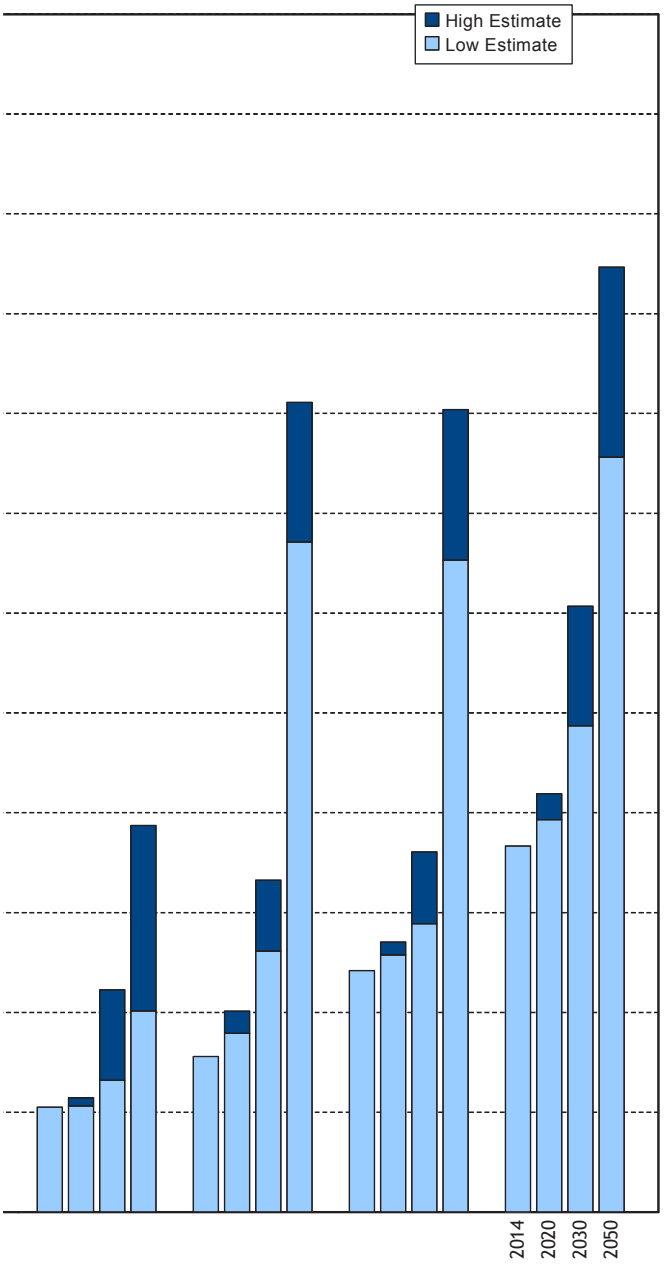


FIGURE 8. TOTAL ENERGY REQUIREMENT PER CAPITA


High Estimate
Low Estimate
2014
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

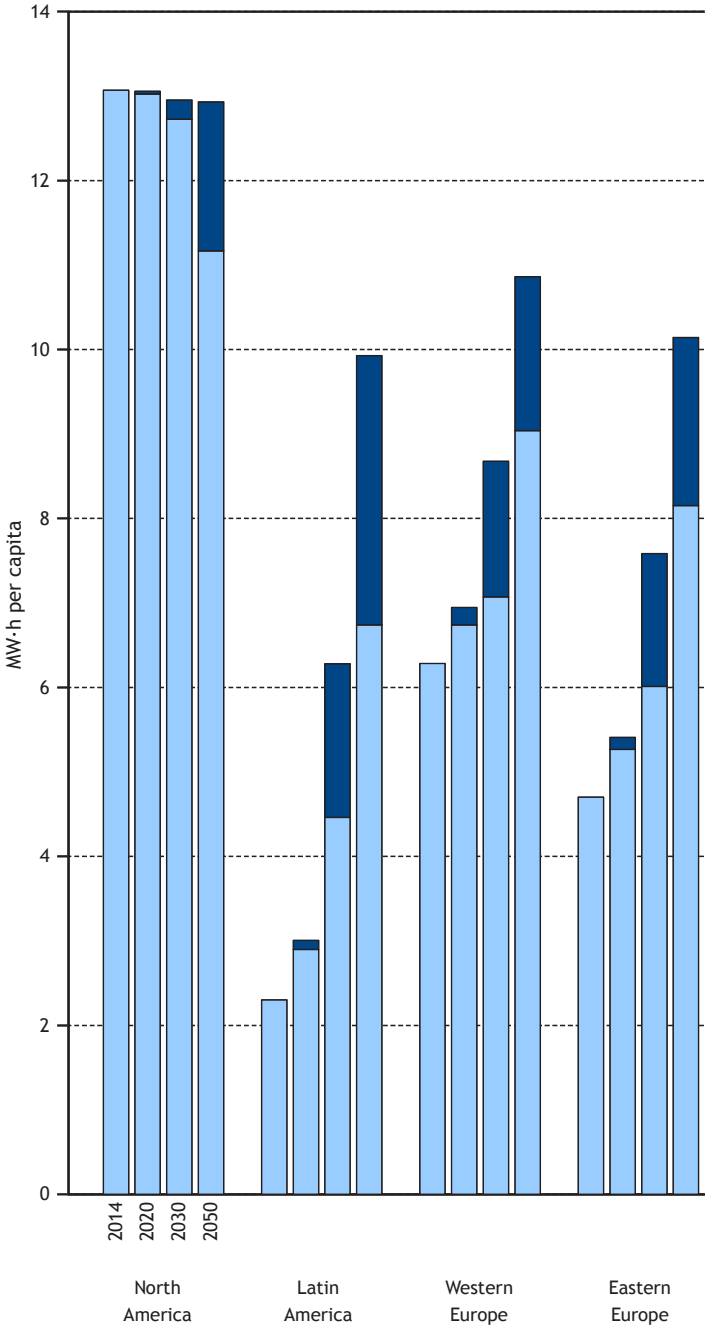


FIGURE 9. TOTAL ELECTRICITY REQUIREMENT PER CAPITA

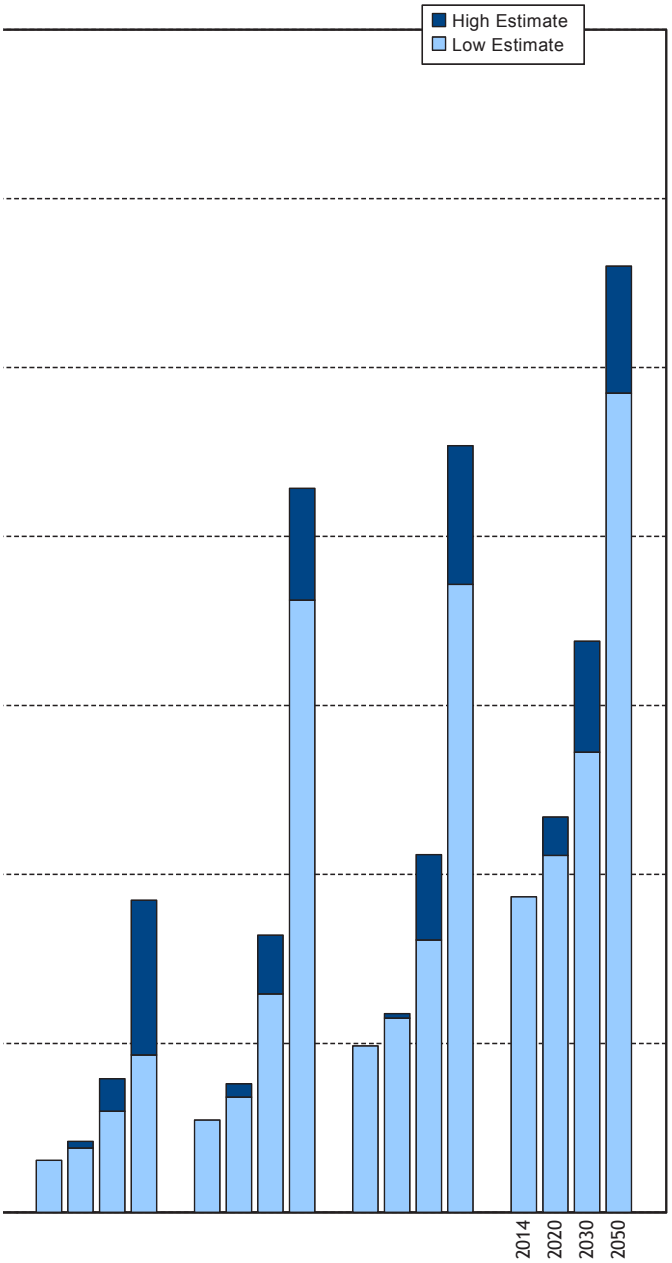

High Estimate
Low Estimate
2014
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

TABLE 12. AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2004—2014 (%)

Country Group	Population	Total Energy	Total Electricity	Nuclear Energy	Nuclear Capacity
North America	0.9	-0.7	0.2	0.3	0.1
Latin America	1.2	1.9	2.8	-0.1	1.6
Western Europe	0.6	-1.2	0.2	-1.4	-1.0
Eastern Europe	0.0	0.0	0.8	1.0	0.1
Africa	2.5	2.0	3.1	0.3	0.0
Middle East and South Asia	1.5	3.9	5.0	9.4	8.8
South East Asia and the Pacific	1.2	2.2	3.3		
Far East	0.7	5.2	6.1	-4.2	1.8
World Average	1.2	2.0	2.6	-0.8	0.2

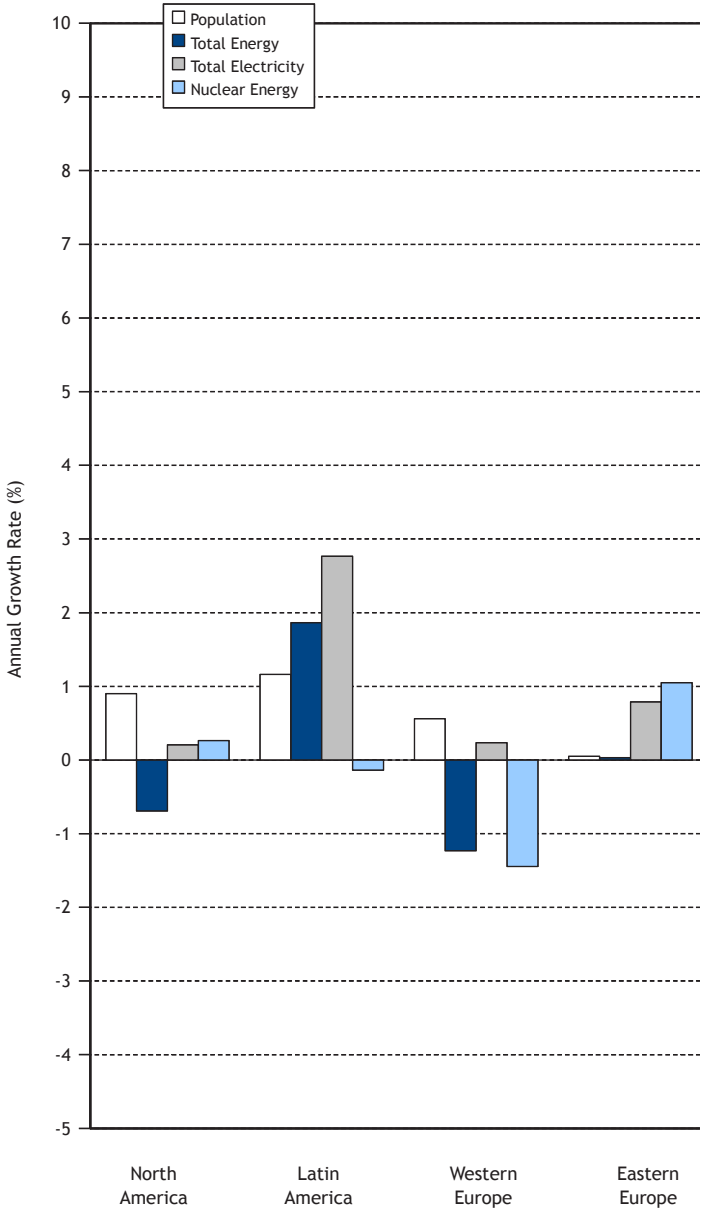


FIGURE 10. AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2004—2014

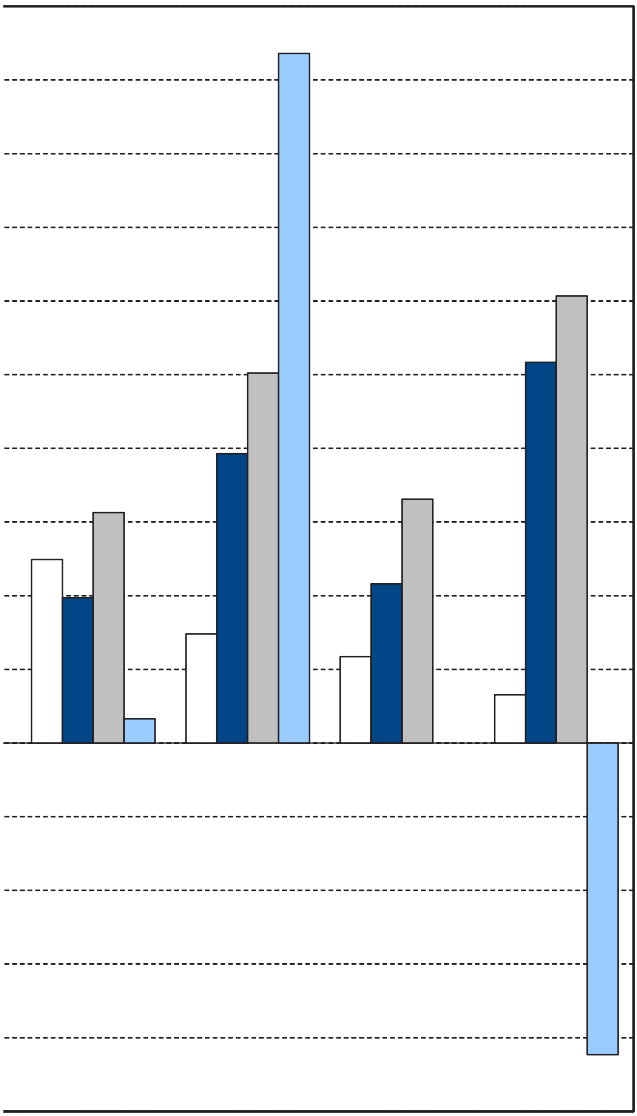

Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

TABLE 13. ESTIMATES OF AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2014—2030 (%)

Country Group	Population	Total Energy	Total Electricity	Nuclear Energy	Nuclear Capacity
North America	0.7	0.0 — 0.3	0.6 — 0.7	-1.3 — 1.3	-1.2 — 1.4
Latin America	0.9	3.2 — 5.2	5.1 — 7.4	3.9 — 8.4	2.2 — 6.6
Western Europe	0.3	0.9 — 1.7	1.1 — 2.4	-2.7 — 0.9	-3.6 — -0.1
Eastern Europe	-0.1	0.4 — 1.5	1.4 — 2.9	2.4 — 4.9	1.6 — 4.0
Africa	2.3	3.7 — 7.2	6.6 — 8.5	0.0 — 8.0	0.0 — 8.1
Middle East and South Asia	1.1	4.4 — 6.0	6.7 — 8.3	10.5 — 14.2	8.6 — 12.2
South East Asia and the Pacific	0.8	2.0 — 3.4	4.0 — 5.8		
Far East	0.3	2.1 — 3.5	2.7 — 4.1	7.4 — 10.6	2.6 — 5.9
World Average	0.9	2.0 — 3.5	2.9 — 4.3	1.3 — 4.4	0.1 — 3.3

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