

REFERENCE DATA SERIES No. 1  
2016 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**

2016 Edition

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

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# Introduction

Reference Data Series No. 1 (RDS-1) is an annual publication — currently in its thirty-sixth 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 2015. 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 2015 are estimated, as the latest information available from the United Nations Department of Economic and Social Affairs is for 2013. 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 2015 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 projections for 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. 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 projections are much more ambitious but are still plausible and technically feasible. The high case assumes that current rates of economic and electricity demand growth will continue, with particularly high growth

in the Far East. Additionally, 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 world. Low natural gas prices are due to technological advances and low energy demand. Moreover, the ongoing global financial crisis continues to present challenges for capital intensive projects such as nuclear power. Heightened safety requirements, deployment of advanced technologies and other factors have increased construction times and costs, contributing to deployment delays. The assumption adopted by the expert group is that these challenges, in addition to the Fukushima Daiichi accident, will continue to temporarily delay nuclear development plans. 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.

Compared with the 2015 projections to 2030, the 2016 projections were reduced by 34 GW(e)<sup>1</sup> in the high case, but were increased by 5 GW(e) in the low case. These projections also factor in the likely future retirements or life extensions of the nuclear reactors currently in operation, more than half of which are over 30 years old. There are, however, uncertainties in the number of retirements and life extensions. In the high case more life extensions are assumed, whereas in the low case more retirements are expected. Consequently, the total new capacity constructed will be much greater than apparent net increase. The low case, which shows essentially no increase in the installed capacity, assumes some 150 GW(e) of new capacity built over the next 15 years.

With respect to projections from 2030 to 2050, assumptions were made about the general rate of development and retirements. Given all the uncertainties,

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<sup>1</sup> 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).



these estimates should be considered as suggestive of the potential outcomes.

Interest in nuclear power remains strong in some regions, particularly in the developing world. Commitments agreed to at the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change have the potential to benefit nuclear energy development in the future.

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%); the 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 =  $3.6 \times 10^{-3}$  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	Guatemala*
Antigua and Barbuda*	Guyana*
Argentina*	Haiti*
Aruba	Honduras*
Bahamas*	Jamaica*
Barbados*	Martinique
Belize*	Mexico*
Bermuda	Montserrat
Bolivia, Plurinational State of*	Nicaragua*
Brazil*	Panama*
Cayman Islands	Paraguay*
Chile*	Peru*
Colombia*	Puerto Rico
Costa Rica*	Saint Kitts and Nevis
Cuba*	Saint Lucia
Dominica*	Saint Pierre and Miquelon
Dominican Republic*	Saint Vincent and the Grenadines
Ecuador*	Suriname
El Salvador*	Trinidad and Tobago*
Grenada	Turks and Caicos Islands
Guadeloupe	Uruguay*
	Venezuela, Bolivarian Republic of*

**Western Europe**

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

**Note:** The designations employed are in line with established IAEA terminology and the designations used for statistical processing purposes by the Statistics Division of the United Nations Secretariat (see: UNITED NATIONS, Standard Country or Area Codes for Statistical Use, Revision 4, (1999) <http://unstats.un.org/unsd/methods/m49/m49.htm>). The designations employed and the presentation of material in this document do not imply the expression of any opinion whatsoever on the part of the IAEA concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

## **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 Yugoslav Republic  
of Macedonia\*  
Turkmenistan\*  
Ukraine\*  
Uzbekistan\*

## **Africa**

Algeria\*  
Angola\*  
Benin\*  
Botswana\*  
Burkina Faso\*  
Burundi\*  
Cabo Verde  
Cameroon\*  
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\*  
Réunion  
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

India\*

Iran, Islamic Republic of\*

Iraq\*

Israel\*

Jordan\*

Kuwait\*

Lebanon\*

Nepal\*

Oman\*

Pakistan\*

Qatar\*

Saudi Arabia\*

Sri Lanka\*

Syrian Arab Republic\*

Palestine

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

Samoa

Singapore\*

Solomon Islands

Thailand\*

Timor-Leste

Tokelau

Tonga

Tuvalu

Vanuatu\*

Wallis and Futuna Islands

## **Far East**

Cambodia\*

China\* <sup>a</sup>

Japan\*

Korea, Democratic People's  
Republic of

Korea, Republic of\*

Lao People's Democratic Republic

Mongolia\*

Philippines\*

Viet Nam\*

<sup>a</sup> Includes Taiwan, China.

TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2015)

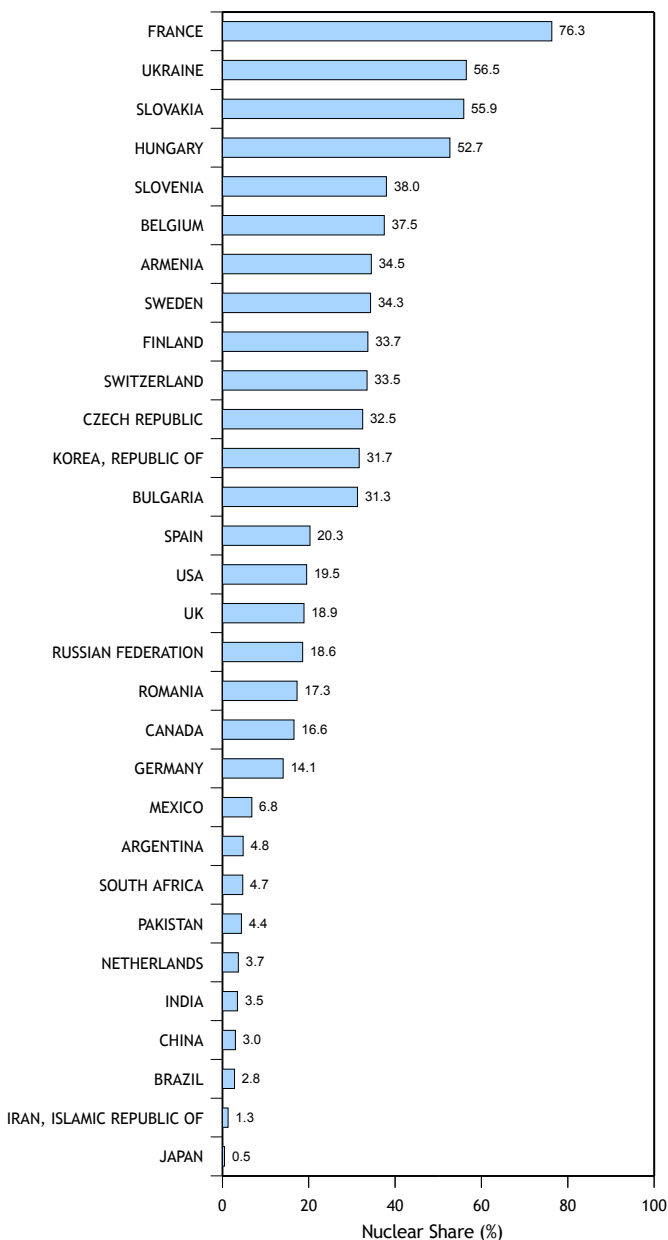
Group and Country	In Operation		Long-term Shut Down Reactors		Under Construction		Electricity Supplied by Nuclear Power Reactors in 2015	
	Number of Units	Total MW(e)	Number of Units	Total MW(e)	Number of Units	Total MW(e)	TW·h	Percent of Total Electricity
<b>North America</b>								
Canada	19	13524					95.6	16.6
United States of America	99	99185			5	5633	798.0	19.5
<b>Latin America</b>								
Argentina	3	1632			1	25	6.5	4.8
Brazil	2	1884			1	1245	13.9	2.8
Mexico	2	1440					11.2	6.8
<b>Western Europe</b>								
Belgium	7	5913					24.8	37.5
Finland	4	2752			1	1600	22.3	33.7
France	58	63130			1	1630	419.0	76.3
Germany	8	10799					86.8	14.1
Netherlands	1	482					3.9	3.7
Spain	7	7121					54.8	20.3
Sweden	10	9648	1	446			54.5	34.3
Switzerland	5	3333					22.2	33.5
United Kingdom	15	8918					63.9	18.9
<b>Eastern Europe</b>								
Armenia	1	375					2.6	34.5
Belarus								
Bulgaria	2	1926			2	2218	14.7	31.3
Czech Republic	6	3930					25.3	32.5

**TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2015) (cont.)**

Group and Country	In Operation		Long-term Shut Down Reactors		Under Construction		Electricity Supplied by Nuclear Power Reactors in 2015	
	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					15.0	52.7
Romania	2	1300					10.7	17.3
Russian Federation	35	25443			8	6582	182.8	18.6
Slovakia	4	1814			2	880	14.1	55.9
Slovenia	1	688					5.4	38.0
Ukraine	15	13107			2	1900	82.4	56.5
<b>Africa</b>								
South Africa	2	1860					11.0	4.7
<b>Middle East and South Asia</b>								
India	21	5308			6	3907	34.6	3.5
Iran, Islamic Republic of	1	915					3.2	1.3
Pakistan	3	690			3	1644	4.3	4.4
United Arab Emirates					4	5380		
<b>Far East</b>								
China	31	26774			24	24128	161.2	3.0
Japan	43	40290	1	246	2	2650	4.3	.5
Korea, Republic of	24	21733			4	5420	157.2	31.7
<b>World Total<sup>a</sup></b>	<b>441</b>	<b>382855</b>	<b>2</b>	<b>692</b>	<b>68</b>	<b>67442</b>	<b>2441.3</b>	<b>11.2</b>

<sup>a</sup> Including the following data from Taiwan, China:

- 6 units in operation with total capacity of 5052 MW(e); 2 units under construction with total capacity of 2600 MW(e);
- 35.1 TW·h of nuclear electricity generation, representing 16.3% of the total electricity generated.



**FIGURE 1. NUCLEAR SHARE OF TOTAL ELECTRICITY GENERATION IN 2015**

Note: The nuclear share of electricity generation in Taiwan, China, was 16.3%.

**TABLE 2. NUMBER OF COUNTRIES WITH NUCLEAR POWER REACTORS IN OPERATION OR UNDER CONSTRUCTION (end of 2015)**

Country Group	Number of Countries in Group	Countries with Nuclear Power Reactors			Total <sup>b</sup>
		In Operation	Long-term Shut Down	Under Construction <sup>a</sup>	
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
<b>World Total</b>	<b>225</b>	<b>30</b>	<b>2</b>	<b>15</b>	<b>32</b>

<sup>a</sup> May include countries having reactors already in operation.

<sup>b</sup> Total number of countries in each group that have nuclear power reactors in operation or under construction.



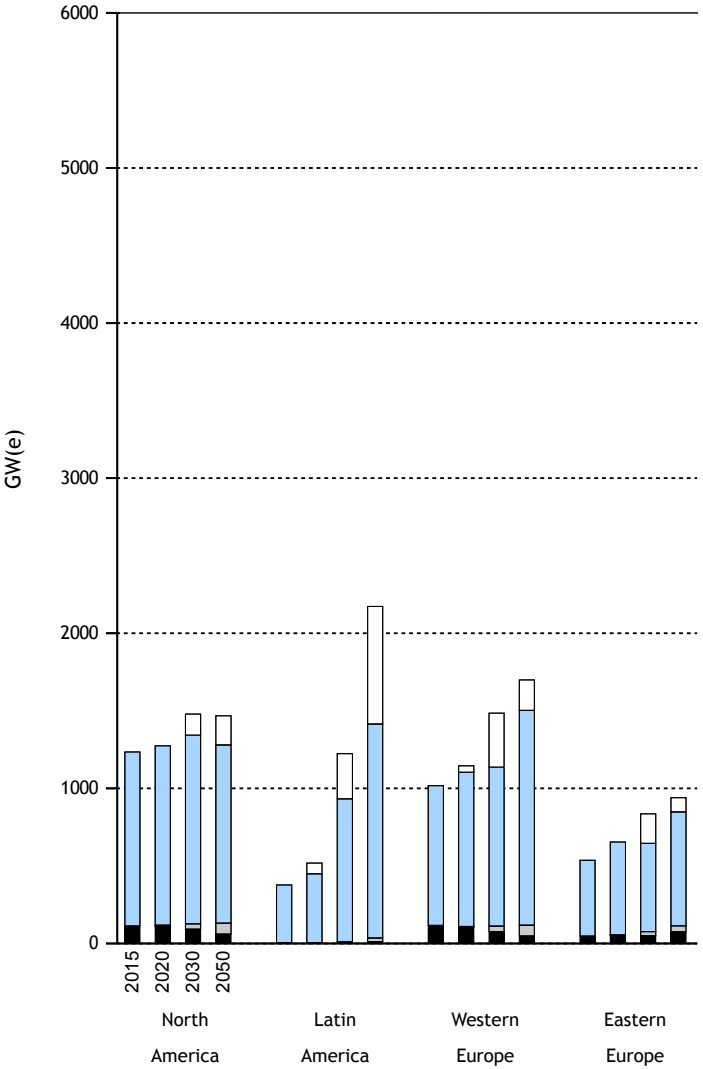


**TABLE 3. ESTIMATES OF TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY**

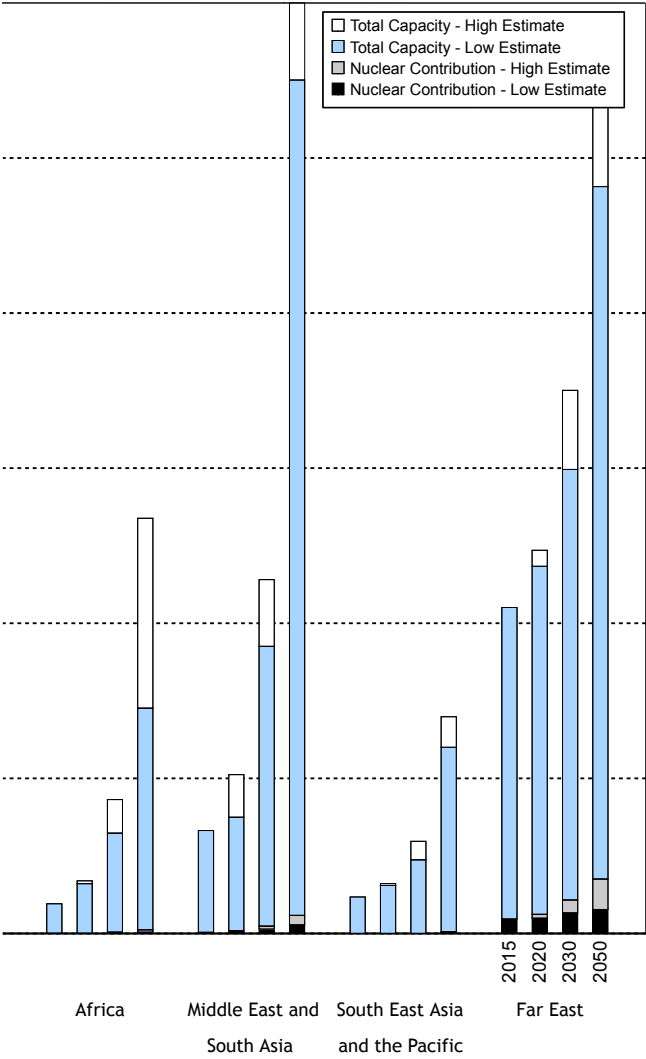
Country Group	2015			2020 <sup>a</sup>			2030 <sup>a</sup>			2050 <sup>a,b</sup>		
	Total Elect. GW(e)	Nuclear		Total Elect. GW(e)	Nuclear		Total Elect. GW(e)	Nuclear		Total Elect. GW(e)	Nuclear	
		GW(e)	%		GW(e)	%		GW(e)	%		GW(e)	%
North America	1234	112.7	9.1	1274	108.2	8.5	1342	92.5	6.9	1374	60	4.4
				1265	118.0	9.3	1479	126.0	8.5		130	9.5
Latin America	377	5.0	1.3	449	4.6	1.0	932	7.9	0.9	1794	11	0.6
				518	5.0	1.0	1223	12.5	1.0		35	2.0
Western Europe	1017	112.1	11.0	1103	101.0	9.2	1136	77.0	6.8	1601	48	3.0
				1145	109.5	9.6	1484	111.8	7.5		118	7.3
Eastern Europe	535	50.5	9.4	654	51.8	7.9	645	49.9	7.7	894	75	8.4
				635	55.2	8.7	835	75.7	9.1		113	12.7
Africa	191	1.9	1.0	321	1.9	0.6	647	2.9	0.4	2065	8	0.4
				339	1.9	0.5	863	8.9	1.0		23	1.1
Middle East and South Asia	663	6.9	1.0	749	12.0	1.6	1851	27.7	1.5	5898	55	0.9
				1023	17.7	1.7	2281	47.7	2.1		116	2.0
South East Asia and the Pacific	235	0.0	0.0	309	0.0		475	0.0	0.0	1299	5	0.4
				321	0.0		594	0.0	0.0		12	0.9
Far East	2101	93.8	4.5	2367	97.7	4.1	2992	132.2	4.4	5108	154	3.0
				2471	123.4	5.0	3501	215.5	6.2		351	6.9
World Total	6353	382.9	6.0	7226	377.1	5.2	10021	390.2	3.9	20031	417	2.1
	High Estimate			7717	430.5	5.6	12260	598.2	4.9		898	4.5

<sup>a</sup> Nuclear capacity estimates take into account the scheduled retirement of the older units at the end of their lifetime.

<sup>b</sup> Projected figures for total electric generating capacities are the arithmetic average between low and high estimates.



**FIGURE 2. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY**



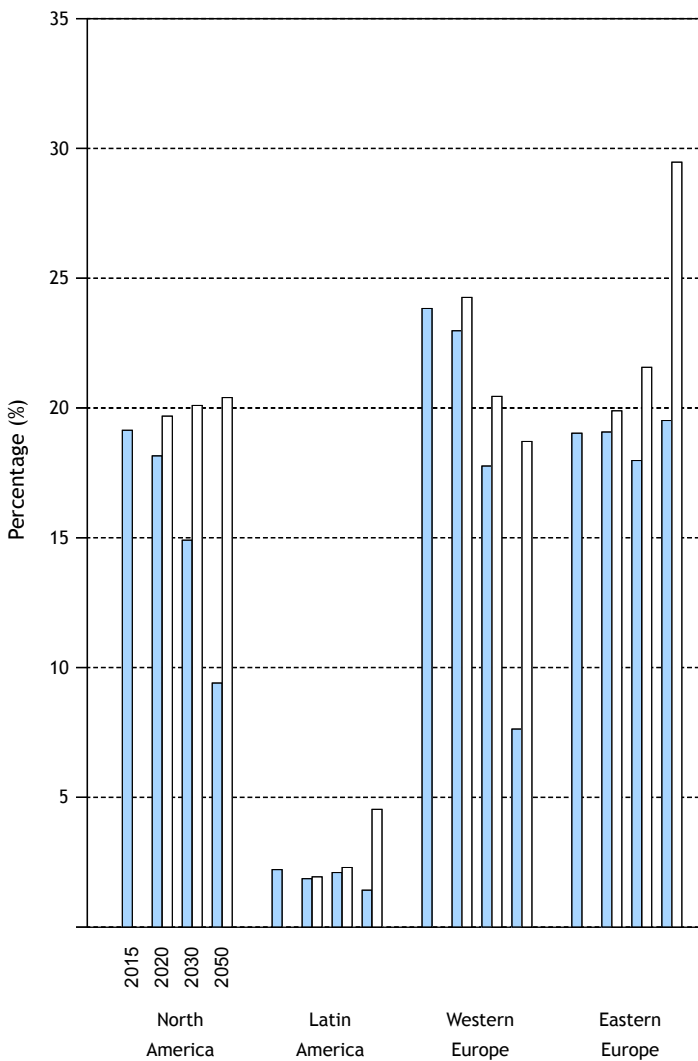


**TABLE 4. ESTIMATES OF TOTAL ELECTRICITY GENERATION AND CONTRIBUTION BY NUCLEAR POWER<sup>a</sup>**

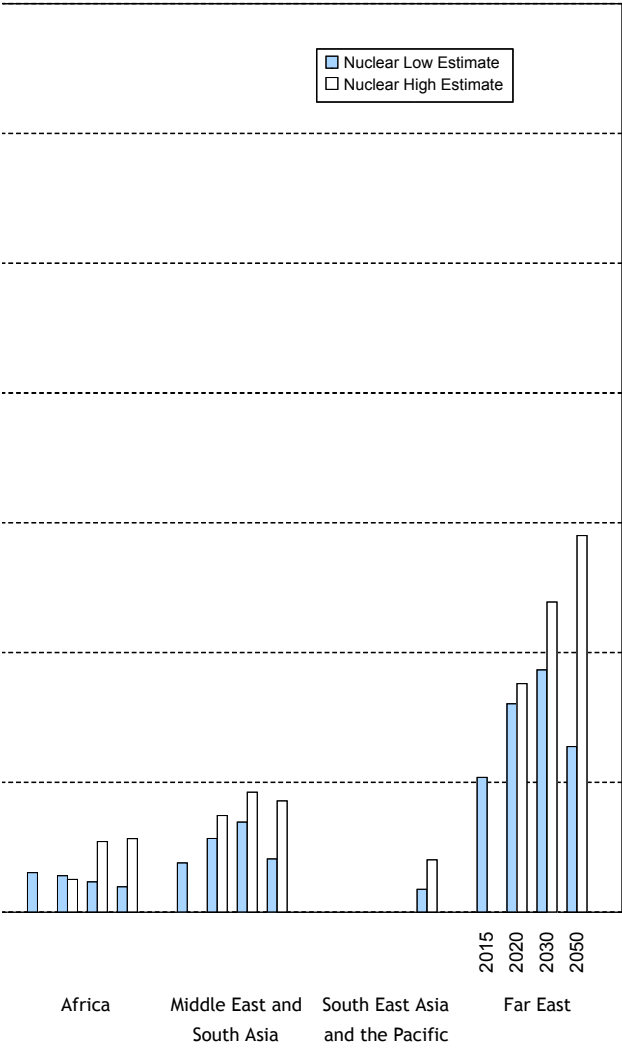
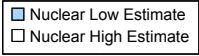
Country Group	2015				2020				2030				2050 <sup>b</sup>					
	Total Elect.		Nuclear		Total Elect.		Nuclear		Total Elect.		Nuclear		Total Elect.		Nuclear			
	TW-h	%	TW-h	%	TW-h	%	TW-h	%	TW-h	%	TW-h	%	TW-h	%	TW-h	%		
North America	4668	19.1	893.6	19.1	4698	18.2	853	18.2	4892	14.9	729	14.9	5144	484	9.4	1049	20.4	
Latin America	1427	2.2	31.6	2.2	1842	1.9	34	1.9	2977	2.1	63	2.1	6249	89	1.4	283	4.5	
Western Europe	3156	23.8	752.1	23.8	3272	23.0	752	23.0	3419	17.8	607	17.8	5064	386	7.6	947	18.7	
Eastern Europe	1855	19.0	353.0	19.0	2023	19.1	386	19.1	2188	18.0	393	18.0	3100	605	19.5	914	29.5	
Africa	720	1.5	11.0	1.5	990	1.4	14	1.4	1935	1.2	23	1.2	6603	64	1.0	187	2.8	
Middle East and South Asia	2225	1.9	42.2	1.9	2957	2.8	84	2.8	6307	3.5	219	3.5	21753	446	2.1	932	4.3	
South East Asia and the Pacific	907				1100				1665	0.0	0	0.0	4609	40	0.9	93	2.0	
Far East	6898	5.2	357.9	5.2	7916	8.0	635	8.0	10554	9.3	985	9.3	19515	1244	6.4	2831	14.5	
World Total	21856	11.2	2441.3	11.2	24798	11.1	2758	11.1	33937	8.9	3019	8.9	72037	3359	4.7	7236	10.0	
High Estimate					26386	11.8	3103	11.8	42159	10.8	4560	10.8						

<sup>a</sup> 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.

<sup>b</sup> Projected figures for total electricity generation are the arithmetic average between low and high estimates.



**FIGURE 3. PERCENTAGE OF ELECTRICITY SUPPLIED BY NUCLEAR POWER**







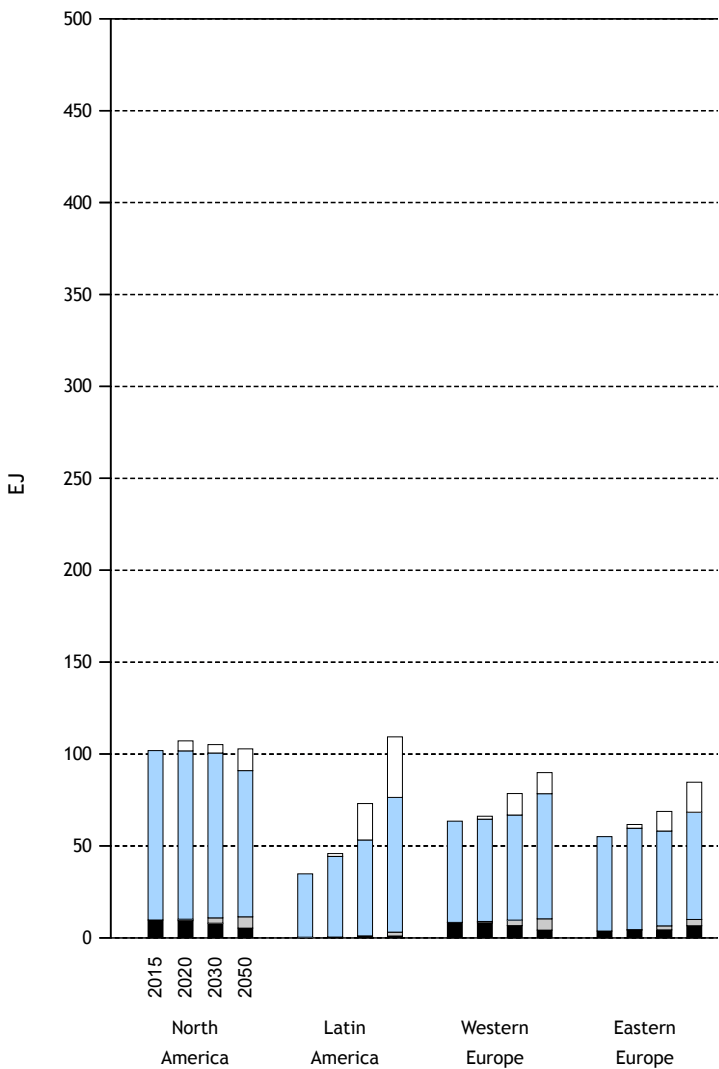
**TABLE 5. ESTIMATES OF TOTAL ENERGY REQUIREMENT (EJ), PERCENTAGE USED FOR ELECTRICITY GENERATION, AND PERCENTAGE SUPPLIED BY NUCLEAR ENERGY<sup>a</sup>**

Country Group	2015			2020			2030			2050 <sup>b</sup>		
	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	101.9	42.6	9.6	102	43	9.2	101	45	7.9	97	49	5.8
				107	41	9.5	105	44	10.3			11.1
Latin America	34.8	27.3	1.0	44	27	0.8	53	37	1.3	93	44	1.3
				46	27	0.9	73	39	1.5			2.8
Western Europe	63.4	39.8	13.3	65	41	12.7	67	40	9.9	84	46	5.4
				66	41	13.4	78	44	12.3			11.5
Eastern Europe	55.1	42.2	6.6	60	42	7.1	58	47	7.4	77	50	9.7
				62	42	7.3	69	50	9.5			11.8
Africa	30.3	23.4	0.4	34	29	0.4	52	37	0.5	173	38	0.6
				37	30	0.4	89	29	0.9			0.9
Middle East and South Asia	79.3	34.8	0.6	94	41	1.0	158	45	1.5	516	52	1.0
				106	41	1.3	201	47	2.0			1.8
South East Asia and the Pacific	27.5	33.3		31	37		37	46	0.0	102	47	0.5
				32	36		46	49	0.0			0.9
Far East	169.9	39.3	2.3	182	42	3.8	230	45	4.7	390	49	3.9
				194	44	4.3	283	45	6.0			7.1
World Total <sup>c</sup>	567.4	37.4	4.7	630	39	4.8	783	42	4.2	1592	46	2.6
Low Estimate				670	39	5.1	977	42	5.1			4.5
High Estimate												

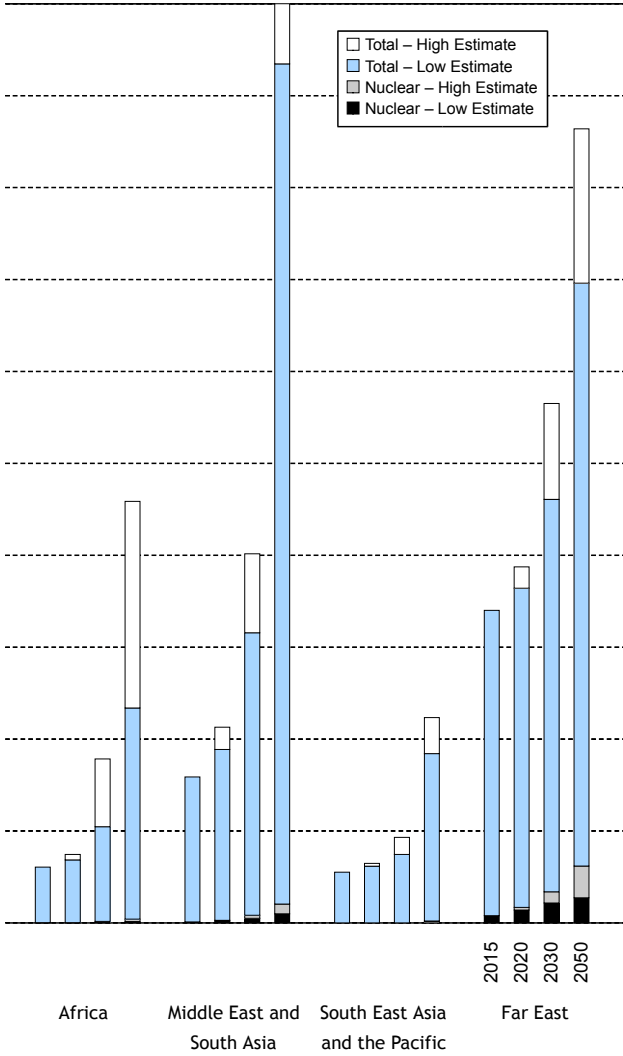
<sup>a</sup> Total energy requirement is estimated as production of primary energy plus net trade (import - export) minus international bunkers and stock changes.

<sup>b</sup> Projected figures for total energy requirement and percentage used for electricity generation are the arithmetic average between low and high estimates.

<sup>c</sup> World total energy requirement includes international bunkers.



**FIGURE 4. ESTIMATES OF TOTAL ENERGY REQUIREMENT**





**TABLE 6. TOTAL ENERGY REQUIREMENT (EJ) BY TYPE OF FUEL IN 2015<sup>a</sup>**

Country Group	Coal <sup>b</sup>	Oil <sup>c</sup>	Natural Gas <sup>d</sup>	Biofuels <sup>e</sup>	Hydro	Nuclear	Renewables <sup>f</sup>	Total
North America	16.76	36.61	30.56	4.54	2.26	9.75	1.40	101.88
Latin America	1.86	15.40	8.79	5.28	2.44	0.34	0.69	34.80
Western Europe	8.76	21.03	15.01	5.84	2.01	8.20	2.39	63.24
Eastern Europe	12.42	12.73	23.24	1.85	1.11	3.85	0.07	55.27
Africa	5.20	6.81	4.26	13.36	0.44	0.12	0.13	30.32
Middle East and South Asia	20.16	25.38	21.20	11.11	0.75	0.46	0.29	79.35
South East Asia and the Pacific	5.11	10.02	6.21	4.73	0.30		1.16	27.53
Far East	93.72	37.75	13.83	13.07	4.72	3.90	2.94	169.93
<b>World Total<sup>g</sup></b>	<b>163.99</b>	<b>179.54</b>	<b>123.10</b>	<b>59.78</b>	<b>14.03</b>	<b>26.62</b>	<b>9.07</b>	<b>576.13</b>

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

<sup>b</sup>The column headed 'Coal' includes coal, coal products, peat and peat products.

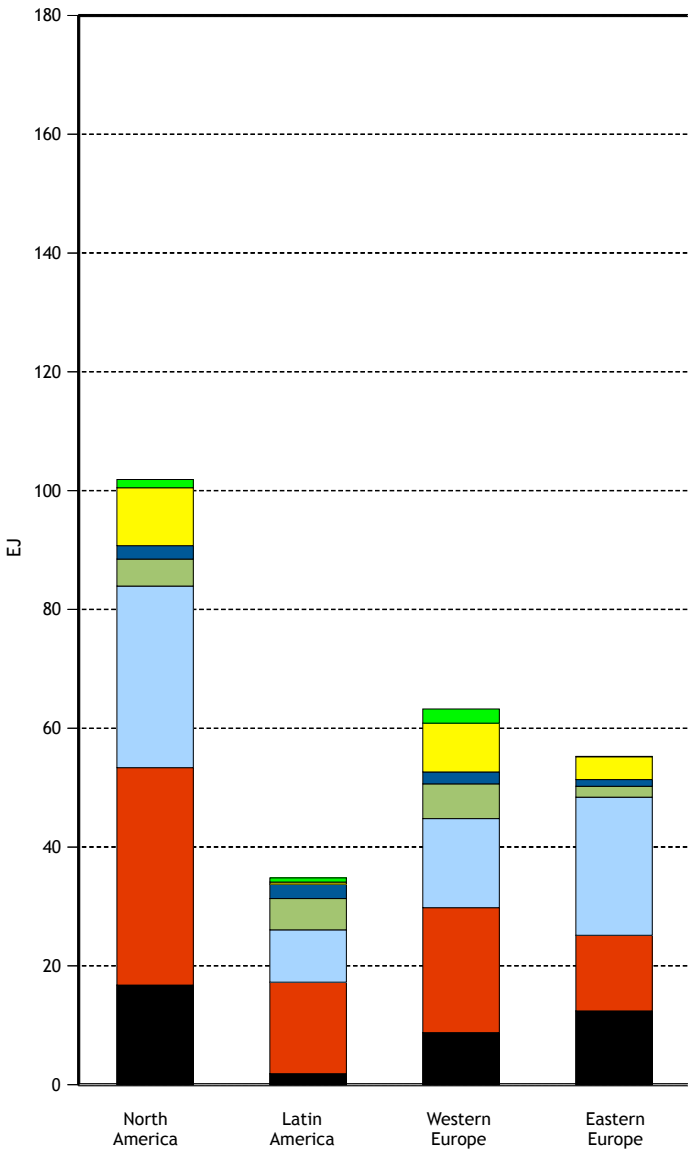
<sup>c</sup>The column headed 'Oil' includes crude oil, natural gas liquids (NGL), oil products, oil shale and oil sands.

<sup>d</sup>The column headed 'Natural Gas' includes natural gas in all its form including liquid natural gas (LNG).

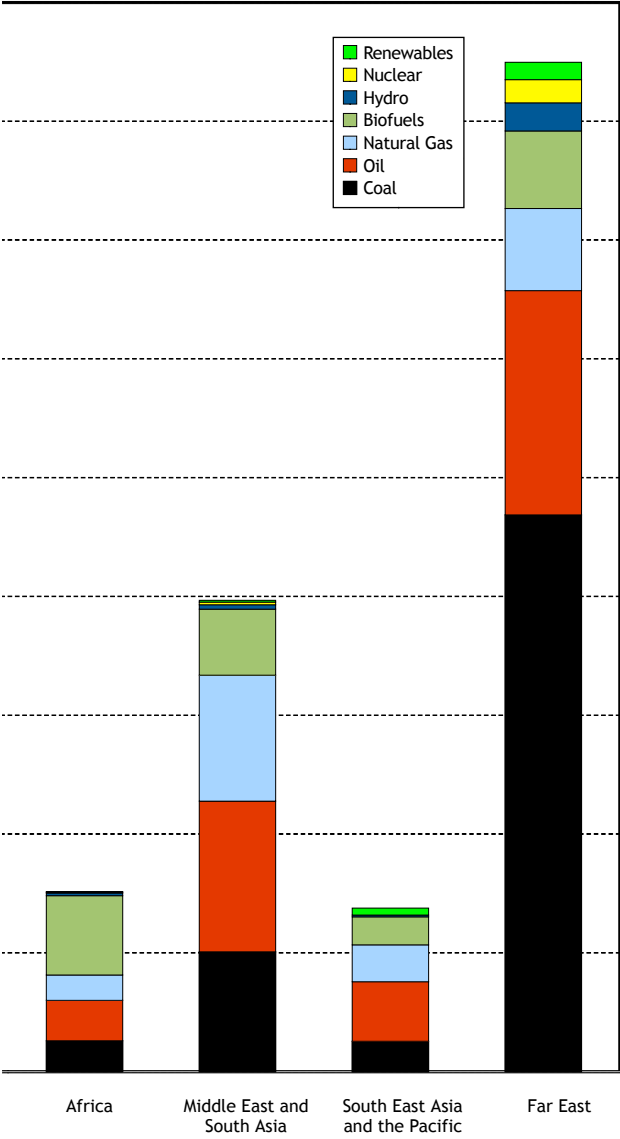
<sup>e</sup>The column headed 'Biofuels' includes commercial wood, charcoal, combustible renewables, waste and other energy products derived directly or indirectly from biomass.

<sup>f</sup>The column headed 'Renewables' includes geothermal, wind, solar, tide energy and net electricity trade.

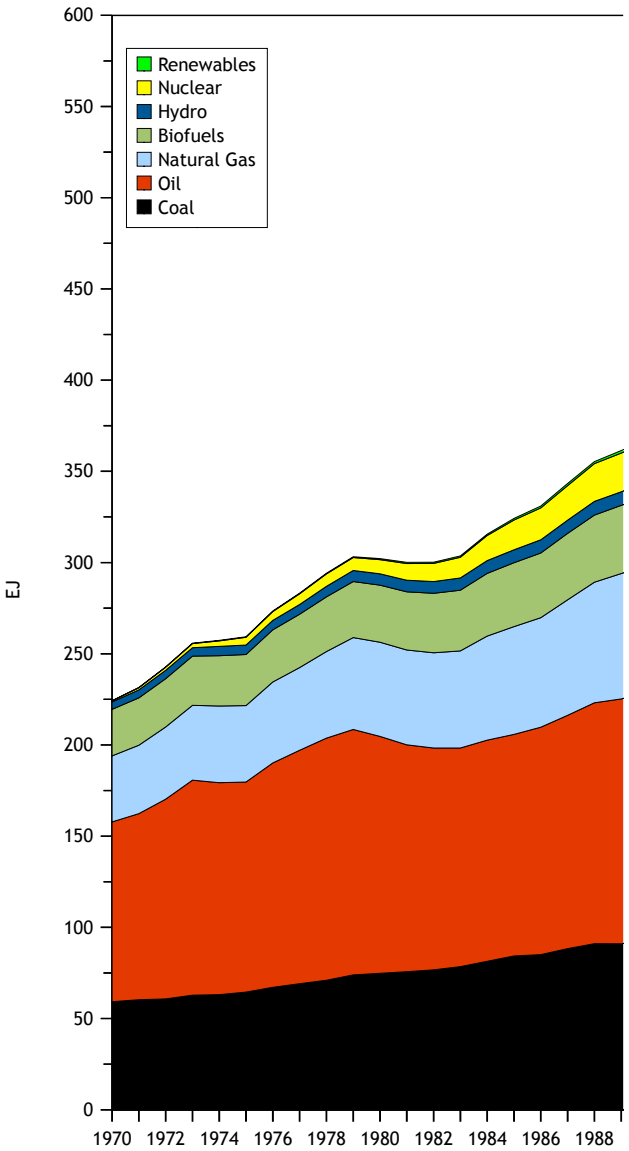
<sup>g</sup>World total energy requirement includes international bunkers.



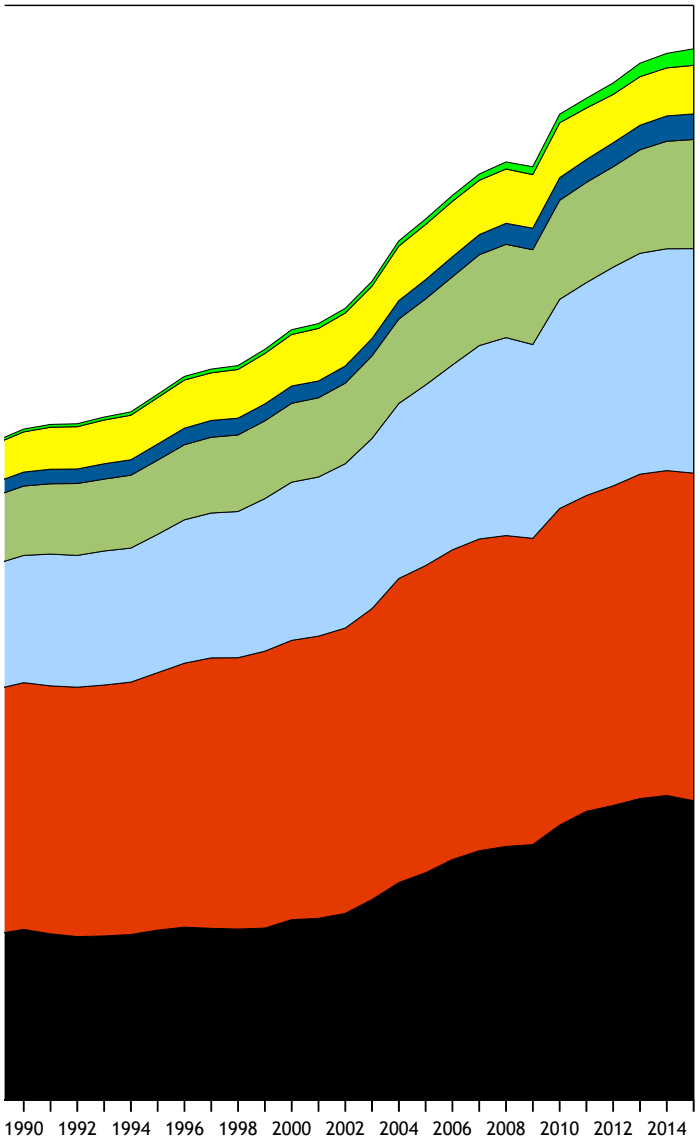
**FIGURE 5. TOTAL ENERGY REQUIREMENT BY TYPE OF FUEL IN 2015**







**FIGURE 6. BREAKDOWN OF WORLD TOTAL ENERGY REQUIREMENT DURING THE PERIOD 1970–2015**



Year



**TABLE 7. FUEL SHARES (%) OF ENERGY REQUIREMENT IN 2015<sup>a</sup>**

Country Group	Coal <sup>b</sup>	Oil <sup>c</sup>	Natural Gas <sup>d</sup>	Biofuels <sup>e</sup>	Hydro	Nuclear	Renewables <sup>f</sup>	Total
North America	16.5	35.9	30.0	4.5	2.2	9.6	1.4	100.0
Latin America	5.3	44.3	25.3	15.2	7.0	1.0	2.0	100.0
Western Europe	13.9	33.3	23.7	9.2	3.2	13.0	3.8	100.0
Eastern Europe	22.5	23.0	42.0	3.3	2.0	7.0	0.1	100.0
Africa	17.2	22.5	14.1	44.1	1.5	0.4	0.4	100.0
Middle East and South Asia	25.4	32.0	26.7	14.0	0.9	0.6	0.4	100.0
South East Asia and the Pacific	18.6	36.4	22.6	17.2	1.1		4.2	100.0
Far East	55.2	22.2	8.1	7.7	2.8	2.3	1.7	100.0
<b>World Total<sup>g</sup></b>	<b>28.5</b>	<b>31.2</b>	<b>21.4</b>	<b>10.4</b>	<b>2.4</b>	<b>4.6</b>	<b>1.6</b>	<b>100.0</b>

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

<sup>b</sup> The column headed 'Coal' includes coal, coal products, peat and peat products.

<sup>c</sup> The column headed 'Oil' includes crude oil, natural gas liquids (NGL), oil products, oil shale and oil sands.

<sup>d</sup> The column headed 'Natural Gas' includes natural gas in all its form including liquid natural gas (LNG).

<sup>e</sup> The column headed 'Biofuels' includes commercial wood, charcoal, combustible renewables, waste and other energy products derived directly or indirectly from biomass.

<sup>f</sup> The column headed 'Renewables' includes geothermal, wind, solar, tide energy and net electricity trade.

<sup>g</sup> World total energy requirement includes international bunkers.

TABLE 8. FUEL USE (EJ) FOR ELECTRICITY GENERATION BY TYPE OF FUEL IN 2015

Country Group	Thermal <sup>a</sup>	Hydro	Nuclear	Renewables <sup>b</sup>	Total
North America	27.76	2.26	9.75	1.29	41.06
Latin America	6.86	2.44	0.34	0.62	10.26
Western Europe	14.95	2.01	8.20	2.15	27.31
Eastern Europe	22.39	1.11	3.85	0.06	27.41
Africa	5.60	0.44	0.12	0.11	6.27
Middle East and South Asia	27.41	0.75	0.46	0.26	28.88
South East Asia and the Pacific	10.80	0.30		1.10	12.20
Far East	51.89	4.72	3.90	2.71	63.22
World Total	167.66	14.03	26.62	8.30	216.61

<sup>a</sup> The column headed 'Thermal' is the total for solids, liquids, gases, biomass and waste.

<sup>b</sup> The column headed 'Renewables' includes geothermal, wind, solar and tide energy.

**TABLE 9. PERCENTAGE CONTRIBUTION OF EACH FUEL TYPE TO ELECTRICITY GENERATION IN 2015**

Country Group	Thermal <sup>a</sup>	Hydro	Nuclear	Renewables <sup>b</sup>	Total
North America	64.1	13.4	19.1	3.4	100.0
Latin America	48.9	47.5	2.2	1.4	100.0
Western Europe	46.6	17.7	23.8	11.8	100.0
Eastern Europe	63.9	16.7	19.0	0.4	100.0
Africa	80.6	16.9	1.5	1.0	100.0
Middle East and South Asia	86.1	9.4	1.9	2.6	100.0
South East Asia and the Pacific	85.5	9.1		5.4	100.0
Far East	71.8	19.0	5.2	4.0	100.0
World Total	66.7	17.8	11.2	4.3	100.0

<sup>a</sup> The column headed 'Thermal' is the total for solids, liquids, gases, biomass and waste.

<sup>b</sup> The column headed 'Renewables' includes geothermal, wind, solar and tide energy.

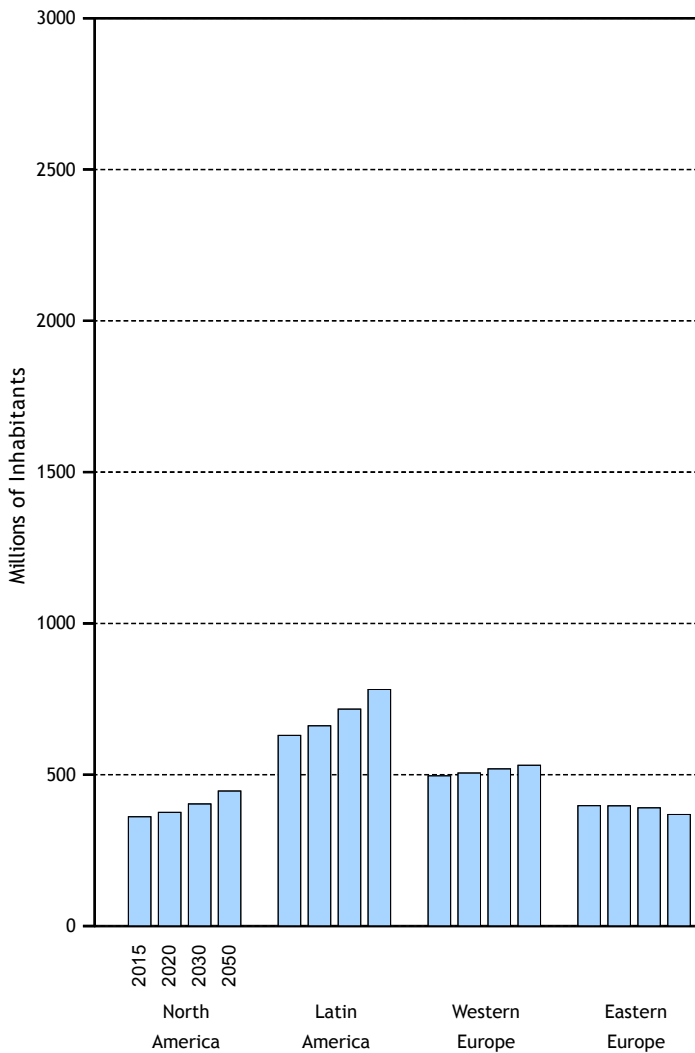


**TABLE 10. ESTIMATES OF POPULATION GROWTH BY REGION<sup>a</sup>**

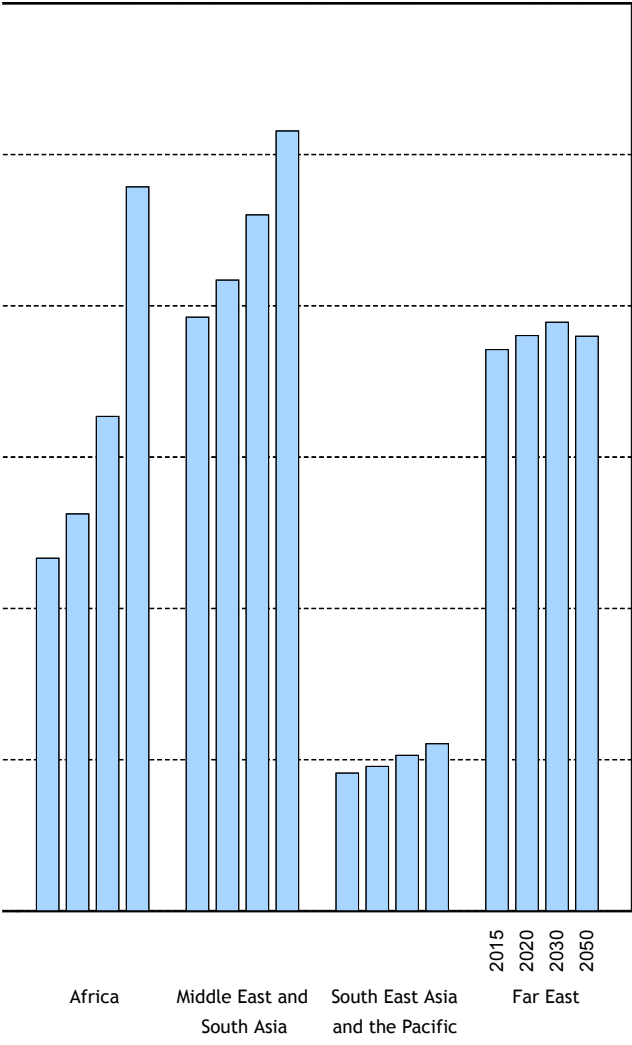
Country Group	2015		2020		2030		2050	
	Million Inhabitants	Growth Rate (%/a) 2000 – 2015	Million Inhabitants	Growth Rate (%/a) 2015 – 2020	Million Inhabitants	Growth Rate (%/a) 2020 – 2030	Million Inhabitants	Growth Rate (%/a) 2030 – 2050
North America	361	0.96	376	0.80	403	0.71	446	0.51
Latin America	630	1.32	662	0.98	717	0.80	782	0.43
Western Europe	496	0.53	506	0.36	519	0.27	531	0.12
Eastern Europe	397	-0.19	397	-0.01	390	-0.17	369	-0.28
Africa	1166	2.67	1312	2.39	1634	2.22	2393	1.93
Middle East and South Asia	1962	1.75	2085	1.22	2301	0.99	2578	0.57
South East Asia and the Pacific	456	1.22	478	0.94	514	0.74	553	0.36
Far East	1855	0.74	1902	0.49	1946	0.23	1899	-0.12
<b>World Total</b>	<b>7325</b>	<b>1.30</b>	<b>7717</b>	<b>1.05</b>	<b>8425</b>	<b>0.88</b>	<b>9551</b>	<b>0.63</b>

<sup>a</sup> Projected figures are the arithmetic average of the low and high estimates.





**FIGURE 7. POPULATION ESTIMATES**

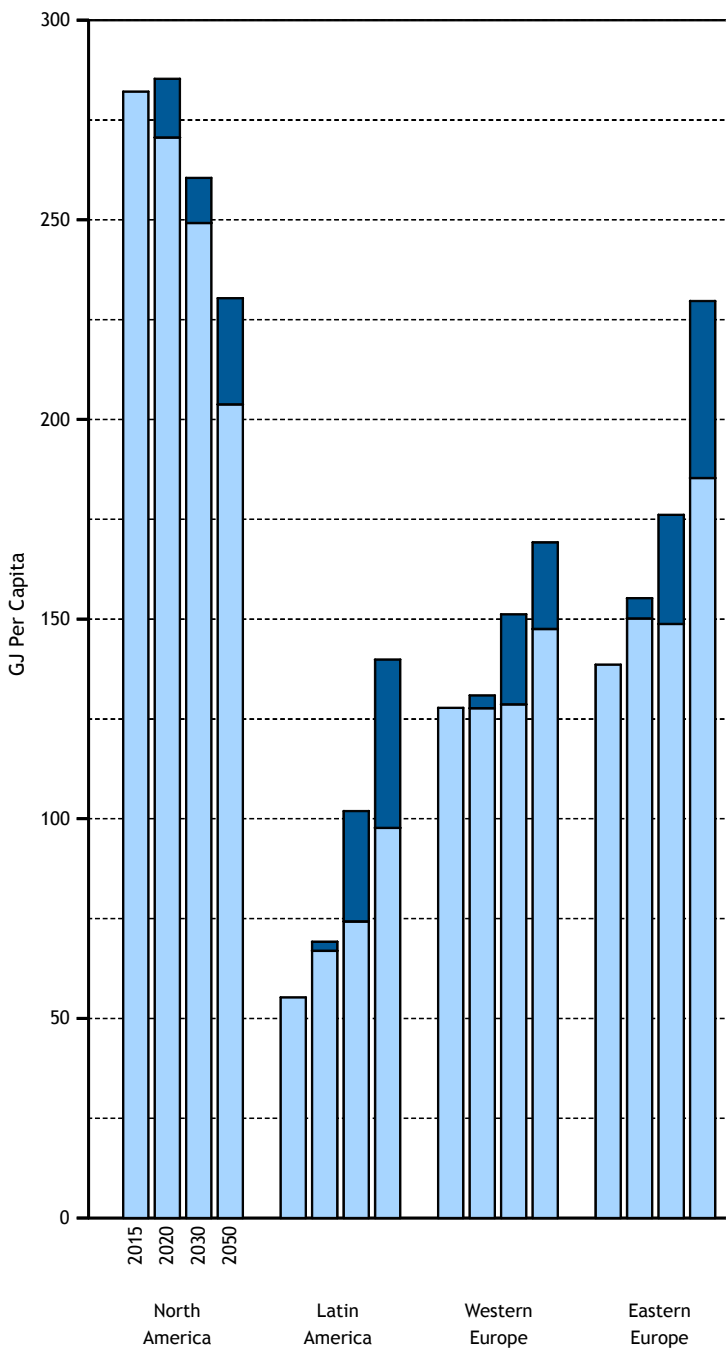




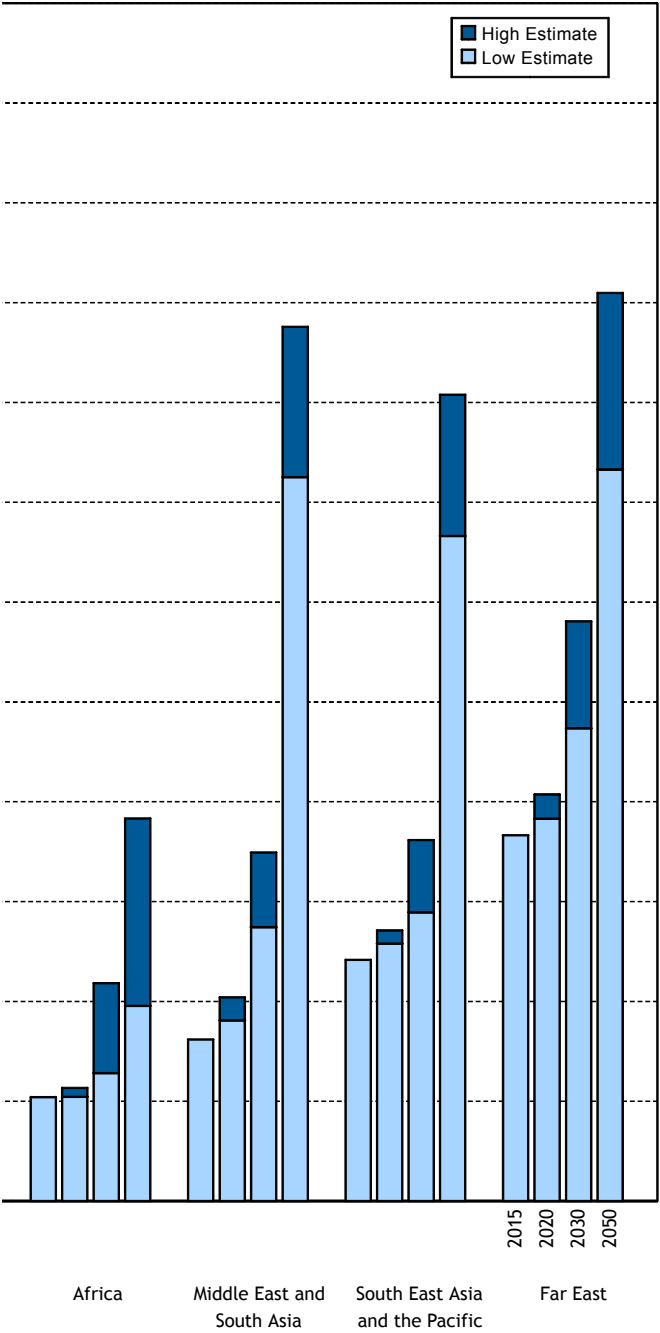
**TABLE 11. ESTIMATES OF TOTAL ENERGY AND ELECTRICITY REQUIREMENT PER CAPITA**

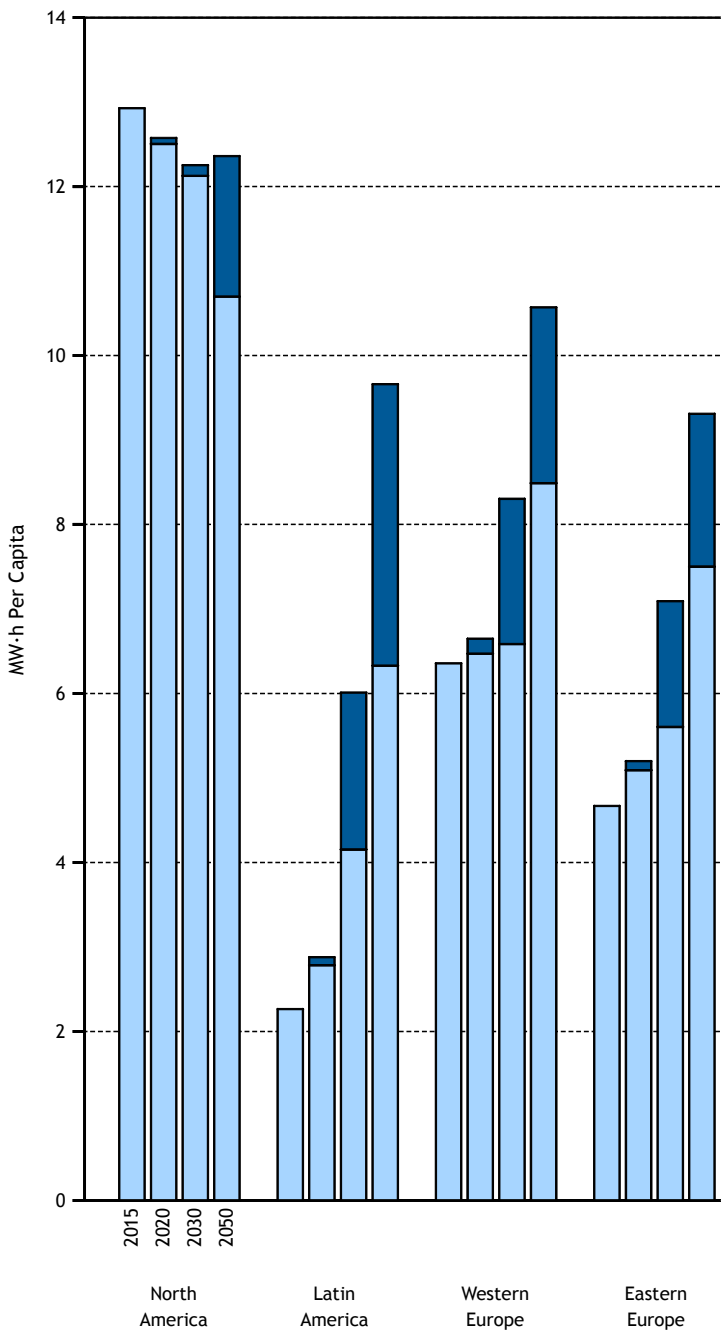
Country Group	2015		2020		2030		2050 <sup>a</sup>	
	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW-h/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW-h/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW-h/cap)	Energy Requirement per Capita (GJ/cap)	Electricity Requirement per Capita (MW-h/cap)
North America	282	12.9	271 – 285	12.5 – 12.6	249 – 260	12.1 – 12.3	217 ± 13	11.5 ± 0.8
Latin America	55	2.3	67 – 69	2.8 – 2.9	74 – 102	4.2 – 6.0	119 ± 21	8.0 ± 1.7
Western Europe	128	6.4	128 – 131	6.5 – 6.6	129 – 151	6.6 – 8.3	158 ± 11	9.5 ± 1.0
Eastern Europe	139	4.7	150 – 155	5.1 – 5.2	149 – 176	5.6 – 7.1	207 ± 22	8.4 ± 0.9
Africa	26	0.6	26 – 28	0.8 – 0.8	32 – 55	1.2 – 1.6	72 ± 23	2.8 ± 0.9
Middle East and South Asia	40	1.1	45 – 51	1.4 – 1.6	69 – 87	2.7 – 3.5	200 ± 19	8.4 ± 0.9
South East Asia and the Pacific	60	2.0	64 – 68	2.3 – 2.4	72 – 90	3.2 – 4.3	184 ± 18	8.3 ± 0.8
Far East	92	3.7	96 – 102	4.2 – 4.6	118 – 145	5.4 – 6.6	205 ± 22	10.3 ± 0.8
World Average	77	3.0	79 – 84	3.2 – 3.4	90 – 112	4.0 – 5.0	160 ± 20	7.5 ± 1.0

<sup>a</sup> Projected figures are the arithmetic average between low and high estimates with indicated range.

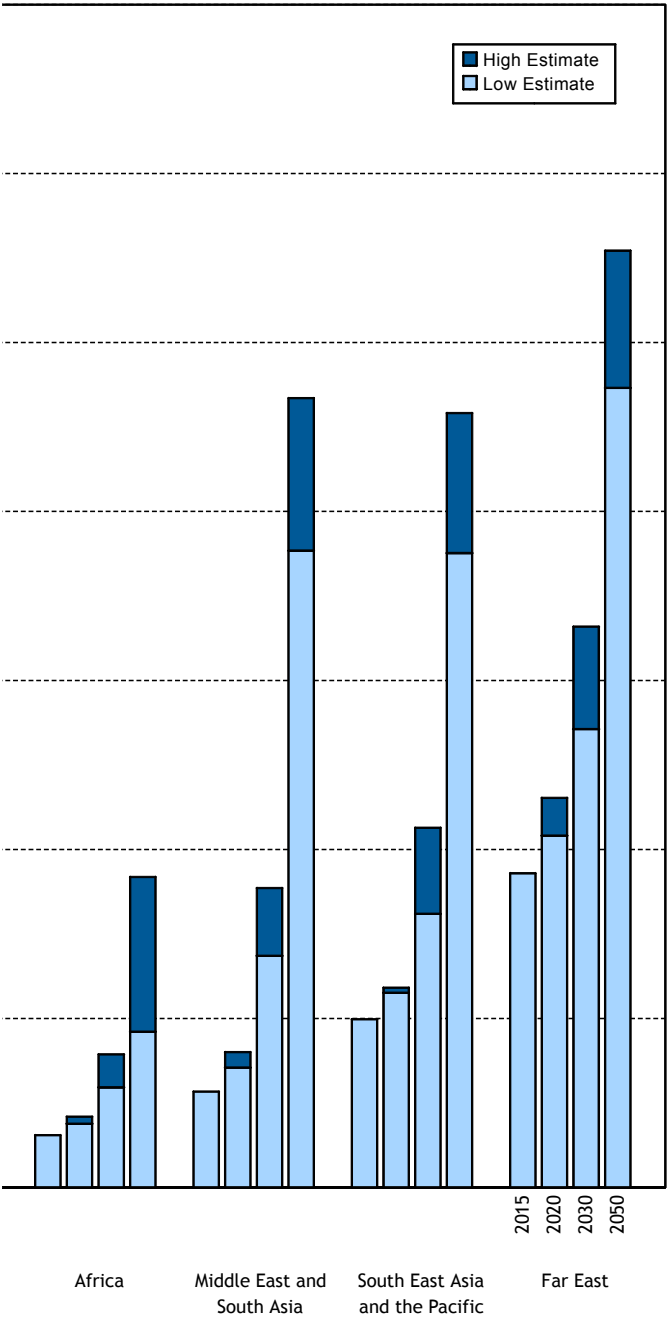


**FIGURE 8. TOTAL ENERGY REQUIREMENT PER CAPITA**





**FIGURE 9. TOTAL ELECTRICITY REQUIREMENT PER CAPITA**

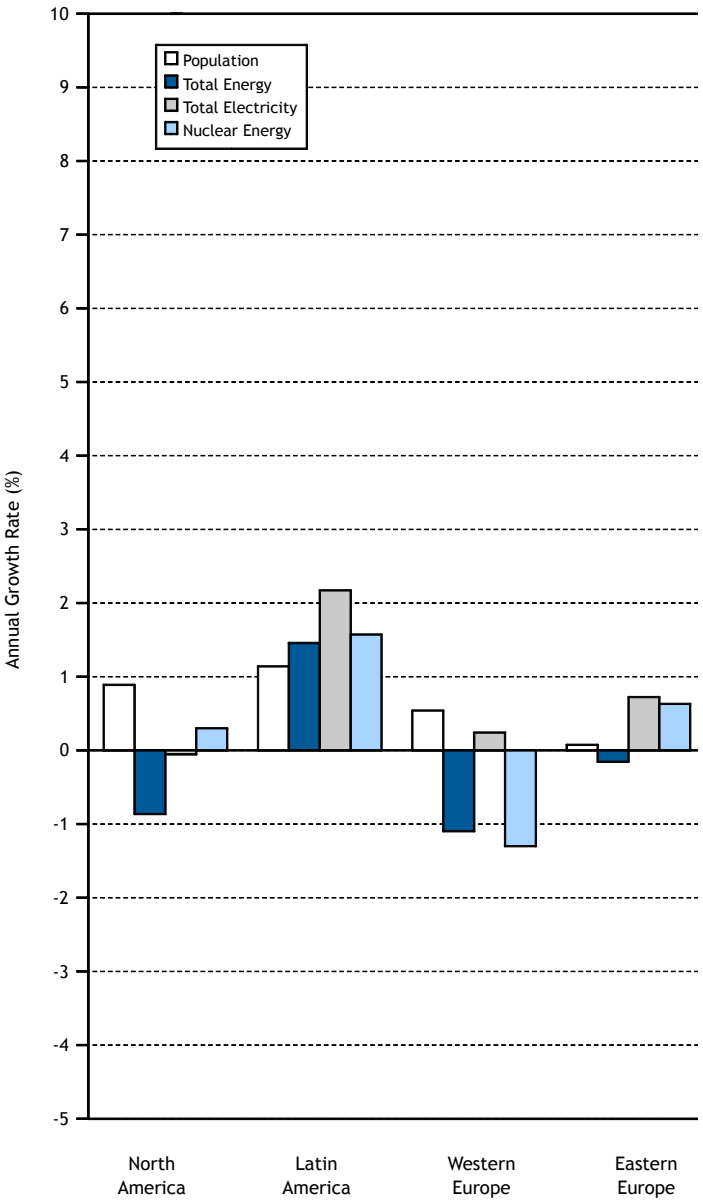




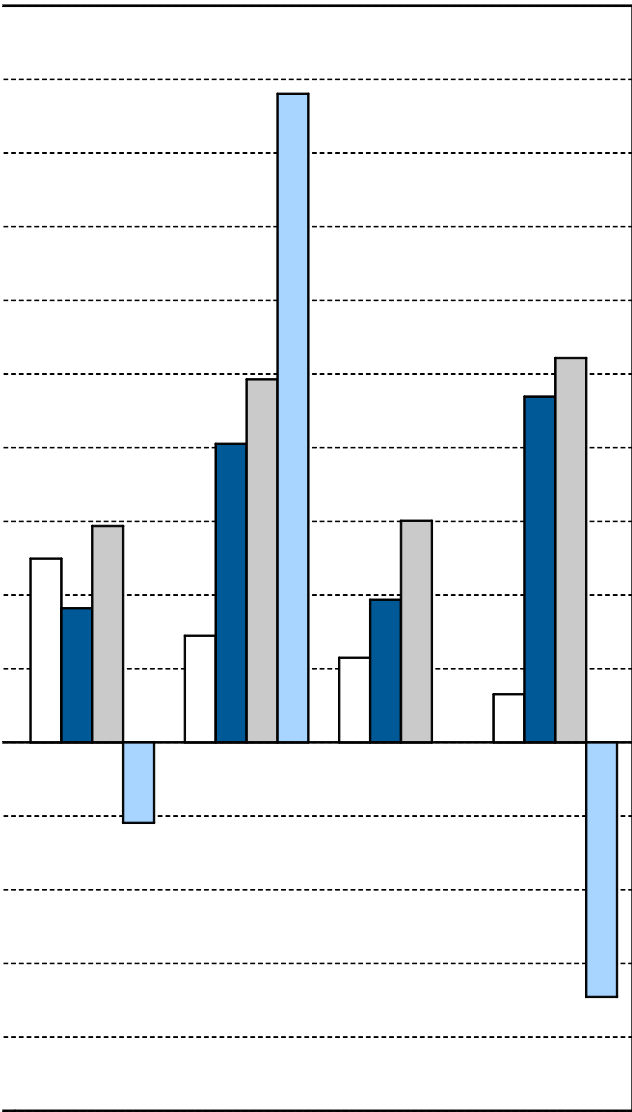


**TABLE 12. AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2005–2015 (%)**

Country Group	Population	Total Energy	Total Electricity	Nuclear Energy	Nuclear Capacity
North America	0.9	-0.9	-0.1	0.3	0.1
Latin America	1.1	1.5	2.2	1.6	1.8
Western Europe	0.5	-1.1	0.2	-1.3	-0.7
Eastern Europe	0.1	-0.2	0.7	0.6	-0.1
Africa	2.5	1.8	2.9	-1.1	0.0
Middle East and South Asia	1.4	4.1	4.9	8.8	7.2
South East Asia and the Pacific	1.1	1.9	3.0		
Far East	0.7	4.7	5.2	-3.5	2.0
World Average	1.2	1.8	2.3	-0.7	0.4



**FIGURE 10. AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2005–2015 (%)**



Africa

Middle East and South Asia

South East Asia and the Pacific

Far East



**TABLE 13. ESTIMATES OF AVERAGE ANNUAL GROWTH RATES DURING THE PERIOD 2015–2030 (%)**

Country Group	Population	Total Energy	Total Electricity	Nuclear Energy	Nuclear Capacity
North America	0.7	-0.1 – 0.2	0.3 – 0.4	-1.3 – 0.7	-1.3 – 0.7
Latin America	0.9	2.9 – 5.1	5.0 – 7.6	4.7 – 7.9	3.2 – 6.4
Western Europe	0.3	0.3 – 1.4	0.5 – 2.1	-1.6 – 0.9	-2.7 – -0.3
Eastern Europe	-0.1	0.4 – 1.5	1.1 – 2.7	1.1 – 3.9	0.3 – 3.2
Africa	2.3	3.7 – 7.5	6.8 – 8.9	4.9 – 13.1	2.9 – 11.0
Middle East and South Asia	1.1	4.7 – 6.4	7.2 – 9.0	11.6 – 15.7	9.7 – 13.7
South East Asia and the Pacific	0.8	2.0 – 3.6	4.1 – 6.1		
Far East	0.3	2.0 – 3.4	2.9 – 4.3	7.0 – 10.2	2.4 – 5.8
World Average	0.9	2.0 – 3.5	3.0 – 4.5	1.4 – 4.3	0.1 – 3.0





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