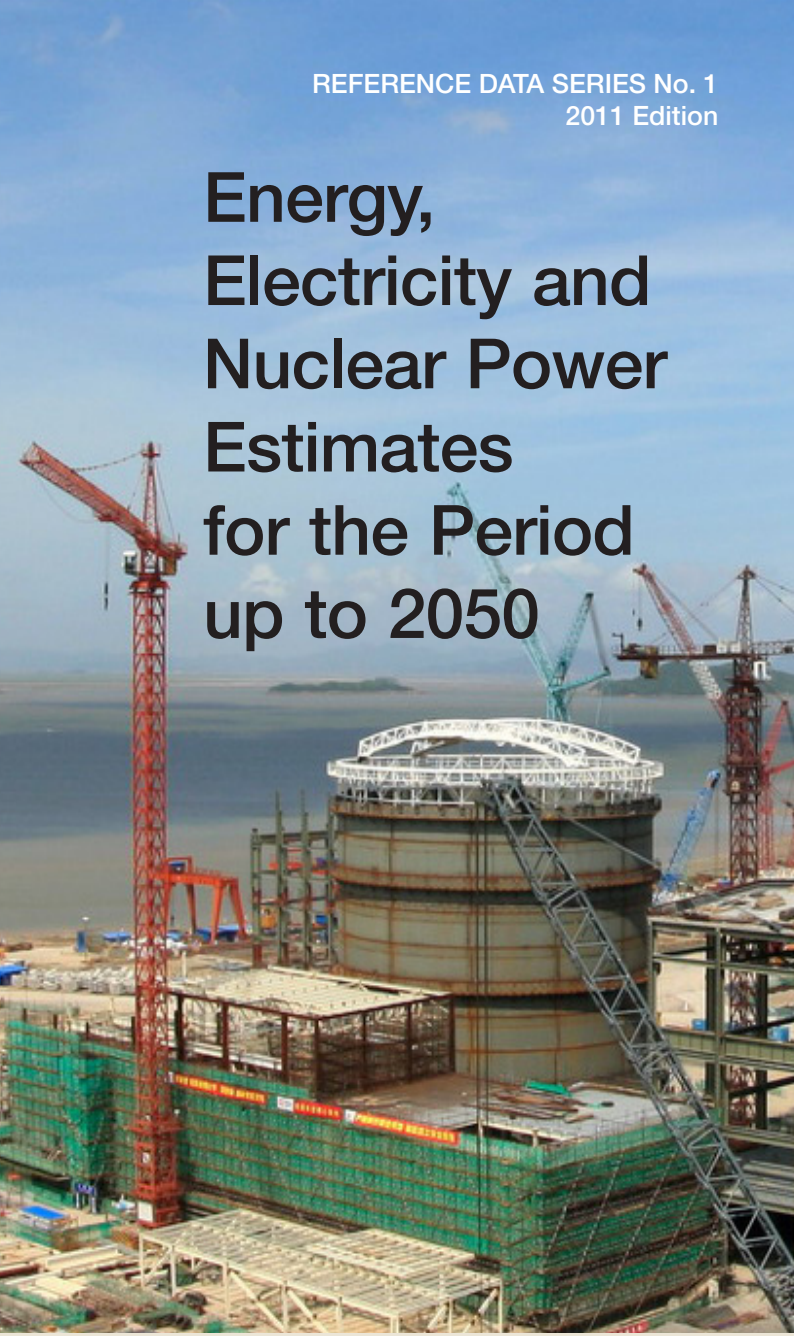
REFERENCE DATA SERIES No. 1
2011 Edition

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

2011 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 first 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 2010. 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 2010 are estimated, as the latest information available from the United Nations Department of Economic and Social Affairs is for 2008 only. Population data originate from the World Population Prospects (2010 revision), published by the Population Division of the United Nations Department of Economic and Social Affairs. The 2010 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.

Beginning with the 30th edition of this publication, however, the end-point of the estimates was extended up to the year 2050 (instead of 2030). Looking beyond 2030 has been prompted by the interest expressed by numerous Member States currently without nuclear power in adding nuclear energy to their future national energy supply mixes. Given the extensive lead times in planning and implementing nuclear power programmes, a fair share of these are likely to result in actual plant commissioning and grid connection after 2030.

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, which make a straightforward comparison and synthesis very difficult. The basic differences refer 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/NEA study;
- Indicators of development published by the World Bank in its World Development Indicators;
- 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 from a country by country 'bottom up' approach. They are established by a group of experts participating each year in the IAEA's consultancy on Nuclear Capacity Projections and based upon a review of nuclear power projects and programmes in Member States. The experts consider all the operating reactors, possible license 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 if current trends continued and there were few changes in policies affecting nuclear power other than those already in the pipeline. This case was explicitly designed to produce a

'conservative but plausible' set of projections. Additionally, the low case did not automatically assume that targets for nuclear power growth in a particular country would necessarily be achieved. These assumptions are relaxed in the high case.

The high case projections are much more optimistic, but still plausible and technically feasible. The high case assumes that the current financial and economic crises will be overcome in the not so distant future and past rates of economic growth and electricity demand, especially in the Far East, would essentially resume. In addition, the high case assumes the implementation of stringent policies globally targeted at mitigating climate change.

Developing the 2011 nuclear power projections posed a considerable challenge. First the financial and economic crises that started in 2008 have not been overcome in many regions. Second, the Fukushima-Daiichi accident and its likely impact on future nuclear power development is difficult to foresee. The accident was a tragedy for the people affected and seriously undermined public confidence in the safety of nuclear power. A number of countries announced reviews of their programmes, some took steps toward phasing out nuclear power entirely, and others re-emphasized their expansion plans. Third, a new international environmental agreement on the regulation of greenhouse gases replacing the Kyoto Protocol that would make the climate benefits of nuclear energy financially visible to investors is still being negotiated.

Regardless of these uncertainties, the continued growth in both the 2011 low and high projections suggests that the reasons for increased interest in nuclear power before the accident have not changed by the accident: (a) energy and electricity demand growth continue to be driven by population growth and economic development; (b) concerns continue to persist about security of energy supply and high and volatile fossil fuel prices; and (c) the quest for stable electricity generating costs is still a major incentive for public and private sector interest in nuclear power. Moreover, the overall performance and safety of nuclear power plants continue to be good. All this points to continued strong growth of nuclear power in the longer term.

The 2011 projections faced the complex need to balance the factors that have traditionally driven, and continue to drive, the future demand for nuclear power with the factors that potentially could adversely affect nuclear power expansion. The result of this balancing act shows the world's installed nuclear power capacity expanding from 375 gigawatts (GW(e)) today to 501 GW(e) in 2030, i.e. a decrease of 8% compared with last years's projection. In the updated high projection, it grows to 746 GW(e) in 2030, down by 7% from last year.

The data on electricity produced by nuclear power plants is 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.

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*

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 Frmr.Yug.Rep. of Macedonia*
Turkmenistan
Ukraine*
Uzbekistan*

Africa

Algeria*
Angola*
Benin*
Botswana*
Burkina Faso*
Burundi*
Cameroon*
Cape 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*
Libyan Arab Jamahiriya*
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 (Fed. States of)
Myanmar*
New Zealand*
Niue
Norfolk Islands
Northern Mariana Islands
Palau*
Papua New Guinea*
Pitcairn Islands
Samoa
Singapore*
Solomon Islands
Thailand*
Timor Leste
Tokelau
Tuvalu
US Minor Outlying Islands
Vanuatu
Wallis and Futuna Islands

Far East

Cambodia*
China*
Dem. P.R. of Korea
Japan*
Korea, Republic of*
Lao P.D.R.
Macau, China
Mongolia*
Philippines*
Taiwan, China
Vietnam*

TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2010)

Group and Country	In Operation		Long-term Shut Down Reactors		Under Construction		Electricity Supplied by Nuclear Power Reactors in 2010	
	Number of Units	Total MW(e)	Number of Units	Total MW(e)	Number of Units	Total MW(e)	TWh	Percent of Total Electricity
North America								
Canada	18	12569	4	2726			85.5	15.1
United States of America	104	101240			1	1165	807.1	19.6
Latin America								
Argentina	2	935			1	692	6.7	5.9
Brazil	2	1884			1	1245	13.9	3.1
Mexico	2	1300					5.6	3.6
Western Europe								
Belgium	7	5926					45.7	51.2
Finland	4	2716			1	1600	21.9	28.4
France	58	63130			1	1600	410.1	74.1
Germany	17	20490					133.0	28.4
Netherlands	1	482					3.8	3.4
Spain	8	7514					59.3	20.1
Sweden	10	9303					55.7	38.1
Switzerland	5	3238					25.3	38.0
United Kingdom	19	10137					56.9	15.7
Eastern Europe								
Armenia	1	375					2.3	39.4
Bulgaria	2	1906			2	1906	14.2	33.1
Czech Republic	6	3678					26.4	33.3
Hungary	4	1889					14.7	42.1

TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2010)

Group and Country	In Operation		Long-term Shut Down Reactors		Under Construction		Electricity Supplied by Nuclear Power Reactors in 2010	
	Number of Units	Total MW(e)	Number of Units	Total MW(e)	Number of Units	Total MW(e)	TWh	Percent of Total Electricity
Romania	2	1300					10.7	19.5
Russian Federation	32	22693			11	9153	159.4	17.1
Slovakia	4	1816			2	782	13.5	51.8
Slovenia	1	666					5.4	37.3
Ukraine	15	13107			2	1900	84.0	48.1
Africa								
South Africa	2	1800					12.9	5.2
Middle East and South Asia								
India	19	4189			6	3766	20.5	2.9
Iran, Islamic Republic of					1	915		
Pakistan	2	425			1	300	2.6	2.6
Far East								
China	13	10058			28	28230	71.0	1.8
Japan	54	46821	1	246	2	2650	280.3	29.2
Korea, Republic of	21	18698			5	5560	141.9	32.2
World Total (*)	441	375267	5	2972	67	64064	2630.0	13.5

Notes:

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

— 6 units in operation with total capacity of 4982 MW(e); 2 units under construction with total capacity of 2600 MW(e);

— 39.9 TWh of nuclear electricity generation, representing 19.3% of the total electricity generated.

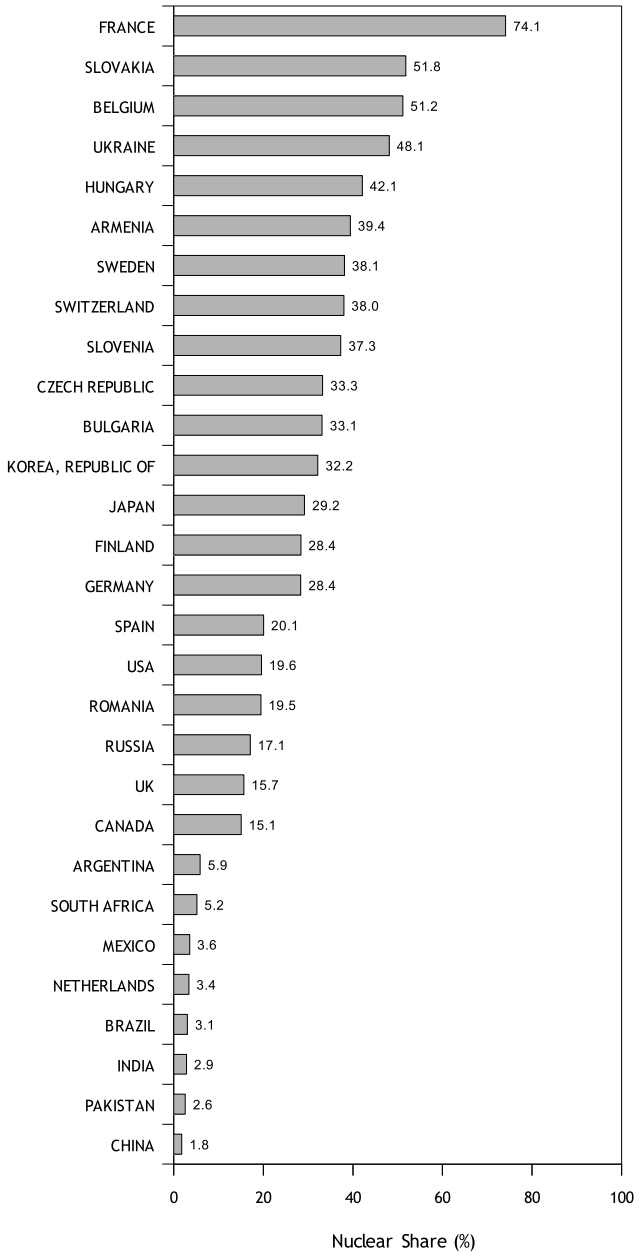


FIGURE 1. NUCLEAR SHARE OF TOTAL ELECTRICITY GENERATION IN 2010

Note: the nuclear share of electricity generation in Taiwan, China was 19.3%.

TABLE 2. NUMBER OF COUNTRIES WITH NUCLEAR POWER REACTORS IN OPERATION OR UNDER CONSTRUCTION (end of 2010)

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	1	2
Latin America	45	3		2	3
Western Europe	29	9		2	9
Eastern Europe	27	9		4	9
Africa	57	1			1
Middle East and South Asia	25	2		3	3
South East Asia and the Pacific	27				
Far East	11	3	1	3	3
World Total	223	29	2	15	30

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	2010			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	1165	113.8	9.8	1273 1310	119 126	9.4 9.6	1346 1526	111 149	8.3 9.7	1475	120 200	8.1 13.6
Latin America	313	4.1	1.3	457 587	6.4 6.4	1.4 1.1	982 1403	9 18	0.9 1.3	1990	15 60	0.8 3.0
Western Europe	843	122.9	14.6	1007 1058	93 126	9.2 11.9	1132 1389	83 141	7.4 10.1	1586	60 170	3.8 10.7
Eastern Europe	465	47.4	10.2	661 661	66 80	10.0 12.1	723 914	82 108	11.3 11.8	1031	80 140	7.8 13.6
Africa	130	1.8	1.4	383 422	1.8 1.8	0.5 0.4	781 1093	5 16	0.6 1.5	2630	10 48	0.4 1.8
Middle East and South Asia	418	4.6	1.1	538 954	13 22	2.4 2.3	1414 1885	30 53	2.1 2.8	5223	50 140	1.0 2.7
South East Asia and the Pacific	173			293 312			473 526	0 6	0.0 1.1	1242	5 20	0.4 1.6
Far East	1564	80.6	5.2	2222 2407	130 164	5.8 6.8	2818 3381	180 255	6.4 7.5	5215	220 450	4.2 8.6
World Total Low Estimate	5071	375.3	7.4	6835	429	6.3	9669	501	5.2	20391	560	2.7
World Total High Estimate				7711	525	6.8	12118	746	6.2		1228	6.0

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.

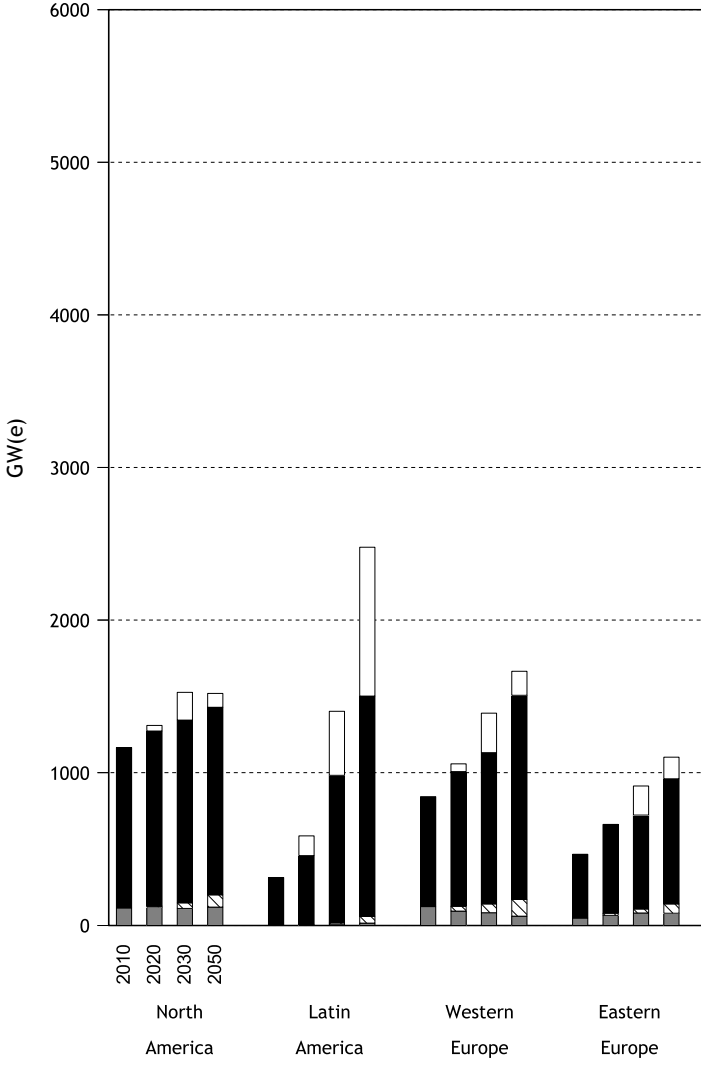


FIGURE 2. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY

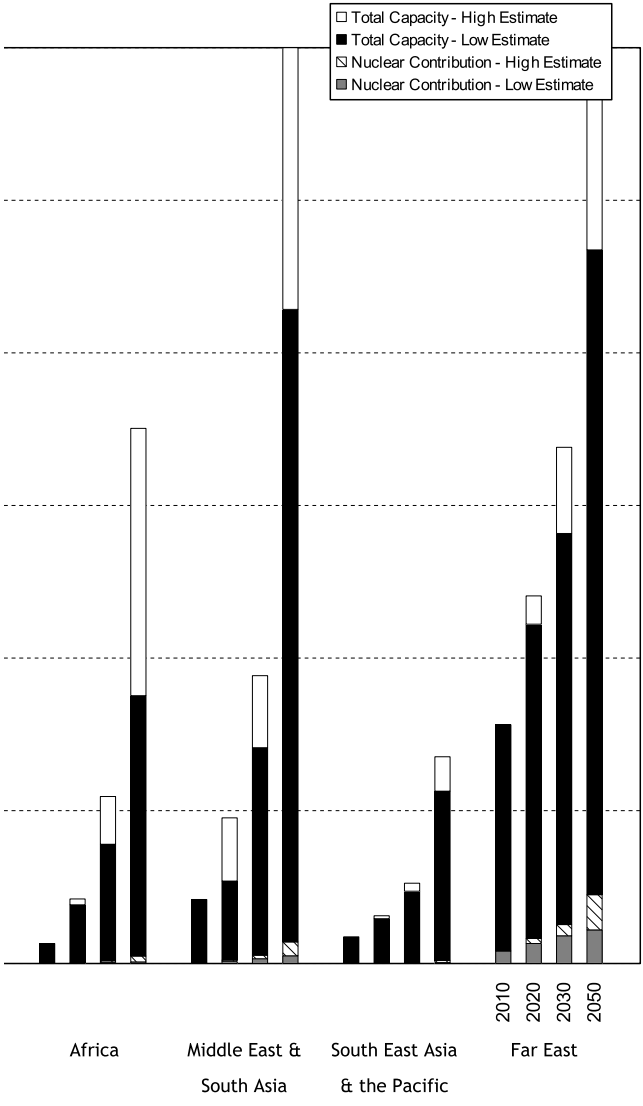

Total Capacity - High Estimate
Total Capacity - Low Estimate
Nuclear Contribution - High Estimate
Nuclear Contribution - Low Estimate
2010
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

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

Country Group	2010			2020			2030			2050 (a)		
	Total Elect. TWh	Nuclear		Total Elect. TWh	Nuclear		Total Elect. TWh	Nuclear		Total Elect. TWh	Nuclear	
		TWh	%		TWh	%		TWh	%		TWh	%
North America	4687	892.6	19.0	5017 5054	939 994	18.7 19.7	5262 5382	875 1171	16.6 21.8	5809	967 1612	16.6 27.7
Latin America	1206	26.2	2.2	1932 2138	48 48	2.5 2.2	3220 4835	70 144	2.2 3.0	6820	121 484	1.8 7.1
Western Europe	3050	811.7	26.6	3540 3728	692 935	19.6 25.1	4015 4781	658 1109	16.4 23.2	5851	484 1370	8.3 23.4
Eastern Europe	1821	330.6	18.2	2255 2348	491 594	21.8 25.3	2664 3235	646 853	24.2 26.4	3857	645 1128	16.7 29.3
Africa	642	12.9	2.0	1278 1534	13 13	1.0 0.9	2499 3593	39 126	1.6 3.5	9314	81 383	0.9 4.1
Middle East and South Asia	1654	23.0	1.4	2246 2967	91 153	4.1 5.1	4949 6127	238 417	4.8 6.8	18080	403 1128	2.2 6.2
South East Asia and the Pacific	750			1025 1074			1630 1893	0 47	0.0 2.5	4317	40 161	0.9 3.7
Far East	5732	533.0	9.3	6985 8262	965 1218	13.8 14.7	9210 12209	1420 2009	15.4 16.5	18971	1773 3627	9.3 19.1
World Total Low Estimate	19542	2630.0	13.5	24279	3240	13.3	33449	3946	11.8	73021	4513	6.2
World Total High Estimate				27104	3955	14.6	42056	5878	14.0		9893	13.5

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.

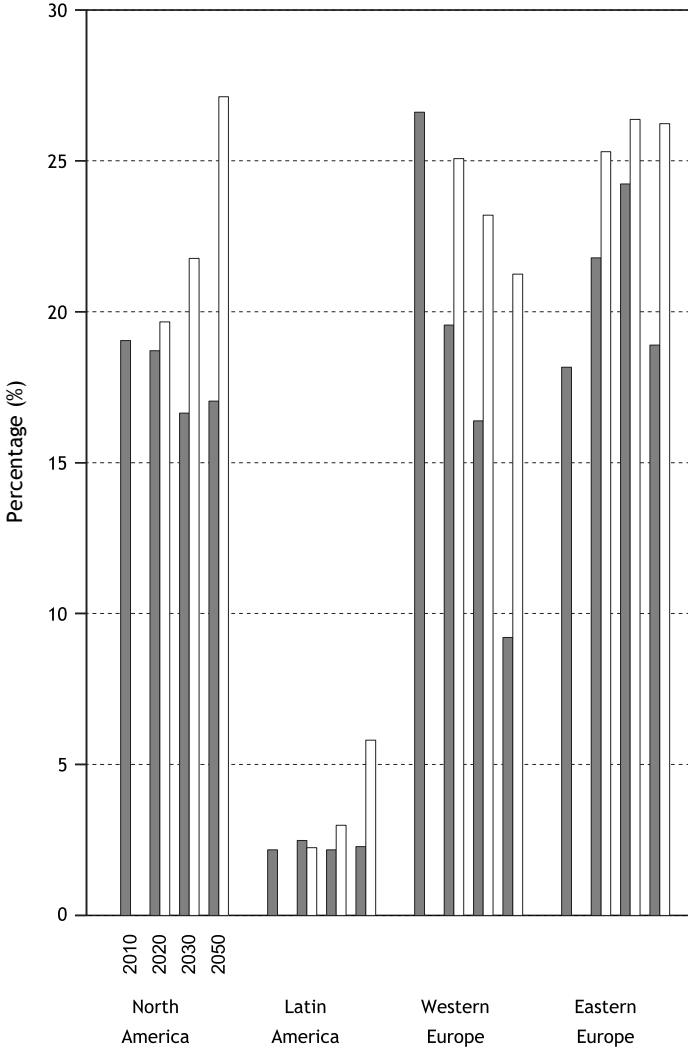
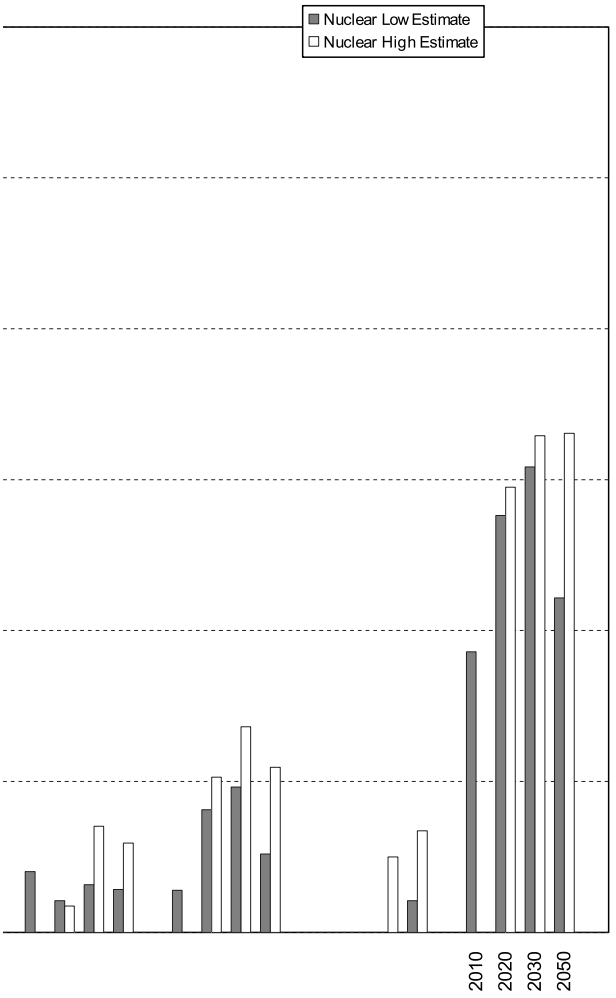


FIGURE 3. PERCENTAGE OF ELECTRICITY SUPPLIED BY NUCLEAR


Nuclear Low Estimate
Nuclear High Estimate
2010
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

POWER

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

Country Group	2010			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	107.5	39.3	9.1	107 115	42 40	9.6 9.4	106 114	44 43	9.0 11.2	108	49	10.1 15.7
Latin America	34.1	25.7	0.8	52 55	27 28	1.0 1.0	65 90	36 39	1.2 1.8	112	44	1.4 4.0
Western Europe	67.8	38.2	13.1	75 78	39 40	10.1 13.1	84 93	39 43	8.5 13.1	100	48	5.7 14.1
Eastern Europe	57.7	39.1	6.2	65 69	43 42	8.3 9.4	67 81	49 49	10.5 11.4	93	51	8.3 12.2
Africa	29.2	22.3	0.5	34 39	38 40	0.4 0.4	53 94	48 39	0.8 1.5	195	48	0.7 1.6
Middle East and South Asia	67.4	32.9	0.4	89 108	34 37	1.1 1.5	151 179	44 45	1.7 2.5	475	51	1.1 2.3
South East Asia and the Pacific	25.3	29.4		30 32	34 33		40 42	40 45	0.0 1.2	99	43	0.5 1.7
Far East	135.3	41.1	4.3	170 189	40 43	6.2 7.0	216 280	42 43	7.2 7.8	377	49	5.9 9.3
World Total Low Estimate	524.4	36.4	5.5	622	38	5.7	782	43	5.5	1558	49	3.5
World Total High Estimate				685	39	6.3	973	43	6.6			6.2

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.

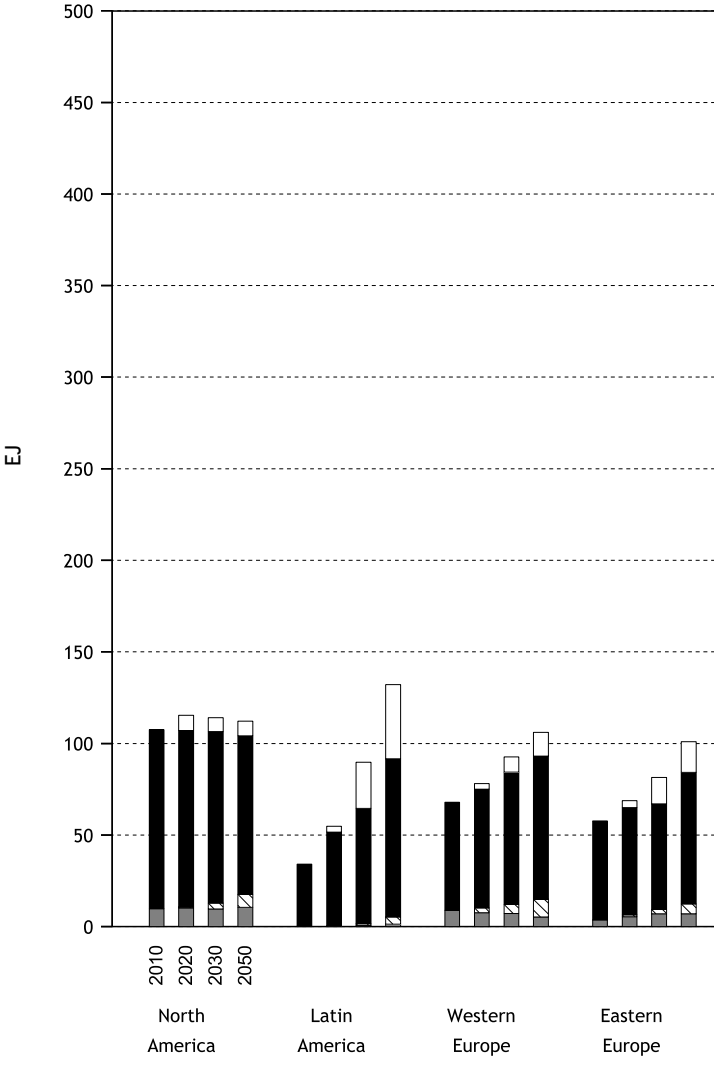


FIGURE 4. ESTIMATES OF ENERGY REQUIREMENT

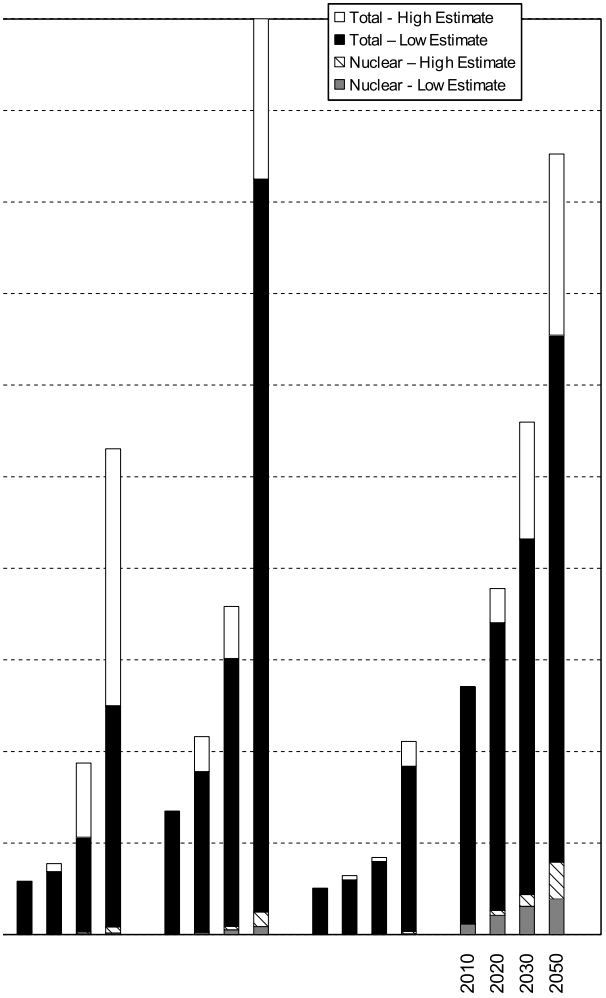

Total - High Estimate
Total – Low Estimate
Nuclear – High Estimate
Nuclear - Low Estimate
2010
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

TABLE 6. TOTAL ENERGY REQUIREMENT (EJ) BY TYPE OF FUEL IN 2010 (*)

Country Group	Solids (a)	Liquids	Gases	Biomass (b)	Hydro	Nuclear	Renewables (c)	Total
North America	22.11	36.31	29.81	6.22	2.36	9.74	0.94	107.49
Latin America	1.31	15.57	8.15	5.83	2.60	0.29	0.41	34.14
Western Europe	9.08	22.41	19.94	4.43	2.08	8.85	1.03	67.81
Eastern Europe	12.85	11.64	27.17	1.42	1.11	3.61	-0.07	57.74
Africa	4.66	7.40	4.33	12.17	0.37	0.14	0.09	29.17
Middle East and South Asia	17.15	22.05	17.54	9.84	0.61	0.25	> 0.01	67.44
South East Asia and the Pacific	5.46	8.21	6.78	4.08	0.26		0.49	25.27
Far East	77.75	32.69	11.02	4.28	3.17	5.81	0.56	135.29
World Total	150.37	156.28	124.74	48.28	12.56	28.69	3.44	524.36

Notes:

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

(a) Solids do not include commercial wood.

(b) The column headed 'Biomass' includes commercial wood, combustible renewables, waste and other biomass products.

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

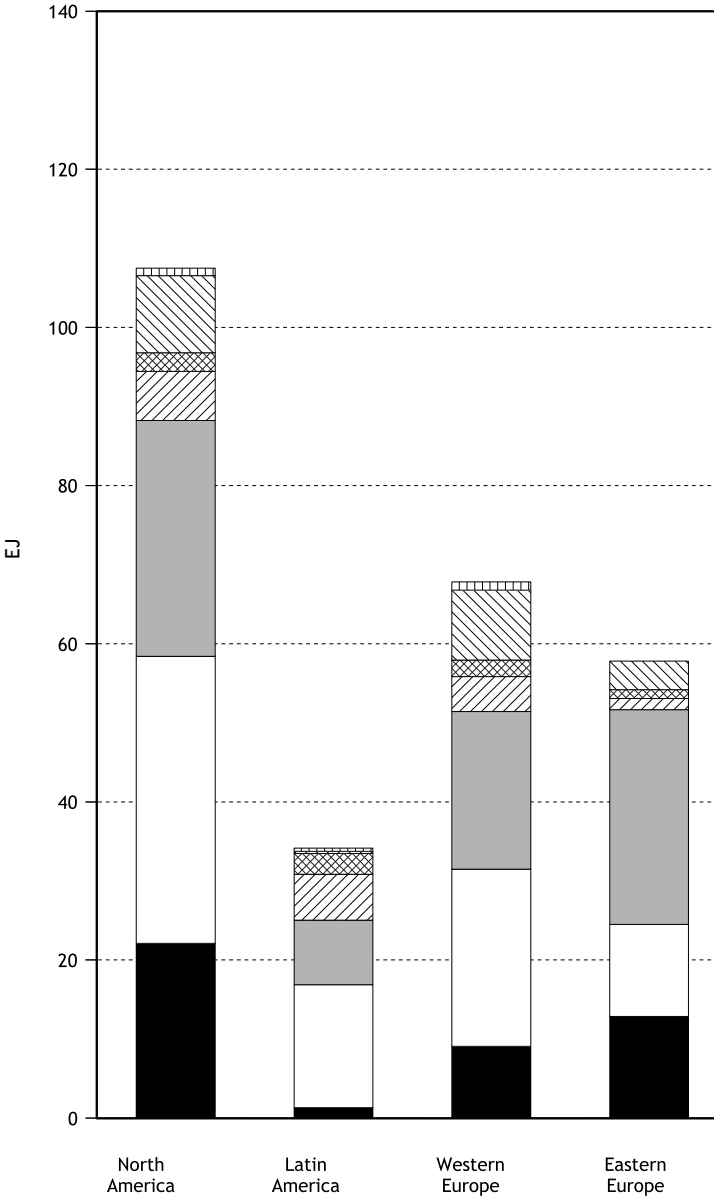
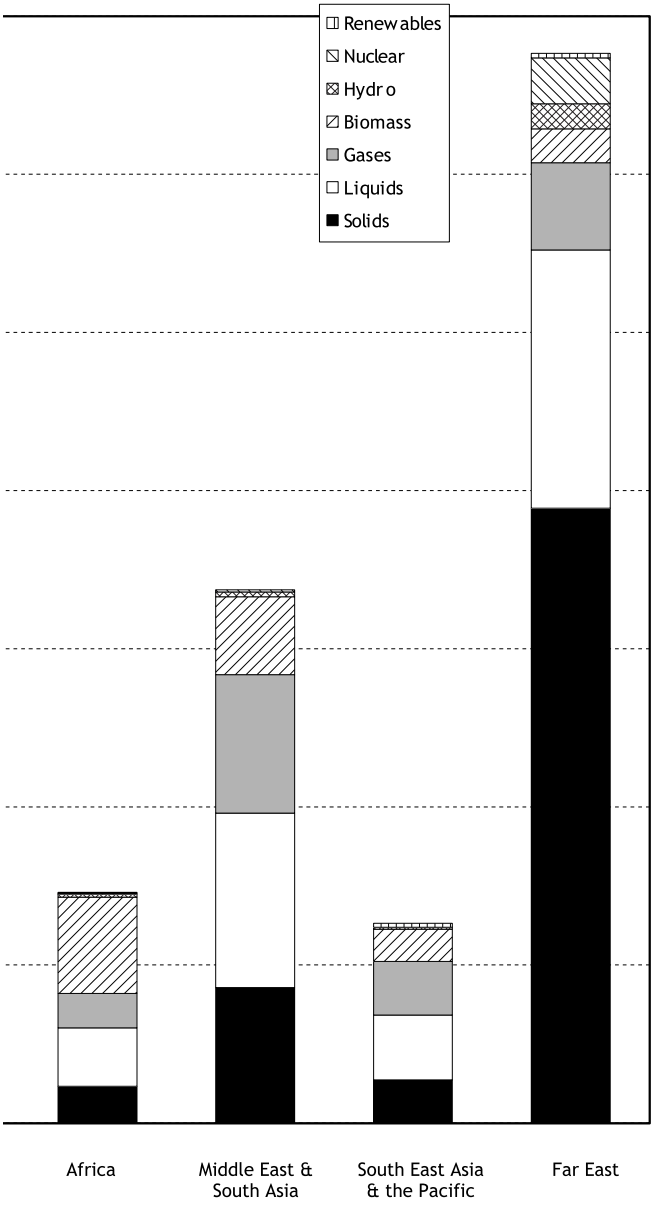


FIGURE 5. TOTAL ENERGY REQUIREMENT BY FUEL TYPE IN 2010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Nuclear
Hydro
Biomass
Gases
Liquids
Solids
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

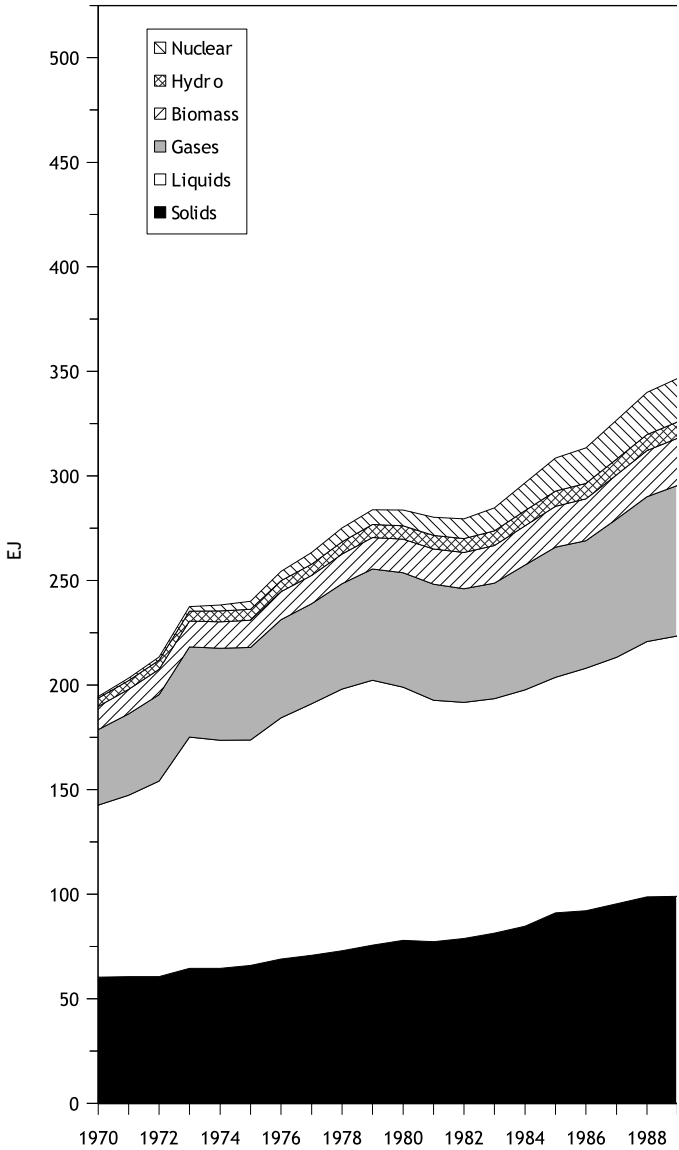


FIGURE 6. BREAKDOWN OF WORLD TOTAL ENERGY REQUIREMENT DURING THE PERIOD 1970 — 2010

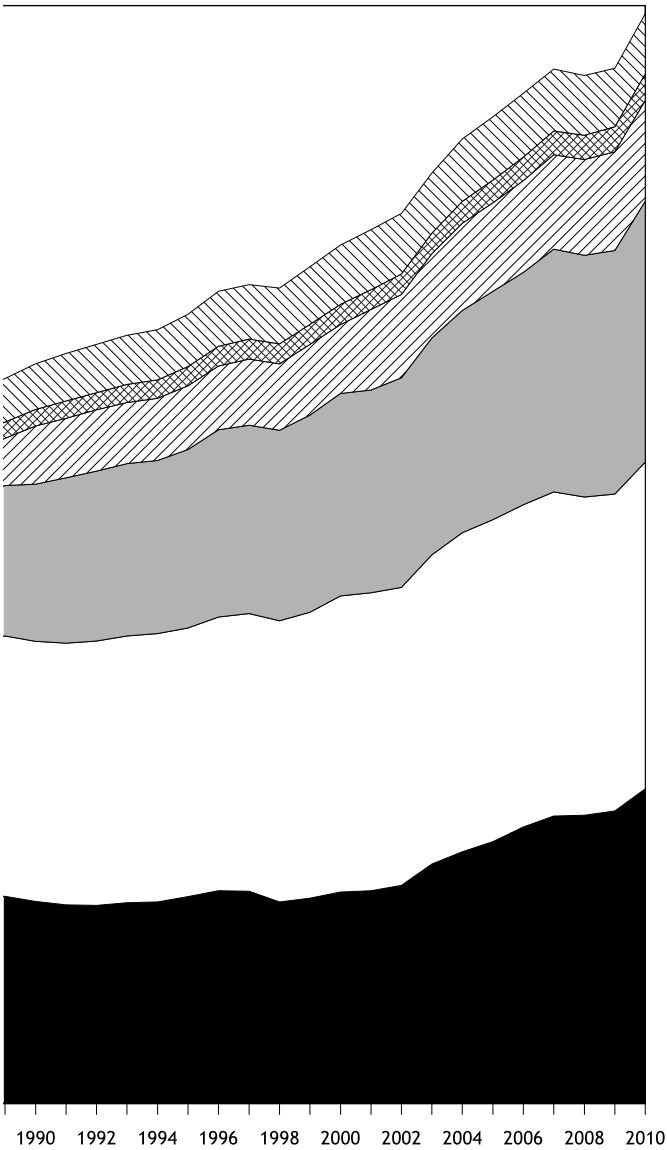

1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year

TABLE 7. FUEL SHARES (%) OF ENERGY REQUIREMENT IN 2010 (*)

Country Group	Solids (a)	Liquids	Gases	Biomass (b)	Hydro	Nuclear	Renewables (c)	Total
North America	20.57	33.78	27.74	5.78	2.20	9.06	0.88	100.00
Latin America	3.83	45.60	23.86	17.06	7.62	0.84	1.19	100.00
Western Europe	13.39	33.04	29.40	6.54	3.06	13.06	1.52	100.00
Eastern Europe	22.26	20.17	47.06	2.47	1.92	6.25	-0.12	100.00
Africa	15.96	25.39	14.85	41.74	1.28	0.48	0.30	100.00
Middle East and South Asia	25.43	32.69	26.01	14.60	0.91	0.37	> 0.01	100.00
South East Asia and the Pacific	21.60	32.47	26.83	16.14	1.02		1.94	100.00
Far East	57.47	24.17	8.14	3.17	2.34	4.30	0.42	100.00
World Total	28.68	29.80	23.79	9.21	2.40	5.47	0.66	100.00

Notes:

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

(a) Solids do not include commercial wood.

(b) The column headed 'Biomass' includes commercial wood, combustible renewables, waste and other biomass products.

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

TABLE 8. FUEL USE (EJ) FOR ELECTRICITY GENERATION BY TYPE OF FUEL IN 2010

Country Group	Thermal (a)	Hydro	Nuclear	Renewables (b)	Total
North America	30.53	2.36	9.74	0.91	43.55
Latin America	5.57	2.60	0.29	0.39	8.85
Western Europe	15.57	2.08	8.85	0.99	27.49
Eastern Europe	19.16	1.11	3.61	0.03	23.91
Africa	5.99	0.37	0.14	0.05	6.55
Middle East and South Asia	21.48	0.61	0.25	> 0.01	22.34
South East Asia and the Pacific	6.96	0.26		0.49	7.70
Far East	47.67	3.17	5.81	0.57	57.22
World Total	152.93	12.56	28.69	3.43	197.61

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 2010

Country Group	Thermal (a)	Hydro	Nuclear	Renewables (b)	Total
North America	65.01	14.00	19.04	1.95	100.00
Latin America	36.90	59.96	2.17	0.97	100.00
Western Europe	49.01	18.90	26.61	5.48	100.00
Eastern Europe	64.79	16.89	18.16	0.15	100.00
Africa	81.42	16.16	2.01	0.42	100.00
Middle East and South Asia	88.33	10.26	1.39	0.02	100.00
South East Asia and the Pacific	87.89	9.52		2.59	100.00
Far East	74.67	15.35	9.30	0.67	100.00
World Total	66.98	17.85	13.46	1.71	100.00

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	2010		2020		2030		2050	
	Million Inhabitants	Growth Rate (%/a) 2000 — 2010	Million Inhabitants	Growth Rate (%/a) 2010 — 2020	Million Inhabitants	Growth Rate (%/a) 2020 — 2030	Million Inhabitants	Growth Rate (%/a) 2030 — 2050
North America	345	0.97	374	0.83	402	0.71	447	0.53
Latin America	590	1.31	652	1.01	702	0.73	751	0.34
Western Europe	485	0.56	504	0.38	515	0.21	520	0.05
Eastern Europe	391	-0.44	389	-0.06	381	-0.21	356	-0.34
Africa	1022	2.66	1278	2.26	1562	2.03	2192	1.71
Middle East and South Asia	1846	2.01	2119	1.39	2357	1.07	2679	0.64
South East Asia and the Pacific	442	1.52	488	1.00	526	0.75	564	0.35
Far East	1775	0.67	1852	0.42	1878	0.14	1798	-0.22
World Total	6896	1.61	7657	1.05	8321	0.84	9306	1.12

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

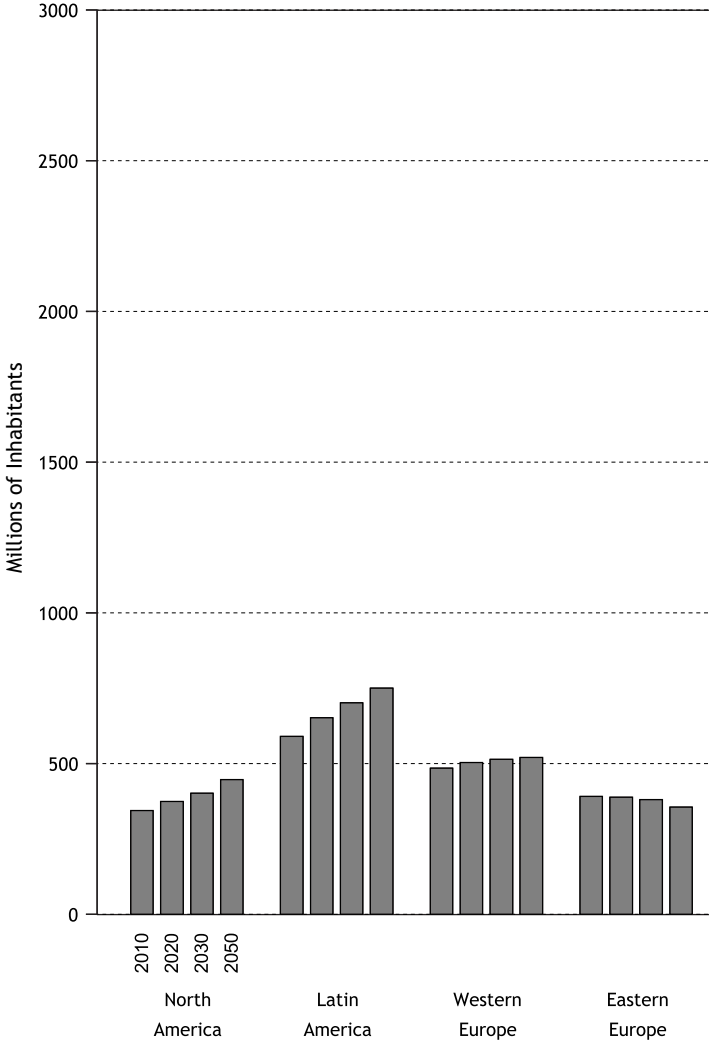


FIGURE 7. POPULATION ESTIMATES

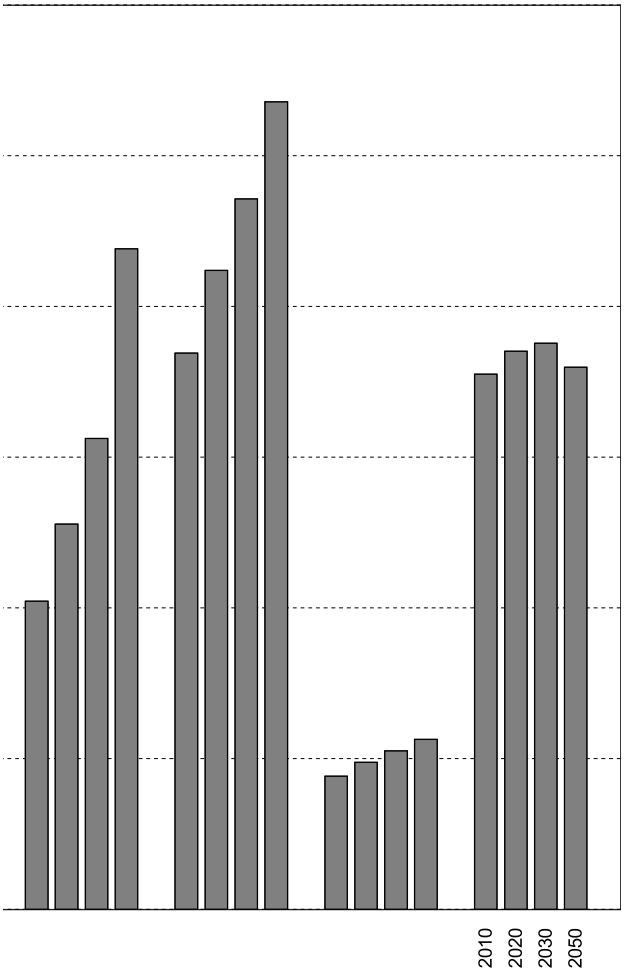

2010
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

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

Country Group	2010		2020		2030		2050 (*)	
	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MWh/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MWh/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MWh/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MWh/cap)
North America	312	13.6	286 – 308	13.4 – 13.5	265 – 284	13.1 – 13.4	242 ± 9	13.0 ± 0.3
Latin America	58	2.0	79 – 84	3.0 – 3.3	92 – 128	4.6 – 6.9	149 ± 27	9.1 ± 2.0
Western Europe	140	6.3	149 – 155	7.0 – 7.4	164 – 180	7.8 – 9.3	191 ± 12	11.2 ± 1.1
Eastern Europe	148	4.7	167 – 177	5.8 – 6.0	176 – 214	7.0 – 8.5	261 ± 24	10.9 ± 1.3
Africa	29	0.6	27 – 30	1.0 – 1.2	34 – 60	1.6 – 2.3	89 ± 32	4.3 ± 1.7
Middle East and South Asia	37	0.9	42 – 51	1.1 – 1.4	64 – 76	2.1 – 2.6	177 ± 23	6.7 ± 0.9
South East Asia and the Pacific	57	1.7	61 – 66	2.1 – 2.2	76 – 80	3.1 – 3.6	175 ± 12	7.6 ± 0.8
Far East	76	3.2	92 – 102	3.8 – 4.5	115 – 149	4.9 – 6.5	210 ± 28	10.6 ± 1.7
World Average	76	2.8	81 – 89	3.2 – 3.5	94 – 117	4.0 – 5.1	167 ± 25	7.8 ± 1.3

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

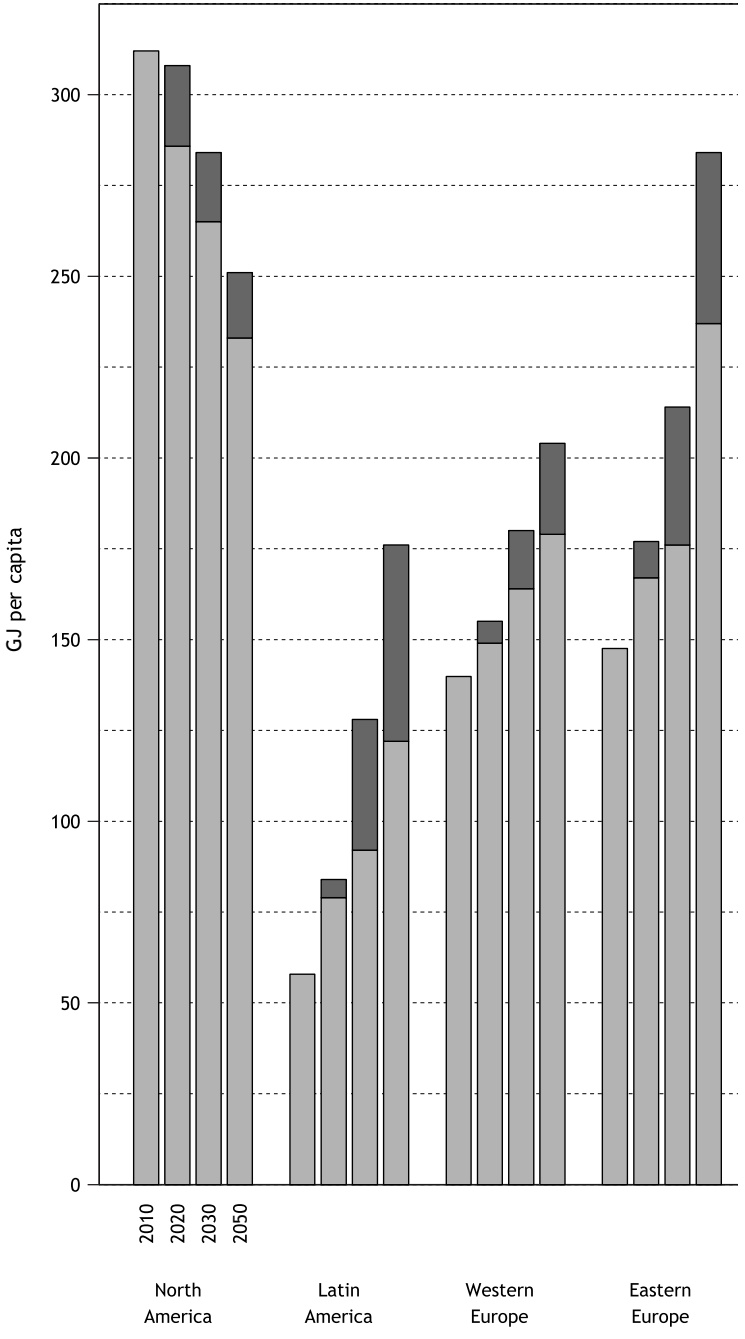
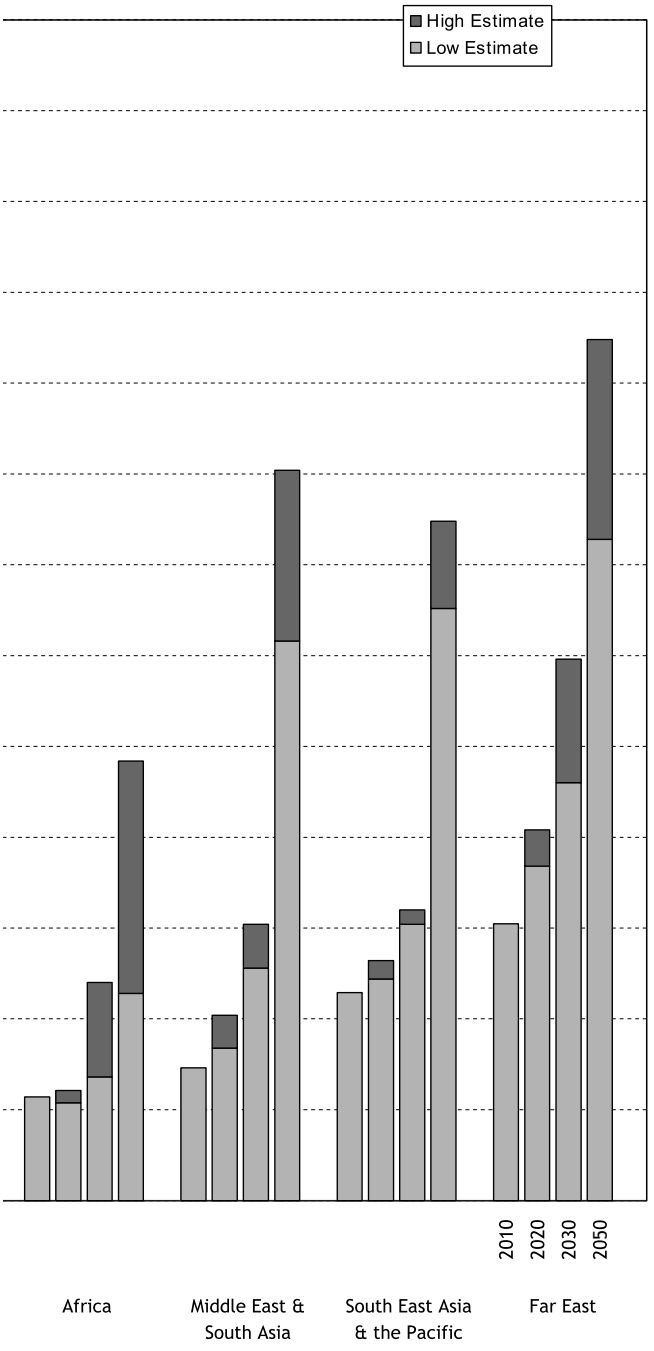


FIGURE 8. TOTAL ENERGY REQUIREMENT PER CAPITA


High Estimate
Low Estimate
2010
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

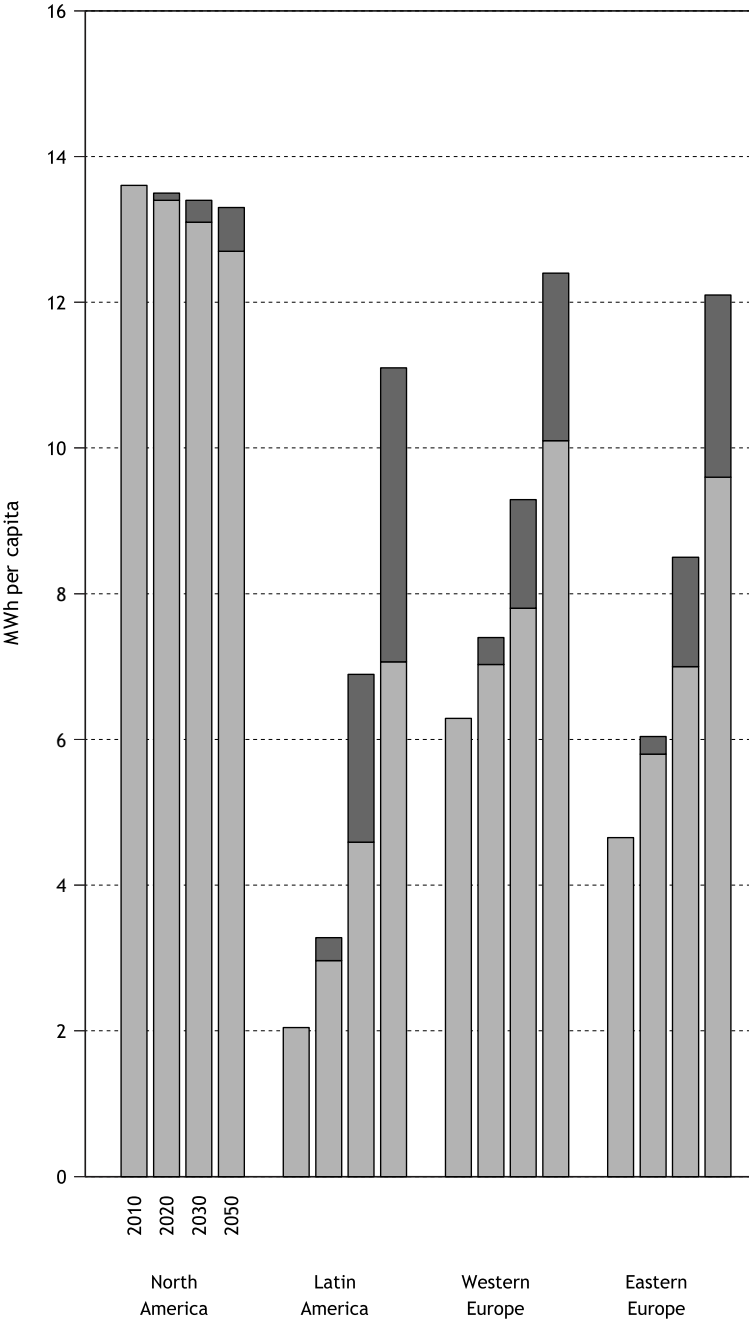


FIGURE 9. TOTAL ELECTRICITY REQUIREMENT PER CAPITA

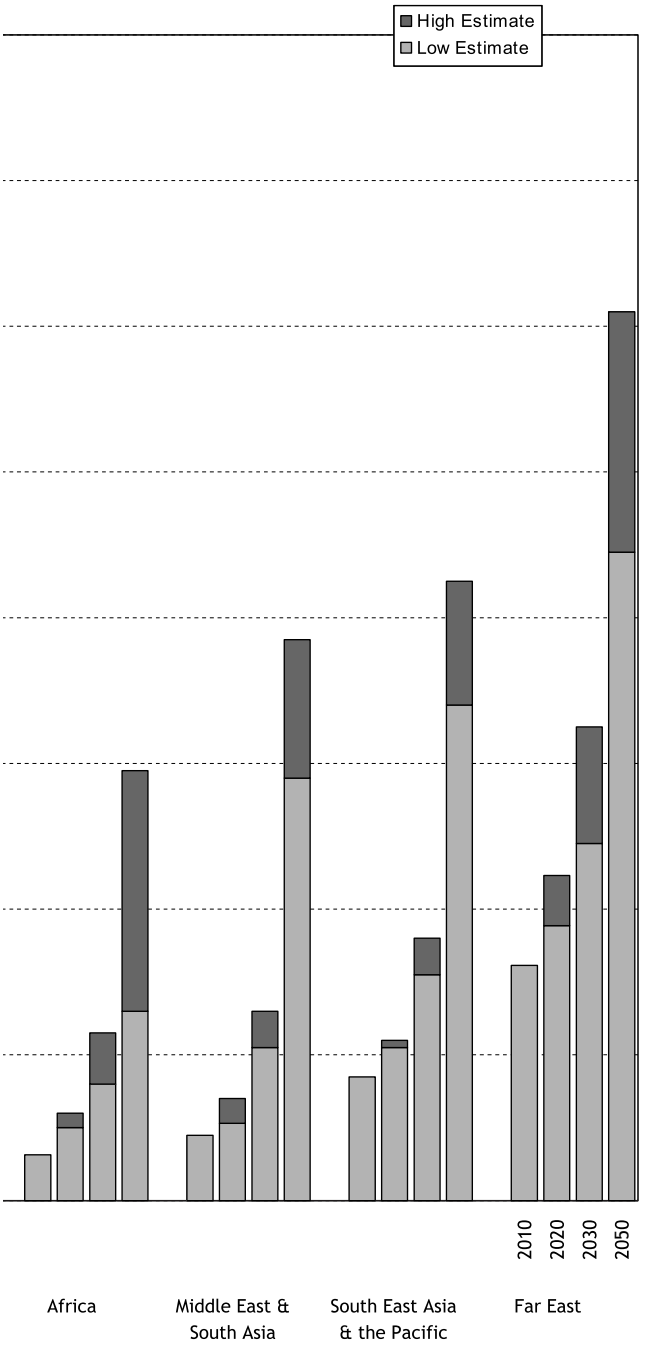

High Estimate
Low Estimate
2010
2020
2030
2050
Africa
Middle East & South Asia
South East Asia & the Pacific
Far East

TABLE 12. AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2000—2010 (%)

Country Group	Population	Total Energy	Total Electricity	Nuclear Energy	Nuclear Capacity
North America	1.0	0.0	0.6	0.8	0.6
Latin America	1.3	2.7	2.1	2.9	-0.1
Western Europe	0.6	0.2	0.8	-0.4	-0.3
Eastern Europe	-0.4	1.0	1.3	1.9	0.4
Africa	2.7	2.7	4.5	-0.1	0.0
Middle East and South Asia	2.0	5.6	4.6	4.2	4.7
South East Asia and the Pacific	1.5	4.0	3.3		
Far East	0.7	5.3	7.2	1.5	2.4
World Average	1.3	2.4	2.9	0.7	0.7

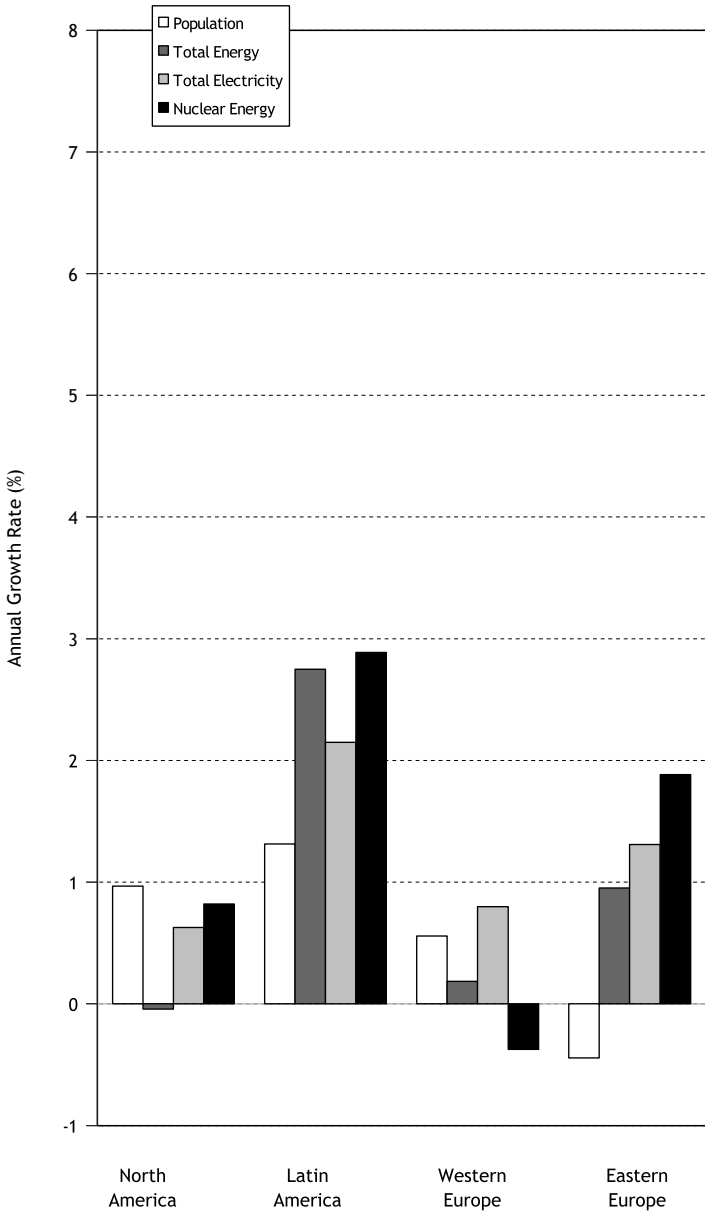
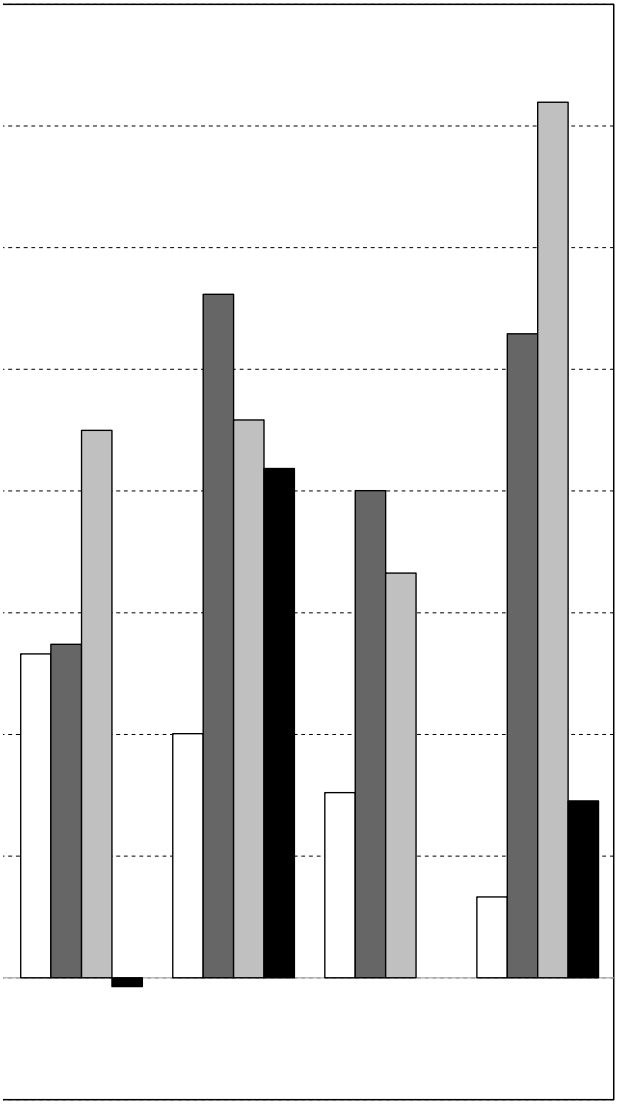


FIGURE 10. AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2000 — 2010



Africa

Middle East & South Asia

South East Asia & the Pacific

Far East

TABLE 13. ESTIMATES OF AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2010—2030 (%)

Country Group	Population	Total Energy	Total Electricity	Nuclear Energy	Nuclear Capacity
North America	0.8	0.0 – 1.8	0.6 – 0.7	-0.1 – 1.4	-0.1 – 1.3
Latin America	0.9	3.2 – 5.0	5.0 – 7.2	5.0 – 8.9	3.9 – 7.7
Western Europe	0.3	1.1 – 1.6	1.4 – 2.3	-1.0 – 1.6	-1.9 – 0.7
Eastern Europe	-0.1	0.7 – 1.7	1.9 – 2.9	3.4 – 4.9	2.8 – 4.2
Africa	2.1	3.0 – 6.0	7.0 – 9.0	5.7 – 12.1	5.2 – 11.5
Middle East and South Asia	1.2	4.1 – 5.0	5.6 – 6.8	12.4 – 15.6	9.9 – 13.0
South East Asia and the Pacific	0.9	2.3 – 2.6	4.0 – 4.7		
Far East	0.3	2.4 – 3.7	2.4 – 3.9	5.0 – 6.9	4.1 – 5.9
World Average	0.9	2.0 – 3.3	2.7 – 3.9	2.0 – 4.1	1.5 – 3.5

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