REFERENCE DATA SERIES No. 1
2018 Edition

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

IAEA
International Atomic Energy Agency

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-eighth edition — containing estimates of energy, electricity and nuclear power trends up to the year 2050.

RDS-1 starts with a summary of the status of nuclear power in IAEA Member States as of the end of 2017 based on statistical data collected by the IAEA's Power Reactor Information System (PRIS). It then presents estimates of energy and electricity up to 2050 derived from various international studies, including the International Energy Agency's World Energy Outlook 2017 and the United States Energy Information Administration's International Energy Outlook 2017. The energy and electricity data for 2017 are estimated, as the latest information available from the United Nations Department of Economic and Social Affairs is for 2015. Population data originate from World Population Prospects (2015 revision), published by the Population Division of the United Nations Department of Economic and Social Affairs. The 2017 values again are estimates.

As in previous editions of RDS-1, projections of nuclear power are presented as low and high estimates encompassing the uncertainties inherent in projecting trends. The projections are based on a critical review of (i) the global and regional energy, electricity and nuclear power projections made by other international organizations, (ii) national projections supplied by individual countries for a recent OECD Nuclear Energy Agency study and (iii) the estimates of the expert group participating in the IAEA's yearly consultancy on nuclear capacity projections.

The estimates of future nuclear electrical generating capacity presented in Table 5 are derived using a country by country 'bottom up' approach. In deriving these estimates, a group of experts considers all the operating reactors, possible licence renewals, planned shutdowns and plausible construction projects foreseen for the next several decades. The experts build the projections project by project by assessing the plausibility of

each in light of, first, the assumptions of the low projections and, second, the assumptions of the high projections.

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 laws, policies and regulations directly affecting nuclear power. This case was explicitly designed to produce a 'conservative' set of projections. Additionally, the low case does not assume that targets for nuclear power 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 consumption growth will continue, particularly in the Eastern Asia region. Country policies toward climate change are also considered in the high case.

Over the short term, the low price of natural gas and the impact of subsidized intermittent renewable energy sources on electricity prices are expected to continue to affect nuclear growth prospects in some regions of the world. Moreover, natural gas has become more competitive owing to low prices and increased supply as a result of technological advances in gas extraction. In the near term, ongoing financial uncertainty and declining electricity consumption in some regions will continue to present challenges for capital intensive projects such as nuclear power. Heightened safety requirements, challenges in deploying advanced technologies and other factors have increased construction times and costs, contributing to delays. The expert group assumed that these challenges, in addition to the accident at the Fukushima Daiichi nuclear power plant, will

continue to affect nuclear development plans. The underlying fundamentals of population growth and electricity consumption in the developing world, as well as climate change and air quality concerns, security of energy supply and price volatility of other fuels, continue to point to nuclear generating capacity playing an important role in the energy mix in the longer run.

Compared with the 2017 projections to 2030, the 2018 projections were reduced by 45 gigawatt (electrical) (GW(e))[1] in the high case and were increased by 6 GW(e) in the low case. These reductions reflect responses to the Fukushima Daiichi accident and other factors noted above. There are increasing uncertainties in these projections owing to the considerable number of reactors scheduled to be retired in some regions around 2030 and beyond. Significant new nuclear capacity would be necessary to offset any retirements resulting from factors such as ageing fleets and economic difficulties.

With respect to projections from 2030 to 2050, assumptions are made about the general rate of development and retirements. Given all the uncertainties, 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 may also have an impact on nuclear energy development in the future.

[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).

Geographical Regions

The nuclear electrical generating capacity projections presented in RDS-1 are grouped according to the geographical regions used by the Statistics Division of the United Nations Secretariat, available on-line at unstats.un.org/unsd/methodology/m49/.

The designations employed and the presentation of material in this publication 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.

Notes

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 from hydropower or from 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).

Total final energy consumption refers to all fuel and energy delivered to users for their energy use and does not include non-energy use (i.e. deliveries of energy products for use as chemical feedstocks or as raw materials).

Owing 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

World

Nuclear Power Development around the World in 2017

- There were 448 operational nuclear power reactors in the world at the end of 2017, with a total net installed power capacity of 392 GW(e).
- An additional 59 units with a total capacity of 60 GW(e) were under construction.
- During 2017, four new nuclear power reactors with a total capacity of 3373 MW(e) were connected to the grid, and five reactors with a total capacity of 3025 MW(e) were retired. In 2017, construction began on four new units that are expected to add a total capacity of 4254 MW(e).
- Electricity generation from operational nuclear reactors increased about 1% in 2017, reaching 2503 TW·h.
- Nuclear power accounted for about 10% of total electricity production in 2017.

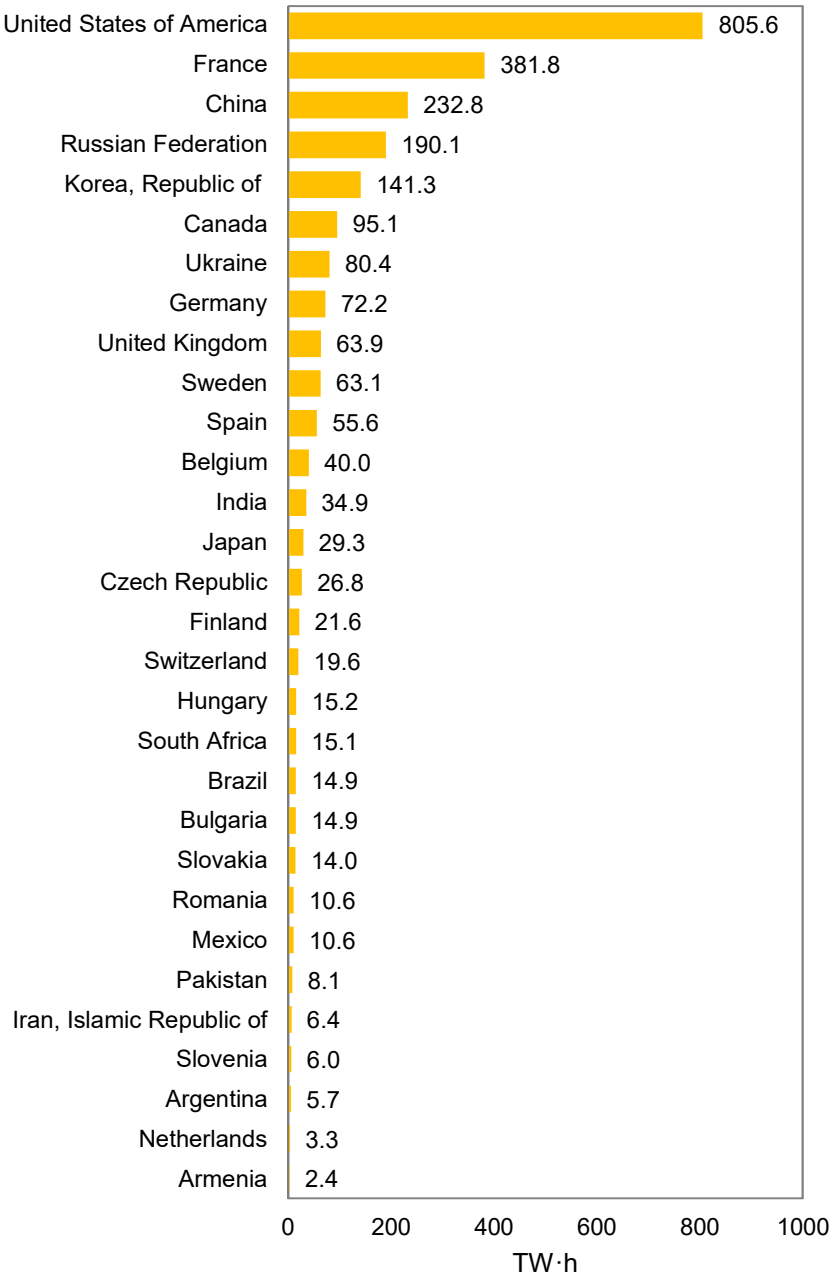
TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2017)

Country	Operational		Under Construction		Nuclear Electricity Production in 2017	
	Number of Units	Net Capacity (MW(e))	Number of Units	Net Capacity (MW(e))	TW·h	Per cent of Total
Argentina	3	1 633	1	25	5.7	4.0
Armenia	1	375			2.4	36.6
Bangladesh			1	1 080		
Belarus			2	2 220		
Belgium	7	5 918			40.0	47.7
Brazil	2	1 884	1	1 340	14.9	2.6
Bulgaria	2	1 926			14.9	40.0
Canada	19	13 554			95.1	13.8
China	39	34 514	18	19 016	232.8	3.8
Czech Republic	6	3 930			26.8	33.5
Finland	4	2 769	1	1 600	21.6	32.6
France	58	63 130	1	1 630	381.8	72.3
Germany	7	9 515			72.2	11.7
Hungary	4	1 889			15.2	49.1
India	22	6 255	7	4 824	34.9	2.4
Iran, Islamic Republic of	1	915			6.4	2.1

Japan	42	39 752	2	2 653	29.3	2.7
Korea, Republic of	24	22 494	4	5 360	141.3	25.5
Mexico	2	1 552			10.6	3.5
Netherlands	1	482			3.3	3.0
Pakistan	5	1 318	2	2 028	8.1	6.8
Romania	2	1 300			10.6	17.9
Russian Federation	35	26 142	7	5 520	190.1	18.5
Slovakia	4	1 814	2	880	14.0	60.1
Slovenia	1	688			6.0	35.5
South Africa	2	1 860			15.1	6.3
Spain	7	7 121			55.6	21.0
Sweden	8	8 629			63.1	39.5
Switzerland	5	3 333			19.6	35.1
Ukraine	15	13 107	2	2 070	80.4	55.3
United Arab Emirates			4	5 380		
United Kingdom	15	8 918			63.9	20.0
United States of America	99	99 952	2	2 234	805.6	19.9
World Total[a]	**448**	**391 721**	**59**	**60 460**	**2 502.9**	**10.3**

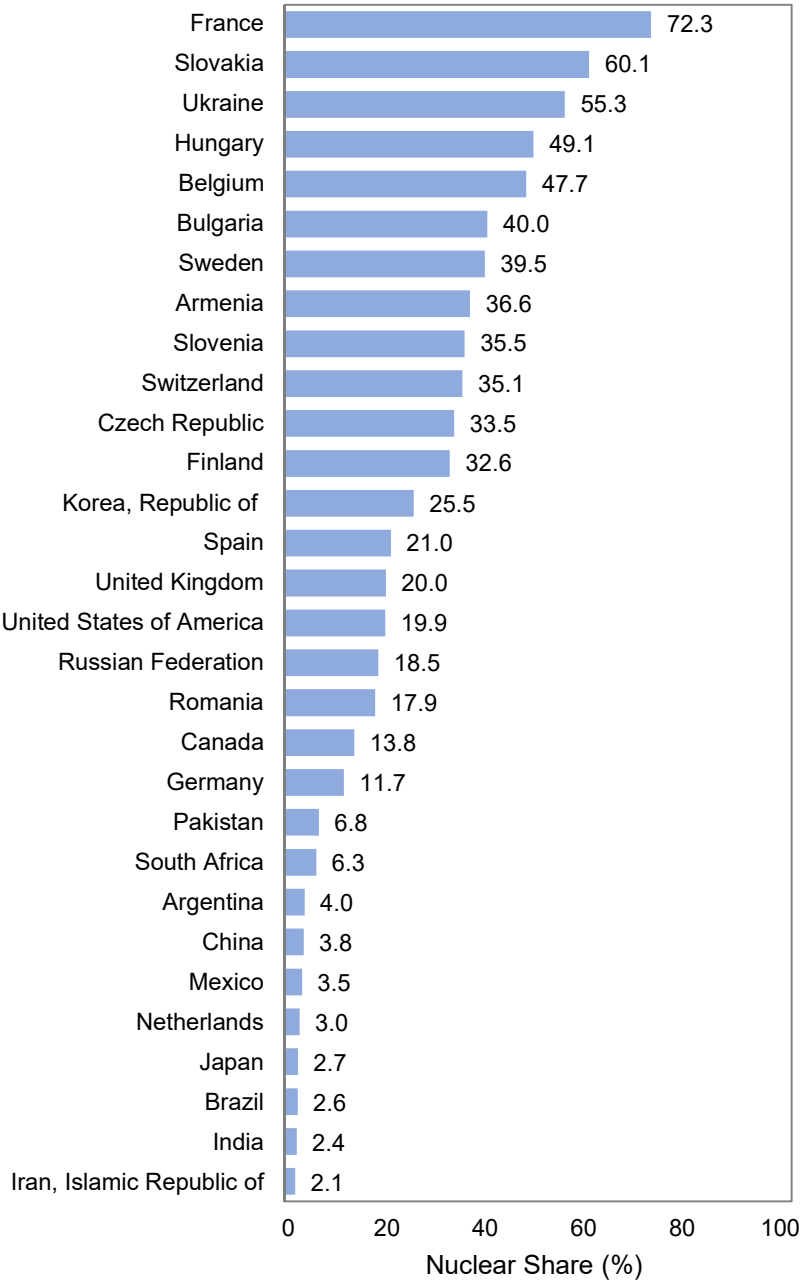
[a] Includes the following data from Taiwan, China: 6 units in operation with a total capacity of 5052 MW(e), 2 units under construction with a total capacity of 2600 MW(e), and 21.6 TW·h of nuclear electricity generation, representing 8.4% of the total electricity produced.

FIGURE 1. WORLD NUCLEAR ELECTRICITY PRODUCTION IN 2017



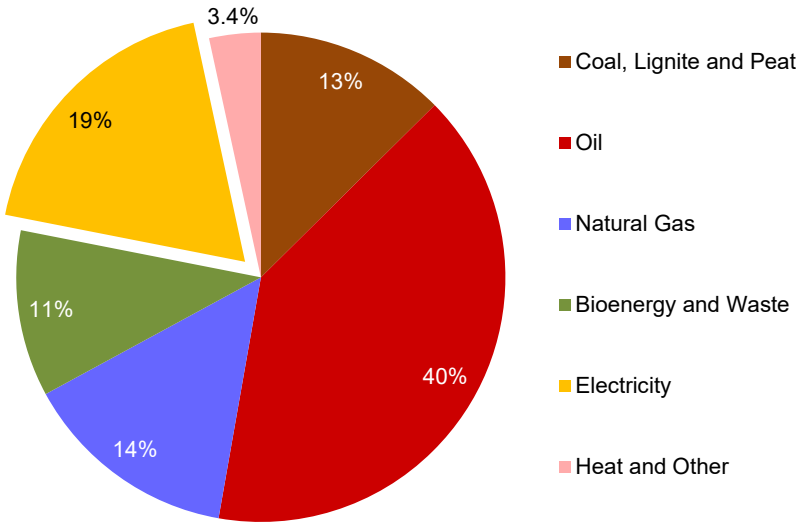
Note: The nuclear electricity production in Taiwan, China, was 21.6 TW·h.

FIGURE 2. SHARE OF NUCLEAR IN TOTAL ELECTRICITY PRODUCTION IN THE WORLD IN 2017



Note: The share of nuclear in the total electricity production of Taiwan, China, was 8.4%.

FIGURE 3. WORLD FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN 2017



Final Energy Consumption in 2017

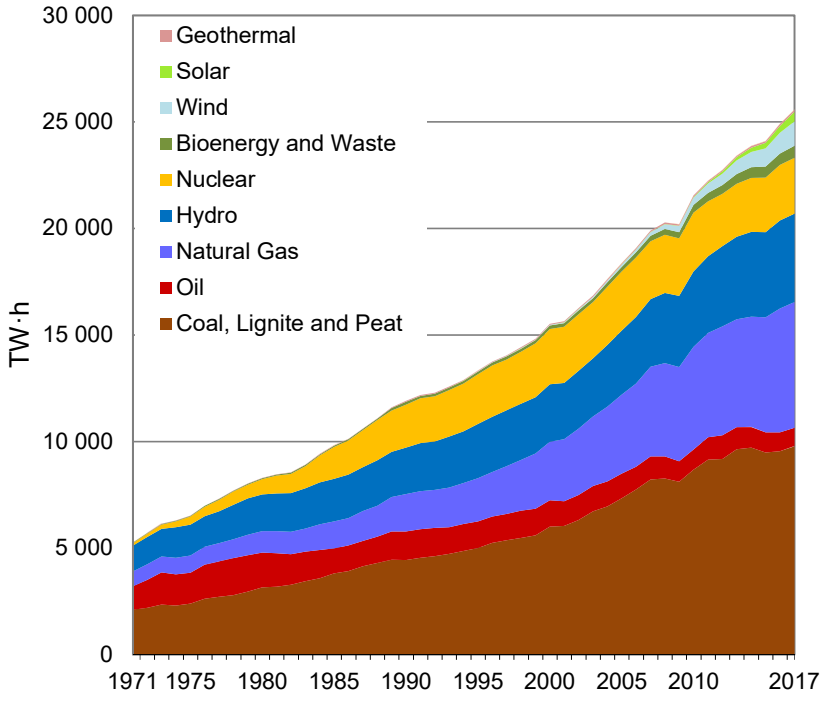
Globally, electricity accounted for about 19% of the total final energy consumption in 2017. About 70% of the final energy consumption was in the form of fossil fuels. Bioenergy and waste accounted for 11%.

As electricity consumption is expected to increase faster than total final energy consumption in the coming years, the share of electricity consumption is expected to rise.

Electricity Production

- Total electricity production grew by 2.7% in 2017 while the growth in nuclear electricity production was 1.1%.
- Among the various sources for electricity production, coal remained dominant despite the significant growth of natural gas based generation.
- The share of electricity production from natural gas increased by 0.4 percentage points to reach 23.1% of total electricity production.
- The contribution of hydropower and renewable energy sources continued to increase significantly, reaching 25.1% in 2017, while the share of nuclear electricity production remained at about 10.3% of the total electricity production.

FIGURE 4. BREAKDOWN OF WORLD TOTAL ELECTRICITY PRODUCTION BY ENERGY SOURCE DURING THE PERIOD 1971–2017



Note: Estimates are expressed in gross figures. Gross electricity production is the total electrical energy produced by all generating units and installations, including pumped storage, measured at the output terminals of the generators.

Energy and Electricity Projections

- World energy consumption is expected to increase by 18% by 2030 and by 38% by 2050, at an annual growth rate of about 1%.
- Electricity consumption will grow at a higher rate of about 2.5% per year up to 2030 and around 2% per year thereafter.
- The share of electricity in total final energy consumption will thus increase from 18.5% in 2017 to 21% by 2030 and to 26.6% by the middle of the century.

FIGURE 5. WORLD FINAL CONSUMPTION OF ENERGY AND ELECTRICITY

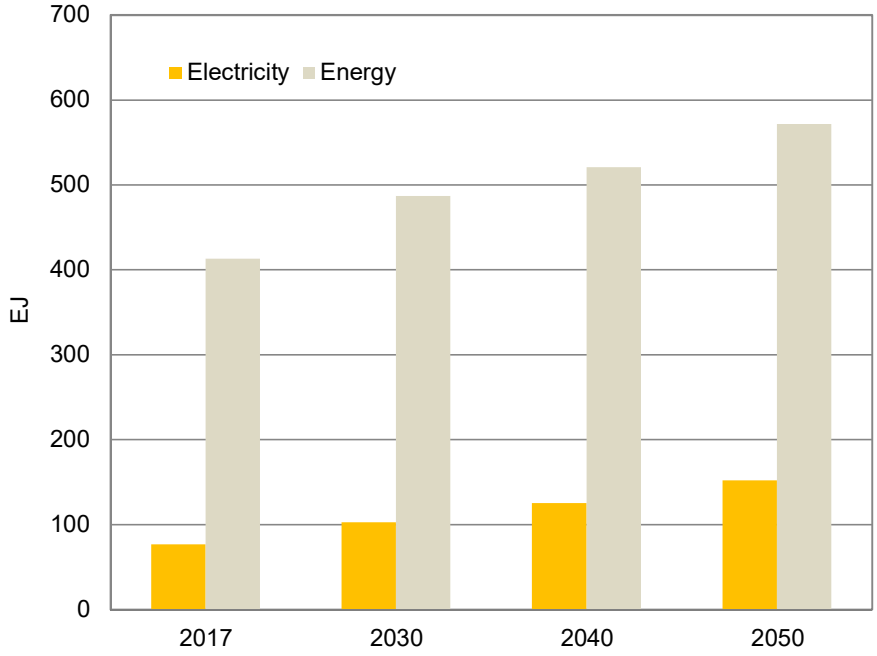


TABLE 2. WORLD FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY

Final Consumption	2017	2030	2040	2050
Energy (EJ)	412.8	486.7	520.7	571.6
Electricity (EJ)	76.5	102.6	125.0	151.8
% of total	18.5	21.1	24.0	26.6

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- The world nuclear electrical generating capacity is projected to increase to 511 GW(e) by 2030 and to 748 GW(e) by 2050 in the high case. This represents a 30% increase over current levels by 2030 and a 90% increase of capacity by 2050.
- In the low case, the world nuclear electrical generating capacity is projected to gradually decline until 2040 and then rebound to the 2030 level by 2050.
- The world total electrical generating capacity is expected to increase from 6922 GW(e) in 2017 to 9826 GW(e) by 2030 and to 12 908 GW(e) by 2050.
- The share of nuclear electrical generating capacity in the world total electrical capacity will be about 3% in the low case and about 6% in the high case by the middle of the century.

FIGURE 6. WORLD NUCLEAR ELECTRICAL GENERATING CAPACITY

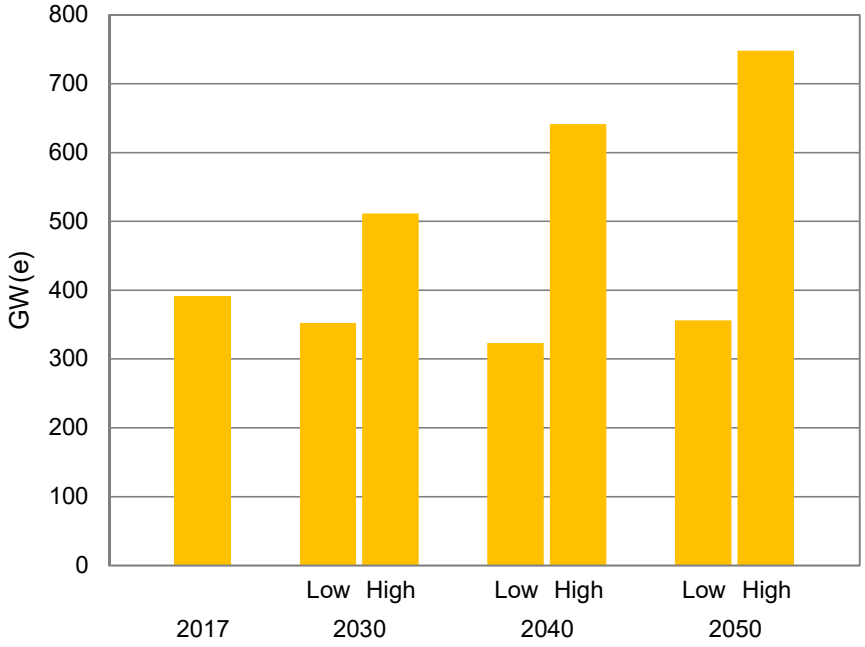


TABLE 3. WORLD TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	6 922	9 826		11 518		12 908	
Nuclear (GW(e))	392	352	511	323	641	356	748
% of total	5.7	3.6	5.2	2.8	5.6	2.8	5.8

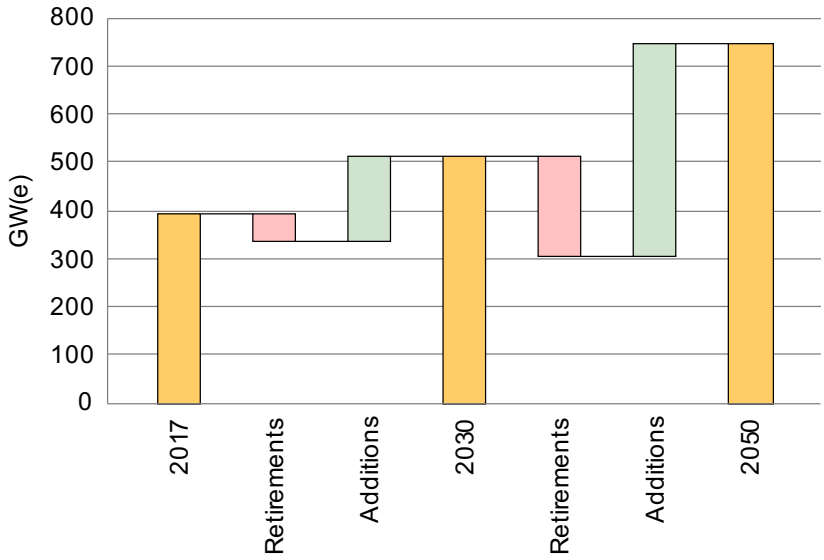
[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Reactor Retirements and Additions

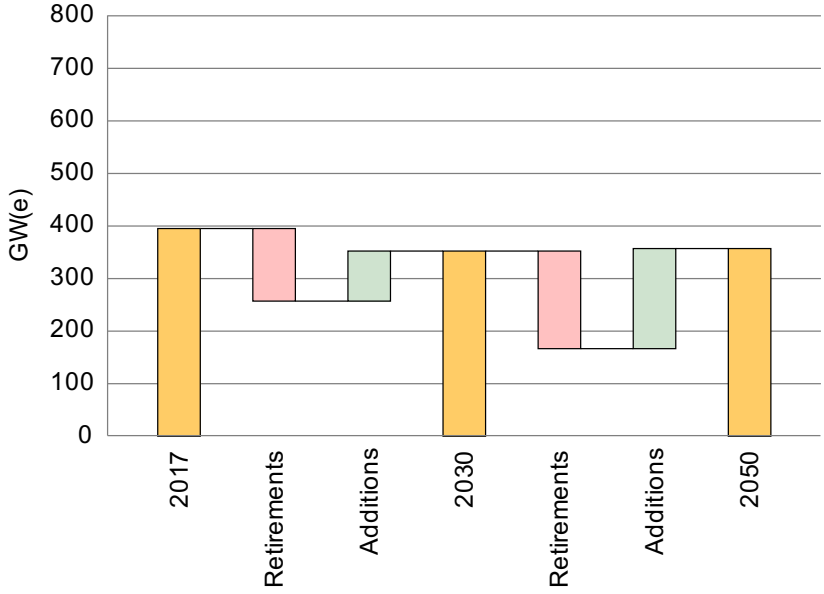
- More than half of the existing nuclear power reactors are over 30 years old and are scheduled to be retired in the coming years.
- In the low case, about 139 GW(e) of nuclear electrical generating capacity will be retired and new reactors will add 99 GW(e) of capacity by 2030. Between 2030 and 2050, an additional 186 GW(e) will be retired and 190 GW(e) of new capacity will be added.
- In the high case, it is assumed that several of the nuclear power reactors scheduled for retirement will be given a life extension, so that only 55 GW(e) of nuclear electrical generating capacity will be retired by 2030, with an additional 207 GW(e) retired by 2050. In this case, the new reactors will add 175 GW(e) of nuclear electrical generating capacity by 2030 and about 443 GW(e) of capacity by 2050.

FIGURE 7. WORLD NUCLEAR CAPACITY: ACTUAL, RETIREMENTS AND ADDITIONS

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- The total nuclear electricity production in the world will continue to increase between now and 2050.
- In the high case, by 2030 nuclear electricity production will increase by 59% from the 2017 level of 2503 TW·h, and a further increase of 52% will occur over the next 20 years. Altogether, a 2.4-fold increase over the present level is expected by 2050.
- In the low case, despite nuclear electrical generating capacity declining from the present level until 2040 and then rebounding, nuclear electricity production will increase by about 9% by 2030 and about 15% by 2050.
- The share of nuclear electricity in total electricity production in the world will decrease in the low case from about 10.3% in 2017 to 7.9% in 2030 and 5.6% in 2050. However, in the high case, its share will increase to 12% in 2030 and to 11.7% in 2050.

FIGURE 8. WORLD NUCLEAR ELECTRICITY PRODUCTION

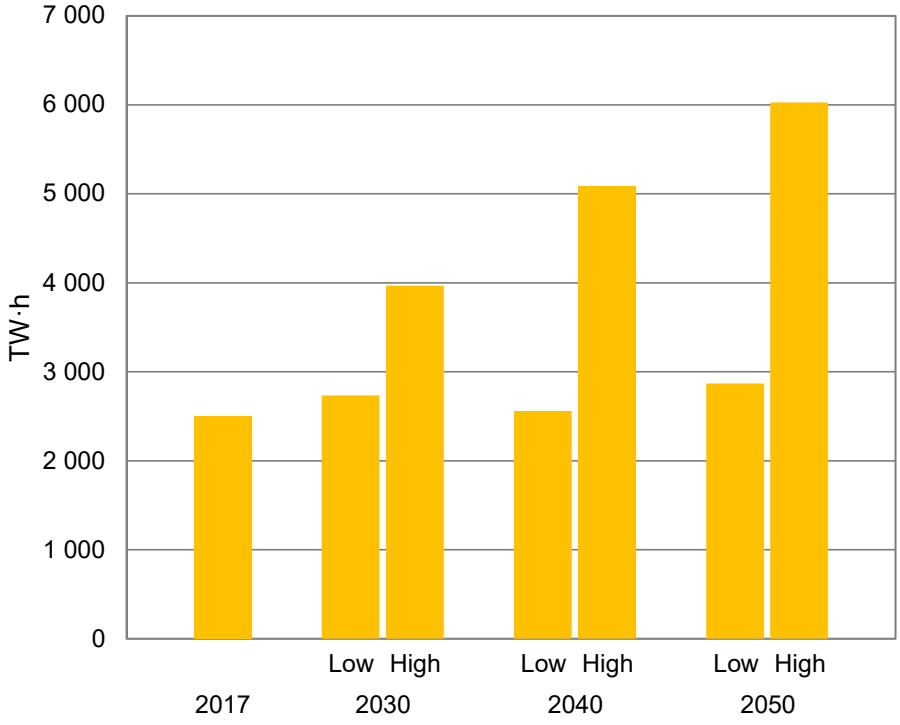


TABLE 4. WORLD TOTAL AND NUCLEAR ELECTRICAL PRODUCTION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	24 269	34 579		42 335		51 388	
Nuclear (TW·h)	2 503	2 732	3969	2 560	5087	2 869	6028
% of total	10.3	7.9	11.5	6.0	12.0	5.6	11.7

[a] The nuclear production data presented in this table and the nuclear electrical generating 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.

TABLE 5. WORLD NUCLEAR ELECTRICAL GENERATING CAPACITY, GW(e)

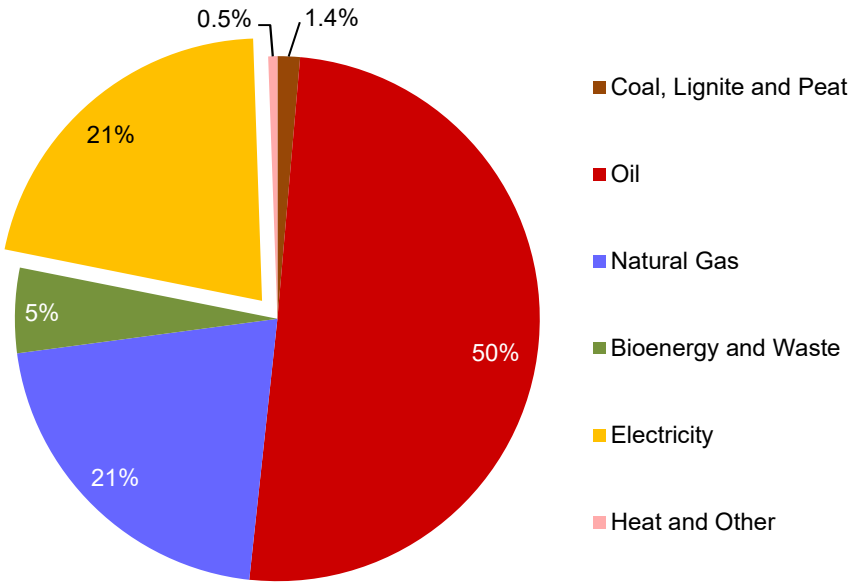
Region	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Northern America	113.5	78	107	36	94	36	107
Latin America and the Caribbean	5.1	8	10	7	17	8	20
Northern, Western and Southern Europe	110.5	66	97	48	94	34	73
Eastern Europe	50.1	51	72	55	84	60	90
Africa	1.9	3	4	4	9	8	13
Western Asia	0.4	8	13	10	21	12	26
Southern Asia	8.5	22	34	31	60	50	98
Central and Eastern Asia	101.8	116	173	131	258	145	310
South-eastern Asia				1	4	3	9
Oceania							2
World Total	**391.7**	**352**	**511**	**323**	**641**	**356**	**748**

TABLE 6. WORLD NUCLEAR ELECTRICITY PRODUCTION, TW·h

Region	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Northern America	900.7	624	854	289	753	291	866
Latin America and the Caribbean	31.2	60	75	54	134	63	162
Northern, Western and Southern Europe	727.1	523	765	383	752	274	590
Eastern Europe	352.0	399	573	440	670	480	723
Africa	15.1	23	32	34	72	68	108
Western Asia	2.4	59	98	77	163	95	208
Southern Asia	49.4	173	272	252	482	404	786
Central and Eastern Asia	425.0	871	1 300	1 023	2 030	1 170	2 496
South-eastern Asia				8	31	24	73
Oceania							16
World Total	**2 502.9**	**2 732**	**3 969**	**2 560**	**5 087**	**2 870**	**6 028**

Northern America

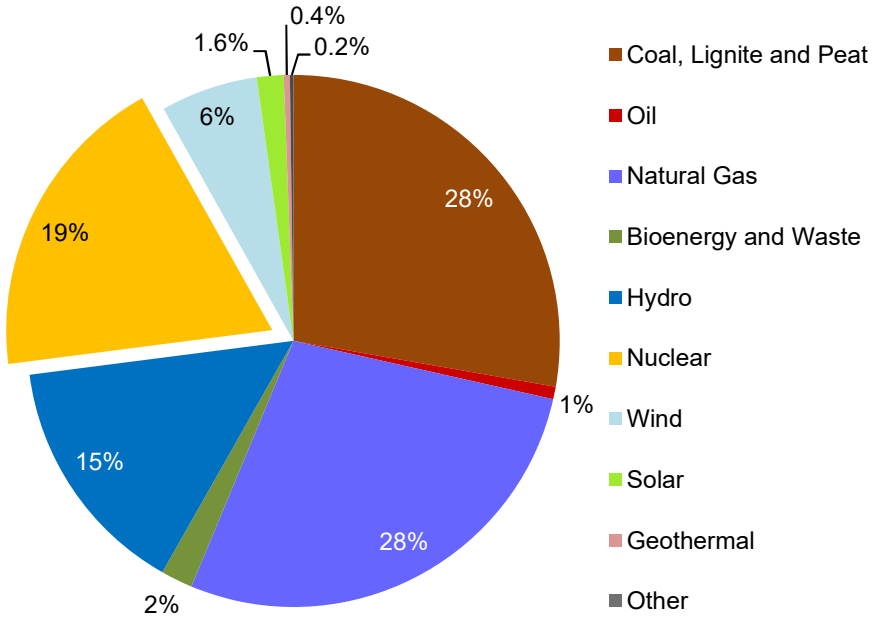
FIGURE 9. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE NORTHERN AMERICA REGION IN 2017



Final Energy Consumption in 2017

Final energy consumption in the Northern America region in 2017 was dominated by the use of oil. Electricity made up about one fifth of the total consumption, followed by gas, accounting for another fifth.

FIGURE 10. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE NORTHERN AMERICA REGION IN 2017



Electricity Production in 2017

In the electricity production mix in 2017, gas based electricity production grew to around 30% of the total, reaching the level of coal. Nuclear electricity remained at about 20% of the total. Hydropower and other renewables provided about 25% of the total electricity production.

Energy and Electricity Projections

- Final energy consumption in the Northern America region is expected to decrease owing to efficiency improvements and structural changes in the economy. A decrease of about 5.6% from the present level of 72 EJ is expected by 2030, reaching about 9.7% by 2050.
- In contrast, electricity consumption will continue to increase, albeit at a slow pace (0.5% growth annually).
- The share of electricity in final energy consumption will thus stay level from 2017 to 2030 at 21.3% and increase to about 27% by the middle of the century.

FIGURE 11. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE NORTHERN AMERICA REGION

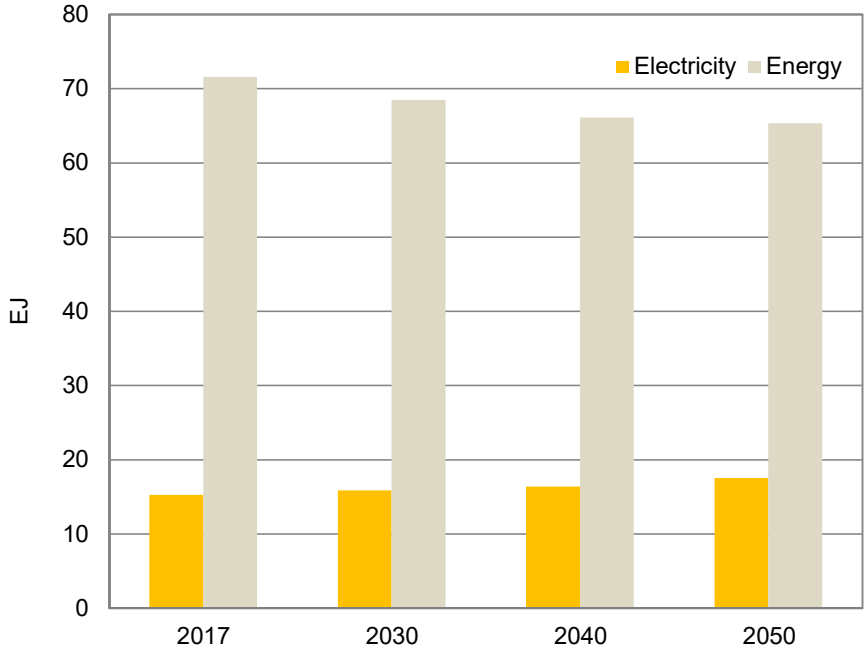


TABLE 7. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE NORTHERN AMERICA REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	71.6	68.5	66.1	65.3
Electricity (EJ)	15.3	15.8	16.4	17.5
% of total	21.3	23.1	24.8	26.8

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the Northern America region is projected to increase by 8.9% to reach 1474 GW(e) by 2030, and then to decrease slightly to 1435 GW(e) by 2050.
- Nuclear electrical generating capacity is expected to change significantly in this region over the next two decades.
- In the low case, nuclear electrical generating capacity is projected to decrease from the 2017 level of 113 GW(e) to 78 GW(e) by 2030 and then to 36 GW(e) by 2050. The share of nuclear electrical generating capacity in total electricity capacity is projected to decrease from 8.4% in 2017 to 5.3% by 2030 and to 2.5% by 2050.
- In the high case, nuclear electrical generating capacity is projected to remain near its current level throughout the period. It will first decrease to 107 GW(e) in 2030, then decrease to 94 GW(e) in 2040, and finally return back to 2030 level. The share of nuclear electrical generating capacity in total electricity capacity will, however, decrease from 8.4% to 7.3% in 2030 and then increase slightly to 7.5% by 2050.

FIGURE 12. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE NORTHERN AMERICA REGION

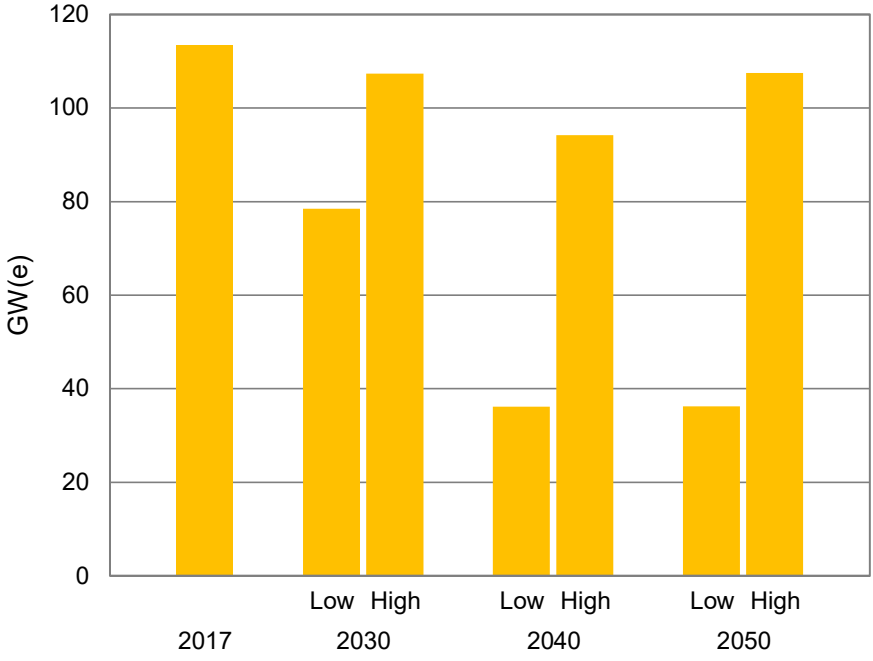


TABLE 8. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE NORTHERN AMERICA REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	1 353	1 474		1 488		1 435	
Nuclear (GW(e))	113	78	107	36	94	36	107
% of total	8.4	5.3	7.3	2.4	6.3	2.5	7.5

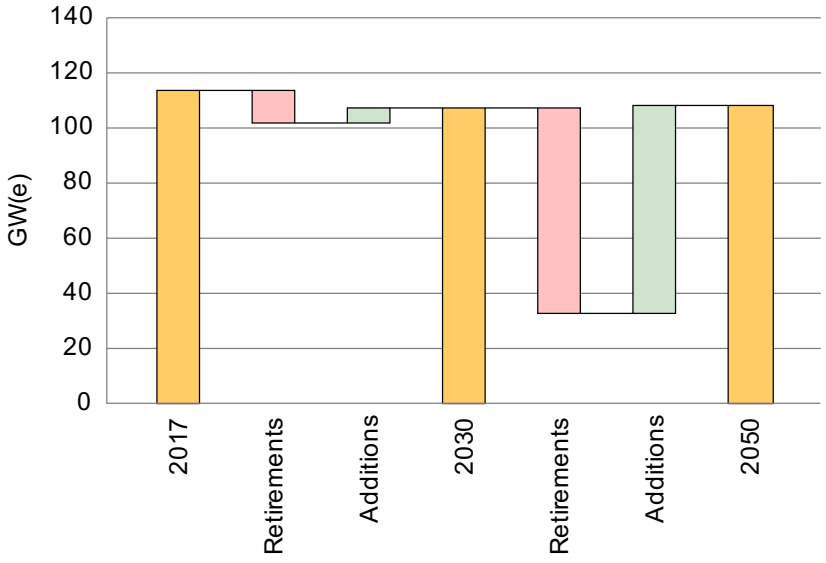
[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Reactor Retirements and Additions

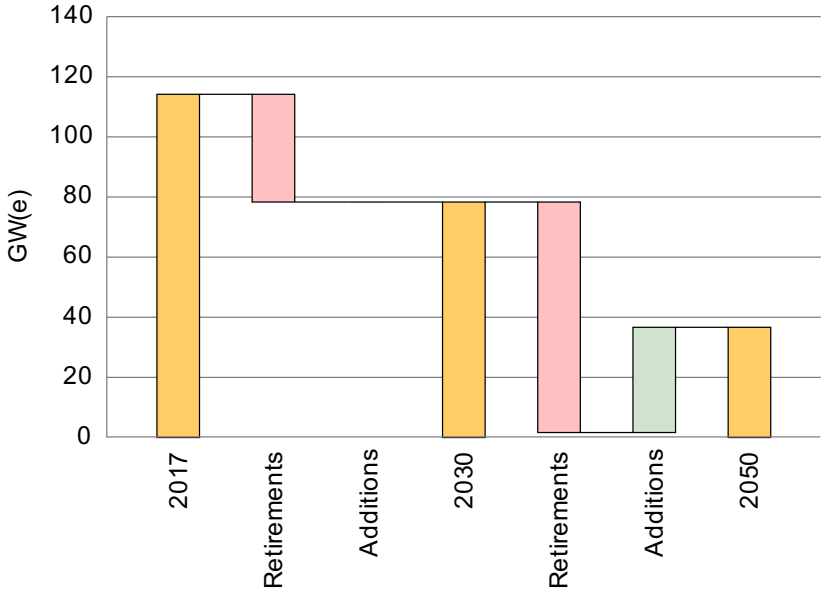
- Almost all of the existing nuclear power reactors in the Northern America region are scheduled to be retired by the middle of the century.
- In the low case, about 36 GW(e) of nuclear electrical generating capacity will be retired by 2030. An additional 77 GW(e) of capacity will be retired between 2030 and 2050. The projected additions of nuclear electrical generating capacity in this case are only minimal by 2030 and some 35 GW(e) by 2050.
- In the high case, some nuclear power reactor retirements will be delayed by plant life extensions; however, these plants will also be retired by the middle of the century. The additions of nuclear electrical generating capacity in this case are projected to be 6 GW(e) by 2030 and some 75 GW(e) by 2050.

FIGURE 13. NUCLEAR CAPACITY IN THE NORTHERN AMERICA REGION: ACTUAL, RETIREMENTS AND ADDITIONS

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- The total electricity production in the Northern America region is projected to increase from 4737 TW·h in 2017 to 5224 TW·h in 2030 — an increase of about 10% over 13 years — and then to 5896 TW·h by 2050.
- The contribution of nuclear electricity is projected to undergo significant changes in both the low and the high case.
- In the low case, nuclear electricity production is projected to decrease significantly — from 901 TW·h in 2017 to 624 TW·h in 2030 and to 291 TW·h in 2050. The share of nuclear electricity in total electricity production will thus decrease from 19% in 2017 to 11.9% in 2030 and to only about 5% in 2050.
- In the high case, nuclear electricity production is projected to decrease by about 5.3% from 901 TW·h in 2017 to 853 TW·h in 2030, and then to increase to 866 TW·h in 2050. The share of nuclear electricity production in total electricity will likewise decrease, falling from 19% to 16.3% in 2030 and to 14.7% in 2050.

FIGURE 14. NUCLEAR ELECTRICITY PRODUCTION IN THE NORTHERN AMERICA REGION

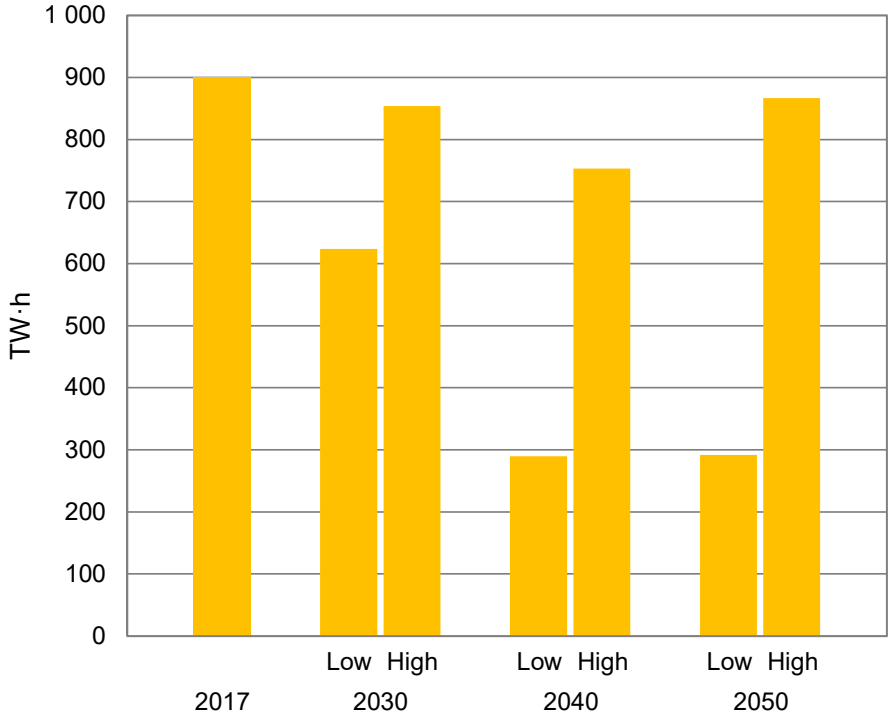


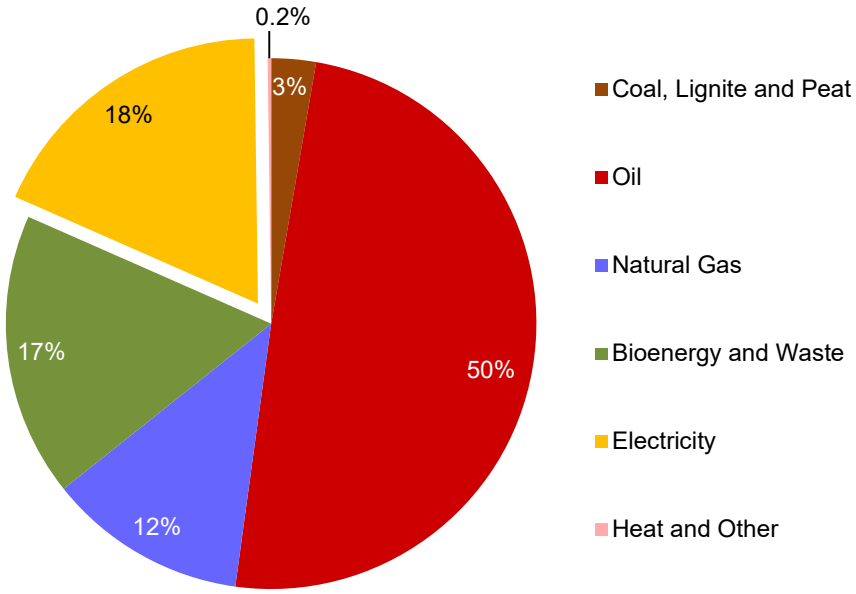
TABLE 9. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE NORTHERN AMERICA REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	4 737	5 224		5 408		5 896	
Nuclear (TW·h)	901	624	853	289	753	291	866
% of total	19.0	11.9	16.3	5.3	13.9	4.9	14.7

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 8 cannot be used to calculate average annual capacity factors for nuclear plants as Table 8 presents year-end capacity.

Latin America and the Caribbean

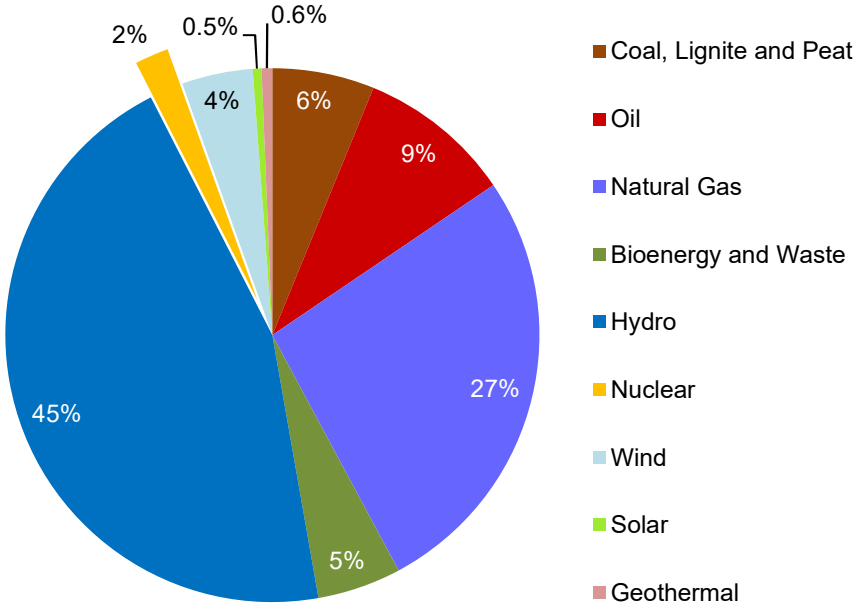
FIGURE 15. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE LATIN AMERICA AND THE CARIBBEAN REGION IN 2017



Final Energy Consumption in 2017

Final energy consumption in the Latin America and the Caribbean region was dominated by oil and gas, which together accounted for over 60% of the total, with coal accounting for only 3% of the final energy consumption in 2017. Electricity use in 2017 was 18% of the total final energy consumption, while bioenergy and waste (traditional fuels) accounted for about 17%.

FIGURE 16. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE LATIN AMERICA AND THE CARIBBEAN REGION IN 2017



Electricity Production in 2017

Hydropower is the main source of electricity production in the Latin America and the Caribbean region, providing about 45% of the total electricity production. Fossil fuel based electricity production accounted for about 42% of the total, led by gas at 27%. Renewables and other sources contributed about 12% to the total electricity production in 2017. Nuclear electricity had only a 2% share in total electricity production in the region.

Energy and Electricity Projections

- The total final energy consumption in the Latin America and the Caribbean region is expected to increase by about 1.5% per year up to the middle of the century.
- Electricity consumption, however, will increase at a slightly faster rate of 2.1% growth annually.
- The share of electricity in final energy consumption will increase from 18.2% in 2017 to 18.8% in 2030 and about 23.7% by the middle of the century.

FIGURE 17. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE LATIN AMERICA AND THE CARIBBEAN REGION

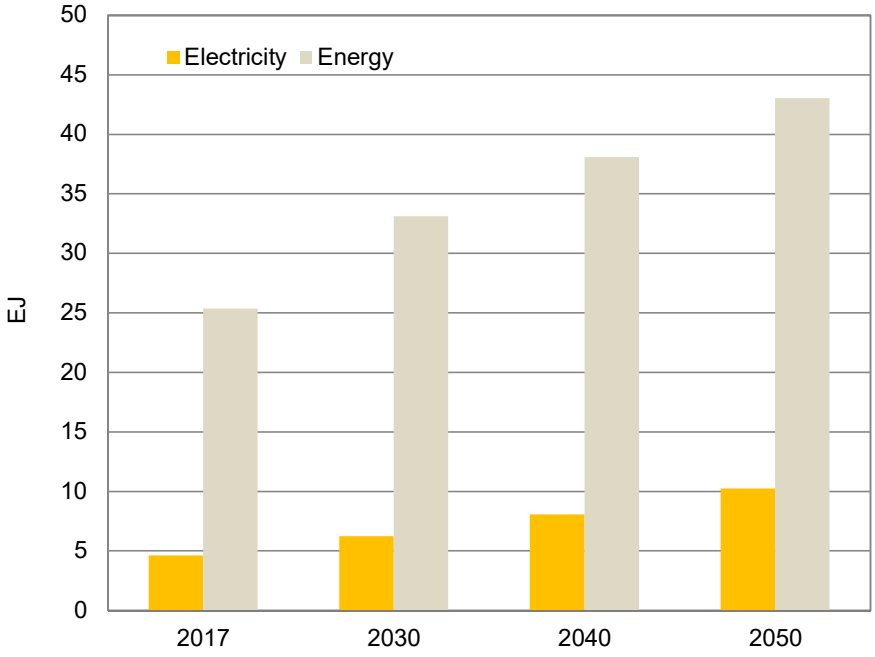


TABLE 10. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE LATIN AMERICA AND THE CARIBBEAN REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	25.3	33.1	38.1	43.0
Electricity (EJ)	4.6	6.2	8.0	10.2
% of total	18.2	18.8	21.1	23.7

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the Latin America and the Caribbean region is projected to increase by 32%, reaching 548 GW(e) by 2030 and 809 GW(e) by 2050.
- Nuclear electrical generating capacity is projected to increase in both the low and the high case, but the role of nuclear electricity will remain small.
- In the low case, nuclear electrical generating capacity is projected to increase from 5 GW(e) in 2017 to 8 GW(e) by 2030 and to stay at that level until 2050. The share of nuclear in the total electrical generating capacity is projected to increase slightly from 1.2% to 1.4% by 2030 and then to decrease to 1% by 2050.
- In contrast, in the high case, nuclear electrical generating capacity is projected to increase to 10 GW(e) in 2030 and to 20 GW(e) in 2050. The share of nuclear electrical generating capacity in total electrical capacity will thus increase to 1.8% in 2030 and to 2.5% in 2050.

FIGURE 18. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE LATIN AMERICA AND THE CARIBBEAN REGION

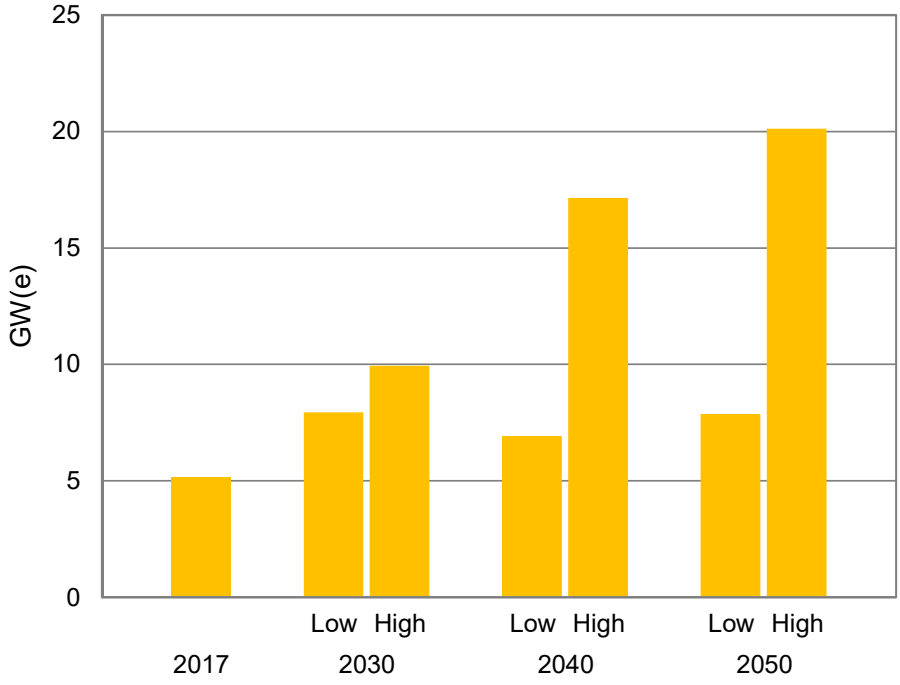


TABLE 11. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE LATIN AMERICA AND THE CARIBBEAN REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	415	548		685		809	
Nuclear (GW(e))	5	8	10	7	17	8	20
% of total	1.2	1.4	1.8	1.0	2.5	1.0	2.5

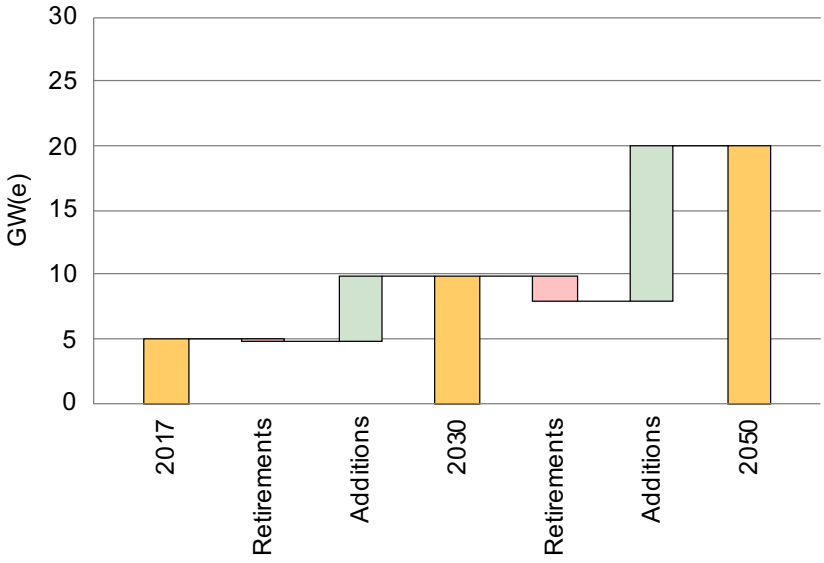
[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Reactor Retirements and Additions

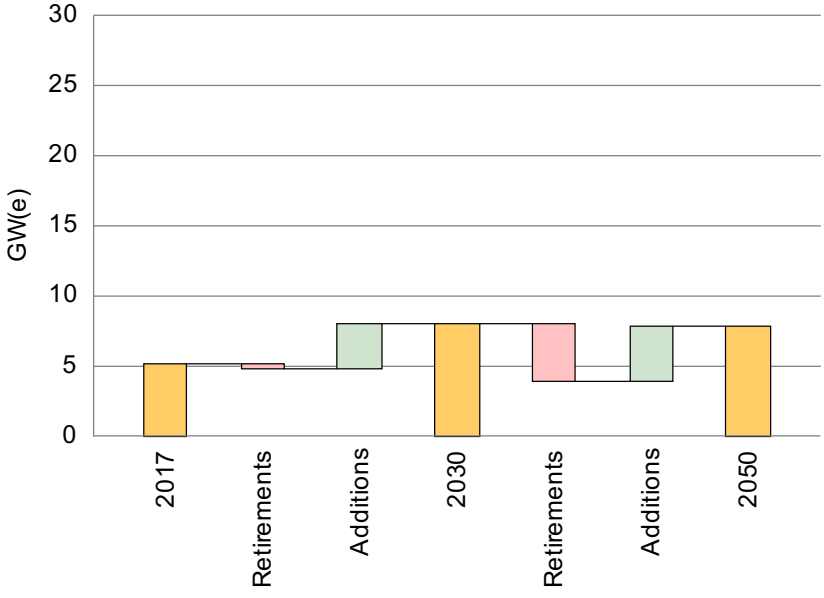
- There are seven nuclear power reactors operating in the Latin America and the Caribbean region. All but one were constructed before 2001 and are scheduled to be retired by the middle of the century.
- In the low case, 4.4 GW(e) of the existing nuclear electrical generating capacity will be retired by 2050. In the high case, retirement of some of the nuclear power reactors will be delayed by plant life extensions, and about half the existing nuclear capacity will be retired.
- The projected additions of nuclear electrical generating capacity in the high case are 5 GW(e) by 2030 and an additional 12 GW(e) by 2050. In the low case, only 7 GW(e) of additional capacity is projected for the entire period.

FIGURE 19. NUCLEAR CAPACITY IN THE LATIN AMERICA AND THE CARIBBEAN REGION: ACTUAL, RETIREMENTS AND ADDITIONS

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- Total electricity production in the Latin America and the Caribbean region is projected to increase by around 2.4% per year.
- Nuclear electricity production is projected to increase in both the low and the high case, but its role will remain small in the coming decades.
- In the low case, nuclear electricity production will almost double in the next 13 years to reach 60 TW·h in 2030, after which it will first decrease and then recover to 63 TW·h in 2050. The share of nuclear electricity in total electricity production will thus initially increase to 2.8% in 2030 and then decrease to 1.8% in 2050.
- In the high case, nuclear electricity production is projected to increase by 7% per year up to 2030 and then by 4% per year up to 2050. The share of nuclear electricity in total electricity production will therefore increase from 2% in 2017 to 3.5% in 2030 and to 4.5% in 2050.

FIGURE 20. NUCLEAR ELECTRICITY PRODUCTION IN THE LATIN AMERICA AND THE CARIBBEAN REGION

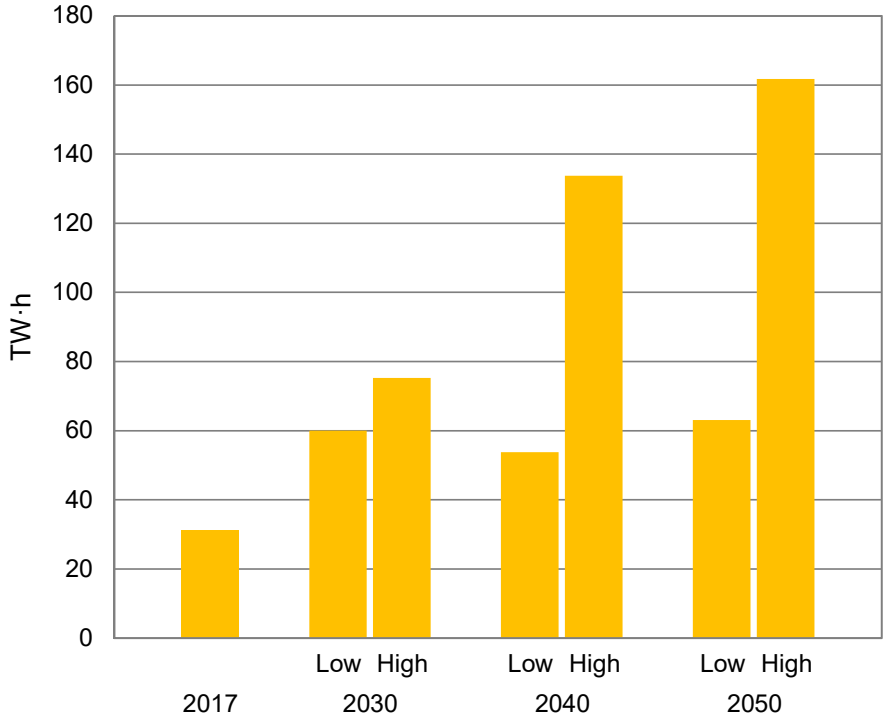


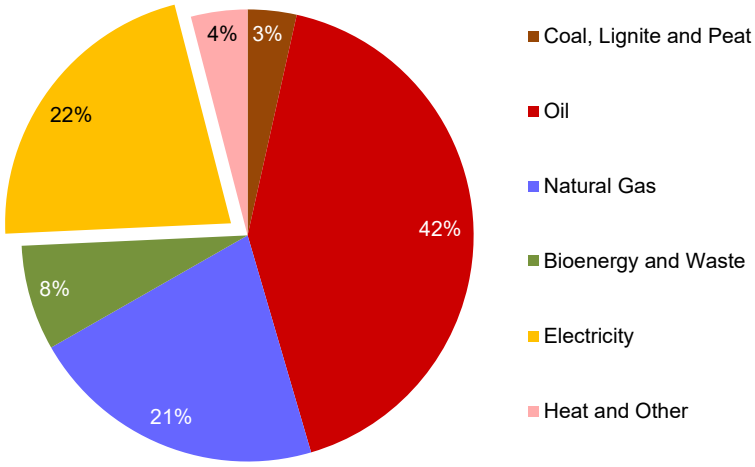
TABLE 12. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE LATIN AMERICA AND THE CARIBBEAN REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	1 559	2 171		2 809		3 576	
Nuclear (TW·h)	31	60	75	54	134	63	162
% of total	2.0	2.8	3.5	1.9	4.8	1.8	4.5

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 11 cannot be used to calculate average annual capacity factors for nuclear plants as Table 11 presents year-end capacity.

Northern, Western and Southern Europe

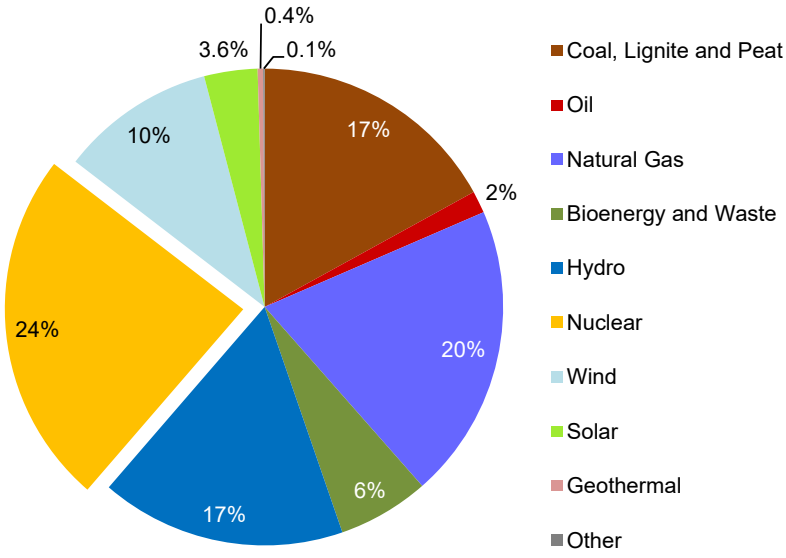
FIGURE 21. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE IN 2017



Final Energy Consumption in 2017

Final energy consumption in the combined regions of Northern, Western and Southern Europe continued to be dominated by fossil fuels in 2017. Electricity provided 22% of the total final energy consumed.

FIGURE 22. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE IN 2017



Electricity Production in 2017

The electricity production mix in the combined regions of Northern, Western and Southern Europe was very diverse in 2017. Nuclear electricity contributed about a quarter of the total production in this region, while hydropower, renewables and other sources provided about a third of the total.

Energy and Electricity Projections

- Total final energy consumption in the combined regions of Northern, Western and Southern Europe is expected to decrease as a result of efficiency improvements and structural changes in the economy. Decreases of about 6% and about 13% from the present level of 45 EJ are expected by 2030 and by 2050, respectively.
- Electricity consumption will initially remain the same but will increase after 2030, with a 20% increase expected between 2030 and 2050.
- The share of electricity in final energy consumption will thus increase from 21.7% in 2017 to 24.2% by 2030 and to 30.3% by 2050.

FIGURE 23. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE

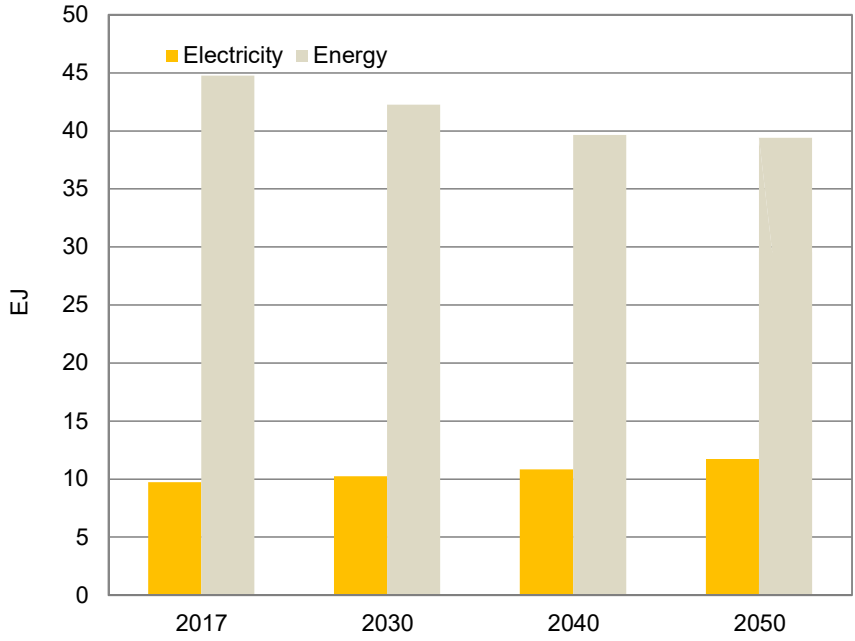


TABLE 13. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE

Final Consumption	2017	2030	2040	2050
Energy (EJ)	44.7	42.2	39.6	39.4
Electricity (EJ)	9.7	10.2	10.8	11.9
% of total	21.7	24.2	27.3	30.3

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity in the combined regions of Northern, Western and Southern Europe is projected to increase by 14% by 2030 and by 10% to reach 1215 GW(e) by 2050.
- Several countries in these regions have announced a phaseout of nuclear power. The regions' nuclear power capacity will therefore change significantly in the coming years.
- In the low case, nuclear electrical generating capacity is projected to decrease by 40% by 2030 and by 70% by 2050. The share of nuclear power capacity in total electricity capacity will thus decrease from 11.3% in 2017 to 6% by 2030 and to 2.8% by 2050.
- In the high case, the nuclear electrical generating capacity is projected to remain to decrease to 97 GW(e) by 2030 and then down to 73 GW(e) in 2050. The share of nuclear power capacity in the total electricity production capacity will therefore decrease from 11.3% in 2017 to 8.7% in 2030 and to 6% in 2050.

FIGURE 24. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE

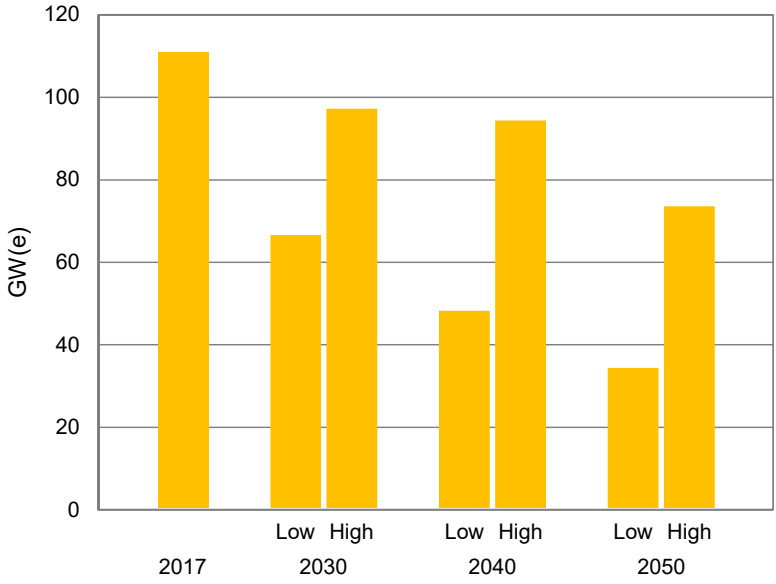


TABLE 14. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	970	1 108		1 164		1 215	
Nuclear (GW(e))	111	66	97	48	94	34	73
% of total	11.3	6.0	8.7	4.1	8.1	2.8	6.0

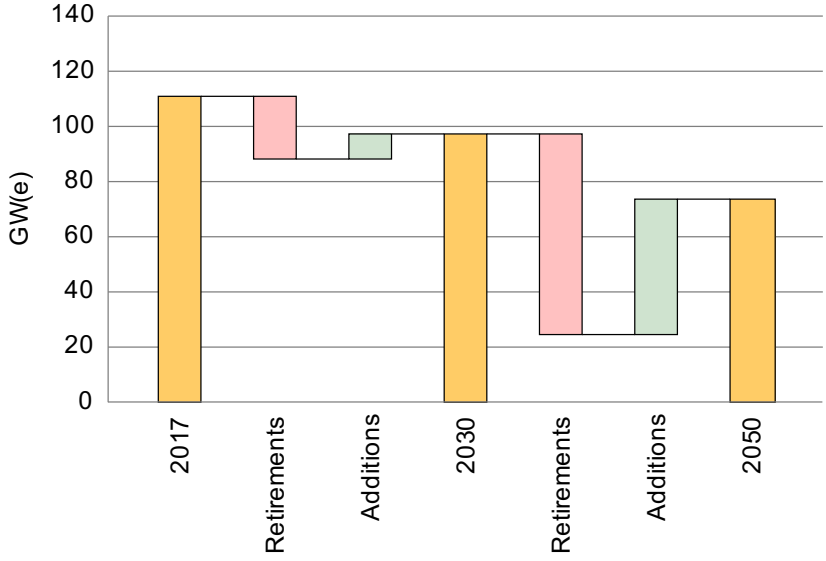
[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Reactor Retirements and Additions

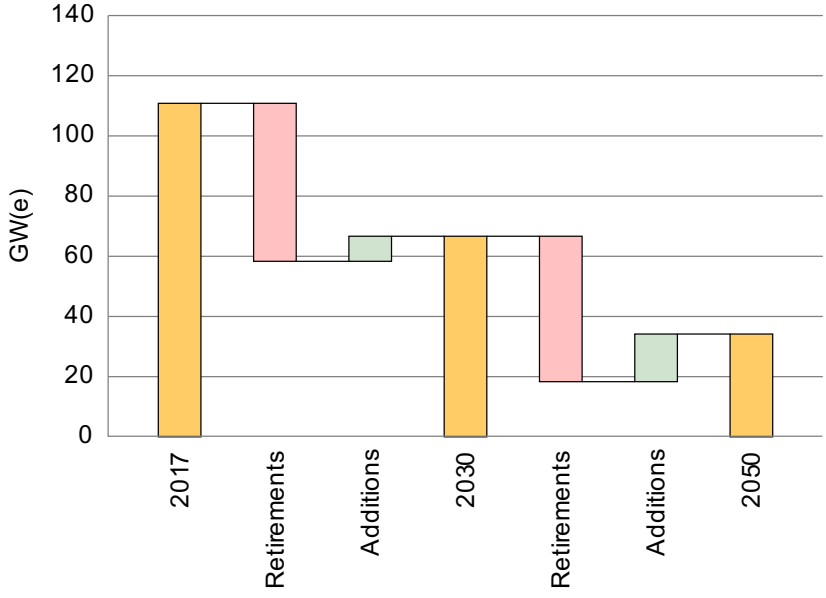
- Almost all of the existing nuclear power reactors in the combined regions of Northern, Western and Southern Europe are scheduled to be retired by the middle of the century.
- In the low case, about 52 GW(e) of nuclear electrical generating capacity will be retired by 2030 and an additional 47 GW(e) of capacity will be retired between 2030 and 2050. The projected additions of nuclear capacity in this case are only 8 GW(e) by 2030 and some 16 GW(e) by 2050.
- In the high case, nuclear power reactor retirements will be delayed; the majority of the reactors will be retired between 2030 and 2050. The additions of nuclear capacity in this case are projected to be 9 GW(e) by 2030 and some 50 GW(e) by 2050.

FIGURE 25. NUCLEAR CAPACITY IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE: ACTUAL, RETIREMENTS AND ADDITIONS

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- Total electricity production in the combined regions of Northern, Western and Southern Europe is projected to increase from 3032 TW·h in 2017 to 3252 TW·h in 2030 — an increase of about 7% over 13 years — with an additional increase of 18% to reach 3809 TW·h by 2050.
- In the low case, nuclear electricity production will decrease significantly from 727 TW·h in 2017 to 523 TW·h in 2030 and to 274 TW·h in 2050. The share of nuclear electricity in the total will thus decrease from 24% in 2017 to 16.1% by 2030 and to 7.2% by 2050.
- In the high case, nuclear electricity production is projected first to increase by about 5% by 2030, and then to decrease significantly by 23% between 2030 and 2050. The share of nuclear electricity in total electricity production will essentially remain constant until 2030, but gradually decrease thereafter to reach 15.5% by 2050.

FIGURE 26. NUCLEAR ELECTRICITY PRODUCTION IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE

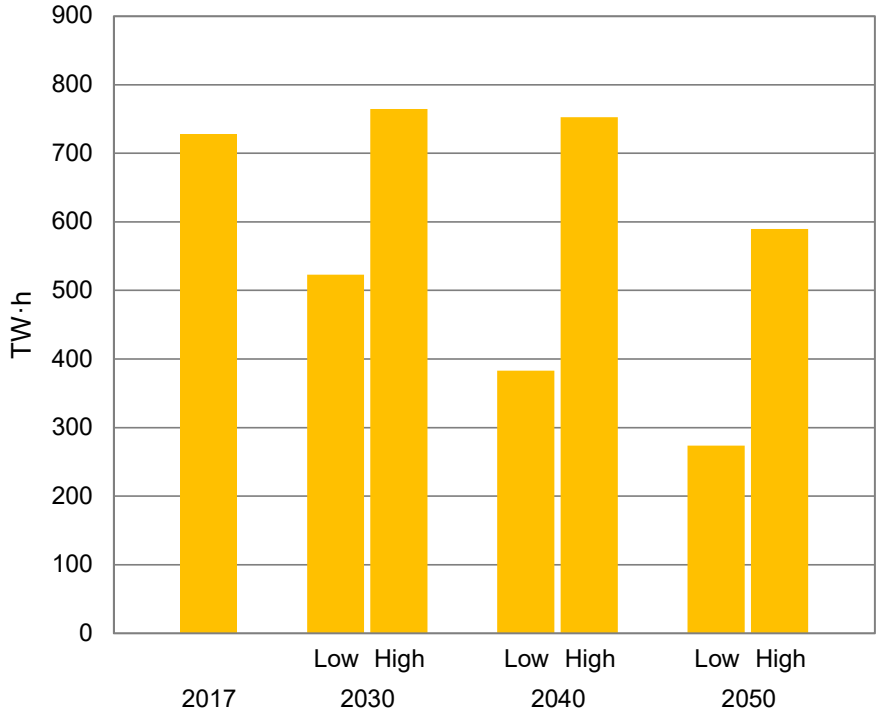


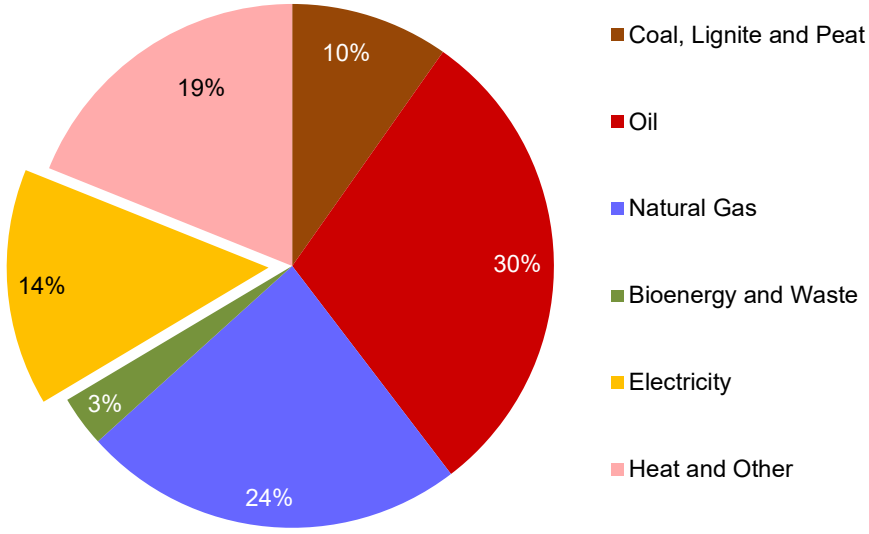
TABLE 15. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	3 032	3 252		3 445		3 809	
Nuclear (TW·h)	727	523	765	383	752	274	590
% of total	24.0	16.1	23.5	11.1	21.8	7.2	15.5

[a]The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 14 cannot be used to calculate average annual capacity factors for nuclear plants as Table 14 presents year-end capacity.

Eastern Europe

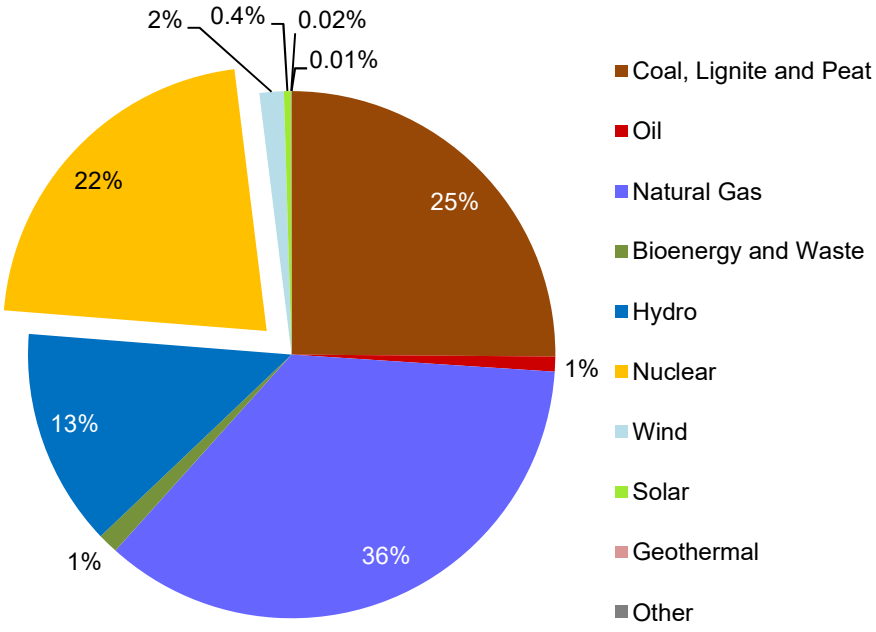
FIGURE 27. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE EASTERN EUROPE REGION IN 2017



Final Energy Consumption in 2017

Final energy consumption in the Eastern Europe region in 2017 was based on a diverse mix of fuels: oil (30%), gas (24%), coal (10%), electricity (14%), heat and other sources (19%).

FIGURE 28. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE EASTERN EUROPE REGION IN 2017



Electricity Production in 2017

Nuclear electricity production is very significant in this region, accounting for 22% of total electricity production in 2017. Nonetheless, fossil fuel based generation accounted for more than 60% of the total electricity production (gas (36%), coal (25%) and oil (1%)). Hydropower accounted for 13%, and renewables and other sources provided about 3% of the total electricity production.

Energy and Electricity Projections

- The final energy consumption in the Eastern Europe region is expected to increase by 5% in the next 13 years, with an additional 15% increase in the subsequent 20 years to 2050. Throughout the period, the annual growth rate will only be 0.8%.
- Electricity consumption will increase much faster, with a 50% increase between 2017 and 2030, and an additional 33% increase in the subsequent 20 years.
- The share of electricity in final energy consumption will thus increase from 15.6% in 2017 to 17.8% in 2030 and to about 23.6% by the middle of the century.

FIGURE 29. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE EASTERN EUROPE REGION

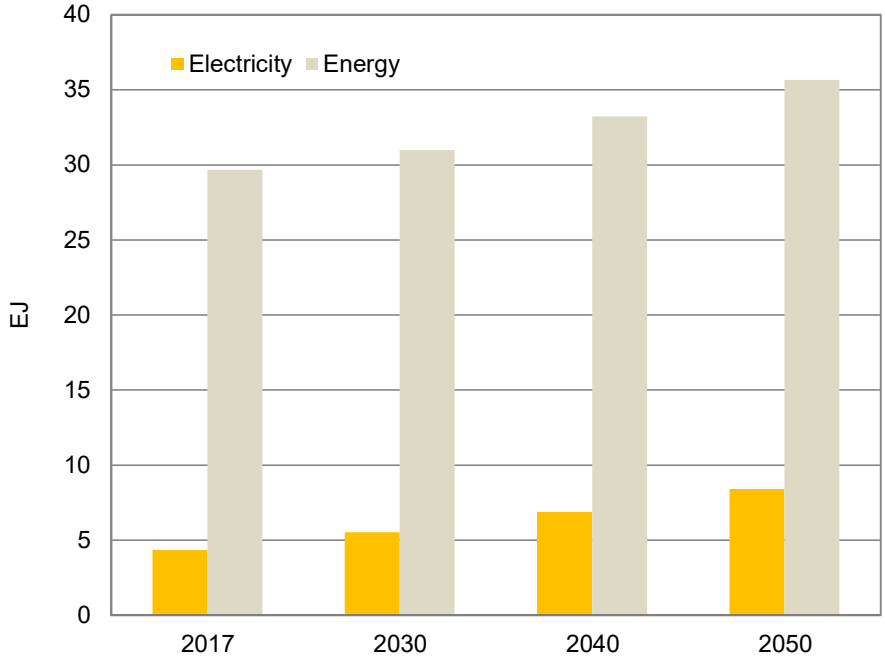


TABLE 16. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE EASTERN EUROPE REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	29.7	31.0	33.2	35.7
Electricity (EJ)	4.3	5.5	6.9	8.4
% of total	15.6	17.8	20.7	23.6

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the Eastern Europe region is projected to increase significantly, by about 20% by 2030 and by an additional 40% in the subsequent 20 years.
- Nuclear electrical generating capacity is also projected to increase significantly in both the low and the high case.
- In the low case, nuclear electrical generating capacity is projected to grow slowly at first, from 50 GW(e) in 2017 to 51 GW(e) in 2030, and then to grow moderately, reaching 60 GW(e) by 2050. However, the share of nuclear capacity in the total electrical generating capacity will remain around 8% throughout the period in this case.
- In the high case, the nuclear electrical generating capacity is projected to increase at a faster rate — from 50 GW(e) in 2017 to 72 GW(e) by 2030 and to 90 GW(e) by 2050. The share of nuclear capacity in the total electrical generating capacity will therefore increase from 11.4% in 2017 to 13.7% in 2030 and fall to 12% in 2050.

FIGURE 30. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE EASTERN EUROPE REGION

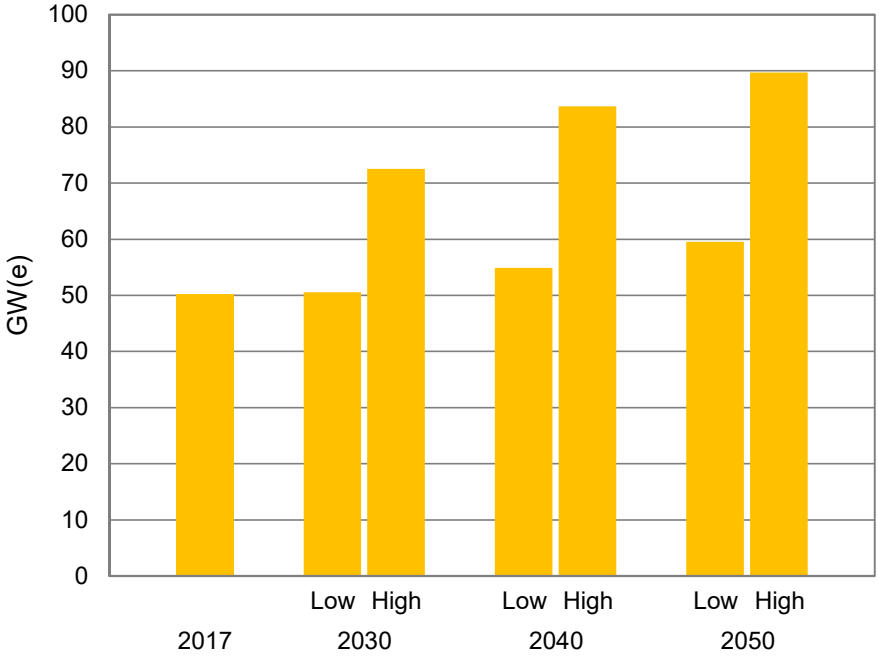


TABLE 17. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE EASTERN EUROPE REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	440	530		635		746	
Nuclear (GW(e))	50	51	72	55	84	60	90
% of total	11.4	9.5	13.7	8.6	13.2	8.0	12.0

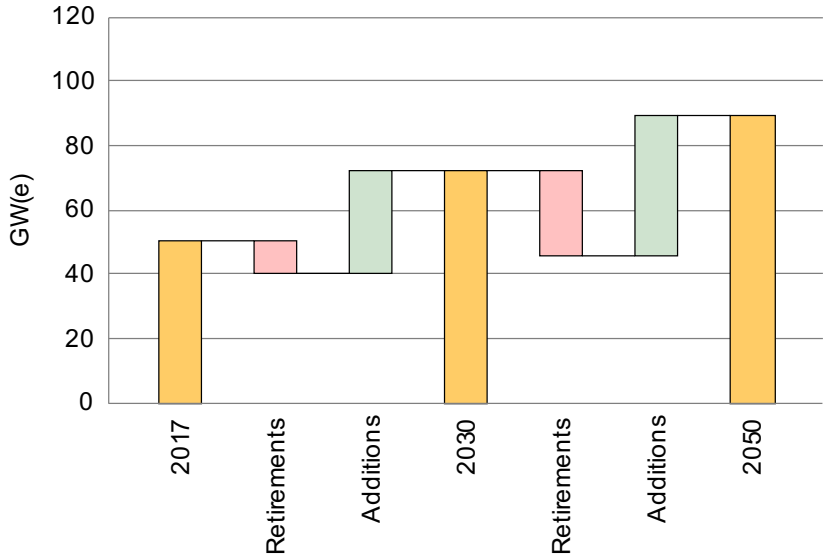
[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Reactor Retirements and Additions

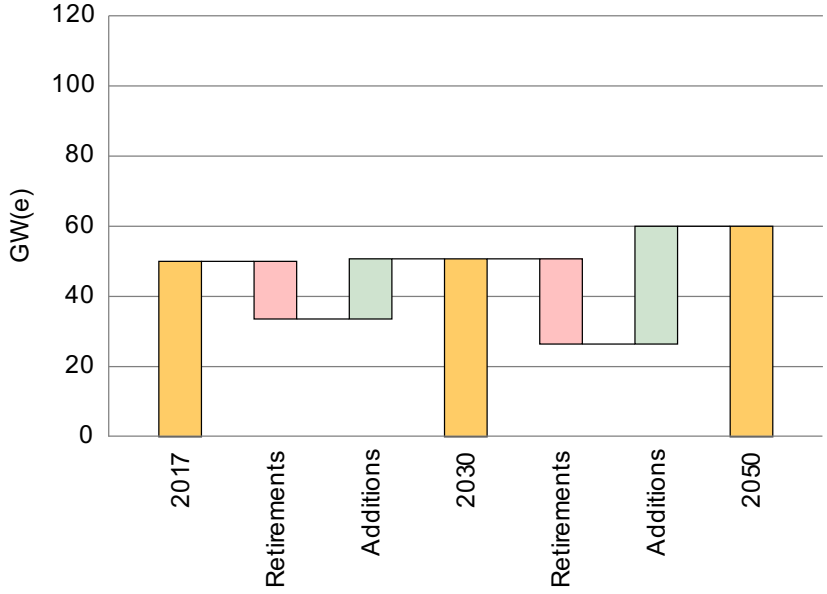
- The majority of the existing nuclear power reactors in the Eastern Europe region are scheduled to be retired by the middle of the century.
- In the low case, about 17 GW(e) of nuclear electrical generating capacity will be retired by 2030 and another 25 GW(e) of capacity will be retired between 2030 and 2050. The projected additions in this case will compensate for the retirements between 2017 and 2030; thereafter, nuclear capacity will increase, with the addition of about 34 GW(e) of nuclear power capacity by 2050.
- In the high case, nuclear power reactor retirements will be delayed. Only 10 GW(e) of nuclear capacity will be retired by 2030, but about 26 GW(e) will be retired between 2030 and 2050. The additions of nuclear capacity in this case are projected to be 32 GW(e) by 2030 and some 44 GW(e) by 2050.

FIGURE 31. NUCLEAR CAPACITY IN THE EASTERN EUROPE REGION: ACTUAL, RETIREMENTS AND ADDITIONS

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- Total electricity production in the Eastern Europe region is expected to double by the middle of the century, with an annual growth rate of 2.3%.
- Nuclear electricity production is also projected to continue to grow in both the low and the high case, albeit at different rates.
- In the low case, nuclear electricity production is projected to increase moderately from 352 TW·h in 2017 to 399 TW·h in 2030 and then at a relatively slower rate, reaching 480 TW·h in 2050. The share of nuclear electricity in total electricity production will, however, decrease from 22% in 2017 to 17.9% in 2030 and to 14.2% in 2050.
- In the high case, nuclear electricity production is projected to increase much faster, with a 63% increase by 2030 and a further 43% increase between 2030 and 2050. The share of nuclear electricity in total electricity production will increase from 22% in 2017 to 25.7% in 2030, but will decrease to 21.4% in 2050.

FIGURE 32. NUCLEAR ELECTRICITY PRODUCTION IN THE EASTERN EUROPE REGION

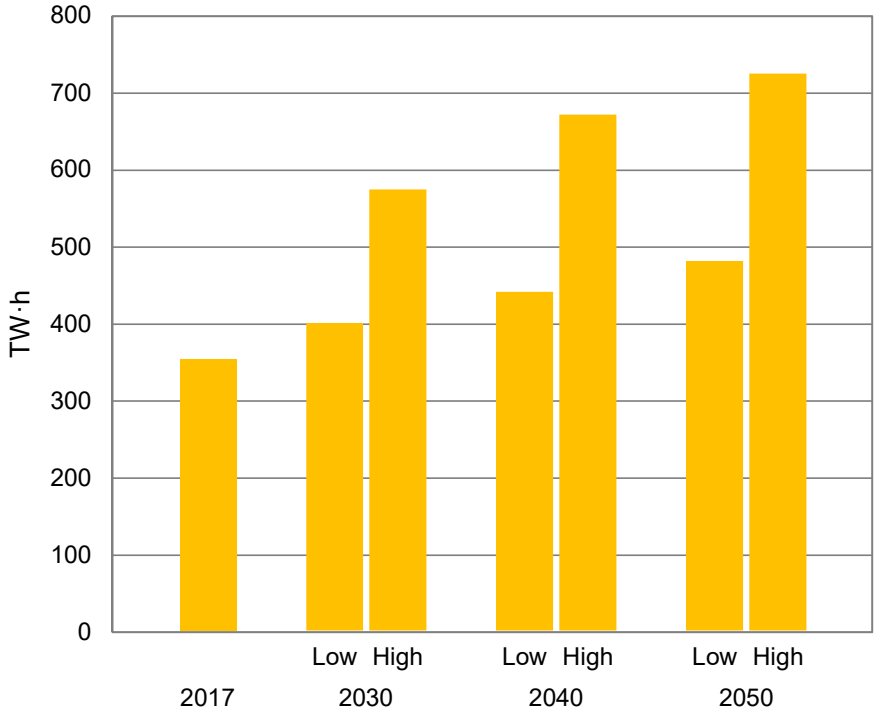


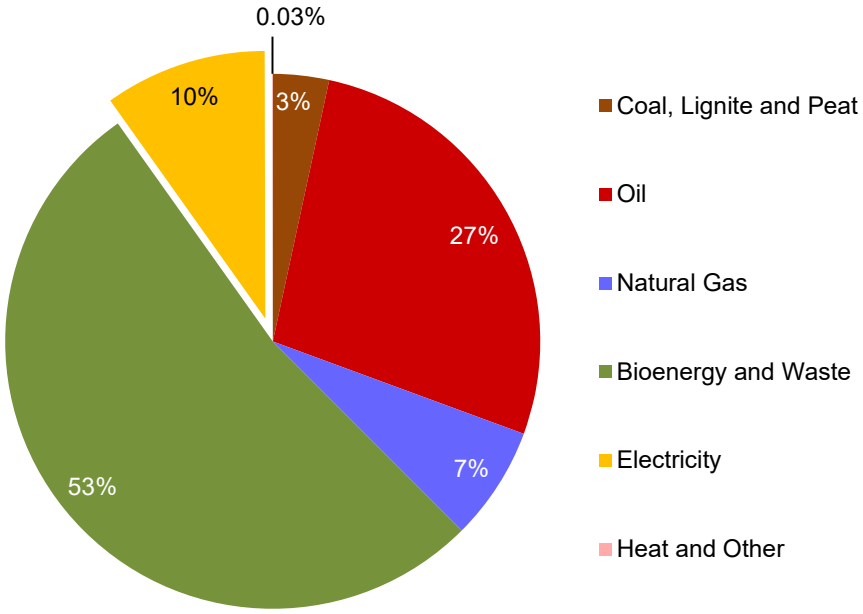
TABLE 18. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE EASTERN EUROPE REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	1 599	2 225		2 778		3 381	
Nuclear (TW·h)	352	399	573	440	670	480	723
% of total	22.0	17.9	25.7	15.8	24.1	14.2	21.4

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 17 cannot be used to calculate average annual capacity factors for nuclear plants as Table 17 presents year-end capacity.

Africa

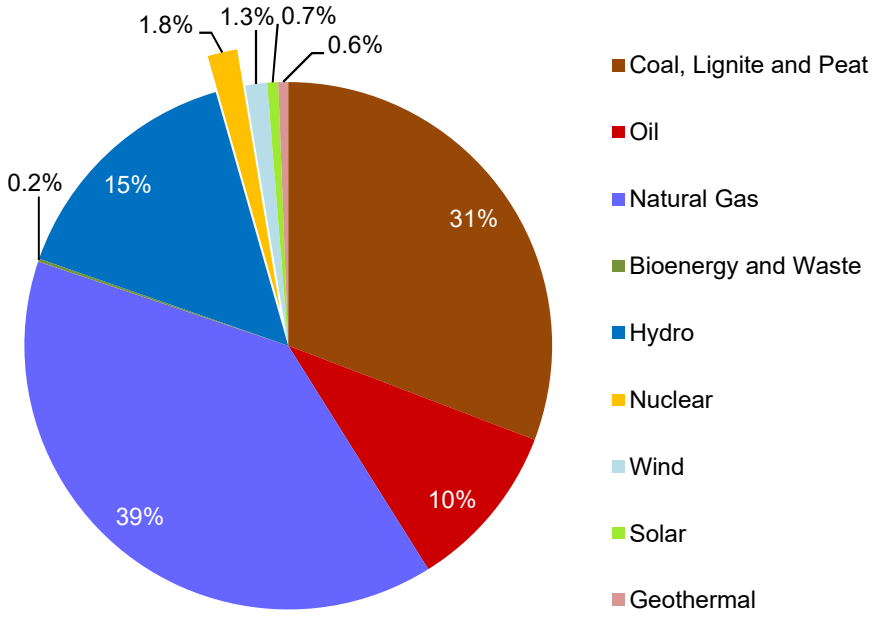
FIGURE 33. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE AFRICA REGION IN 2017



Final Energy Consumption in 2017

Final energy consumption in the Africa region in 2017 was dominated by the use of bioenergy and waste (traditional fuels); electricity accounted for only 10% of the total final energy consumption.

FIGURE 34. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE AFRICA REGION IN 2017



Electricity Production in 2017

About 80% of electricity production in 2017 was based on fossil fuels (gas (39%), coal (31%) and oil (10%)). Hydropower provided 15% of the total, while other renewables contributed about 3%. Only one country in this region uses nuclear power. Nuclear generated electricity accounted for 1.8% of total electricity production for the region.

Energy and Electricity Projections

- Final energy consumption in the Africa region is expected to initially increase by about 2% per year and then to grow by 3% per year.
- Electricity consumption is expected to grow at a faster rate — about 5% per year during the entire period. It is expected to increase from 2 EJ in 2017 to 4 EJ and 11 EJ by 2030 and 2050, respectively.
- The share of electricity in final energy consumption will thus increase from 9.8% in 2017 to 13.1% in 2030 and to 18.5% by the middle of the century.

FIGURE 35. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE AFRICA REGION

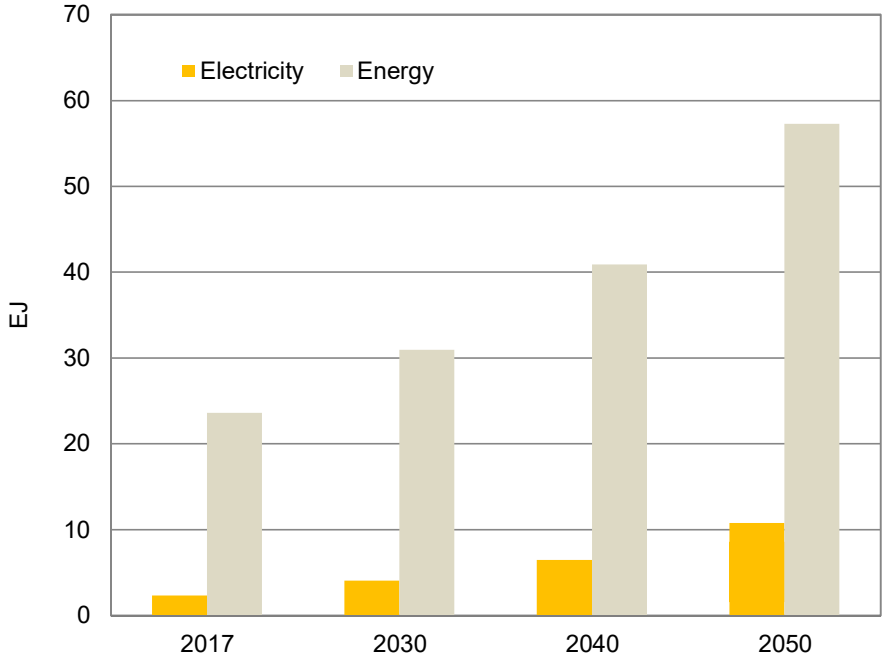


TABLE 19. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE AFRICA REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	23.6	30.9	40.9	57.3
Electricity (EJ)	2.3	4.0	6.5	10.6
% of total	9.8	13.1	15.8	18.5

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Per Capita Energy and Electricity

- The region's final energy consumption on a per capita basis is not expected to increase by 2030 owing to continued population growth. However, between 2030 and 2050, there will be a significant increase in per capita energy consumption.
- Electricity consumption on a per capita basis is expected to increase significantly, with a 50% increase in the next 13 years, from 0.6 MW·h per person in 2017 to 0.9 MW·h per person in 2030, and a further 67% increase to reach 1.5 MW·h per person in 2050.

FIGURE 36. PER CAPITA ELECTRICITY PRODUCTION IN THE AFRICA REGION

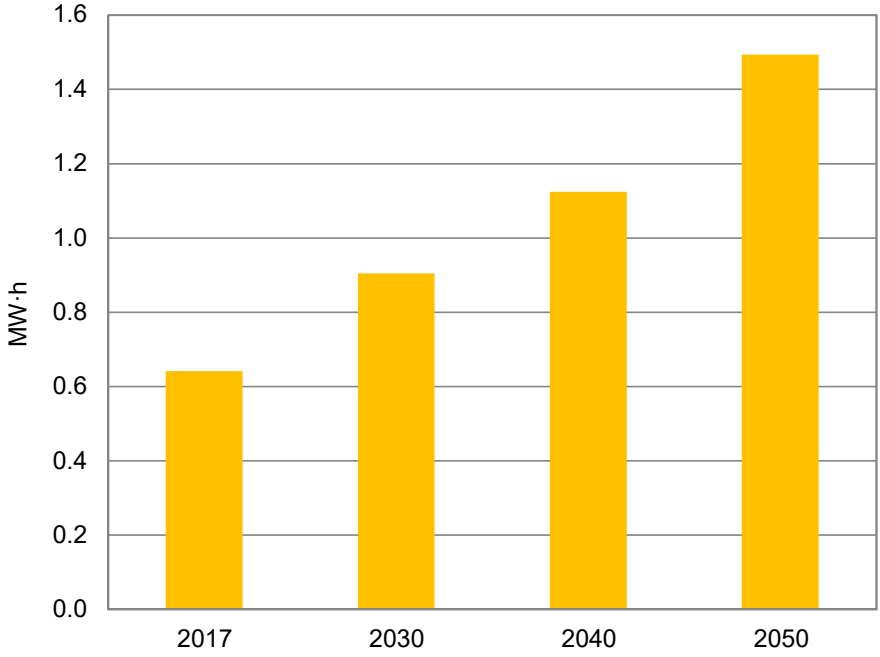
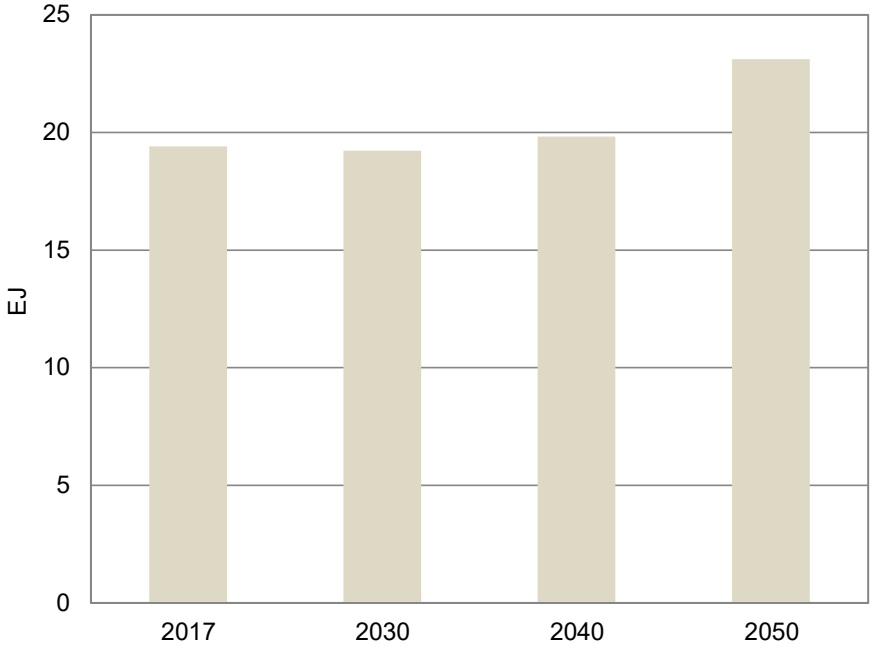


FIGURE 37. PER CAPITA FINAL ENERGY CONSUMPTION IN THE AFRICA REGION



Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the Africa region is expected to increase substantially, from 202 GW(e) in 2017 to 349 GW(e) by 2030 and to 841 GW(e) by 2050.
- The development of nuclear power is expected to face significant uncertainty.
- In the low case, nuclear electrical generating capacity is projected to increase from present level of 2 GW(e) to 3 GW(e) by 2030 and then to 8 GW(e) by 2050. The share of nuclear electrical generating capacity in the total electrical generating capacity is thus projected to stay at the present level of 0.9% until 2030 and then to increase slightly to 1% by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase to 4 GW(e) by 2030 and then to 13 GW(e) by 2050. The share of nuclear electrical generating capacity in total electrical capacity is expected to reach about 1.6% by 2050.

FIGURE 38. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE AFRICA REGION

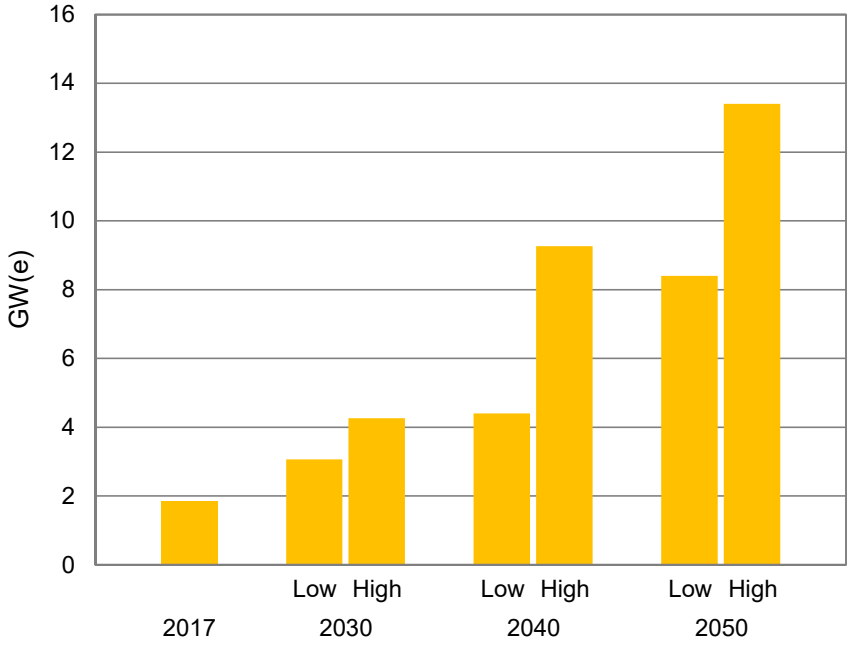


TABLE 20. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE AFRICA REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	202	349		556		841	
Nuclear (GW(e))	2	3	4	4	9	8	13
% of total	0.9	0.9	1.2	0.8	1.7	1.0	1.6

[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Electricity and Nuclear Production Projections

- Total electricity production in the Africa region is expected to double by 2030 and then increase further, at an even faster rate, reaching 3699 TW·h by 2050.
- Nuclear electricity production is projected to follow the nuclear electrical generating capacity trend.
- In the low case, nuclear electricity production is projected to increase to 23 TW·h by 2030 and then to 68 TW·h by 2050. The share of nuclear electricity in total electricity production will thus decrease from 1.9% in 2017 to 1.6% in 2030 and then increase to 1.8% in 2050.
- In the high case, nuclear electricity production is projected to first increase by about 50%, growing from 15 TW·h in 2017 to 32 TW·h by 2030, and then to increase substantially, reaching 108 TW·h by 2050. The share of nuclear electricity in total electricity production will increase from 1.9% in 2017 to 2.2% in 2030 and then to 2.9% in 2050.

FIGURE 39. ELECTRICITY PRODUCTION BY NUCLEAR POWER IN THE AFRICA REGION

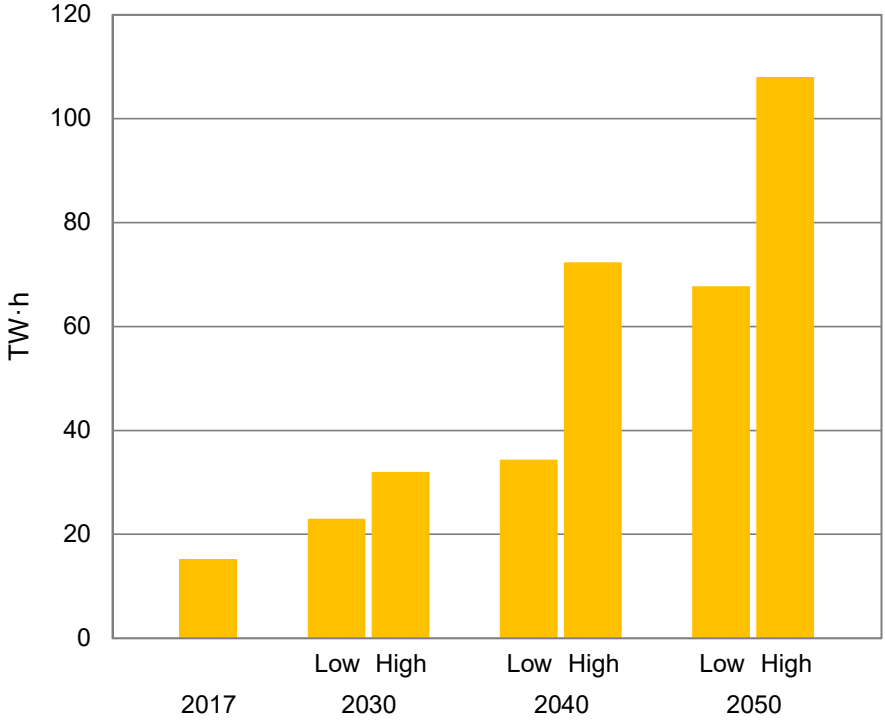


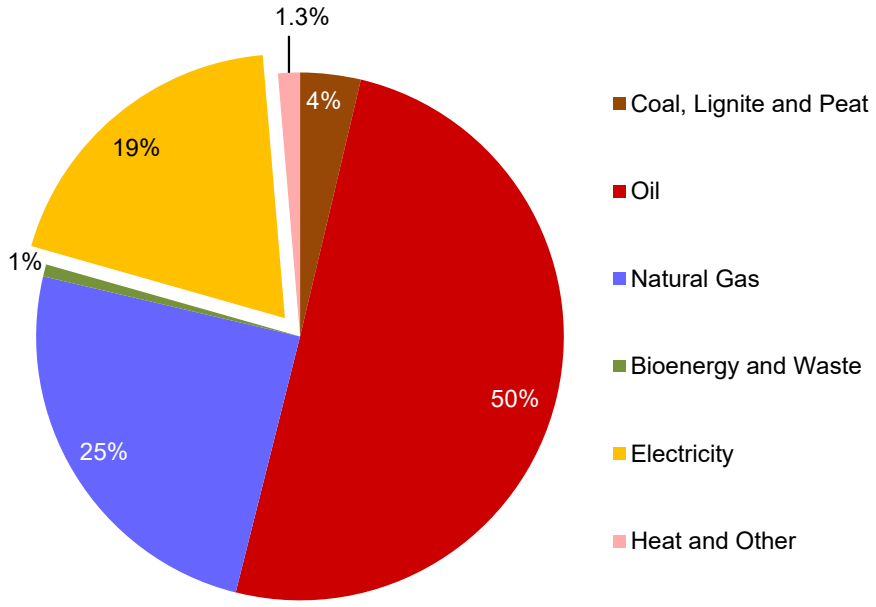
TABLE 21. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE AFRICA REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	780	1 454		2 319		3 699	
Nuclear (TW·h)	15	23	32	34	72	68	108
% of total	1.9	1.6	2.2	1.5	3.1	1.8	2.9

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 20 cannot be used to calculate average annual capacity factors for nuclear plants as Table 20 presents year-end capacity.

Western Asia

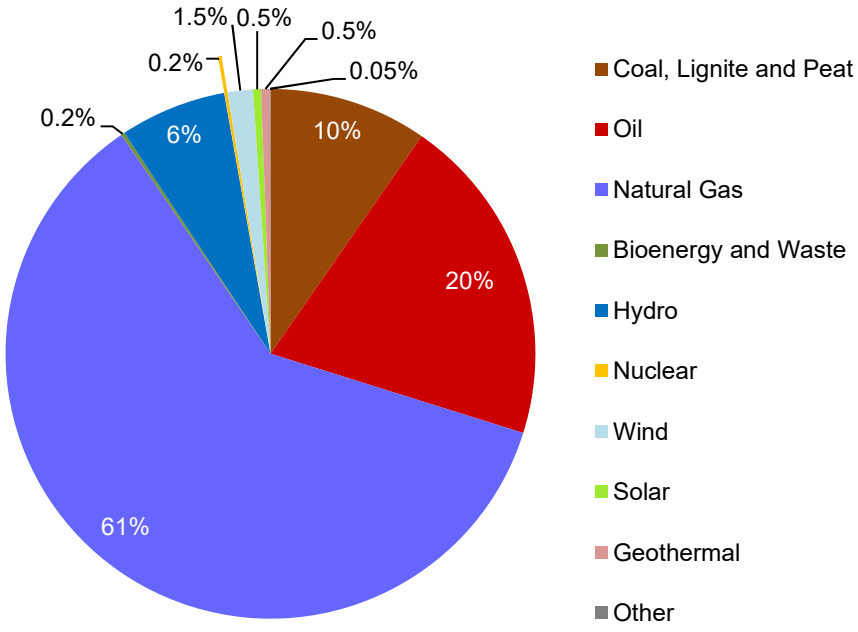
FIGURE 40. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE WESTERN ASIA REGION IN 2017



Final Energy Consumption in 2017

More than half the final energy consumed in the Western Asia region in 2017 was in the form of oil and gas. Electricity accounted for 19% of the total energy consumption.

FIGURE 41. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE WESTERN ASIA REGION IN 2016



Electricity Production in 2017

The electricity production mix in the Western Asia region in 2017 was dominated by gas (61%), followed by oil (20%) and coal (10%). Hydropower and other renewables contributed about 8.5%. Nuclear electricity accounted for only 0.2% of total electricity production in the region.

Energy and Electricity Projections

- Final energy consumption in the Western Asia region is expected to stay at around the present level up to 2030 and to increase slightly thereafter.
- Electricity consumption, however, is expected to increase by about 2.5% per year over the entire period — by 2% per year between 2017 to 2030 and by 2.8% per year in the subsequent 20 years.
- Consequently, the share of electricity in final energy consumption will increase from 19.3% in 2017 to 23.5% by 2030 and to 32.7% by the middle of the century.

FIGURE 42. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE WESTERN ASIA REGION

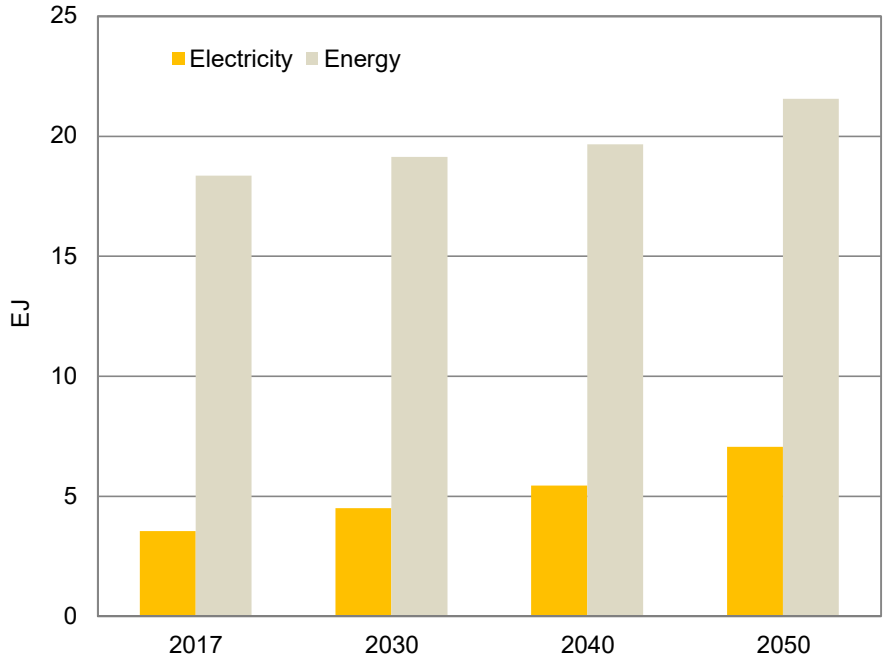


TABLE 22. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE WESTERN ASIA REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	18.4	19.1	19.7	21.6
Electricity (EJ)	3.5	4.5	5.4	7.1
% of total	19.3	23.5	27.7	32.7

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the Western Asia region is projected to increase by 27% to reach 409 GW(e) by 2030, from 325 GW(e) in 2017, and then by 40% to reach 574 GW(e) by 2050.
- Although there currently is only one nuclear power reactor operating in this region, more nuclear electrical generating capacity is projected in the coming years.
- In the low case, the nuclear electrical generating capacity is projected to be 8 GW(e) in 2030 and 12 GW(e) by 2050. The share of nuclear electrical generating capacity in the total electrical capacity will thus increase from 0.1% to 1.9% by 2030 and to about 2.1% by 2050.
- In the high case, the nuclear electrical generating capacity is projected to increase to 13 GW(e) in 2030 and to about 26 GW(e) in 2050. The share of nuclear electrical generating capacity in total electricity capacity will reach 3.1% in 2030 and about 4.5% in 2050.

FIGURE 43. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE WESTERN ASIA REGION

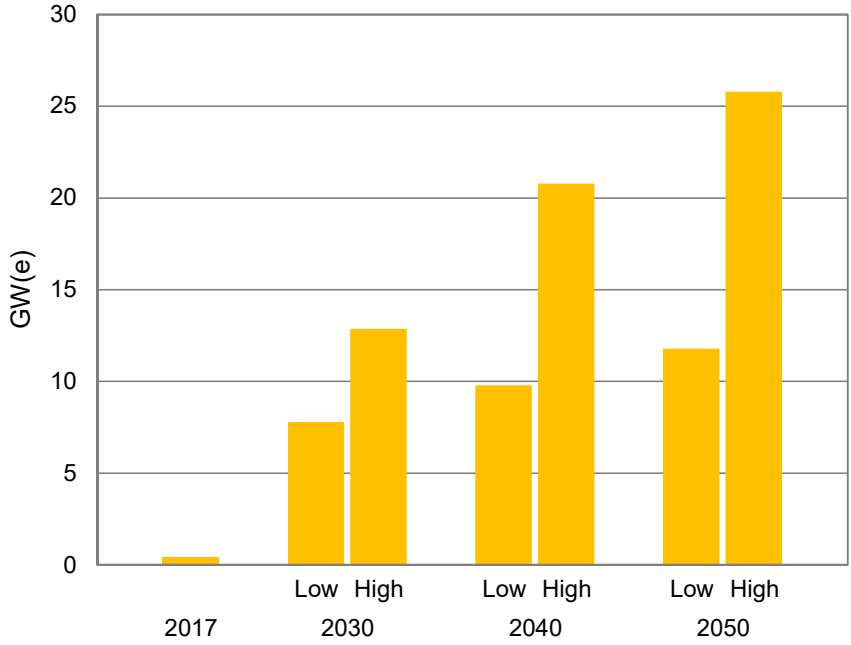


TABLE 23. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE WESTERN ASIA REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	335	409		481		574	
Nuclear (GW(e))	0.38	8	13	10	21	12	26
% of total	0.1	1.9	3.1	2.0	4.3	2.1	4.5

[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Electricity and Nuclear Production Projections

- Total electricity production in the Western Asia region is projected to increase from 1163 TW·h in 2017 to 1479 TW·h in 2030 — an increase of about 27% — and then to 2281 TW·h by 2050 — an additional increase of about 69%.
- Although the single nuclear power reactor in the region provided only 2 TW·h in 2017, nuclear electricity production is expected to increase significantly in both the low and the high case.
- In the low case, nuclear electricity production is projected to increase to 59 TW·h in 2030 and to 95 TW·h in 2050. The share of nuclear electricity in total electricity production will thus increase from 0.2% in 2017 to 4% in 2030 and to about 4.2% in 2050.
- In the high case, nuclear electricity production is projected to grow faster, reaching 98 TW·h by 2030 and 208 TW·h by 2050. The share of nuclear electricity in total electricity production will thus increase to 6.6% in 2030 and to 9.1% in 2050.

FIGURE 44. NUCLEAR ELECTRICITY PRODUCTION IN THE WESTERN ASIA REGION

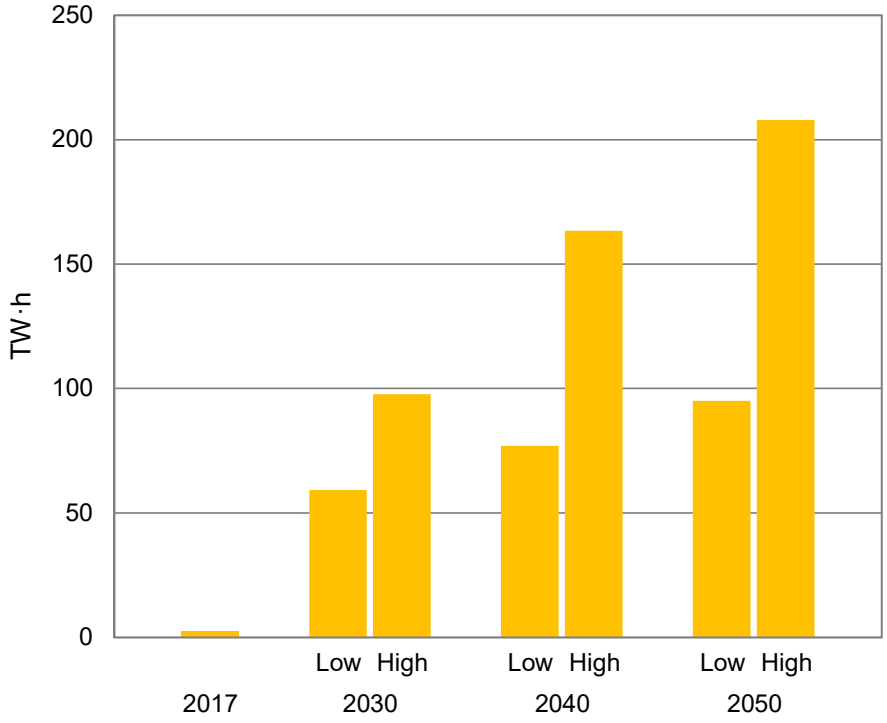


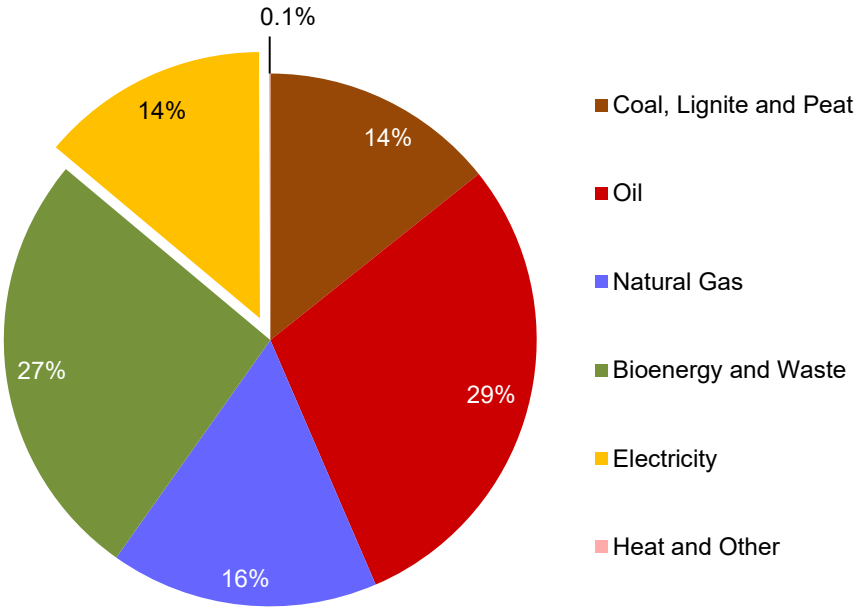
TABLE 24. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE WESTERN ASIA REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	1 163	1 479		1 773		2 281	
Nuclear (TW·h)	2	59	98	77	163	95	208
% of Nuclear	0.2	4.0	6.6	4.3	9.2	4.2	9.1

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 23 cannot be used to calculate average annual capacity factors for nuclear plants as Table 23 presents year-end capacity.

Southern Asia

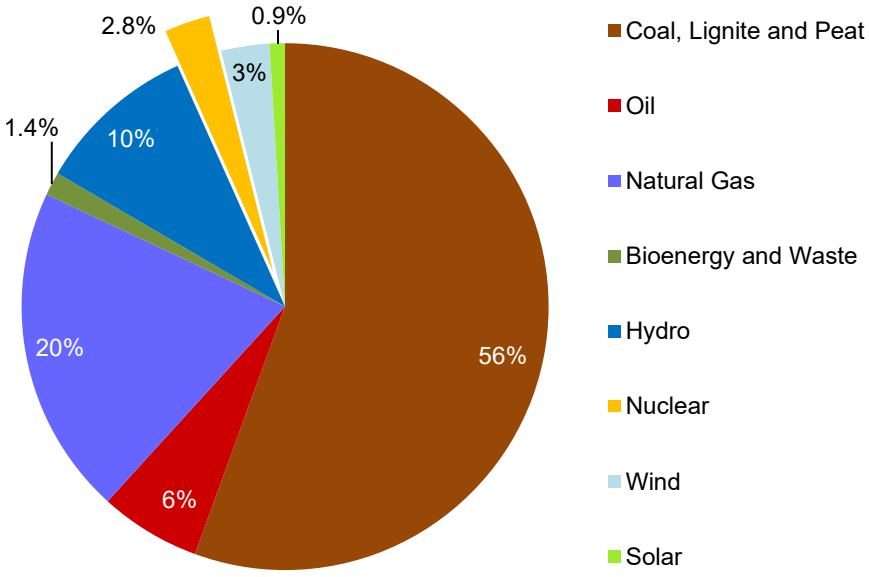
FIGURE 45. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE SOUTHERN ASIA REGION IN 2017



Final Energy Consumption in 2017

Final energy consumption in the Southern Asia region was dominated by the use of fossil fuels in 2017, but bioenergy and waste (traditional fuels) continued to provide a large proportion, accounting for 27% of the total. The use of electricity is growing but still accounted for only 14% of total consumption.

FIGURE 46. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE SOUTHERN ASIA REGION IN 2017



Electricity Production in 2017

About 82% of electricity production in 2017 was fossil fuel based (coal (56%), gas (20%) and oil (6%)). Hydropower accounted for 10%, while nuclear power contributed only 2.8% of the total. Renewables and other sources accounted for about 5% of the total electricity production.

Energy and Electricity Projections

- Final energy consumption in the Southern Asia region is expected to increase at an average annual growth rate of 2.5% — more than doubling between 2017 and 2050. The growth rate is expected to be 3.2% per year until 2030, decreasing to 2% per year thereafter.
- Electricity consumption is expected to grow even faster, doubling in the next 13 years and doubling again between 2030 and 2050.
- The share of electricity in final energy consumption will thus increase from 13.8% in 2017 to 16.6% in 2030 and to 22.8% by the middle of the century.

FIGURE 47. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE SOUTHERN ASIA REGION

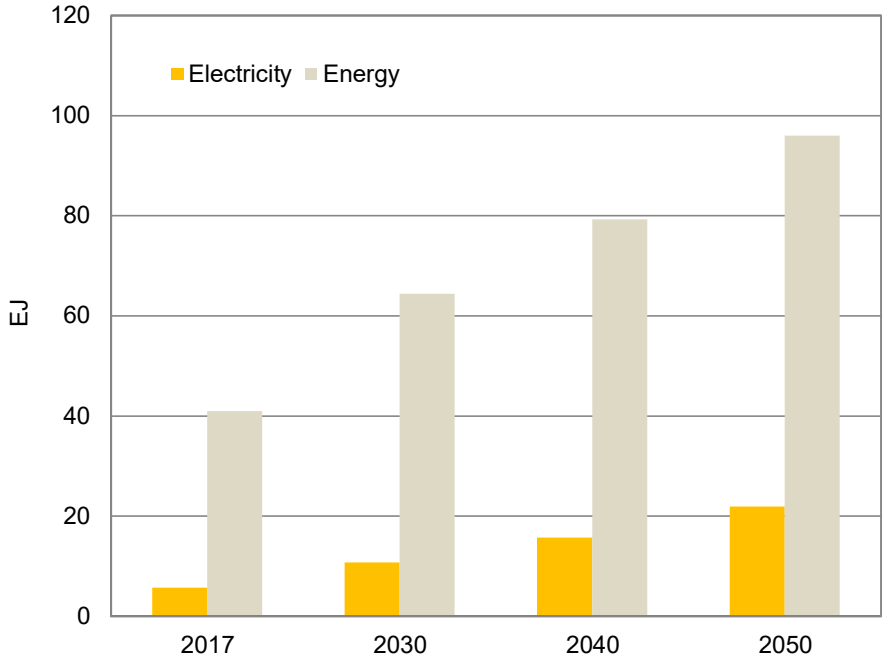


TABLE 25. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE SOUTHERN ASIA REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	41.0	64.4	79.3	96.0
Electricity (EJ)	5.7	10.7	15.7	21.9
% of total	13.8	16.6	19.8	22.8

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the Southern Asia region is projected to reach 973 GW(e) by 2030, from the 2017 level of 495 GW(e), representing a doubling of the capacity in 13 years. This trend will continue in the subsequent 20 years, resulting in an 85.6% increase in total electrical generating capacity.
- Nuclear electrical generating capacity is also projected to increase considerably in both the low and the high case.
- In the low case, nuclear electrical generating capacity is projected to increase from the 2017 level of 8.5 GW(e) to 22 GW(e) by 2030 and to 50 GW(e) by 2050. The share of nuclear electrical generating capacity in total electricity capacity is thus projected to increase from 1.7% in 2017 to 2.3% by 2030 and 2.8% by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase substantially, from 8.5 GW(e) in 2017 to 34 GW(e) by 2030 and 98 GW(e) by 2050. The share of nuclear in total electrical generating capacity will thus increase from 1.7% in 2017 to 3.5% by 2030 and to 5.4% by 2050.

FIGURE 48. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE SOUTHERN ASIA REGION

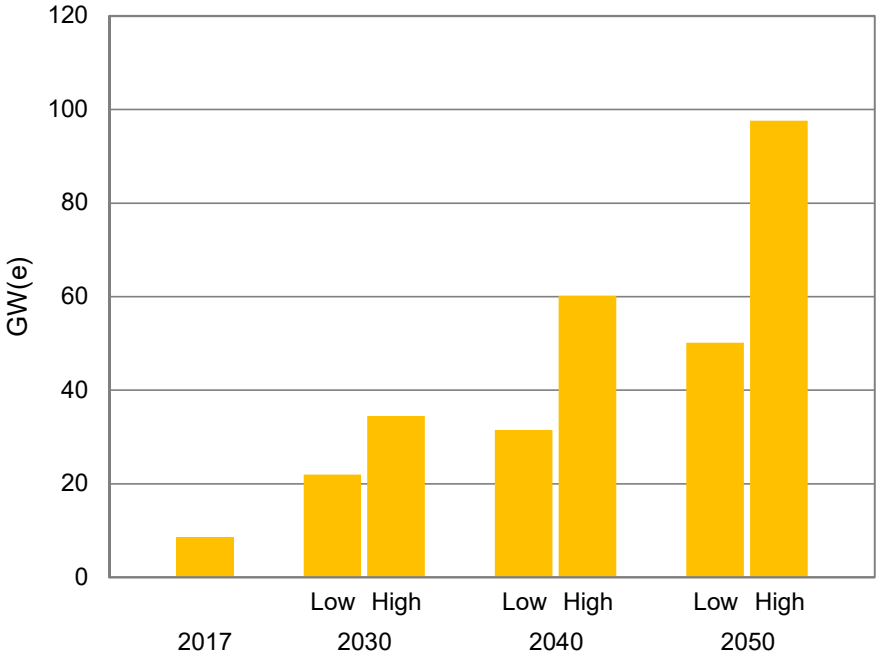


TABLE 26. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE SOUTHERN ASIA REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	495	973		1 330		1 806	
Nuclear (GW(e))	8.5	22	34	31	60	50	98
% of total	1.7	2.3	3.5	2.4	4.5	2.8	5.4

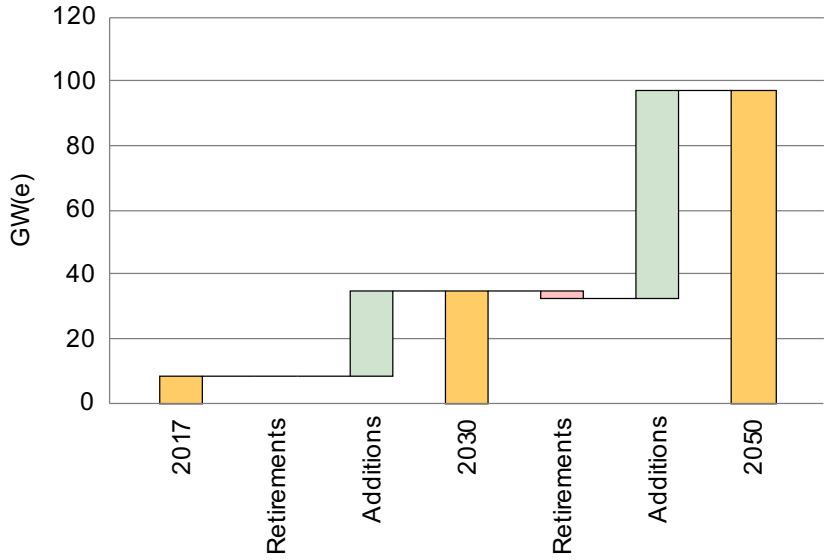
[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Reactor Retirements and Additions

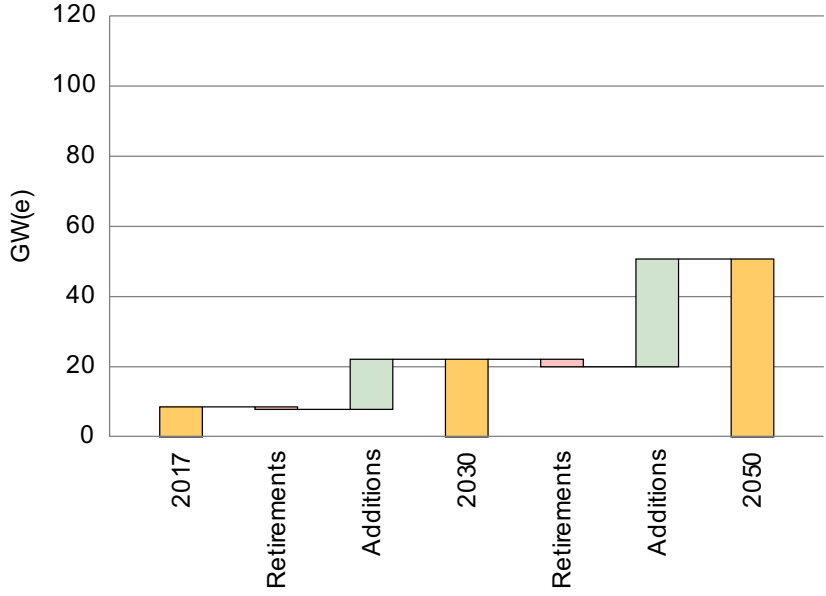
- The existing nuclear power reactors in the Southern Asia region are relatively young, and the majority are expected to remain in operation until the middle of the century.
- In the low case, only 1 GW(e) of nuclear electrical generating capacity will be retired by 2030 and an additional 2 GW(e) of capacity will be retired between 2030 and 2050. The projected additions of nuclear capacity in this case are 15 GW(e) by 2030 and some 30 GW(e) by 2050.
- In the high case, the nuclear capacity retired will be even smaller — only 2 GW(e) over the entire period. The projected additions of nuclear electrical generating capacity in this case are very substantial — about 26 GW(e) added by 2030 and some 65 GW(e) added by 2050.

FIGURE 49. NUCLEAR CAPACITY IN THE SOUTHERN ASIA REGION: ACTUAL, RETIREMENTS AND ADDITIONS

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- The total electricity production in the Southern Asia region is expected to double in the next 13 years, and then to double again in the subsequent 20 years to 2050.
- The nuclear generated electricity is projected to show even higher growth.
- In the low case, nuclear electricity production is projected to increase 3.5-fold in the next 13 years, with a further 2.5-fold increase over the subsequent 20 years. The share of nuclear electricity in the total will thus increase from 2.5% in 2017 to 4.4% in 2030 and to 5% in 2050.
- In the high case, much greater increases in nuclear electricity production are projected: an almost sixfold increase in the next 13 years and another almost threefold increase in the subsequent 20 years. The share of nuclear electricity in total electricity production will increase from 2.5% in 2017 to 6.9% in 2030 and to 9.8% in 2050.

FIGURE 50. NUCLEAR ELECTRICITY PRODUCTION IN THE SOUTHERN ASIA REGION

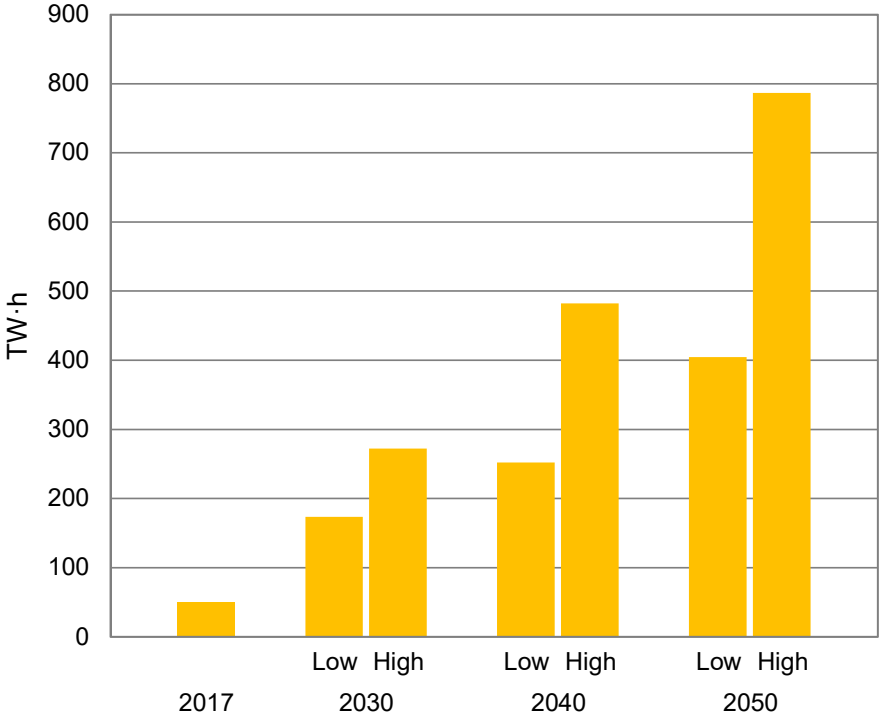


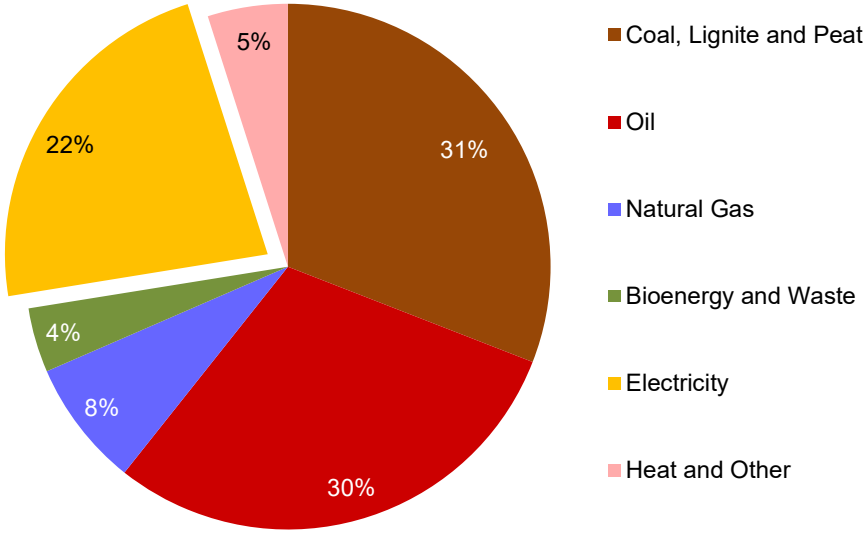
TABLE 27. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE SOUTHERN ASIA REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	1 953	3 921		5 754		8 044	
Nuclear (TW·h)	49	173	272	252	482	404	786
% of total	2.5	4.4	6.9	4.4	8.4	5.0	9.8

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 26 cannot be used to calculate average annual capacity factors for nuclear plants as Table 26 presents year-end capacity.

Central and Eastern Asia

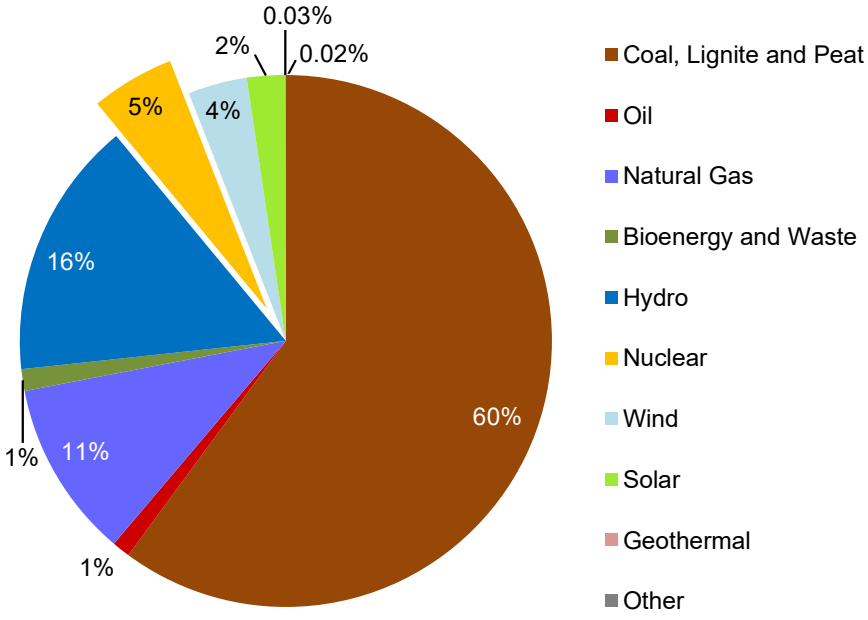
FIGURE 51. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA IN 2017



Final Energy Consumption in 2017

Fossil fuels accounted for about two thirds of the final energy consumption in the combined regions of Central and Eastern Asia in 2017. Electricity supplied 22% of the total final energy used.

FIGURE 52. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA IN 2017



Electricity Production in 2017

The electricity production mix in 2017 was highly dominated by coal, which accounted for as much as 60% of the total production, followed by hydropower (16%) and gas (11%). Nuclear power contributed about 5%, while renewable sources accounted for about 7% of total electricity production.

Energy and Electricity Projections

- Final energy consumption in the combined regions of Central and Eastern Asia is expected to increase significantly (21%) between 2017 and 2030, and to flatten out thereafter, increasing only 3.5% from 2030 to 2050.
- Electricity consumption will increase much faster, with a 45% increase from 2017 to 2030. This trend will continue thereafter, with an additional increase of 36% in the subsequent 20 years until 2050. Altogether, there will be almost doubling of electricity use between 2017 and 2050.
- The share of electricity in final energy consumption will thus increase from 22.6% in 2017 to 27.2% in 2030 and to 35.7% in 2050.

FIGURE 53. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA

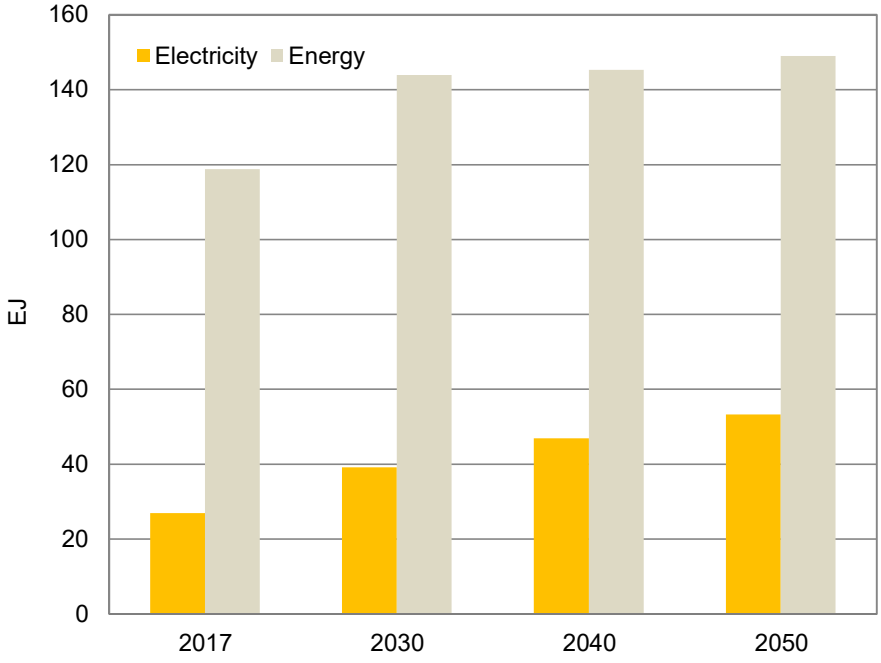


TABLE 28. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA

Final Consumption	2017	2030	2040	2050
Energy (EJ)	118.8	143.9	145.3	149.0
Electricity (EJ)	26.9	39.1	46.9	53.3
% of total	22.6	27.2	32.3	35.7

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- The combined regions of Central and Eastern Asia are expected to continue to grow at a fast pace. Electrical generating capacity is projected to increase by 64% in the next 13 years to reach 3903 GW(e) by 2030 and 4609 GW(e) by 2050.
- Nuclear electrical generating capacity is also projected to increase significantly in both the low and the high case.
- Even in the low case, nuclear electrical generating capacity is projected to increase from the 2017 level of 102 GW(e) to 116 GW(e) by 2030 and 145 GW(e) by 2050. However, since the growth of nuclear electrical generating capacity is projected to be slower than that of total electrical capacity, the share of nuclear electrical generating capacity is projected to decrease from 4.3% in 2017 to 3% by 2030 and 3.1% by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase much faster, doubling in the next 13 years and increasing by a further 80% by 2050. The share of nuclear electrical generating capacity in total electrical generating capacity will thus increase from 4.3% in 2017 to 4.4% in 2030 and to 6.7% in 2050.

FIGURE 54. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA

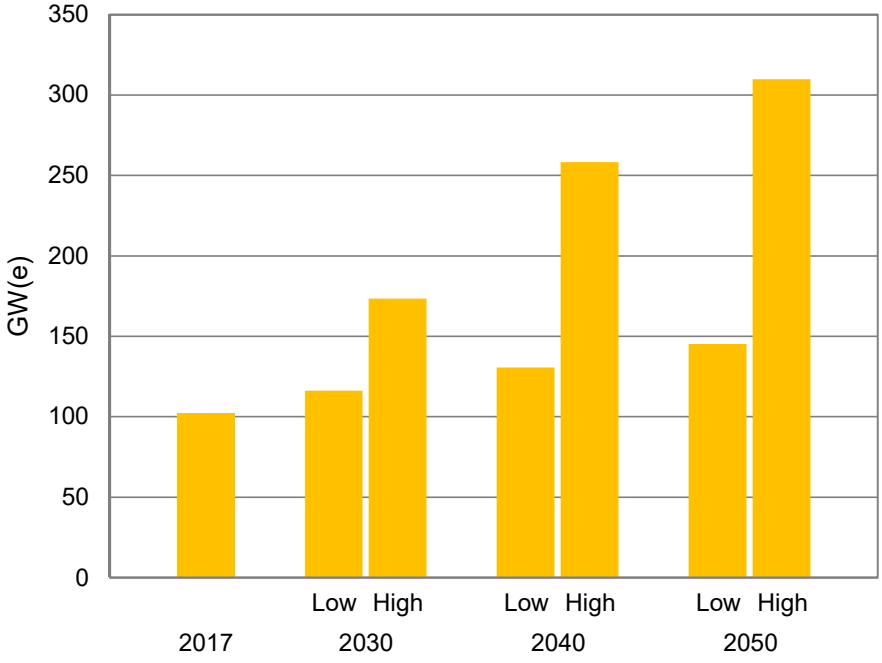


TABLE 29. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	2 383	3 903		4 487		4 609	
Nuclear (GW(e))	102	116	173	131	258	145	310
% of total	4.3	3.0	4.4	2.9	5.8	3.1	6.7

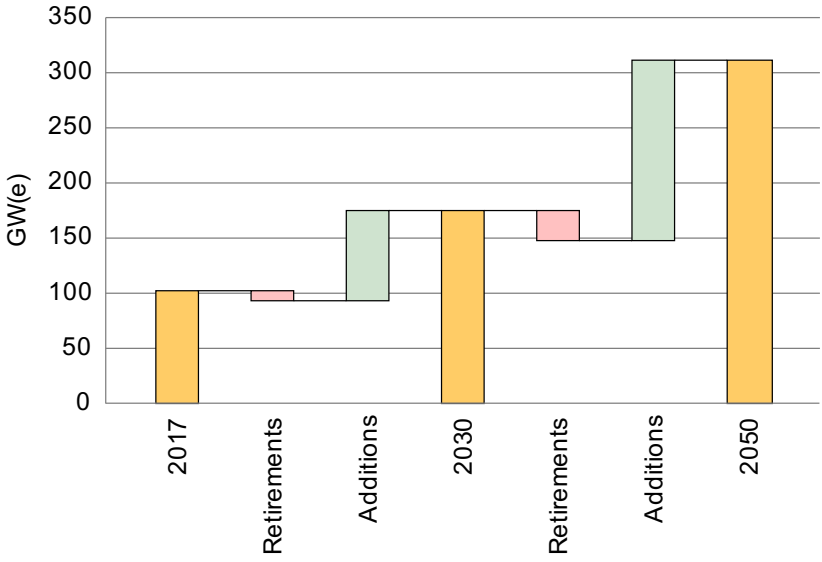
[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

Reactor Retirements and Additions

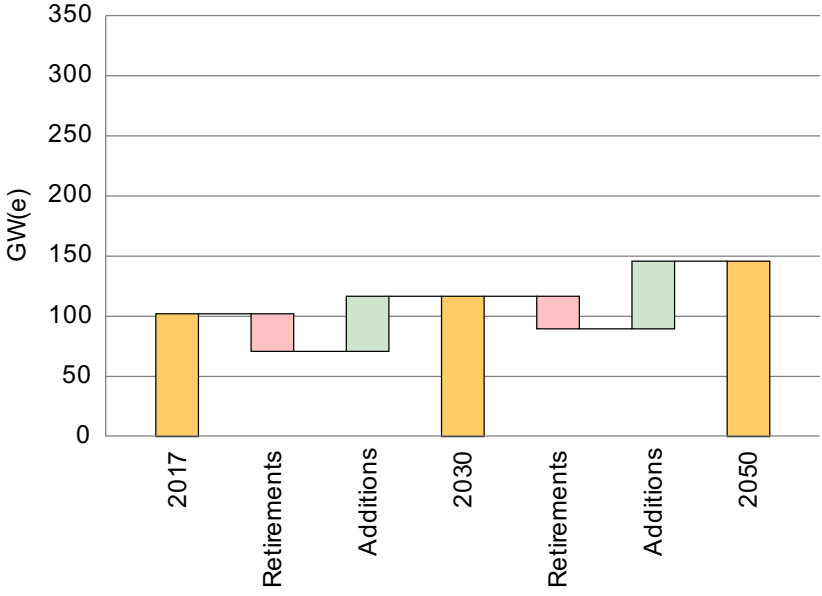
- Most of the existing nuclear power reactors in the combined regions of Central and Eastern Asia are relatively new, and only a few are scheduled to be retired by 2030.
- In the low case, several of the nuclear power reactors in this region currently out of operation in the aftermath of the Fukushima Daiichi accident will not be put back into operation. Consequently, some 32 GW(e) of nuclear power capacity will be retired by 2030 and an additional 28 GW(e) will be retired by 2050. The projected additions of nuclear capacity in this case are 46 GW(e) by 2030 and an additional 57 GW(e) by 2050.
- In the high case, it is assumed that most of the units taken out of operation after the Fukushima Daiichi accident will resume operation. As such, only 10 GW(e) of nuclear capacity will be retired by 2030; thereafter, some 27 GW(e) of capacity will be retired by 2050. Construction of new capacity in this case is projected to be extensive: about 81 GW(e) in the next 17 years and some 163 GW(e) between 2030 and 2050.

FIGURE 55. NUCLEAR CAPACITY IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA: ACTUAL, RETIREMENTS AND ADDITIONS

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- To meet the fast growing demand for electricity in the combined regions of Central and Eastern Asia, electricity production will increase by 57% by 2030, with a further increase of 80% by 2050.
- The contribution of nuclear power is projected to undergo significant changes in both the low and the high case.
- In the low case, nuclear electricity production is projected to increase significantly — from 425 TW·h in 2017 to 871 TW·h by 2030 and to 1170 TW·h by 2050. The share of nuclear electricity in the total will thus increase from 5.2% in 2017 to 6.8% in 2030 and stay nearly constant until 2050.
- In the high case, there will be about a threefold increase in nuclear electricity production in the next 13 years — from 425 TW·h in 2017 to 1300 TW·h by 2030 — with a further 90% increase, to 2496 TW·h, by 2050. The share of nuclear electricity in total electricity will thus increase from 5.2% in 2017 to 10.1% in 2030 and to 14.4% in 2050.

FIGURE 56. NUCLEAR ELECTRICITY PRODUCTION IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA

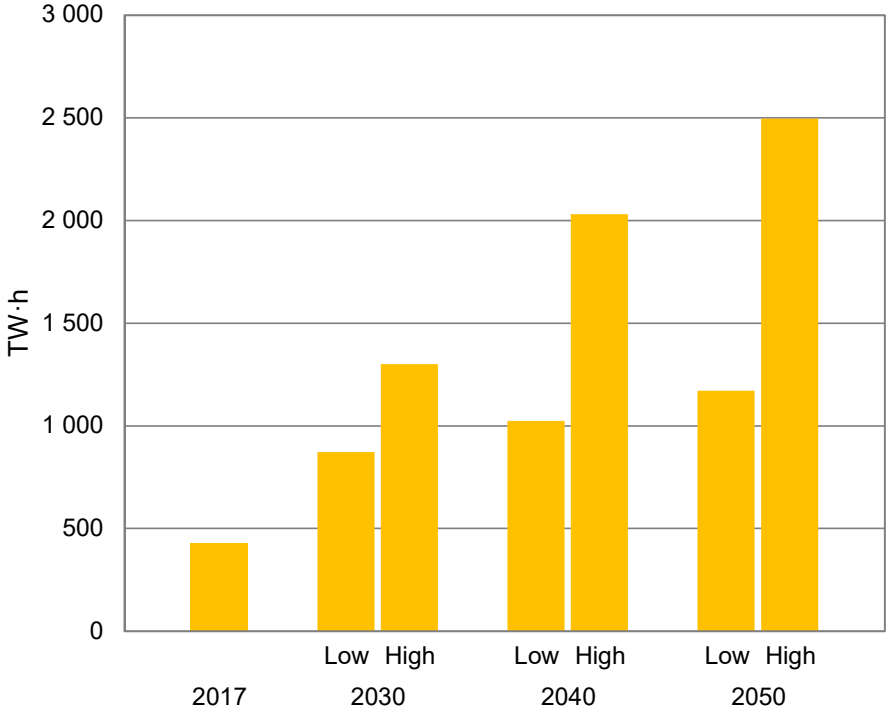


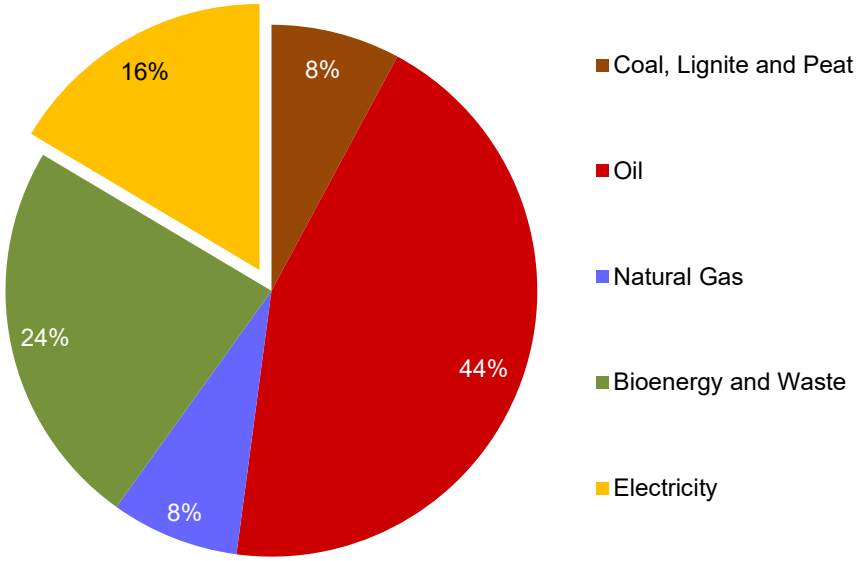
TABLE 30. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	8 217	12 861		15 418		17 281	
Nuclear (TW·h)	425	871	1 300	1 023	2 030	1 170	2 496
% of total	5.2	6.8	10.1	6.6	13.2	6.8	14.4

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 29 cannot be used to calculate average annual capacity factors for nuclear plants as Table 29 presents year-end capacity.

South-eastern Asia

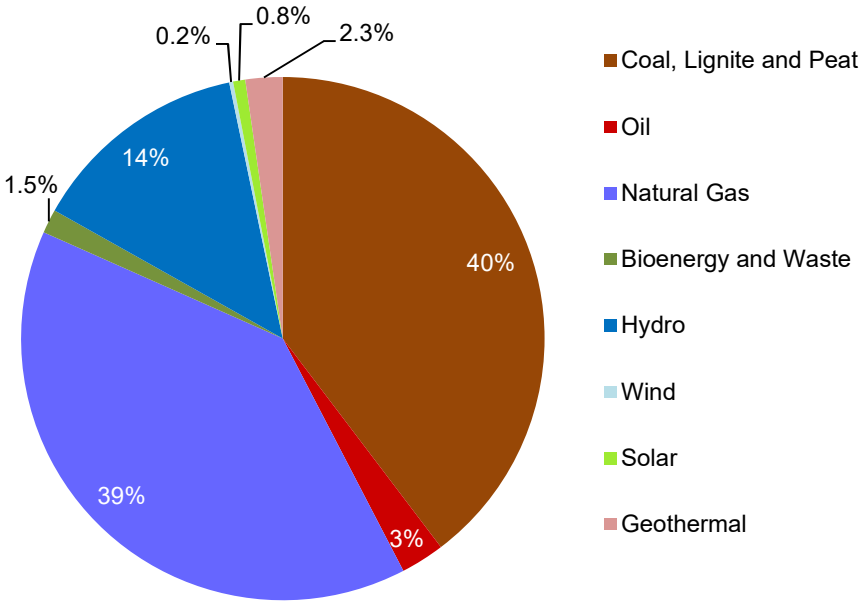
FIGURE 57. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE SOUTH-EASTERN ASIA REGION IN 2017



Final Energy Consumption in 2017

Final energy consumption in the South-eastern Asia region was dominated by the use of fossil fuels (oil (44%), gas (8%) and coal (8%)). Electricity use in 2017 was about one sixth of the total energy consumption.

FIGURE 58. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE SOUTH-EASTERN ASIA REGION IN 2017



Electricity Production in 2017

Coal was the primary source of electricity production in 2017, followed by gas. Hydropower, renewables and other sources accounted for about one fifth of the total electricity production. At present, nuclear power is not used in this region.

Energy and Electricity Projections

- Final energy consumption in the South-eastern Asia region is expected to continue to increase at a relatively rapid rate up to 2030, with about a 50% increase between 2017 and 2030. In the subsequent 20 years, the growth is expected to slow to about 1% per year.
- Electricity consumption is expected to increase at an even faster rate: 3.7% per year from 2017 to 2030 and about 3% per year in the subsequent 20 years to 2050.
- The share of electricity in final energy consumption will thus increase from 16.5% in 2017 to 17.8% in 2030 and to 25.6% by the middle of the century.

FIGURE 59. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE SOUTH-EASTERN ASIA REGION

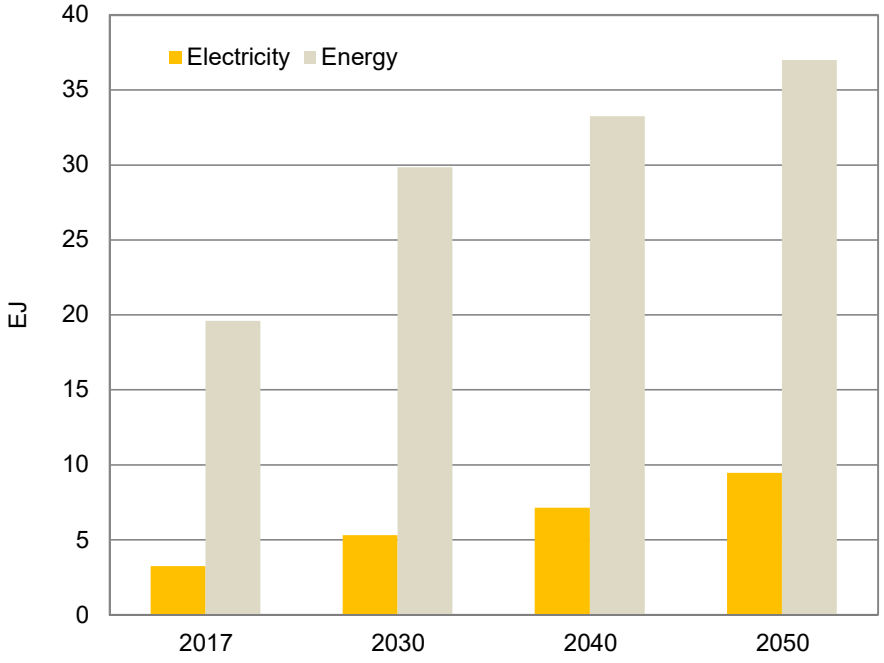


TABLE 31. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE SOUTH-EASTERN ASIA REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	19.6	29.8	33.2	37.0
Electricity (EJ)	3.2	5.3	7.1	9.5
% of total	16.5	17.8	21.4	25.6

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the South-eastern Asia region is projected to increase by 72% to reach 421 GW(e) by 2030 and then to increase by 68% to 709 GW(e) by 2050.
- The nuclear electrical generating capacity in this region is not projected to make a significant contribution: no nuclear reactor is projected to be operational up to 2030 and only 3 GW(e) of nuclear electrical generating capacity is projected by 2050 in the low case.
- Even in the high case, no nuclear power plant is projected to be on-line by 2030. However, some 9 GW(e) of nuclear power capacity is projected to be operational by 2050.
- Correspondingly, nuclear electricity will appear in the electricity production mix of this region only after 2030. In the low case, its contribution to total electricity production is projected to be only 0.8% in 2050, while in the high case it is projected to be 2.5% of the total electricity production in 2050.

TABLE 32. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE SOUTH-EASTERN ASIA REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	245	421		556		709	
Nuclear (GW(e))	0	0	0	1	4	3	9
% of total	0	0	0	0.2	0.7	0.4	1.3

[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

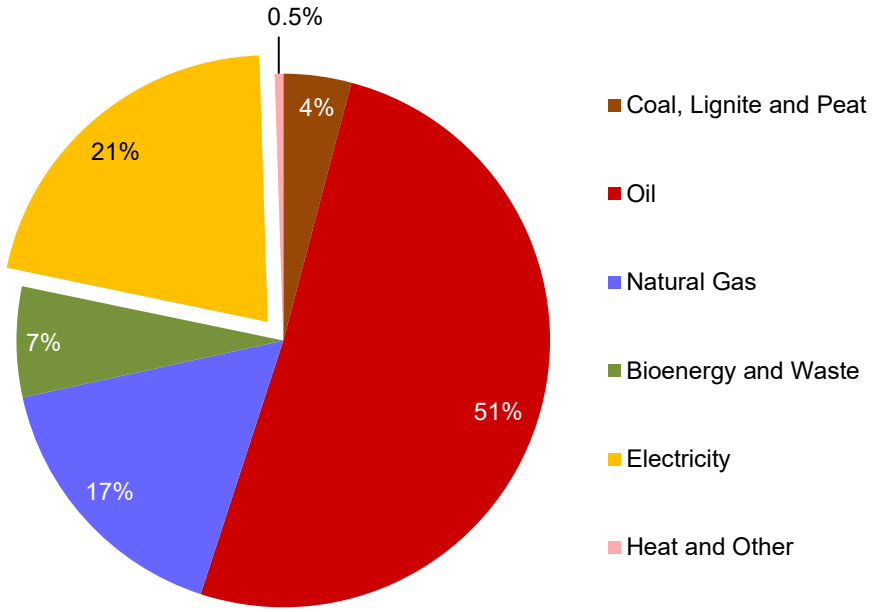
TABLE 33. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE SOUTH-EASTERN ASIA REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	904	1 642		2 210		2 928	
Nuclear (TW·h)	0	0	0	8	31	24	73
% of total	0	0	0	0.4	1.4	0.8	2.5

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 32 cannot be used to calculate average annual capacity factors for nuclear plants as Table 32 presents year-end capacity.

Oceania

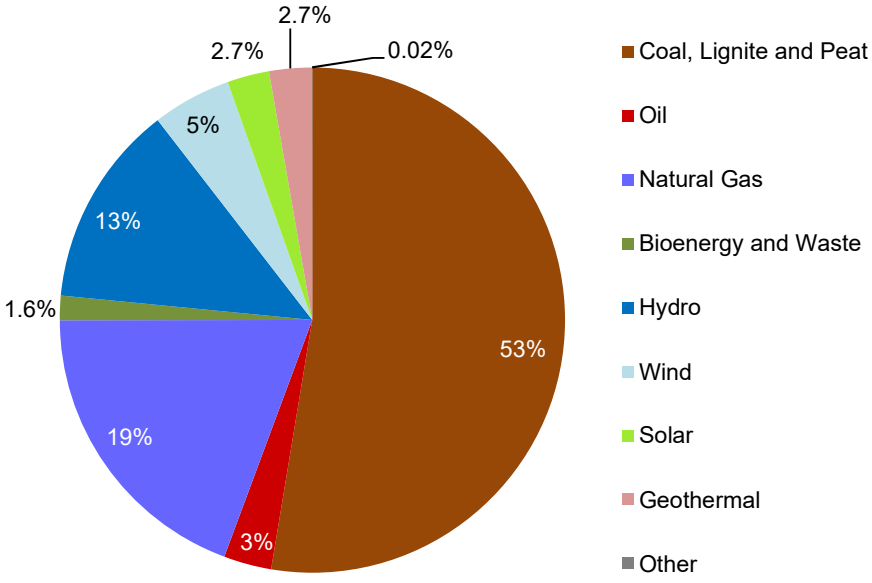
FIGURE 60. FINAL ENERGY CONSUMPTION BY ENERGY SOURCE IN THE OCEANIA REGION IN 2017



Final Energy Consumption in 2017

Final energy consumption in the Oceania region was dominated by oil in 2017. Electricity contributed 21% to total consumption, followed by gas at 17%.

FIGURE 61. ELECTRICITY PRODUCTION BY ENERGY SOURCE IN THE OCEANIA REGION IN 2017



Electricity Production in 2017

Coal based electricity production was 53% in the Oceania region in 2017, while natural gas contributed 19% and hydropower about 13%. Renewables and other sources together provided about 12% of the total electricity production.

Energy and Electricity Projections

- Final energy consumption in the Oceania region is expected to increase at about 1% per year to 2050 — an increase of about 11% by 2030 and another 12% by 2050.
- Electricity consumption will grow faster, at an average annual rate of about 1.5%.
- The share of electricity in final energy consumption will thus increase from 21.2% in 2017 to 28% by the middle of the century.

FIGURE 62. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE OCEANIA REGION

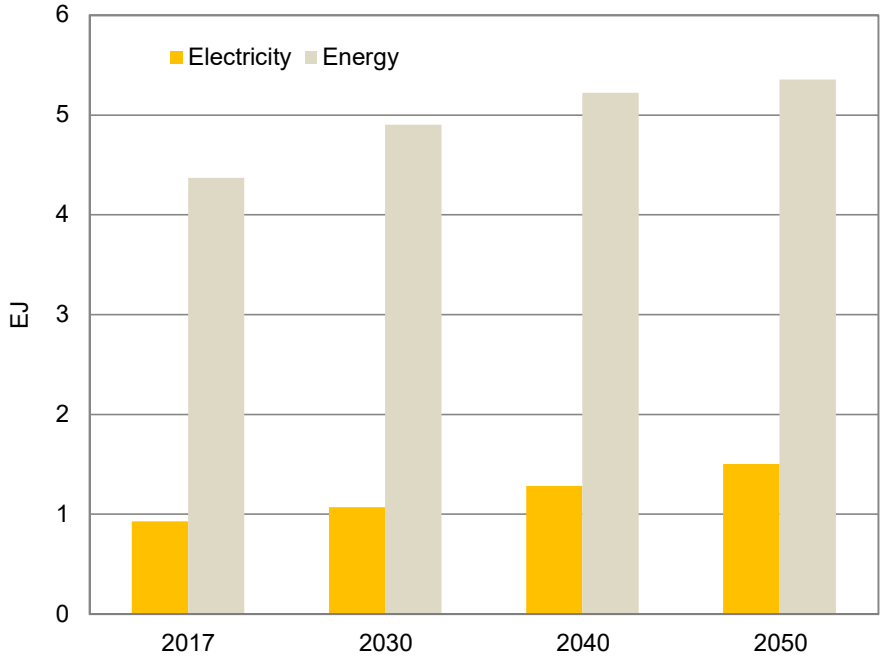


TABLE 34. FINAL CONSUMPTION[a] OF ENERGY AND ELECTRICITY IN THE OCEANIA REGION

Final Consumption	2017	2030	2040	2050
Energy (EJ)	4.4	4.9	5.2	5.4
Electricity (EJ)	0.9	1.1	1.3	1.5
% of total	21.2	21.8	24.6	28.0

[a] Final consumption refers to all fuel and energy that is delivered to energy consumers.

Nuclear Electrical Generating Capacity Projections

- Electrical generating capacity in the Oceania region is projected to increase at a higher rate than electricity consumption. A 40% increase in electrical generating capacity is expected, reaching 111 GW(e) by 2030, followed by another increase of 48% over the next 20 years, reaching 164 GW(e) by 2050.
- Total electricity production is expected to reach an annual growth rate of about 1.5%.
- Nuclear power is not projected to be introduced into the electricity generation mix of this region in the low case.
- In the high case, nuclear power is projected to become part of the electricity production system by the middle of the century, reaching 2 GW(e) of capacity in 2050, providing some 3% of total electricity production in the region.

TABLE 35. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE OCEANIA REGION

Electrical Capacity	2017	2030[a]		2040[a]		2050[a]	
		Low	High	Low	High	Low	High
Total (GW(e))	79	111		136		164	
Nuclear (GW(e))	0	0	0	0	0	0	2
% of total	0	0	0	0	0	0	1.2

[a] Nuclear capacity estimates take into account the scheduled retirement of older units at the end of their lifetime.

TABLE 36. TOTAL AND NUCLEAR ELECTRICAL PRODUCTION IN THE OCEANIA REGION[a]

Electricity Production	2017	2030		2040		2050	
		Low	High	Low	High	Low	High
Total (TW·h)	289	350		421		493	
Nuclear (TW·h)	0	0	0	0	0	0	16
% of total	0	0	0	0	0	0	3.3

[a] The nuclear production data presented in this table and the nuclear electrical generating capacity data presented in Table 35 cannot be used to calculate average annual capacity factors for nuclear plants as Table 35 presents year-end capacity.

Regional Population Data

TABLE 37. POPULATION GROWTH BY REGION

Region	2017 (Million Inhabitants)	2050 (Million Inhabitants)	Growth Rate (%/a) 2017–2050	Ratio (2050:2017)
Northern America	363	433	0.53	1.19
Latin America and the Caribbean	648	784	0.58	1.21
Northern, Western and Southern Europe	447	455	0.05	1.02
Eastern Europe	292	252	– 0.45	0.86
Africa	1 247	2 478	2.10	1.99
Western Asia	266	395	1.21	1.49
Southern Asia	1 870	2 424	0.79	1.30
Central and Eastern Asia	1 694	1 655	– 0.07	0.98
South-eastern Asia	648	792	0.61	1.22
Oceania	40	57	1.02	1.43
World Total	**7 515**	**9 725**	**0.78**	**1.29**

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