REFERENCE DATA SERIES No. 1
2023 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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2023 Edition

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Introduction

Reference Data Series No. 1 (RDS-1) is an annual publication — currently in its 43rd edition — containing estimates of energy, electricity and nuclear power trends up to the year 2050.

The publication is organized into world and regional subsections and starts with a summary of the status of nuclear power in IAEA Member States as of the end of 2022 based on the latest statistical data collected by the IAEA's Power Reactor Information System. It then presents global and regional projections for energy and electricity up to 2050 derived from two international studies: the International Energy Agency's World Energy Outlook 2022 [1] and the United States Energy Information Administration's International Energy Outlook 2021 [2]. The energy and electricity data for 2022 are estimated, as the latest information available from the United Nations Department of Economic and Social Affairs [3] and International Energy Agency [4] is for 2020. Population data originate from World Population Prospects 2022 [5], published by the Population Division of the United Nations Department of Economic and Social Affairs.

Global and regional nuclear power projections are presented as low and high cases, 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 joint OECD Nuclear Energy Agency and IAEA study [6] and (iii) estimates of the expert group participating in an annual IAEA consultancy meeting.

The nuclear electrical generating capacity estimates presented in Table 5 on page 24 of the publication are derived using a country by country 'bottom-up' approach. In deriving these estimates, the group of experts considered all operating reactors, possible licence renewals, planned shutdowns and plausible construction projects foreseen for the next several decades. The experts build the estimates project by project by assessing the plausibility of each considering a high and low case.

The assumptions of the low case are 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 designed to produce a 'conservative but plausible' set of projections. Additionally, the low case does not

assume that targets for nuclear power in a particular country will necessarily be achieved. The high case projections are much more ambitious but are still plausible and technically feasible. Country policies on climate change are also considered in the high case. In both cases the same outlook of economic and electricity demand growth based on current expectations is assumed. The high case projection is not intended to reflect a net zero carbon emissions ambition. It does not assume a specific pathway for energy system transitions in the different countries but integrates the expressed intentions of the countries for expanding the use of nuclear power.

The low and high estimates reflect contrasting, but not extreme, underlying assumptions about the different driving factors that have an impact on nuclear power deployment. These factors, and the way they might evolve, vary from country to country. The estimates presented provide a plausible range of nuclear capacity development 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.

By 2050 global final energy consumption is projected to increase by about 30% and electricity production is expected to double [1, 2]. Worldwide, coal remains the dominant energy source for electricity production at about 35% for 2022. While its share in electricity production has changed little since 1980, that of nuclear, renewables and natural gas has increased over the past 40 years. Today, nuclear contributes about 9% of global electricity production.

The adoption of the Glasgow Climate Pact following the 26th United Nations Climate Change Conference of the Parties (COP26) in November 2021 has led to renewed momentum toward reaching net zero global CO_2 emissions by 2050. In the lead-up to COP27, a number of countries revised their nationally determined contributions, committed to reaching net zero CO_2 emissions in the coming decades and recognized the role that nuclear energy can play in reaching this climate goal. As of the end of 2022 more than three quarters of global energy use and the global economy are in countries that have announced ambitions to reach net zero emissions by the middle of the twenty-first century. One of the key outcomes of COP26 is the pledge by a number of countries and international finance institutions to stop financing new coal power plants and to phase out existing coal power plants.

Energy security and resilience continue to be major policy concerns. Recent events such as the COVID-19 pandemic,

geopolitical tensions and military conflict in Europe have disrupted the reliability of energy systems, impeded energy flows across regions and led to significant volatility in energy prices. There is growing recognition of the role of nuclear energy as a key contributor to the security of energy supply to avert future shocks in energy supply and prices.

In light of this evolving energy landscape, with strong commitment to climate action and renewed scrutiny of energy supply security, a number of Member States have revised their energy policy towards nuclear, leading to decisions for the long term operation of existing reactors and new construction of Generation III/III+ designs. There has been also an acceleration in the interest and the development of small modular reactors in a growing number of countries targeting both electric and non-electric applications.

These factors are contributing to government announcements in support of a larger role for nuclear energy in their energy and climate strategy, leading an upward revision of the low case by 14% and of the high case by about 2% compared with the 2022 edition of this publication. Relative to a global nuclear operable electrical generating capacity of 371 gigawatts (electrical) (GW(e)) in 2022, the low case projections indicate that world nuclear capacity will increase modestly to 458 GW(e). In the high case, world nuclear capacity is expected to more than double to 890 GW(e) by 2050.

There are a number of necessary conditions for a substantial increase in installed nuclear capacity. A number of these issues are being addressed, including international efforts toward regulatory and industrial harmonization, as well as progress with final disposal of high level radioactive waste. However, a number of challenges remain, including financing, economic and supply chain difficulties for new nuclear construction in some regions.

Climate change mitigation is a key driver for maintaining and expanding the use of nuclear power. According to the IEA [7], the use of nuclear power has avoided about 70 gigatonnes of CO_2 emissions over the past 50 years. Commitments made under the Paris Agreement and other initiatives could support nuclear power development, provided the necessary energy policies and market designs are established to facilitate investments in dispatchable low carbon technologies.

As stated by the International Energy Agency [8], almost half of the CO_2 emission reductions needed to reach net zero in 2050 will need to come from technologies that are currently under

development but are not yet on the market. This is true for nuclear technologies such as small and medium sized, modular and other advanced reactors. Accelerating the pace of innovation and demonstration of these technologies is required if nuclear is to play a role in decarbonization beyond electricity by providing low carbon heat or hydrogen to the industrial and transport sectors.[1]

Currently, about two thirds of nuclear power reactors have been in operation for over 30 years, highlighting the need for significant new nuclear capacity to offset retirements in the long term. There have been positive developments in several regions and countries with large nuclear fleets. Ageing management programmes and long term operation are being implemented for an increasing number of reactors. However, uncertainty remains regarding the extended operation of a large number of reactors scheduled to be retired in the coming decades.

It is important to consider the changes in nuclear electrical generating capacity in each region within the context of region specific factors. In recent years, construction cost overruns and delays for first of a kind projects have led to high project risk perception in the Americas and Europe, hampering investment decisions for new projects. In some regions nuclear power plants have been built on time and on budget. The expert group assumed that the aforementioned challenges may continue to affect some nuclear development plans, especially in the low case.

The current pace of nuclear power development shows that urgent actions are needed to maintain the existing role of nuclear power in the energy mix. The involvement of a broad range of actors including policy makers, the nuclear industry, the financing community and international organizations, along with active engagement with the public, is necessary.

The underlying fundamentals of population and electricity consumption growth, as well as climate change and air quality concerns, the security of energy supply and the price volatility of other fuels, point to nuclear energy continuously playing an essential role in the energy mix in the longer run, provided concerted actions are taken.

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[1] The projections do not explicitly take into account all the potential technologies (i.e. small and advanced reactors) and potential uses of nuclear power (e.g. heat, hydrogen, water desalination) under climate change constraints.

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 (see annex I to Ref. [9]). 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 estimates for nuclear electricity production in 2022 are from the 2023 edition of Nuclear Power Reactors in the World, Reference Data Series No. 2 (RDS-2) [10]. The estimates for energy and electricity are made by the IAEA Secretariat on the basis of different international and national data sources available as of August 2023.

In accordance with the International Recommendations for Energy Statistics [11], the estimates for the breakdown of historical electricity production by energy source are expressed in gross figures. Gross electricity production is the total electrical energy produced by all generating units and installations measured at the output terminals of the generators. Current data on nuclear electrical production and future estimates of nuclear and total electrical production are expressed in net values, as the data are adapted from the RDS-2 publication.

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.

Total final energy consumption refers to all fuel and energy delivered to end users for their energy use.

Nuclear electrical generating capacity estimates consider the scheduled retirement of older units at the end of their lifetime.

The global and regional nuclear electrical production data and the nuclear electrical generating capacity data cannot be used to calculate average annual capacity factors for nuclear power plants, as the nuclear electrical generating capacity data are year-end capacity.

World

7 942

million people

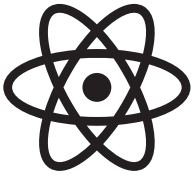
Energy Overview 2022

20.1%

of final energy consumed was electricity

27 672 TW·h

of electricity produced



9.2%

of electricity produced by nuclear

Nuclear Power Development in 2022

- At the end of 2022, 411 nuclear power reactors were operational, with a total net installed power capacity of 371 GW(e).
- In addition, 58 reactors with a total capacity of 59.3 GW(e) were under construction, and 27 reactors with a total capacity of 22.8 GW(e) were in suspended operation.
- Six new nuclear power reactors with a total capacity of 7.4 GW(e) were connected to the grid, and five reactors with a total capacity of 3.3 GW(e) were retired. Construction began on eight new reactors that are expected to add a total capacity of 9.3 GW(e).
- Compared with 2021, total electricity production from all energy sources increased by about 2% and electricity production from nuclear power reactors decreased about 4% to 2 545 TW·h.
- Nuclear power accounted for 9.2% of total electricity production in 2022, a decrease of 0.6 percentage points from the previous year.
- The reduction in global electricity demand in 2020 was the biggest annual decline since the mid-20th century. In 2022 global electricity consumption and the total energy consumption rebounded and exceeded levels for 2019.

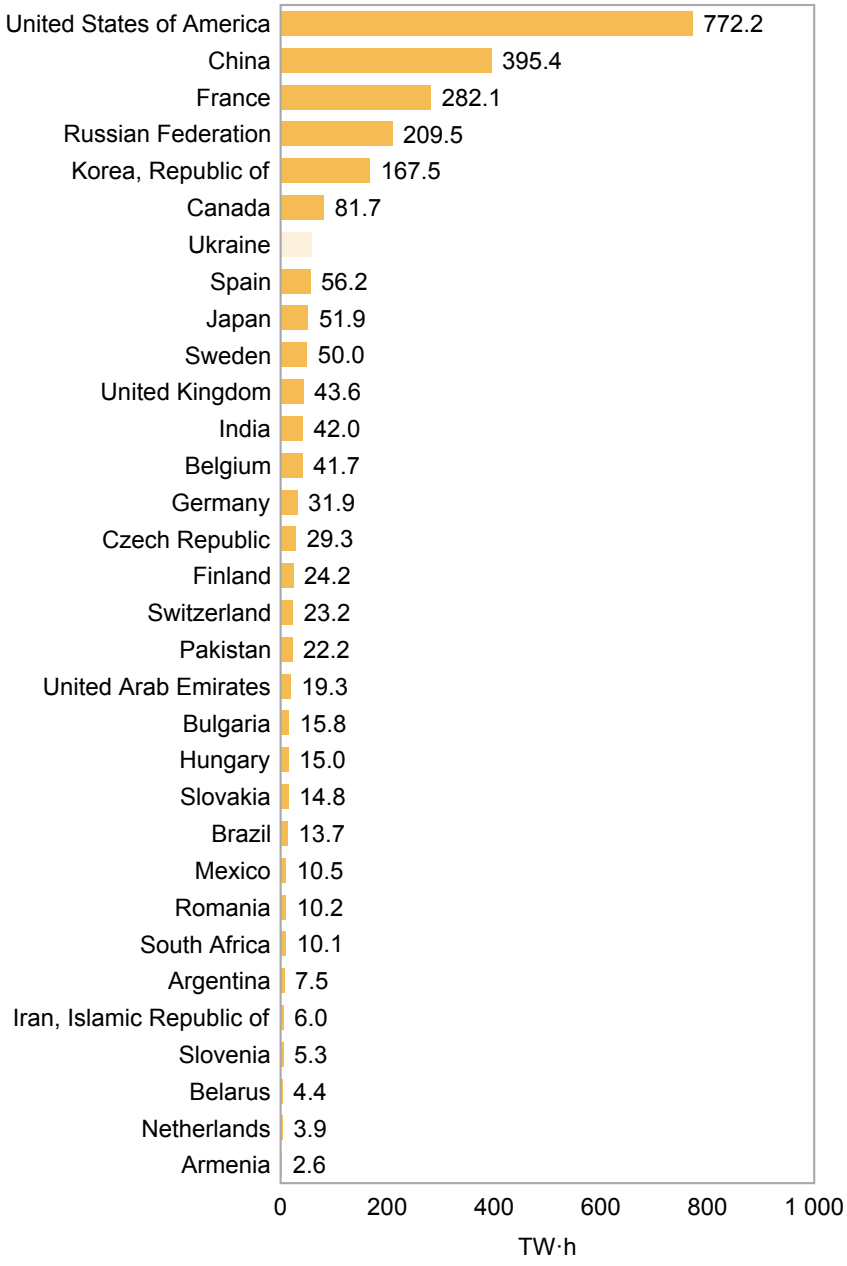
TABLE 1. NUCLEAR POWER REACTORS IN THE WORLD (end of 2022)

Country	Operational		Under Construction		Nuclear Electricity Production in 2022	
	Number of units	Net capacity (MW(e))	Number of units	Net capacity (MW(e))	TW·h	% of total
World Total [a,b]	**411**	**370 991**	**58**	**59 334**	**2545.0**	**9.2**
Argentina	3	1 641	1	25	7.5	5.1
Armenia	1	416			2.6	31.0
Bangladesh			2	2 160		
Belarus	1	1 110	1	1 110	4.4	11.7
Belgium	6	4 936			41.7	45.6
Brazil	2	1 884	1	1 340	13.7	2.1
Bulgaria	2	2 006			15.8	34.6
Canada	19	13 624			81.7	12.8
China	54	52 181	20	20 284	395.4	4.8
Czech Republic	6	3 934			29.3	37.5
Egypt			2	2 200		
Finland	5	4 394			24.2	34.7
France	56	61 370	1	1 630	282.1	62.4
Germany	3	4 055			31.9	5.8
Hungary	4	1 916			15.0	44.5
India	19	6 290	8	6 028	42.0	2.5

Iran, Islamic Republic of	1	915	1	974	6.0	1.8
Japan	10	9 486	2	2 653	51.9	5.0
Korea, Republic of	25	24 489	3	4 020	167.5	27.9
Mexico	2	1 552			10.5	3.2
Netherlands	1	482			3.9	3.3
Pakistan	6	3 262			22.2	15.7
Romania	2	1 300			10.2	19.9
Russian Federation	37	27 727	3	2 700	209.5	19.2
Slovakia	4	1 868	2	880	14.8	62.1
Slovenia	1	688			5.3	41.1
South Africa	2	1 854			10.1	4.5
Spain	7	7 123			56.2	19.9
Sweden	6	6 937			50.0	29.5
Switzerland	4	2 973			23.2	36.5
Türkiye			4	4 456		
Ukraine [c]	15	13 107	2	2 070	—	—
United Arab Emirates	3	4 011	1	1 310	19.3	13.1
United Kingdom	9	5 883	2	3 260	43.6	13.9
United States of America	92	94 718	2	2 234	772.2	17.8

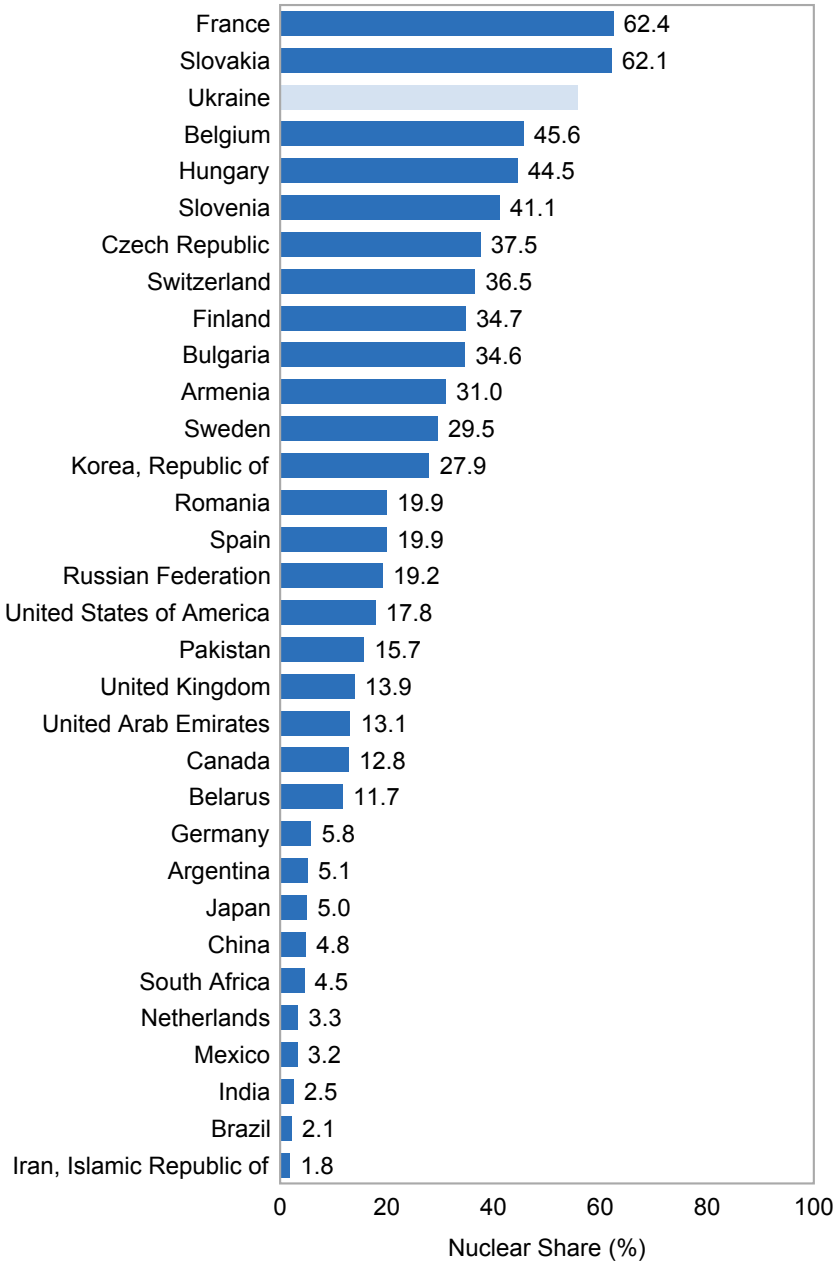
[a] Includes the following data from Taiwan, China: 3 units in operation with a total capacity of 2859 MW(e) and 22.9 TW·h of nuclear electricity generation, representing 8.3% of the total electricity produced.
[b] All missing data are internal estimates by the Secretariat.
[c] Ukrainian operational data was not available for the year 2022 in the 2023 edition of Nuclear Power Reactors in the World [10].

FIGURE 1. WORLD NUCLEAR ELECTRICITY PRODUCTION IN 2022



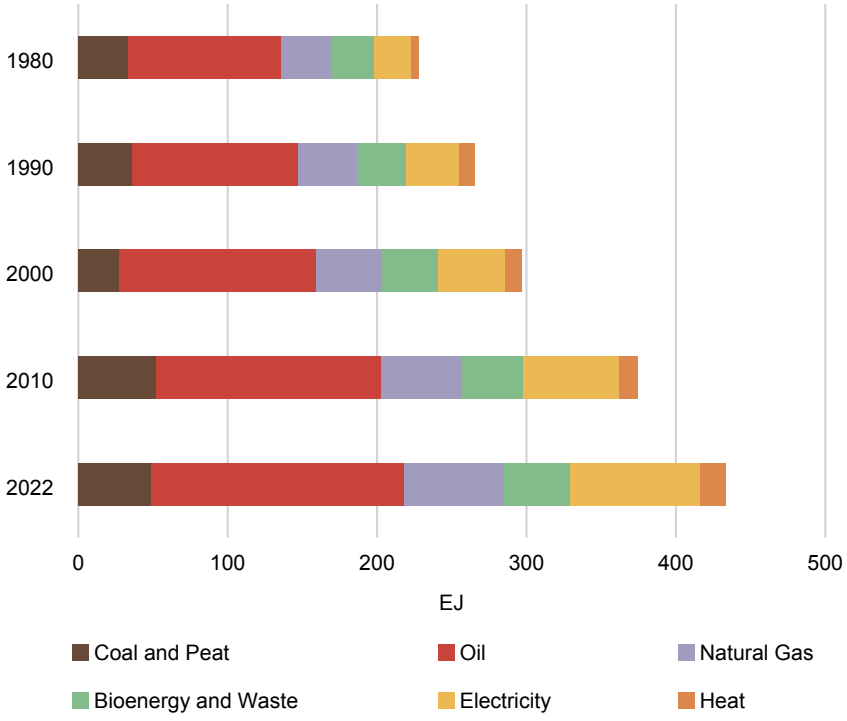
Note: The nuclear electricity production in Taiwan, China, was 22.9 TW·h.

FIGURE 2. SHARE OF NUCLEAR IN TOTAL ELECTRICITY PRODUCTION IN THE WORLD IN 2022



Note: The share of nuclear in the total electricity production of Taiwan, China, was 8.3%.

FIGURE 3. WORLD FINAL ENERGY CONSUMPTION BY ENERGY SOURCE



Final Energy Consumption

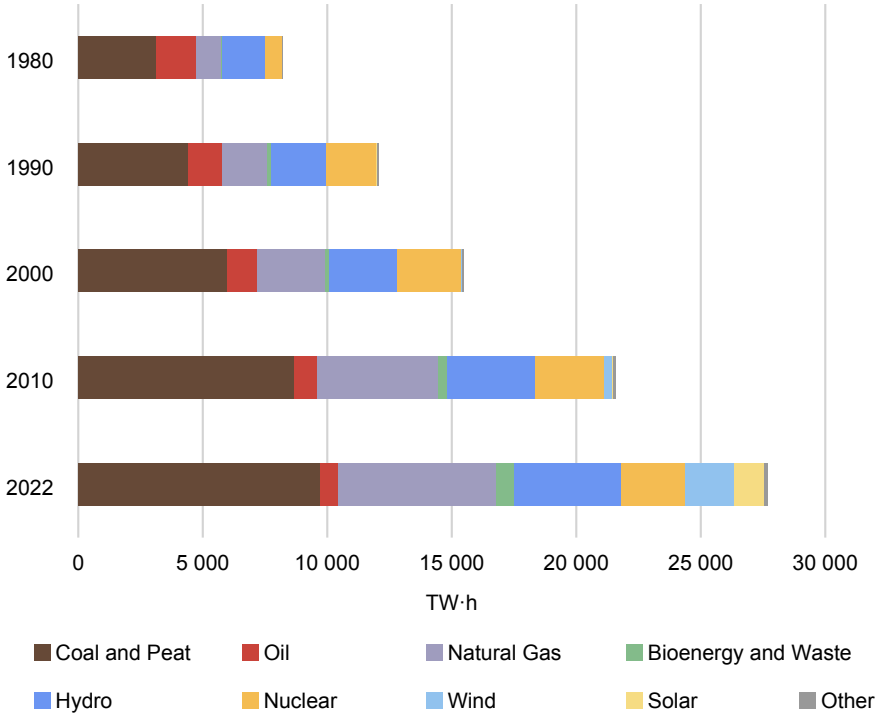
Since 1980 fossil fuels have continued to dominate final energy consumption, although there has been a gradual reduction in their combined share from 74% in 1980 to 66% in 2022.

The share of coal declined slightly from 1980 to 2000 and increased from 2000 to 2010 and has since declined again. Natural gas has maintained a consistent share of about 15%. The share of oil has declined slightly since 1980, stabilizing at about 40% since 2010.

The share of electricity has undergone the most significant change since 1980, increasing by 10 percentage points, with consumption growing at an average annual rate of about 3%.

Looking to the future, electricity consumption is expected to increase faster than final energy consumption, thus it is anticipated that the share of electricity will continue to grow.

FIGURE 4. WORLD TOTAL ELECTRICITY PRODUCTION BY ENERGY SOURCE



Electricity Production

With a share of more than 60%, fossil fuels — particularly coal — have remained dominant sources of electricity production since 1980, despite increases in the combined share of nuclear and renewables over the years.

The share of natural gas has increased more than 10 percentage points since 1980. The share of coal remained around 40% until 2010 but has since gradually decreased by a few percentage points. Of all fossil fuels, the share of oil has experienced the most significant change, decreasing from about 20% in 1980 to about 2% in 2022.

Hydro remains the largest contributor of low carbon electricity, accounting for 16%, although its share has decreased by about 4 percentage points since 1980. In recent years, the share of solar and wind has undergone a rapid increase, rising from less than 1% in 1980 to about 12% in 2022.

The share of nuclear grew rapidly from 1980 to 1990, almost doubling, but has declined since 2000.

Energy and Electricity Projections

- Final energy consumption is expected to increase by about 9% from 2022 levels by 2030 and by about 23% by 2050, at an average annual rate of approximately 1%.
- Electricity consumption is expected to grow at a faster rate of about 2.4% per year. Electricity consumption is expected to almost double by 2050.
- By 2050 the share of electricity in final energy consumption is expected to increase by about 10 percentage points from its 2022 share.

FIGURE 5. WORLD FINAL CONSUMPTION OF ENERGY AND ELECTRICITY

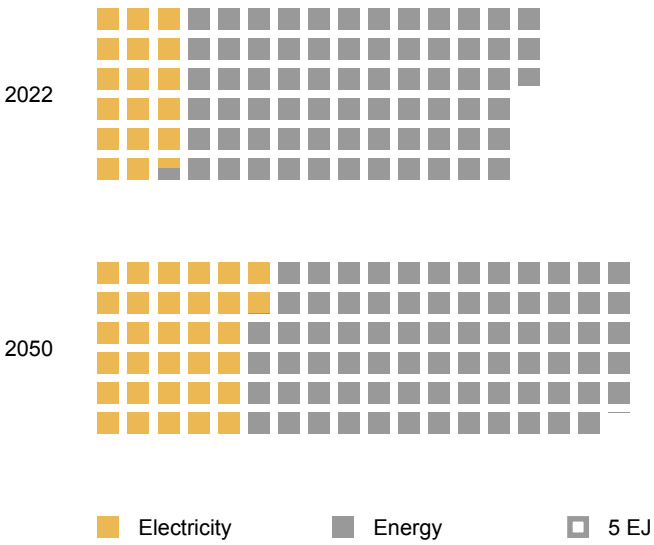


TABLE 2. WORLD FINAL CONSUMPTION OF ENERGY AND ELECTRICITY, EJ

Final Consumption	2022	2030	2040	2050
Energy	434.0	471.2	498.3	535.1
Electricity	87.1	105.5	132.1	159.6
Electricity as % of Energy	*20.1%*	*22.4%*	*26.5%*	*29.8%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is expected to increase by about 22% by 2030 and then double by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase by about 24% by 2030 and increase by about 140% by 2050 compared with 2022 capacity.
- In the low case, nuclear electrical generating capacity is projected to increase by about 9% by 2030 and then increase by about 23% by 2050.
- In the low case, the share of nuclear in total electrical generating capacity is projected to decrease by 2050. A reduction of about 1.7 percentage points is expected. In the high case, the share of nuclear in total electrical generating capacity is expected to increase by about one percentage point by 2050.

FIGURE 6. WORLD NUCLEAR ELECTRICAL GENERATING CAPACITY

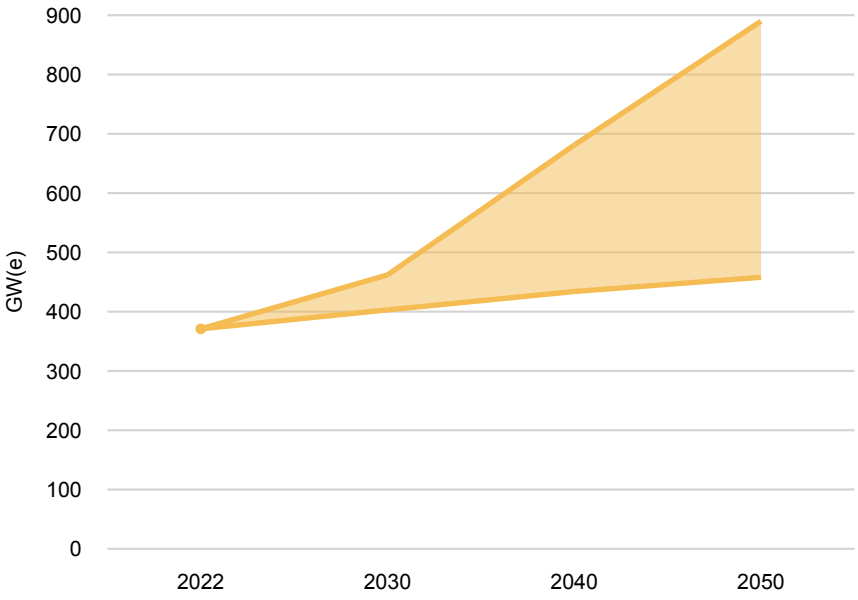


TABLE 3. WORLD TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY, GW(e)

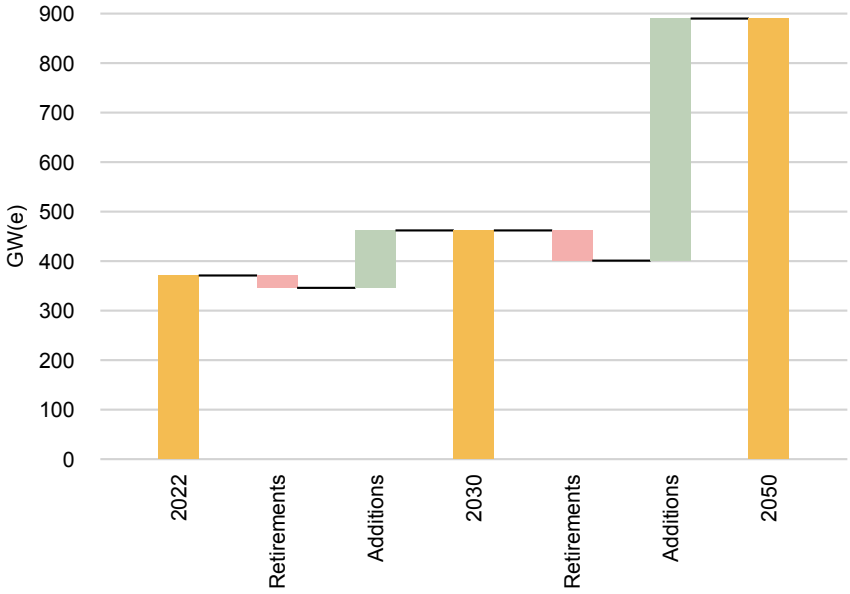
Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	8 281	10 079	10 079	12 841	12 841	16 590	16 590
Nuclear	371	403	462	434	681	458	890
Nuclear as % of Electrical Capacity	*4.5%*	*4.0%*	*4.6%*	*3.4%*	*5.3%*	*2.8%*	*5.4%*

Reactor Retirements and Additions

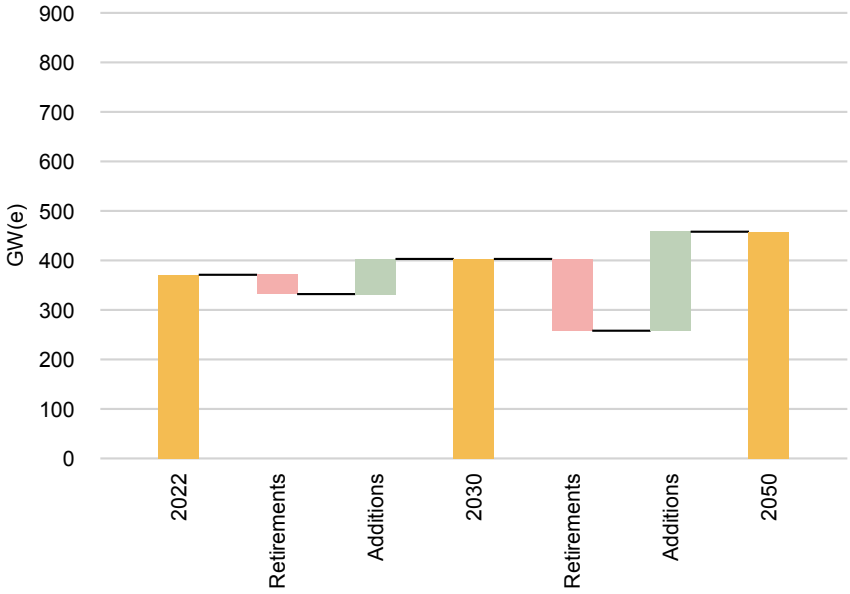
- Two out of every three nuclear power reactors have been in operation for more than 30 years and are scheduled for retirement in the foreseeable future.
- In the high case, it is assumed that the operating life of several nuclear power reactors scheduled for retirement will be extended such that only about 7% of the 2022 nuclear electrical generating capacity is retired by 2030. This is expected to result in net capacity additions (newly installed less retired) of about 90 GW(e) by 2030 and about 430 GW(e) over the subsequent 20 years.
- In the low case, it is assumed that about 11% of existing nuclear power reactors will be retired by 2030, while new reactors will add about 70 GW(e) of capacity. Between 2030 and 2050 it is expected that capacity additions of new reactors will exceed retirements by about 55 GW(e).

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

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- Total electricity production is expected to increase by about 20% by 2030 and by about 80% by 2050 compared with 2022 levels.
- In the high case, nuclear electricity production is expected to increase by about 40% from the 2022 level by 2030 and by almost 3-fold by 2050. The share of nuclear in total electricity production is expected to increase by more than 5 percentage points.
- In the low case, nuclear electricity production is expected to increase by about 24% from the 2022 level by 2030, rising to 53% by 2050. The share of nuclear in total electricity production is expected to decline by about one and a half percentage points.

FIGURE 8. WORLD NUCLEAR ELECTRICITY PRODUCTION

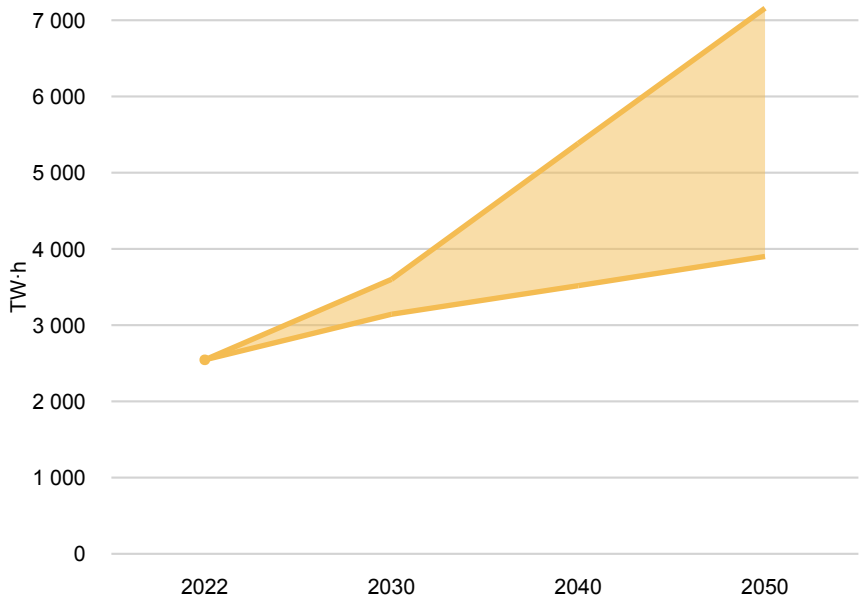


TABLE 4. WORLD TOTAL AND NUCLEAR ELECTRICITY PRODUCTION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	27 672	33 275	33 275	41 508	41 508	50 071	50 071
Nuclear	2 545	3 143	3 601	3 518	5 385	3 901	7 158
Nuclear as % of Electricity Production	*9.2%*	*9.4%*	*10.8%*	*8.5%*	*13.0%*	*7.8%*	*14.3%*

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

Region	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
World Total	**371.4**	**403**	**462**	**434**	**681**	**458**	**890**
Northern America	108.0	105	112	88	128	67	156
Latin America and the Caribbean	5.1	6	6	8	13	12	25
Northern, Western and Southern Europe	99.0	88	90	72	114	60	131
Eastern Europe	53.0	52	59	51	90	59	102
Africa	1.9	2	3	8	11	9	20
Western Asia	4.4	8	9	12	19	14	24
Southern Asia	11.0	17	26	33	50	42	74
Central and Eastern Asia	89.0	125	157	161	255	192	345
South-eastern Asia				1	1	3	11
Oceania							2

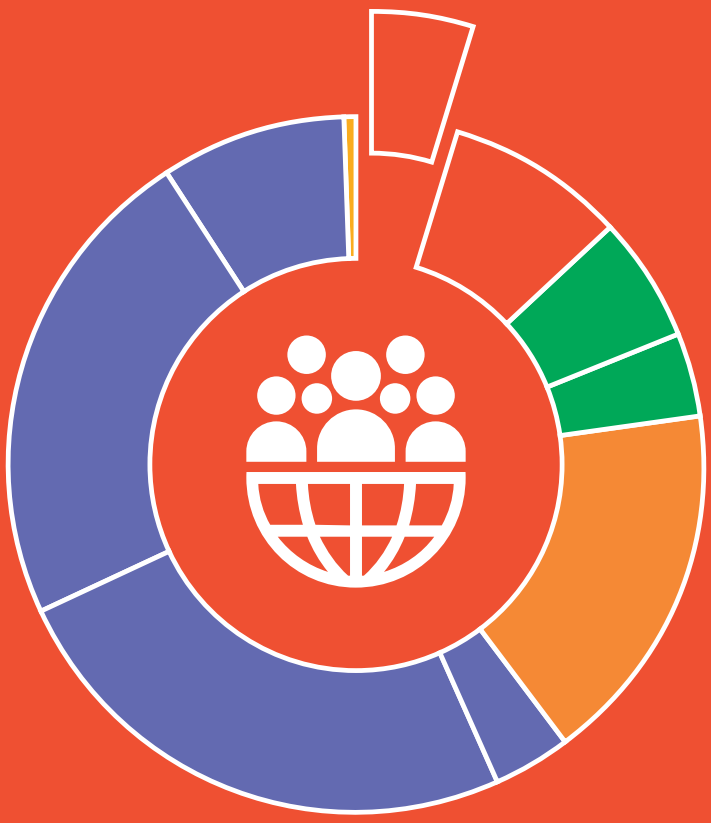
TABLE 6. WORLD NUCLEAR ELECTRICITY PRODUCTION, TW·h

Region	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
World Total	**2545.0**	**3 143**	**3 601**	**3 518**	**5 385**	**3 901**	**7 158**
Northern America	853.9	853	913	720	1 056	547	1 297
Latin America and the Caribbean	31.7	42	46	58	100	92	197
Northern, Western and Southern Europe	562.1	711	727	597	945	493	1 075
Eastern Europe	357.4	392	446	394	684	461	800
Africa	10.1	13	22	57	77	69	144
Western Asia	21.9	56	64	91	141	112	189
Southern Asia	70.2	125	189	246	368	331	578
Central and Eastern Asia	637.7	951	1 194	1 347	2 007	1 772	2 777
South-eastern Asia				7	7	24	87
Oceania							14

Northern America

376

million people



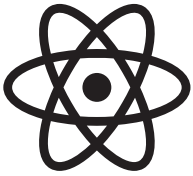
Energy Overview 2022

22.3%

of final energy consumed was electricity

4 967 TW·h

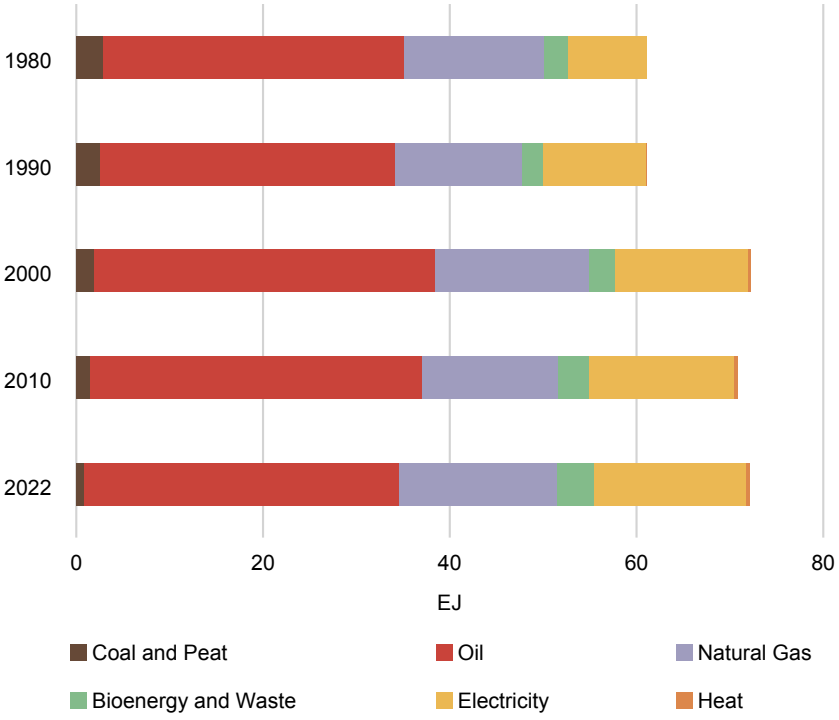
of electricity produced



17.2%

of electricity produced by nuclear

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



Final Energy Consumption

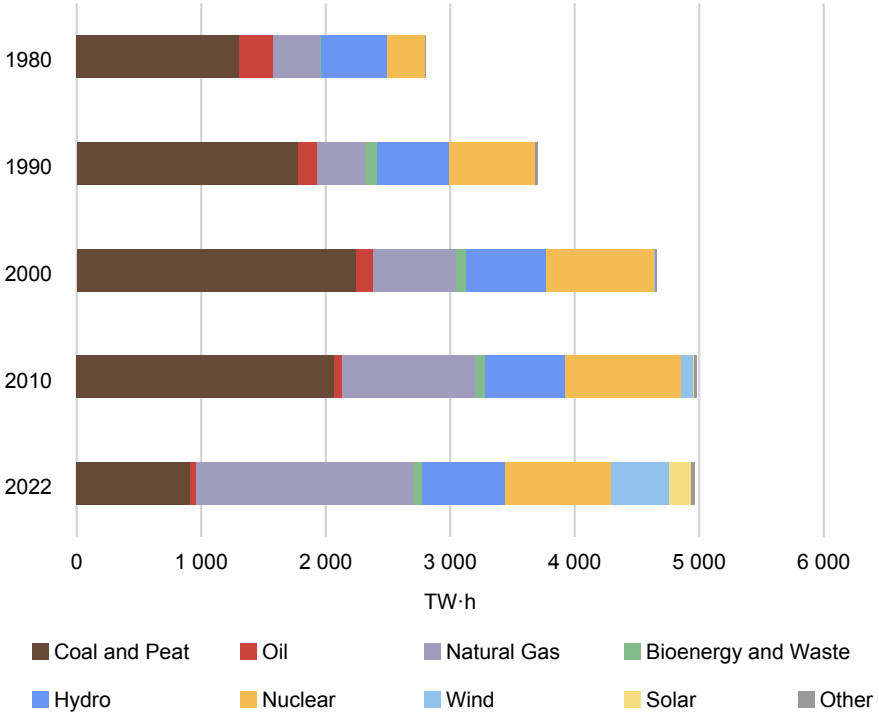
Since 1980, the share of fossil fuels in final energy consumption has remained above 70%, with a slight reduction from 82% in 1980 to 71% in 2022.

Of all fossil fuels, oil has the largest share, having remained at about 50% since 1980. In 2022 the share of oil decreased to 47%.

With a share of 23%, natural gas was the second largest energy source in 2022. Its share has remained relatively stable since 1980.

From 1980 to 2010, the share of electricity gradually increased by 8 percentage points. Its share in 2022 was 22% of final energy consumption.

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



Electricity Production

Fossil fuels contributed more than half of the electricity produced in 2022.

The share of coal has decreased by more than half since 1980, whereas the share of natural gas has more than doubled. The share of oil has decreased from 10% in 1980 to around 1% in 2022.

Nuclear is the largest low carbon energy source. Its share nearly doubled from 1980 to 1990 and has remained relatively stable since 1990 at about 17% in 2022.

The share of hydro has decreased by about 6 percentage points over the past 40 years.

The share of wind has increased rapidly since 2000, exceeding 9% by 2022. In recent years, the share of solar has also undergone a rapid increase, rising from less than 1% in 2010 to almost 4% in 2022.

Energy and Electricity Projections

- Final energy consumption is expected to decrease by about 8% by 2040 and then stay almost constant up to 2050.
- Electricity consumption is expected to continue to grow. By 2030 it is projected to increase by 6% from 2022 levels, reaching an increase of about 36% by 2050.
- The share of electricity in final consumption of energy is expected to gradually increase by about 11 percentage points by 2050.

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

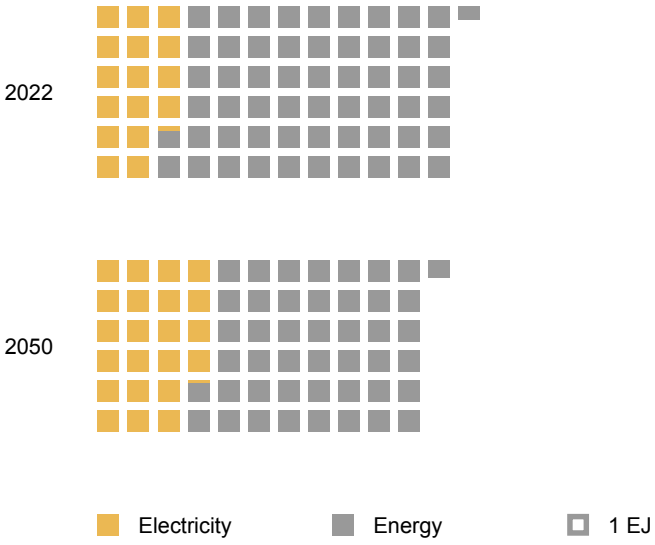


TABLE 7. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE NORTHERN AMERICA REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	72.6	68.3	66.9	66.8
Electricity	16.2	17.1	19.5	22.1
Electricity as % of Energy	*22.3%*	*25.0%*	*29.1%*	*33.1%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is projected to increase by 11% by 2030 and by about 48% by 2050.
- A significant reduction in nuclear electrical generating capacity is projected over the next three decades for the low case, whereas the high case is expected to remain relatively stable until 2030 with a considerable increase by 2050.
- In the high case, nuclear electrical generating capacity is projected to remain roughly constant until 2030, with an increase of about 44% by 2050. The share of nuclear in total electrical capacity is expected to remain stable until 2050.
- In the low case, nuclear electrical generating capacity is projected to decrease by about 20% from current levels by 2040 and to be around two thirds of current capacity by 2050. The share of nuclear in total electrical capacity is projected to decrease by about 2.5 percentage points by 2040 and by about 4.5 percentage points by 2050.

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

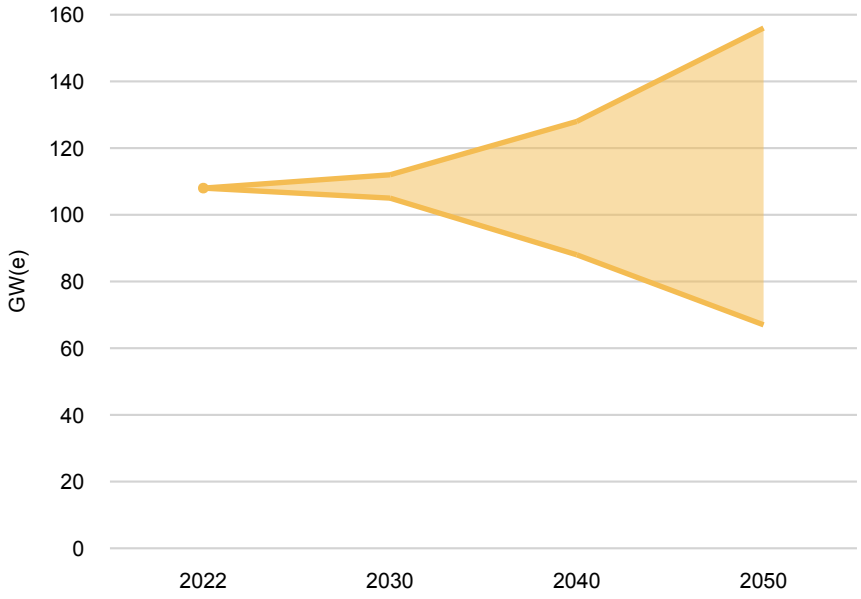


TABLE 8. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE NORTHERN AMERICA REGION, GW(e)

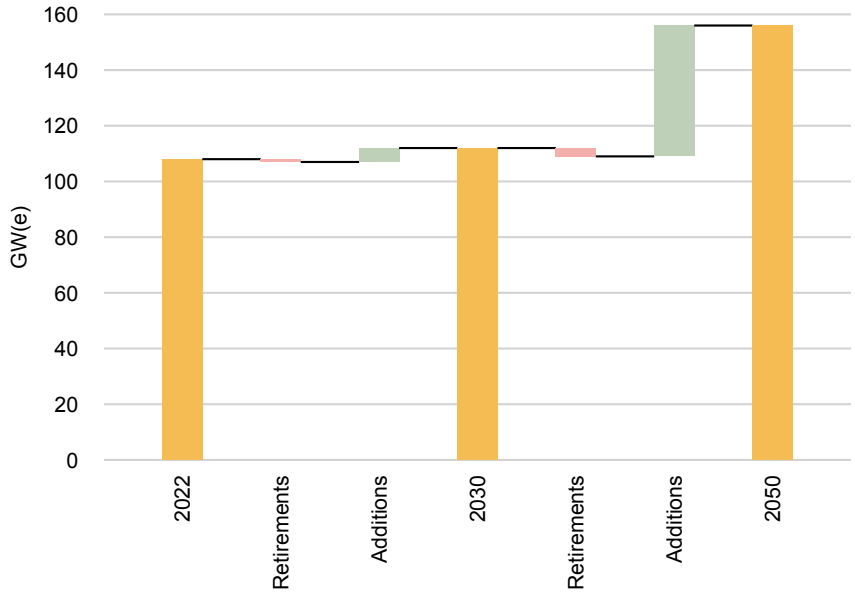
Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	1 344	1 495	1 495	1 628	1 628	1 990	1 990
Nuclear	108	105	112	88	128	67	156
Nuclear as % of Electrical Capacity	*8.0%*	*7.0%*	*7.5%*	*5.4%*	*7.9%*	*3.4%*	*7.8%*

Reactor Retirements and Additions

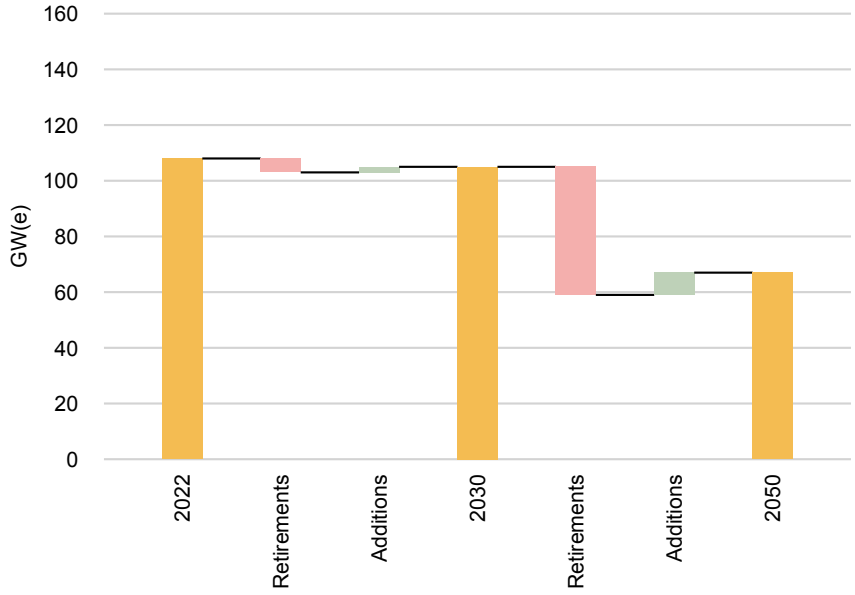
- In the high case, a net increase in nuclear capacity of 4 GW(e) is expected by 2030. Between 2030 and 2050 it is expected that capacity additions of new reactors exceed retirements by 44 GW(e).
- In the low case, a net decrease in nuclear capacity of 3 GW(e) is expected by 2030. Between 2030 and 2050 it is expected that significantly more capacity will be retired than is added, resulting in a net reduction in capacity of almost 38 GW(e).

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

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- Total electricity production is projected to increase about 7% by 2030 and is expected to be about 39% higher than 2022 production levels by 2050.
- In the high case, nuclear electricity production is projected to increase about 7% by 2030 and is expected to be about 50% higher than 2022 production levels by 2050. The share of nuclear in total electricity production is expected to remain stable until 2040 with a considerable increase by 2050 by about one and a half percentage points.
- In the low case, nuclear electricity production is projected to decrease by 16% from 2022 levels by 2040 and by one third by 2050. The share of nuclear in total electricity production is expected to decrease by about 5 percentage points by 2040 and 9 percentage points by 2050.

FIGURE 14. NUCLEAR ELECTRICITY PRODUCTION IN THE NORTHERN AMERICA REGION

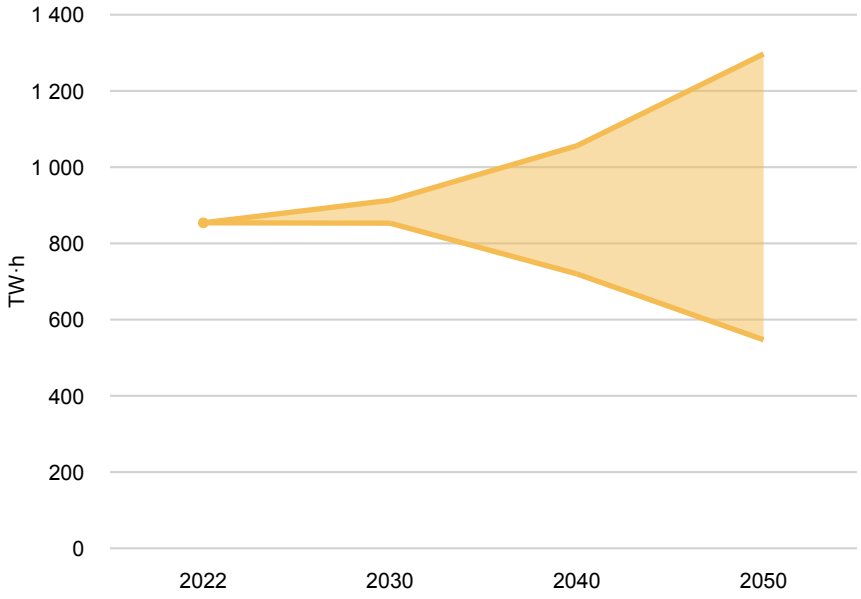


TABLE 9. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE NORTHERN AMERICA REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	4 967	5 334	5 334	6 091	6 091	6 883	6 883
Nuclear	854	853	913	720	1 056	547	1 297
Nuclear as % of Electricity Production	*17.2%*	*16.0%*	*17.1%*	*11.8%*	*17.3%*	*7.9%*	*18.8%*

Latin America and the Caribbean

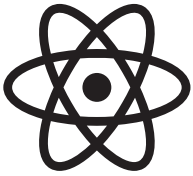
658

million people

Energy Overview 2022

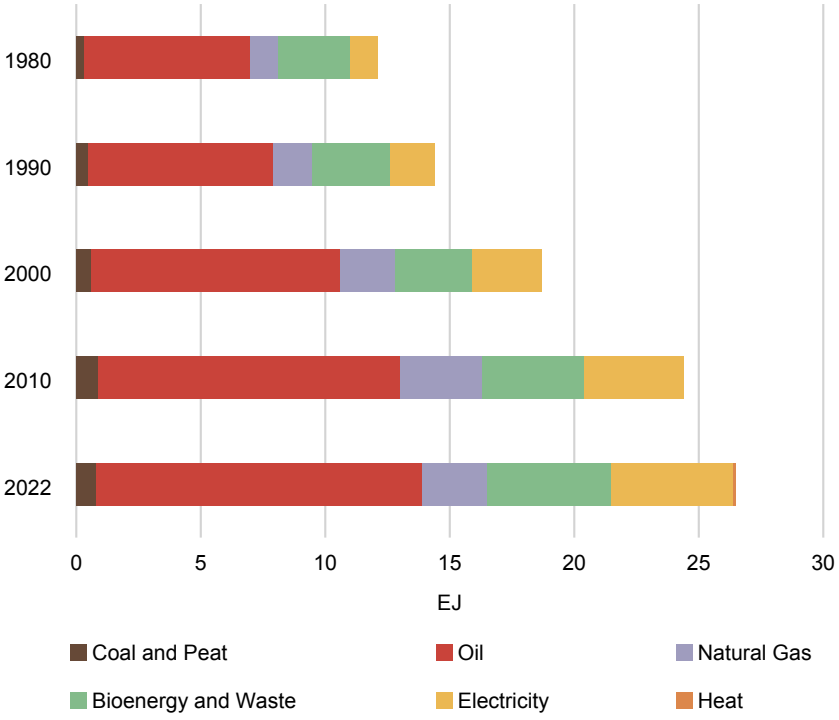
18.5%
of final energy consumed was electricity

1 664 TW·h
of electricity produced



1.9%
of electricity produced by nuclear

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



Final Energy Consumption

From 1980 to 2000 the share of fossil fuels in final energy consumption increased slightly, but since 2000 it has gradually decreased. The combined share of fossil fuels in 2022 was about 60%.

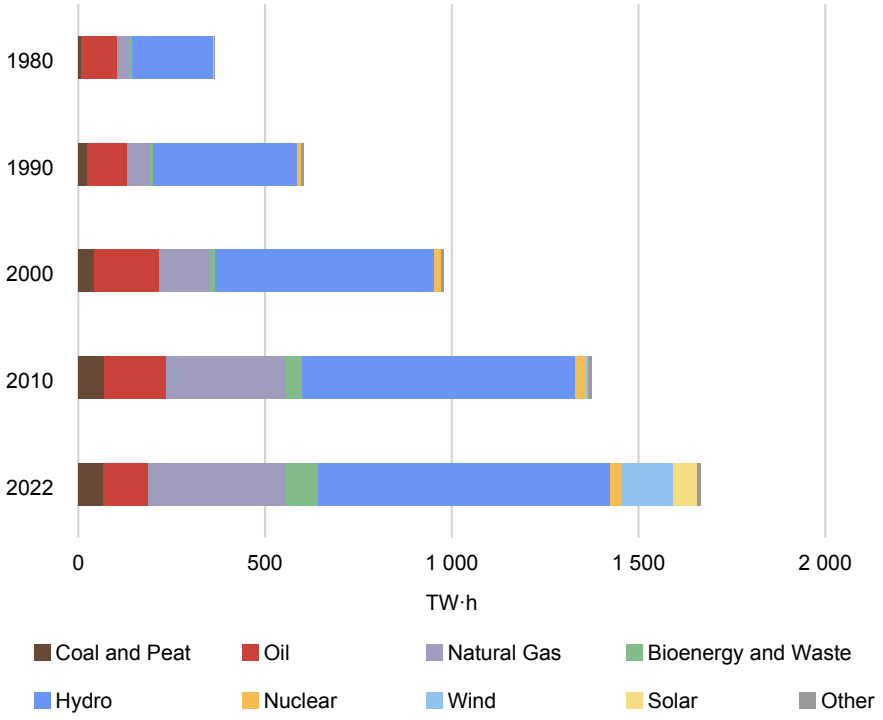
Oil accounted for about 49% of final energy consumption in 2022, although its share has decreased by about 10 percentage points since 1980.

The share of natural gas has risen by a few percentage points over the past 40 years but declined in 2022.

The share of coal has remained small at about 3%.

The share of electricity has undergone the most significant change, more than doubling since 1980.

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



Electricity Production

Since 1980 hydro has been the largest source of electricity; its production has increased throughout this period, although its share has decreased by about 13 percentage points. In 2000, other renewables started contributing to electricity production. In 2022 the combined share of other renewables exceeded 13%.

Of all fossil fuels, natural gas accounted for the largest share of electricity production in 2022, having displaced oil as the largest source after 2000. The share of natural gas has undergone an almost threefold increase over the past 40 years. The share of coal has more than doubled since 1980, whereas the share of oil has steadily decreased by almost 20 percentage points.

The share of nuclear has increased almost fourfold since 1980, although its overall share has remained relatively small and was just about 2% in 2022.

Energy and Electricity Projections

- Final consumption of energy is expected to increase by about 12% from 2022 levels by 2030 and by 30% by 2050, at an average annual rate of about 1%.
- Electricity consumption is expected to grow at a faster rate of about 3% per year, more than doubling over the next 28 years.
- By 2050 the share of electricity in final energy consumption is expected to increase by about 12 percentage points from its 2022 share.

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

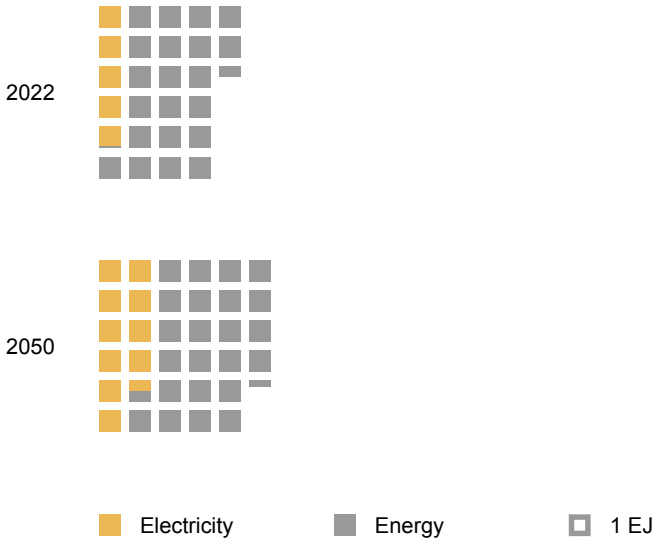


TABLE 10. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE LATIN AMERICA AND THE CARIBBEAN REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	26.5	29.7	31.9	34.3
Electricity	4.9	6.3	8.3	10.5
Electricity as % of Energy	*18.5%*	*21.2%*	*26.0%*	*30.6%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is projected to increase by about 16% by 2030 and to almost double by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase fivefold by 2050, with its share of total electrical capacity growing by 1.6 percentage points.
- In the low case, nuclear electrical generating capacity is projected to more than double over the next 28 years, although its share in total electrical capacity is expected to remain nearly constant.

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

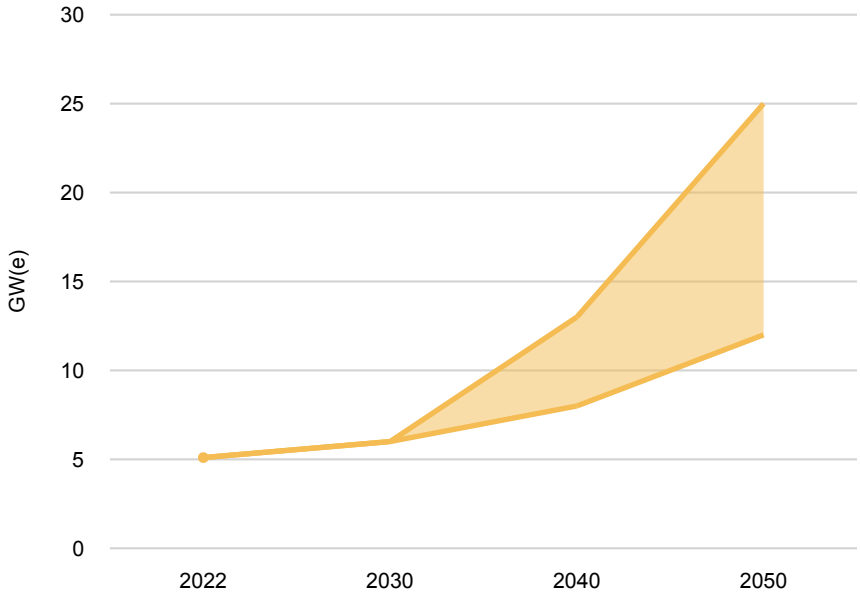


TABLE 11. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE LATIN AMERICA AND THE CARIBBEAN REGION, GW(e)

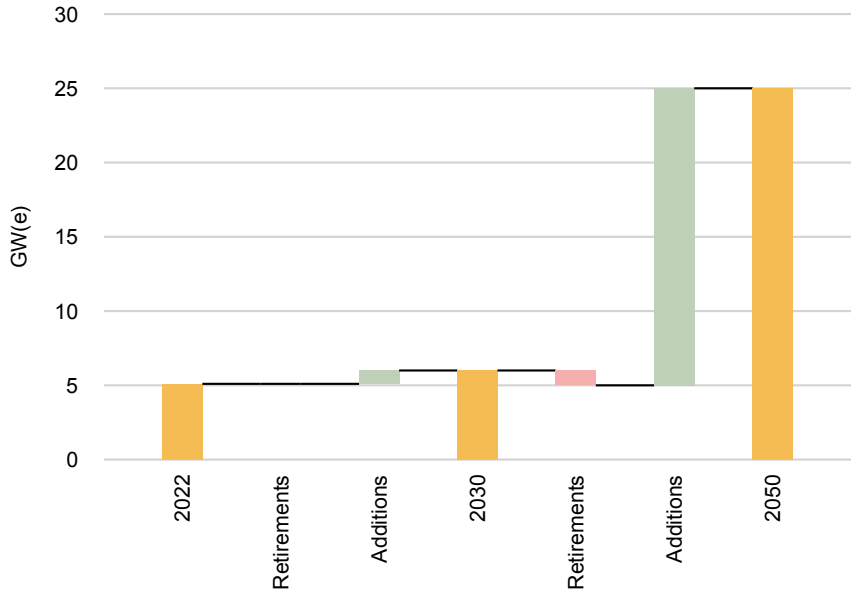
Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	508	589	589	731	731	959	959
Nuclear	5.1	6	6	8	13	12	25
Nuclear as % of Electrical Capacity	*1.0%*	*1.0%*	*1.0%*	*1.1%*	*1.8%*	*1.3%*	*2.6%*

Reactor Retirements and Additions

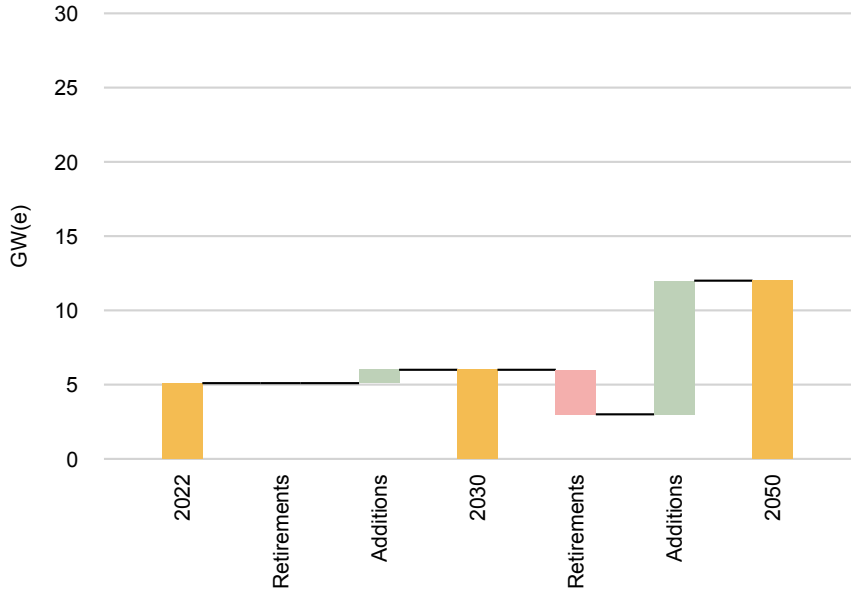
- In the high case, no reactor retirements are expected by 2030 and it is assumed that just about 1 GW(e) of capacity will be added. Between 2030 and 2050 it is expected that there will be a significant number of additions with only a few retirements, resulting in a net increase in capacity of almost 19 GW(e).
- In the low case, it is assumed that there will be a net increase in capacity of about 1 GW(e) by 2030 as well, and no reactors are expected to be retired. Between 2030 and 2050 it is expected that there will be more capacity added than retired, resulting in a net increase in capacity of 6 GW(e).

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 is projected to rise significantly by 2030, with an increase of about 25% from 2022 levels. It is expected to more than double by 2050.
- In the high case, nuclear electricity production is projected to rise about 31% by 2030 and to increase more than sixfold over the subsequent 20 years. The share of nuclear in total electricity production is expected to gradually increase, nearly tripling by 2050.
- In the low case, nuclear electricity production is projected to increase by about 30% by 2030 and nearly tripling by 2050. The share of nuclear in total electricity production is expected to rise but much slower than in the high case.

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

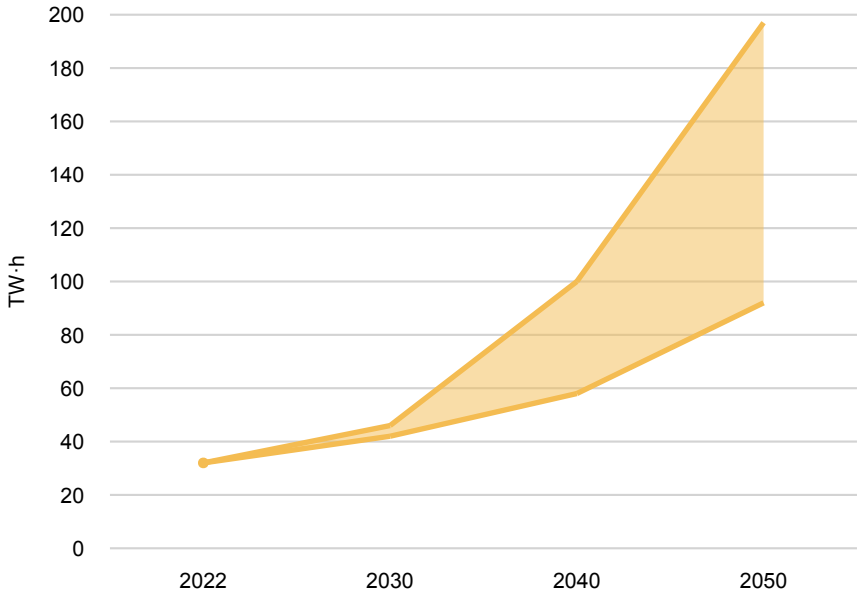


TABLE 12. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE LATIN AMERICA AND THE CARIBBEAN REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	1 664	2 094	2 094	2 708	2 708	3 395	3 395
Nuclear	32	42	46	58	100	92	197
Nuclear as % of Electricity Production	*1.9%*	*2.0%*	*2.2%*	*2.1%*	*3.7%*	*2.7%*	*5.8%*

Northern, Western and Southern Europe

454

million people

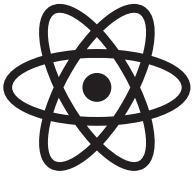
Energy Overview 2022

21.0%

of final energy consumed was electricity

2 898 TW·h

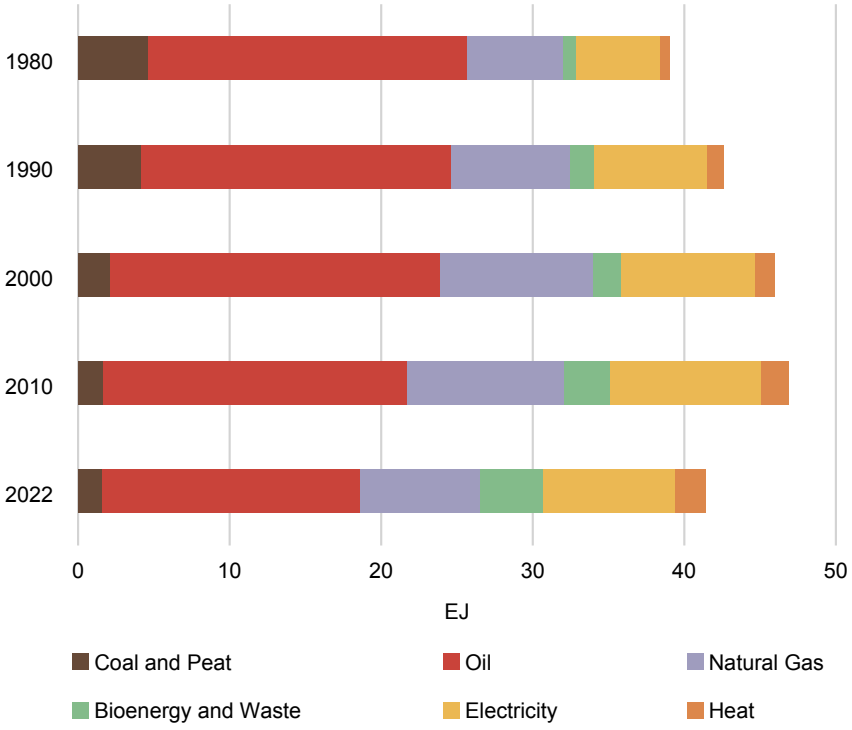
of electricity produced



19.4%

of electricity produced by nuclear

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



Final Energy Consumption

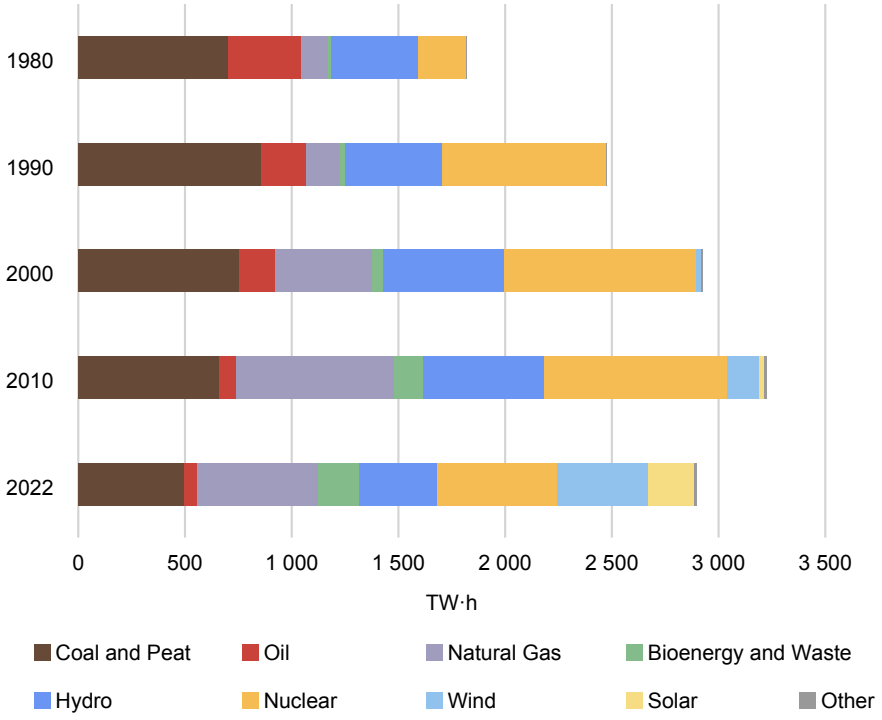
Since 1980 fossil fuels have continued to dominate final energy consumption, although there has been a gradual reduction in their combined share, which fell about 18 percentage points to about 64% in 2022.

Of all fossil fuels, oil has the largest share, although its share has been declining over the past 40 years. In 2022 the share of oil remained significant at about 41%.

The share of natural gas has increased by about 5 percentage points since 1980. It accounted for about one fifth of the final energy consumed in 2022. The share of coal has decreased by about 8 percentage points over the past 40 years, but its share has remained at 3–4% since 2010.

In 2022 the share of electricity in final energy consumption was about 21%, an increase of almost 7 percentage points since 1980.

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



Electricity Production

In the past 40 years the combined share of fossil fuels in electricity production has effectively decreased by half. More than one third of electricity was produced by fossil fuels in 2022, with natural gas being the largest contributor at about 20%. The share of natural gas has effectively tripled since 1980, whereas that of oil has declined from almost 20% in 1980 to 2% in 2022. Since 1980 the share of coal in electricity production has fallen from almost 40% to about 17% in 2022.

Nuclear is the largest contributor of low carbon electricity production. Its share more than doubled from 1980 to 1990 and then decreased by about 11 percentage points from 2000 to 2022 to a share of about 19%.

Over the past 40 years the share of hydro has decreased by about 10 percentage points. In 2022 it was around 13%. Wind and solar did not contribute significantly to electricity production in 1980. The contributions of these energy sources have since increased substantially to a combined share of 22% in 2022.

Energy and Electricity Projections

- Final energy consumption is expected to decrease by about 16% by 2050, at an average annual rate of approximately 0.6%.
- Electricity consumption is projected to increase by about 31% by 2050, at an average annual rate of approximately 1%.
- The share of electricity in final energy consumption is expected to increase by about 12 percentage points.

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

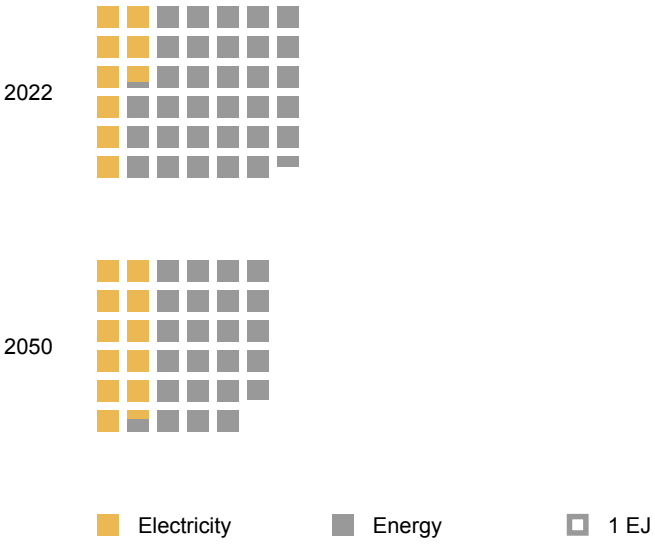


TABLE 13. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE, EJ

Final Consumption	2022	2030	2040	2050
Energy	41.5	41.1	37.2	34.9
Electricity	8.7	10.4	10.9	11.4
Electricity as % of Energy	*21.0%*	*25.3%*	*29.3%*	*32.7%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is projected to increase almost 5% by 2030 and by 40% by 2050 compared with 2022 capacity.
- In the high case, nuclear electrical generating capacity is projected to decrease by 2030, but to a lesser extent than in the low case, and then to grow significantly by 2050, with an increase of about one third over 2022 capacity. The share of nuclear in total electrical capacity is expected to decrease about half of a percentage point by 2050.
- In the low case, nuclear electrical generating capacity is projected to decrease by almost 40% by 2050. The share of nuclear in total electrical capacity is expected to decline by 5 percentage points.

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

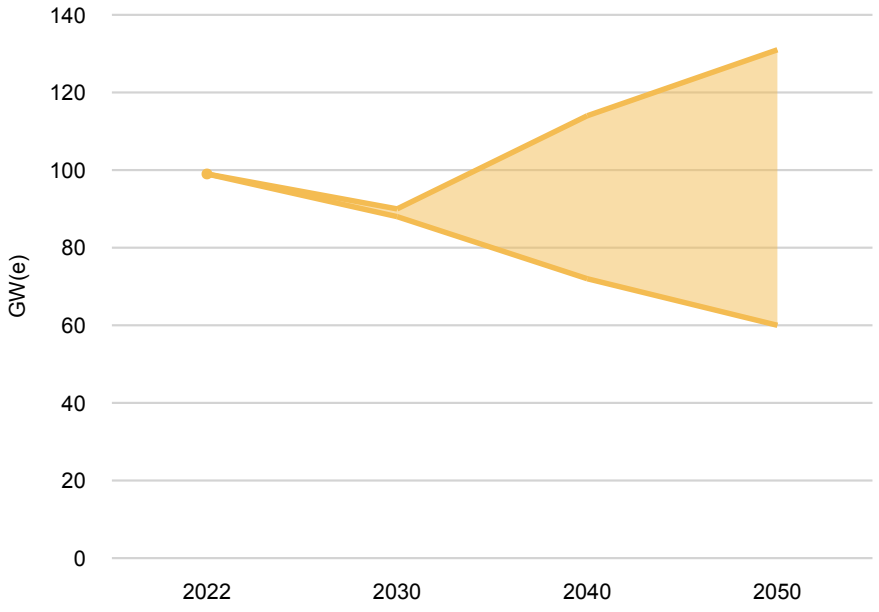


TABLE 14. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE, GW(e)

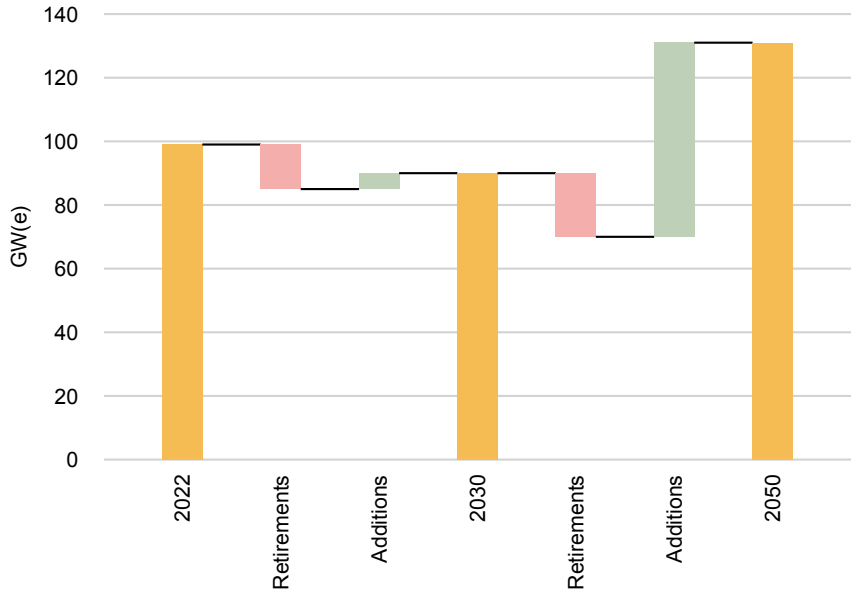
Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	1 100	1 152	1 152	1 244	1 244	1 531	1 531
Nuclear	99	88	90	72	114	60	131
Nuclear as % of Electrical Capacity	*9.0%*	*7.6%*	*7.8%*	*5.8%*	*9.2%*	*3.9%*	*8.6%*

Reactor Retirements and Additions

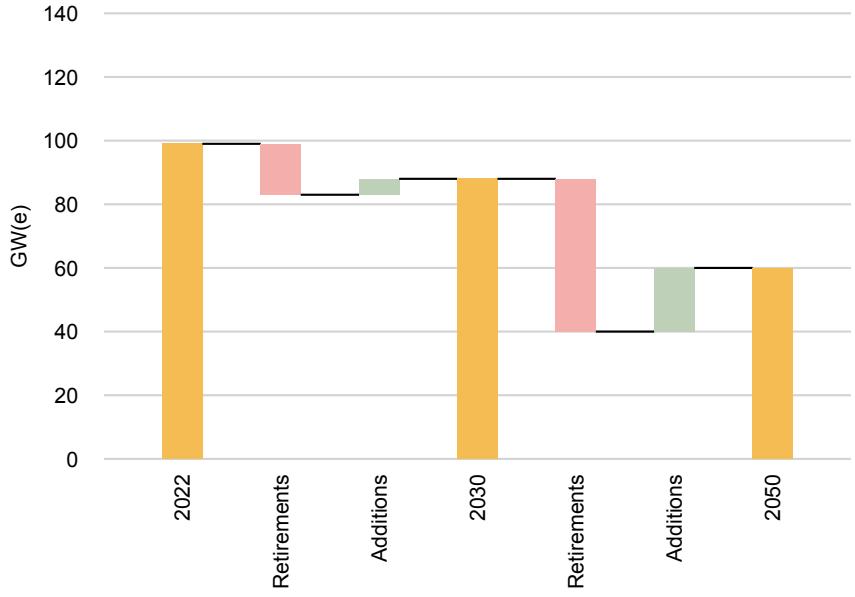
- In the high case, it is assumed that there will be a net decrease in capacity by 2030 owing to more retirements than additions of capacity in this period. Capacity is expected to decrease by about 9 GW(e). From 2030 until 2050 a net increase of about 41 GW(e) is expected.
- In the low case, it is assumed that there will be a net decrease in capacity of 11 GW(e) by 2030, as more retirements are expected than in the high case. Between 2030 and 2050 a further reduction of 28 GW(e) is expected.

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 is projected to increase by about 11% by 2030 and 22% by 2050, compared with 2022 production levels.
- In the high case, nuclear electricity production is projected to increase by 29% by 2030 and 91% by 2050, compared with 2022 production levels. The share of nuclear in total electricity production is expected to increase by about 11 percentage points by 2050.
- In the low case, nuclear electricity production is projected to increase by 2030, similar to the high case, and then decrease by about 12% by 2050. The share of nuclear in total electricity production is expected to decline by more than 5 percentage points by 2050.

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

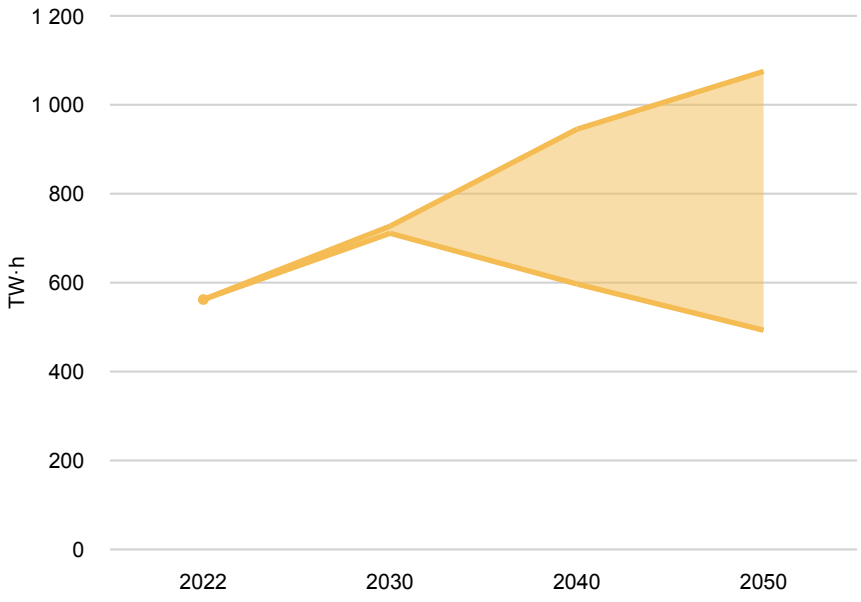


TABLE 15. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE COMBINED REGIONS OF NORTHERN, WESTERN AND SOUTHERN EUROPE, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	2 898	3 217	3 217	3 352	3 352	3 527	3 527
Nuclear	562	711	727	597	945	493	1 075
Nuclear as % of Electricity Production	*19.4%*	*22.1%*	*22.6%*	*17.8%*	*28.2%*	*14.0%*	*30.5%*

Eastern Europe

291

million people

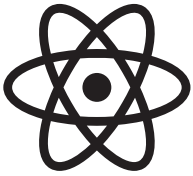
Energy Overview 2022

14.2%

of final energy consumed was electricity

1 549 TW·h

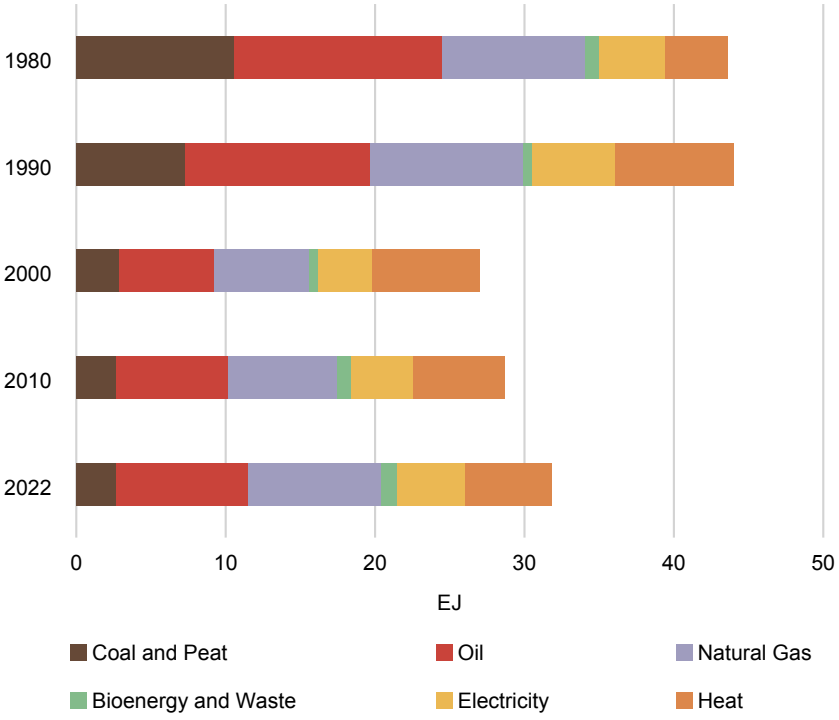
of electricity produced



23.0%

of electricity produced by nuclear

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



Final Energy Consumption

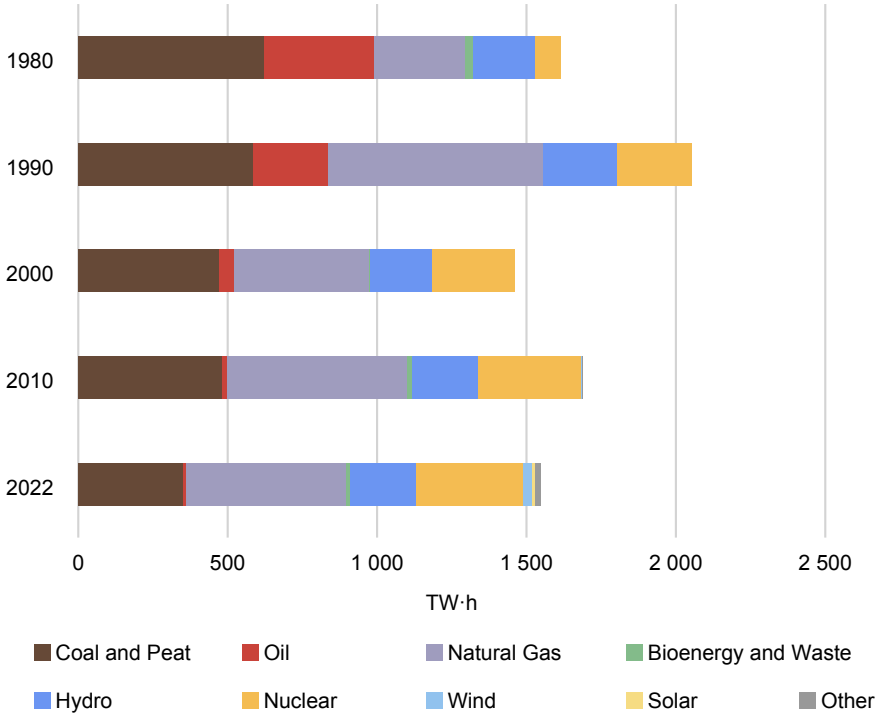
Since 1980 fossil fuels have accounted for the largest share of final energy consumption. Between 1980 and 2000 the combined share of fossil fuels declined by around 20 percentage points. However, from 2000 onwards there has been a gradual increase to about 64% in 2022.

Oil has the largest share of all fossil fuels, although its share has declined by about 4 percentage points over the past 40 years. In contrast, the share of natural gas has increased by about 6 percentage points since 1980. The share of coal has also declined and in 2022 was almost one third of its 1980 share.

The share of electricity has increased gradually by about 4 percentage points over the years.

With almost a doubling of its share since 1980, heat has seen the most significant change of all energy sources.

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



Electricity Production

Although their combined share has declined by more than 20 percentage points since 1980, fossil fuels remain the dominant sources of electricity production, with a share of about 58% in 2022.

Over the years the share of natural gas has almost doubled. In 2022 more than one third of the electricity produced was from natural gas. The share of oil has dropped significantly, from almost 23% in 1980 to less than 1% in 2022. Coal contributed about 23% of electricity production in 2022, down from 40% in 1980.

The share of nuclear has quadrupled since 1980, and nuclear accounted for 23% of the electricity produced in 2022.

The share of hydro has remained relatively stable throughout the years at about 12–14%. The combined share of solar and wind remained small at about 3% in 2022, although in 1980 these sources did not contribute to electricity production at all.

Energy and Electricity Projections

- Final consumption of energy is expected to remain stable until 2050.
- Electricity consumption is expected to grow at about 1.5% per year, increasing by about 53% by 2050.
- The share of electricity in final consumption of energy is expected to increase by almost 8 percentage points by 2050.

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

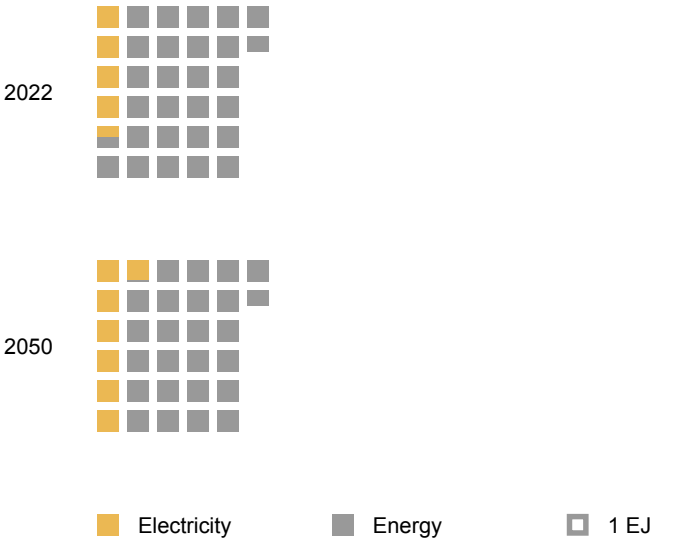


TABLE 16. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE EASTERN EUROPE REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	31.7	30.8	30.9	31.7
Electricity	4.5	5.1	6.1	6.9
Electricity as % of Energy	*14.2%*	*16.6%*	*19.7%*	*21.8%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is projected to increase by about 18% by 2030 and 29% by 2050 compared with 2022 capacity.
- In the high case, nuclear electrical generating capacity is projected to almost double by 2050. However, its share of total electrical capacity is expected to increase by only about 6 percentage points.
- In the low case, nuclear electrical generating capacity is projected to remain relatively stable over the next 20 years, with an 11% increase expected by 2050. The share of nuclear in total electrical capacity is expected to decline by one and a half percentage points by 2050.

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

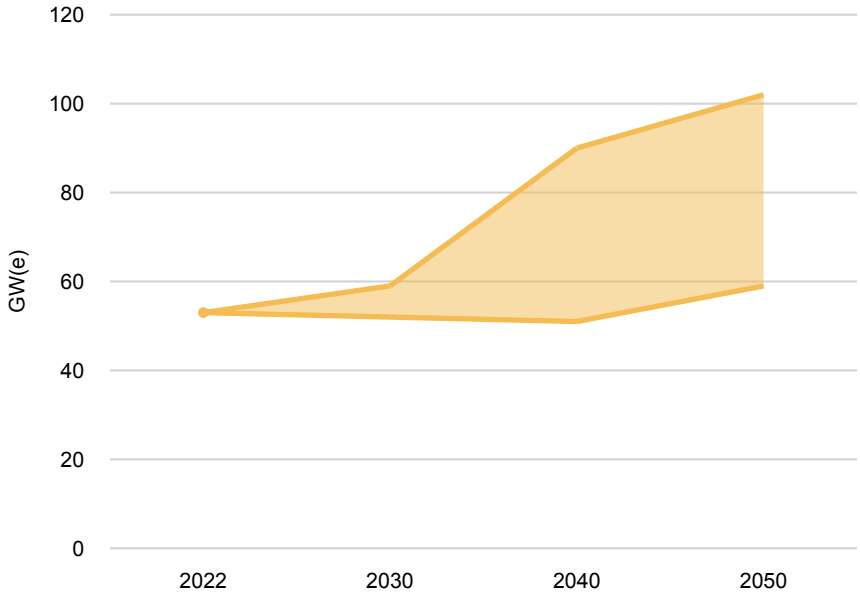


TABLE 17. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE EASTERN EUROPE REGION, GW(e)

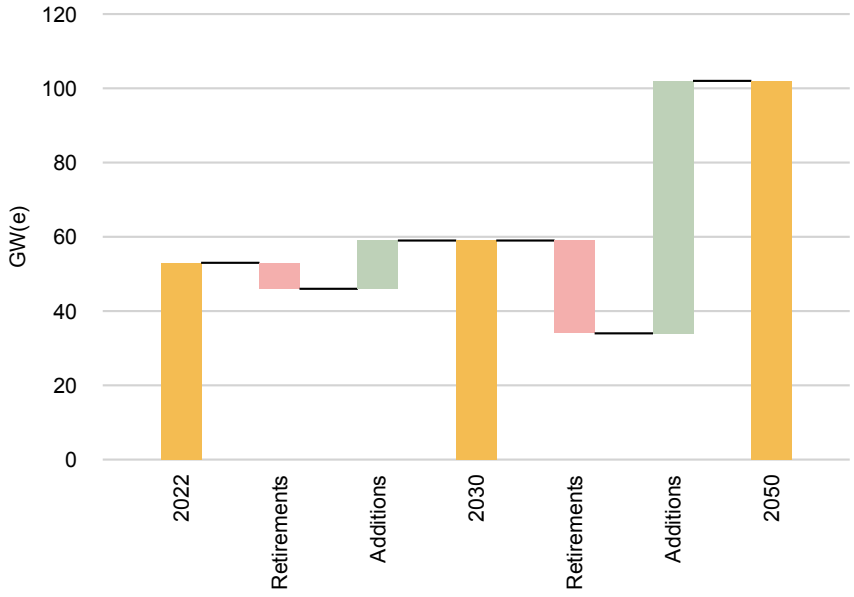
Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	478	563	563	626	626	616	616
Nuclear	53	52	59	51	90	59	102
Nuclear as % of Electrical Capacity	*11.1%*	*9.2%*	*10.5%*	*8.1%*	*14.4%*	*9.6%*	*16.6%*

Reactor Retirements and Additions

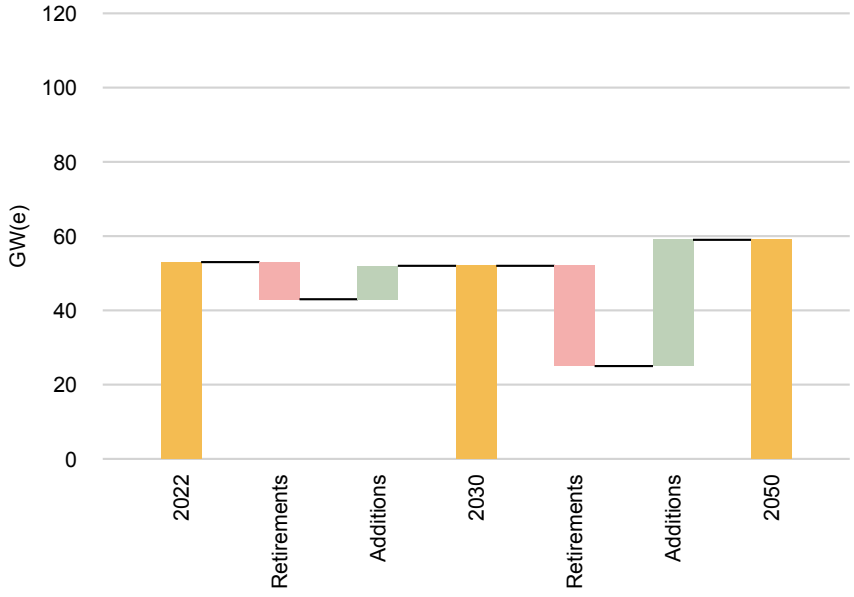
- In the high case, it is assumed that almost twice as much capacity will be added as retired by 2030, resulting in a net increase in capacity of 6 GW(e). Similarly, between 2030 and 2050 more than twice as much capacity is expected to be added as retired, resulting in a net increase in capacity of 43 GW(e).
- In the low case, it is assumed that there will be almost the same number of units retired as added by 2030. Between 2030 and 2050 slightly more reactors are expected to be added than retired, resulting in a net increase in capacity of 7 GW(e).

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 is projected to increase by about 14% by 2030 and by about 41% by 2050 compared with 2022 production.
- In the high case, nuclear electricity production is projected to rise by 25% by 2030 compared with 2022 levels and to more than double by 2050. The share of nuclear in total electricity production is expected to increase by more than 13 percentage points.
- In the low case, nuclear electricity production is projected to increase by about 10% by 2030 compared with 2022 levels, and an increase of 29% is expected by 2050. The share of nuclear in total electricity production is expected to decline by about two percentage points by 2050.

FIGURE 32. NUCLEAR ELECTRICITY PRODUCTION IN THE EASTERN EUROPE REGION

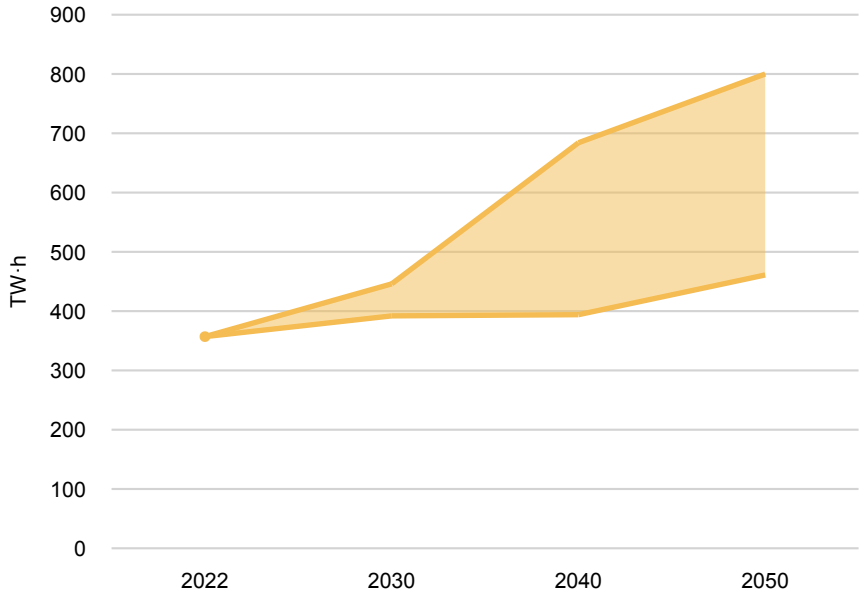


TABLE 18. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE EASTERN EUROPE REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	1 549	1 763	1 763	1 984	1 984	2 186	2 186
Nuclear	357	392	446	394	684	461	800
Nuclear as % of Electricity Production	*23.0%*	*22.2%*	*25.3%*	*19.9%*	*34.5%*	*21.1%*	*36.6%*

Africa

1 411

million people

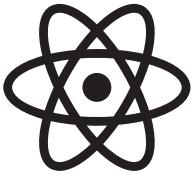
Energy Overview 2022

10.3%

of final energy consumed was electricity

856 TW·h

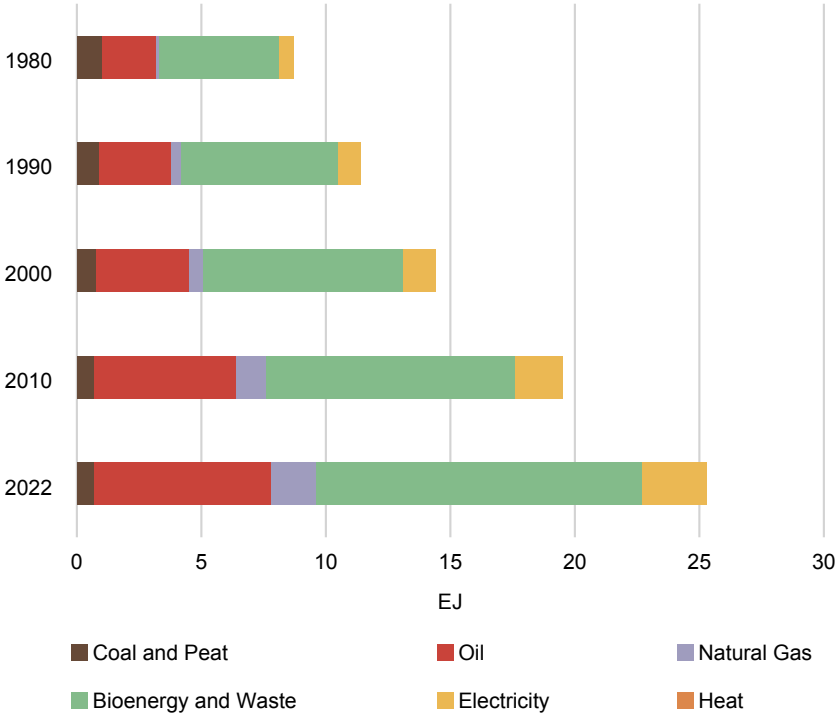
of electricity produced



1.2%

of electricity produced by nuclear

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



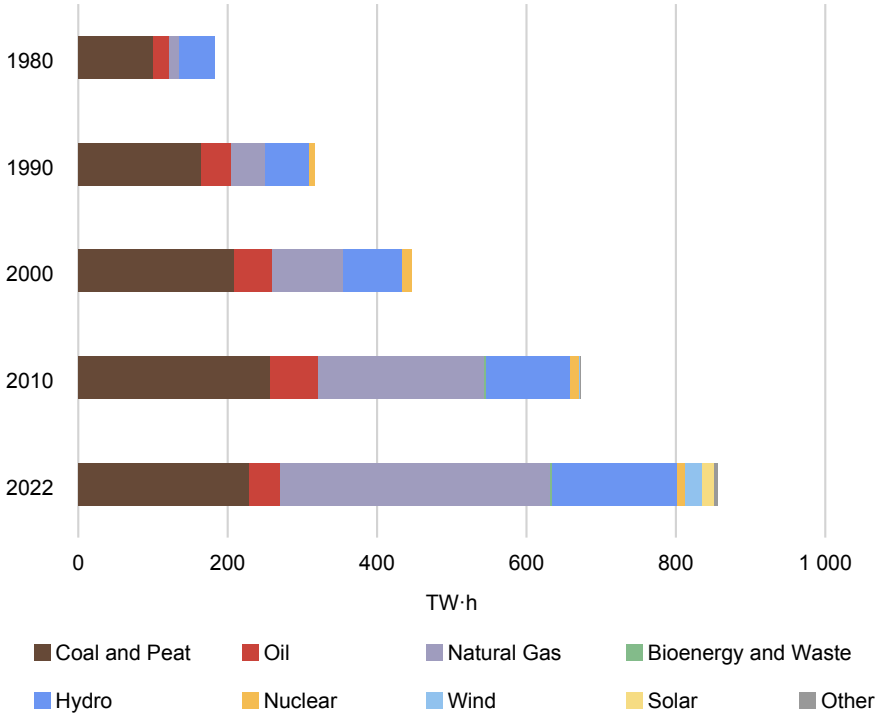
Final Energy Consumption

Bioenergy and waste has accounted for the largest share of final energy consumption over the past 40 years at around 50%.

The combined share of fossil fuels has been relatively stable since 1980 at about 40%. The share of natural gas has increased by about 6 percentage points over the past 40 years, while the share of oil has increased by about 2 percentage points. The share of coal has gradually decreased by about 7 percentage points.

The share of electricity has increased a few percentage points since 1980 to reach almost 10% in 2022.

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



Electricity Production

From 1980 until 2010 the combined share of fossil fuels in electricity production gradually increased by about 6 percentage points. From 2010 to 2022 their combined share decreased by the same amount but was still 74% of electricity production in 2022.

Since 1980 the share of natural gas has steadily increased by about 30 percentage points, whereas the share of coal has declined almost 50%. The share of oil has decreased by about 5 percentage points.

The share of nuclear was around 2–3% from 1990 to 2010 and 1.2% in 2022.

Hydro was the largest contributor of low carbon energy, accounting for about 19% of electricity production in 2022, although its share has decreased by about 8 percentage points over the past 40 years. The share of wind and solar has increased slightly since 2000, rising from less than 1% to about 4.5% in 2022.

Energy and Electricity Projections

- Final energy consumption is expected to increase 17% from 2022 levels by 2030 and by 78% by 2050, at an average annual rate of approximately 2%.
- Electricity consumption will grow much faster, at an average annual rate of approximately 5%, and is expected to increase more than fourfold from 2022 levels by 2050.
- Over the next 28 years the share of electricity in final energy consumption is expected to more than double from its 2022 share.

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

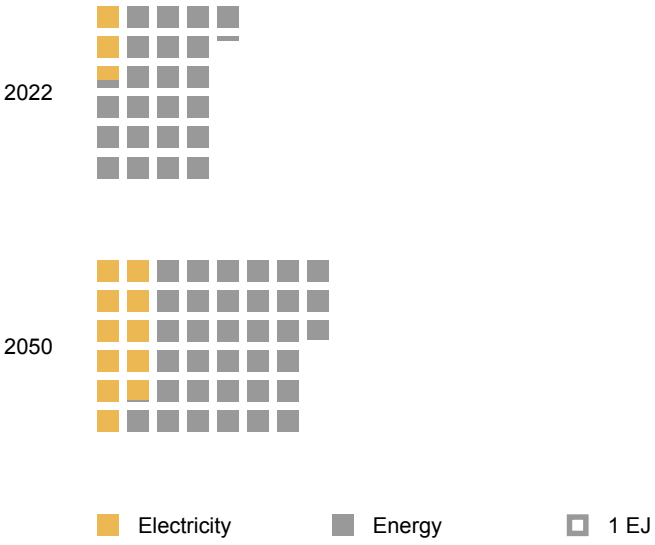


TABLE 19. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE AFRICA REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	25.2	29.5	35.7	44.9
Electricity	2.6	3.9	6.7	10.9
Electricity as % of Energy	*10.3%*	*13.2%*	*18.8%*	*24.3%*

Per Capita Energy and Electricity

- Only about 25% of the electricity produced in Africa is consumed by the residential sector.
- Electricity consumption on a per capita basis is expected to more than double from 0.5 MW·h per person in 2022 to 1.2 MW·h per person in 2050. This would be enough electricity to power one high efficiency modern (circa 2020) washing machine or one small high efficiency (induction) electric stove for 30 minutes per day.
- In 2010 the world average electricity consumption for households with electricity access was about 3.5 MW·h, almost six times that for the residential sector in Africa in 2022.

FIGURE 36. PER CAPITA ELECTRICITY CONSUMPTION IN THE AFRICA REGION

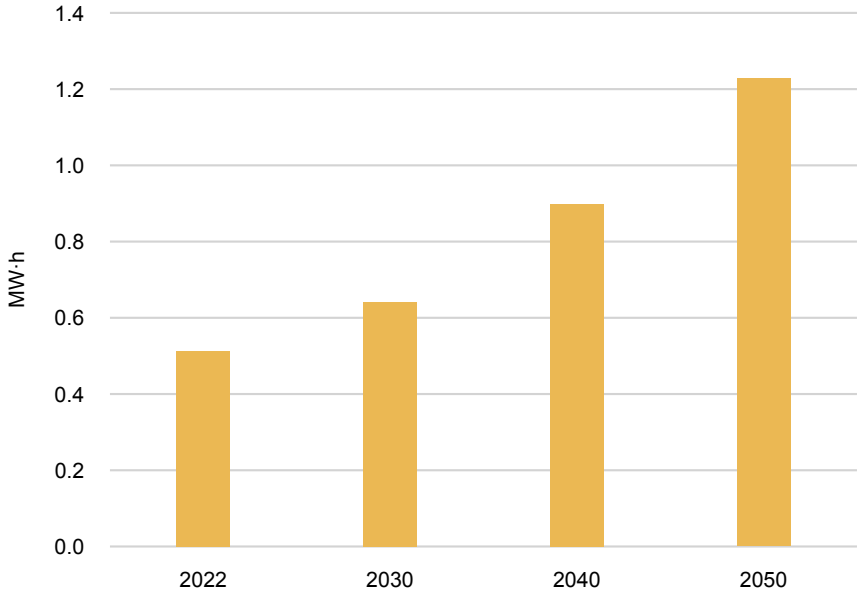
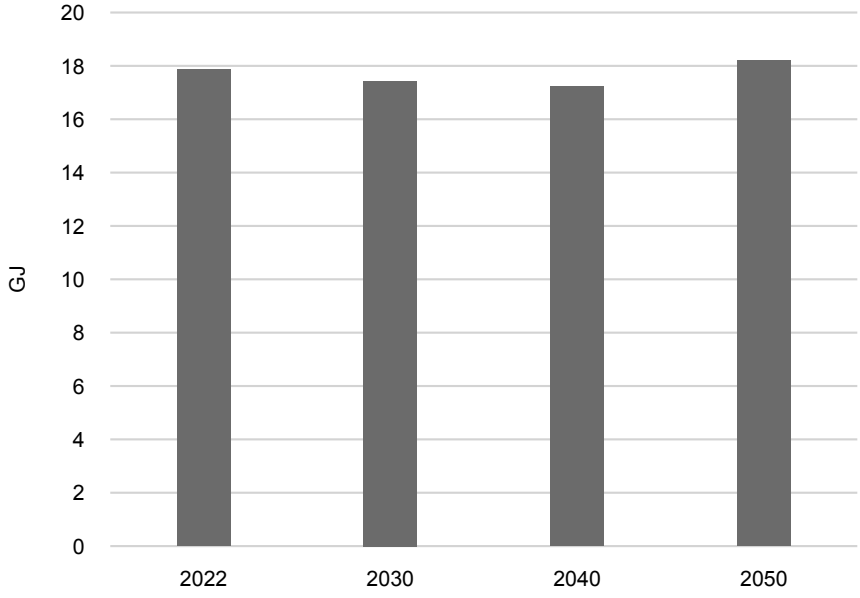


FIGURE 37. PER CAPITA FINAL ENERGY CONSUMPTION IN THE AFRICA REGION



Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is expected to increase by 44% by 2030 and to undergo a almost fourfold increase by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase by 58% by 2030 and to undergo more than a tenfold increase by 2050 compared with 2022 capacity.
- In the low case, nuclear electrical generating capacity is projected to remain constant to 2030, and by 2050 it is expected to undergo close to a fivefold increase compared with 2022 levels.

FIGURE 38. NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE AFRICA REGION

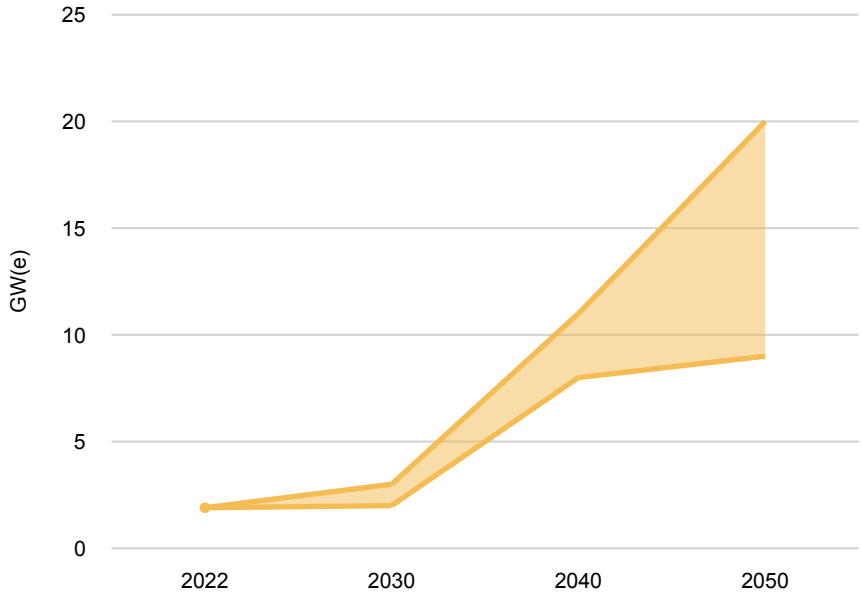


TABLE 20. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE AFRICA REGION, GW(e)

Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	262	378	378	617	617	1 028	1 028
Nuclear	1.9	2	3	8	11	9	20
Nuclear as % of Electrical Capacity	*0.7%*	*0.5%*	*0.8%*	*1.3%*	*1.8%*	*0.9%*	*1.9%*

Electricity and Nuclear Production Projections

- Total electricity production is projected to increase by 50% by 2030 and to increase more than fourfold by 2050.
- In the high case, nuclear electricity production is expected to more than double from 2022 levels by 2030 and to increase more than 14-fold by 2050. The share of nuclear in total electricity production is expected to more than triple.
- In the low case, nuclear electricity production is expected to remain almost the same to 2030 and to increase about sevenfold by 2050. The share of nuclear in total electricity production is expected to decline slightly by 2030, increasing again thereafter to reach 2% by 2050.

FIGURE 39. NUCLEAR ELECTRICITY PRODUCTION IN THE AFRICA REGION

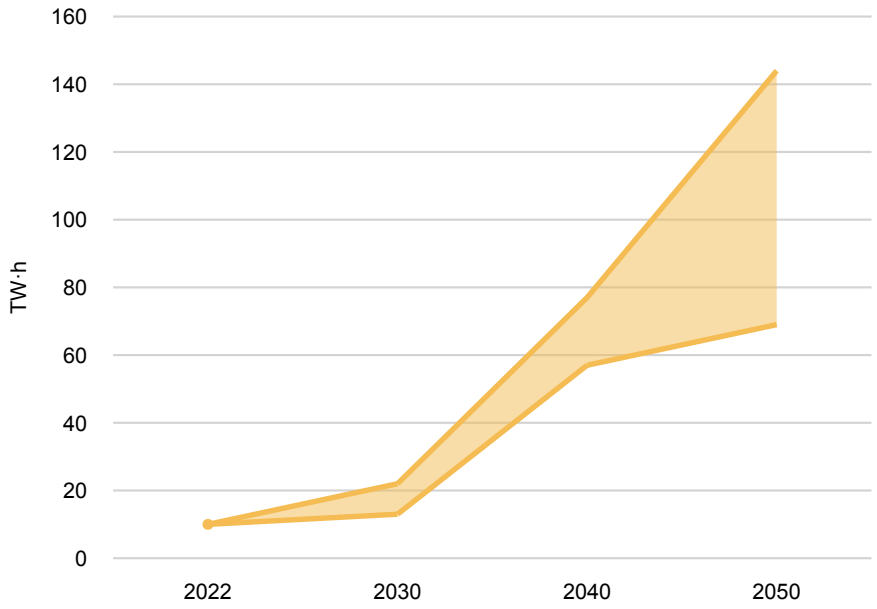


TABLE 21. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE AFRICA REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	856	1 285	1 285	2 205	2 205	3 533	3 533
Nuclear	10	13	22	57	77	69	144
Nuclear as % of Electricity Production	*1.2%*	*1.0%*	*1.7%*	*2.6%*	*3.5%*	*2.0%*	*4.1%*

Western Asia

292

million people

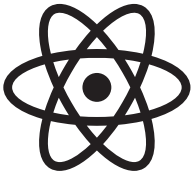
Energy Overview 2022

20.1%

of final energy consumed was electricity

1 297 TW·h

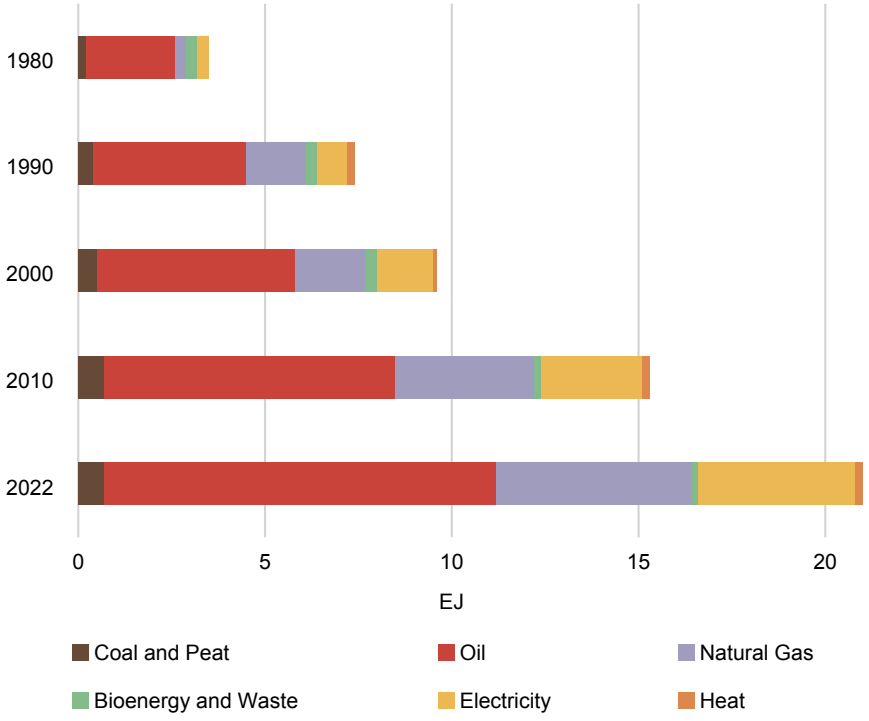
of electricity produced



1.7%

of electricity produced by nuclear

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



Final Energy Consumption

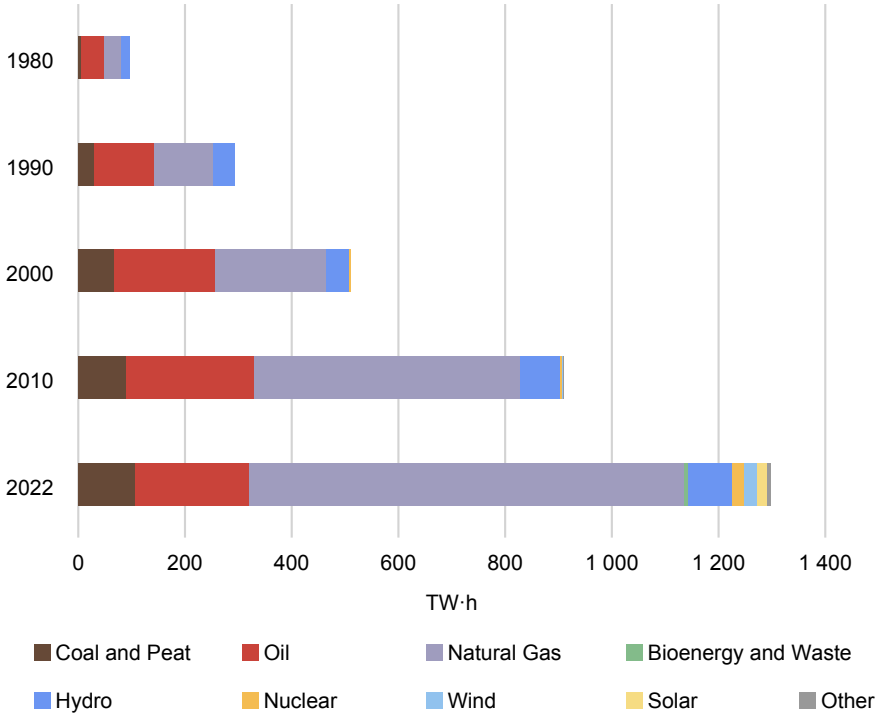
Fossil fuels have continued to dominate final energy consumption, with a stable share of about 80% since 1980.

At about 50% in 2022, oil had the largest share of final energy of all fossil fuels, despite a reduction of 19 percentage points since 1980. The share of natural gas has increased steadily since 1980 and was the second largest, accounting for about a quarter of final energy consumption in 2022. The share of coal was about 3% in 2022, remaining relatively small and decreasing by a few percentage points since 1980.

At about 20% in 2022, the share of electricity in final energy consumption has more than doubled since 1980.

The share of bioenergy and waste in final energy consumption has declined gradually over the years, decreasing from about 9% in 1980 to less than 1% in 2022.

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



Electricity Production

With a share of almost 90%, fossil fuels — particularly natural gas — have remained dominant sources of electricity production since 1980.

Hydro remains the largest contributor of low carbon electricity, accounting for about 6% of total production, although its share has declined by more than half since 1980.

The share of nuclear in electricity production remains small at 1.7% by 2022.

In recent years, solar and wind have begun generating electricity, and in 2022 their combined share was more than 3%.

Energy and Electricity Projections

- Final energy consumption is expected to increase from 2022 levels by about 3% by 2030 and about 19% by 2050, at an average annual rate of approximately 0.6%.
- Electricity consumption is expected to grow at a faster rate of about 2.6% per year. Electricity consumption is expected to more than double by 2050.
- By 2050 the share of electricity in final energy consumption is expected to increase by almost 15 percentage points from its 2022 share.

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

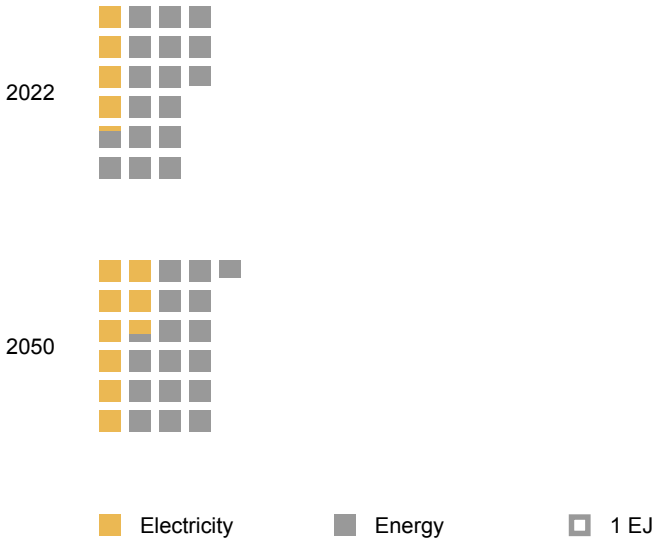


TABLE 22. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE WESTERN ASIA REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	20.9	21.5	22.7	24.8
Electricity	4.2	5.3	6.9	8.6
Electricity as % of Energy	*20.1%*	*24.7%*	*30.4%*	*34.7%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is expected to increase by about 39% by 2030 and about 170% by 2050.
- In the high case, nuclear electrical generating capacity is projected to more than double by 2030 and increase more than a fivefold by 2050 compared with 2022 capacity.
- In the low case, nuclear electrical generating capacity is projected to increase almost twofold by 2030 and more than a threefold by 2050 compared with 2022 capacity.
- The share of nuclear in total electrical generating capacity is expected to increase by 2050 in both the high and the low case.

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

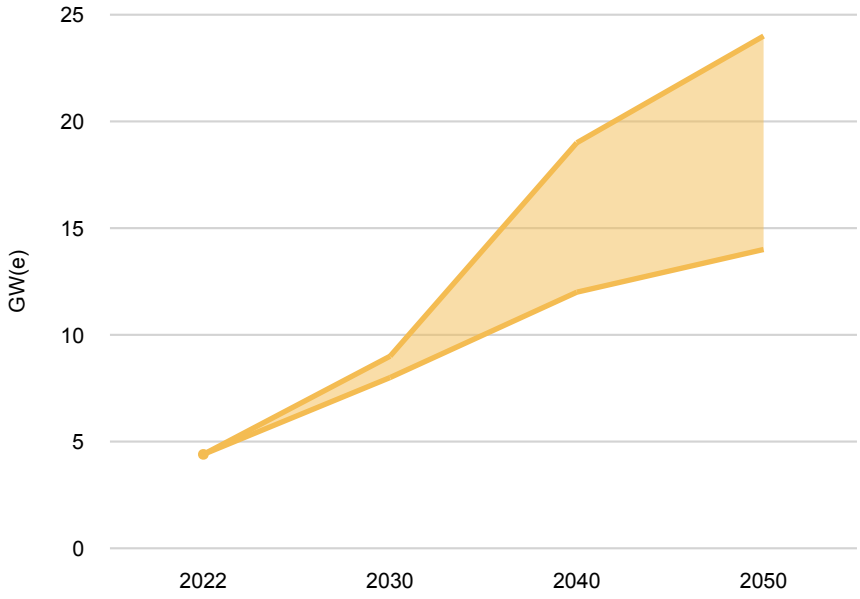


TABLE 23. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE WESTERN ASIA REGION, GW(e)

Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	377	525	525	716	716	1 023	1 023
Nuclear	4.4	8	9	12	19	14	24
Nuclear as % of Electrical Capacity	*1.2%*	*1.5%*	*1.7%*	*1.7%*	*2.7%*	*1.4%*	*2.3%*

Electricity and Nuclear Production Projections

- Total electricity production is projected to increase by about 32% by 2030 and to more than double by 2050.
- In the high case, nuclear electricity production is expected to undergo an almost threefold increase from 2022 levels by 2030 and a more than eightfold increase by 2050. The share of nuclear in total electricity production is expected to increase by about 5 percentage points.
- In the low case, nuclear electricity production is expected to undergo a 2.5-fold increase from 2022 levels by 2030, rising to more than a fivefold increase by 2050. The share of nuclear in total electricity production is expected to increase by about 2 percentage points.

FIGURE 44. NUCLEAR ELECTRICITY PRODUCTION IN THE WESTERN ASIA REGION

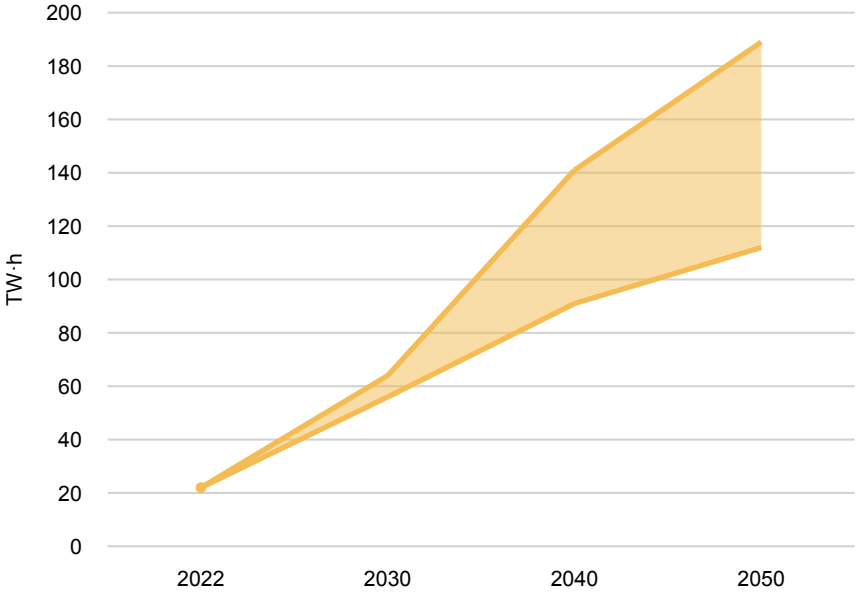


TABLE 24. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE WESTERN ASIA REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	1 297	1 717	1 717	2 256	2 256	2 817	2 817
Nuclear	22	56	64	91	141	112	189
Nuclear as % of Electricity Production	*1.7%*	*3.3%*	*3.7%*	*4.0%*	*6.2%*	*4.0%*	*6.7%*

Southern Asia

1 998

million people

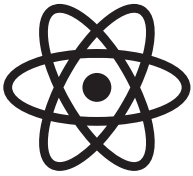
Energy Overview 2022

16.0%

of final energy consumed was electricity

2 397 TW·h

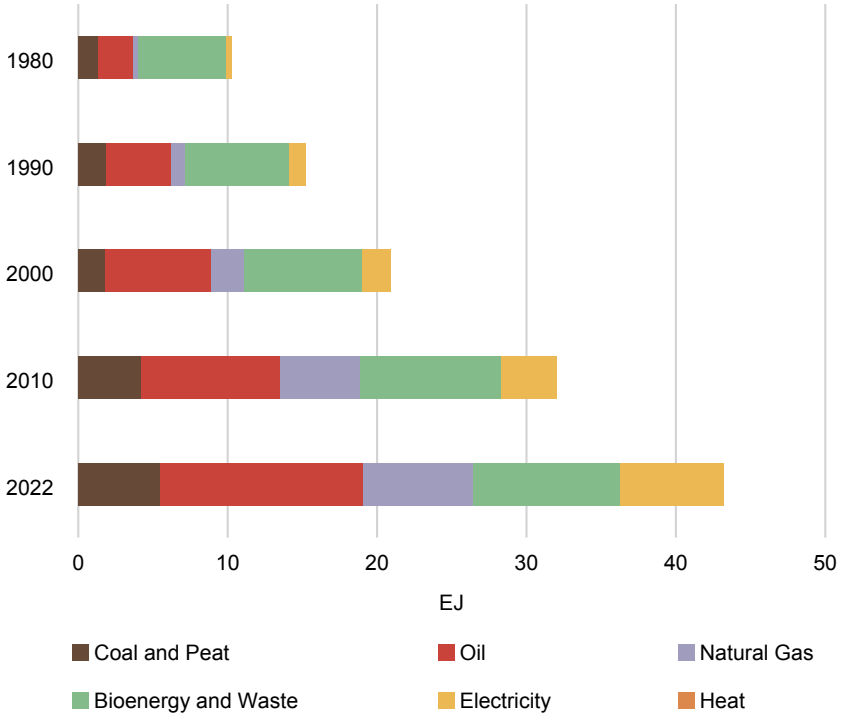
of electricity produced



2.9%

of electricity produced by nuclear

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



Final Energy Consumption

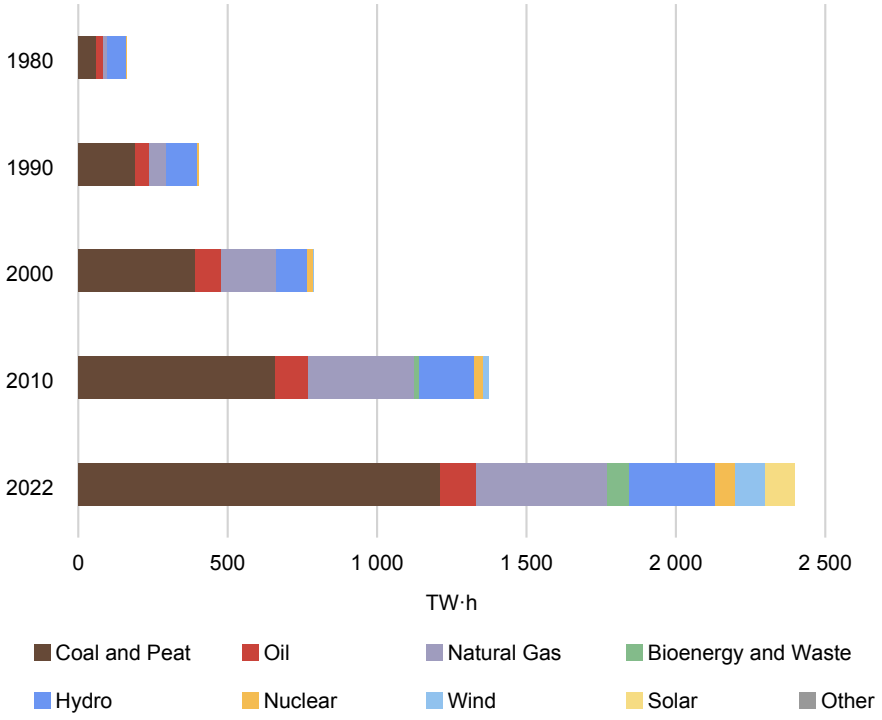
Since 1980 the share of fossil fuels in final energy consumption has been increasing steadily from approximately 40% in 1980 to more than 62% in 2022.

The share of natural gas has increased from less than 3% in 1980 to about 16% in 2022. The share of oil has also been gradually increasing, accounting for almost one third of final energy consumption in 2022, which is an increase of about 8 percentage points since 1980. Coal has remained relatively stable with a share of about 12–14%.

In 2022 the share of electricity was about 15%, more than tripling since 1980.

The share of bioenergy and waste has declined by more than half since 1980, reaching about 23% in 2022.

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



Electricity Production

From 1980 to 2000, fossil fuels increased their share of electricity production from about 60% to more than 80%. Their share has since declined to about 74% in 2022.

Coal is the largest source of electricity with a share of 60%, an increase of about 24 percentage points since 1980. The share of natural gas has increased since 1980, accounting for about 10% of the electricity produced in 2022. The share of oil has decreased 9 percentage points since 1980 to about 4% in 2022.

Hydro remains the largest contributor of low carbon electricity, accounting for 13% of total production, although its share has decreased by about 26 percentage points since 1980. In recent years, the share of solar and wind has undergone a rapid increase, rising from less than 1% in 2000 to more than 7% in 2022.

The share of nuclear was about 3% in 2022.

Energy and Electricity Projections

- Final energy consumption is expected to increase by about 40% from 2022 levels by 2030 and to double by 2050, at an average annual rate of approximately 2.6%.
- Electricity consumption is expected to grow at a faster rate of 4.2% per year. Electricity consumption is expected to more than triple by 2050.
- By 2050 the share of electricity in final energy consumption is expected to increase by about 9 percentage points from its 2022 share.

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

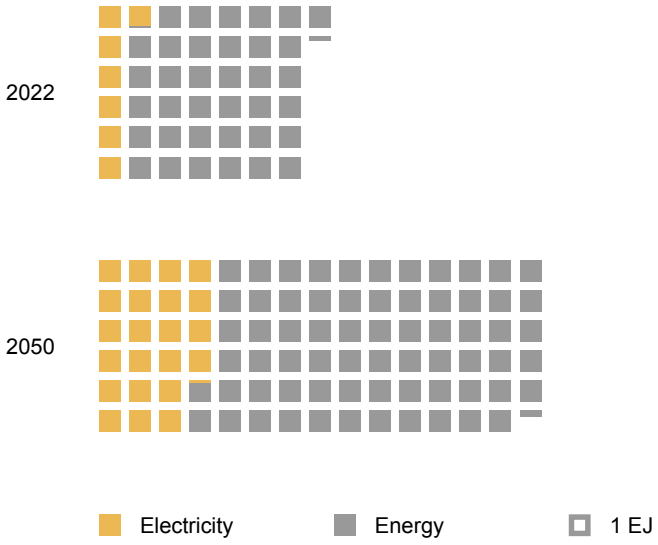


TABLE 25. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE SOUTHERN ASIA REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	43.2	60.6	74.7	89.3
Electricity	6.9	10.7	16.1	22.1
Electricity as % of Energy	*16.0%*	*17.7%*	*21.6%*	*24.7%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is expected to nearly double by 2030 and to increase more than fourfold by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase by more than 130% by 2030 and to undergo an almost sevenfold increase by 2050 compared with 2022 capacity. The share of nuclear in total electrical generating capacity is expected to increase to 2.5% by 2050.
- In the low case, nuclear electrical generating capacity is projected to increase by 55% by 2030 and increase almost fourfold by 2050. The share of nuclear in total electrical generating capacity is expected to remain roughly at the 2022 level until 2040 with a small decline by 2050.

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

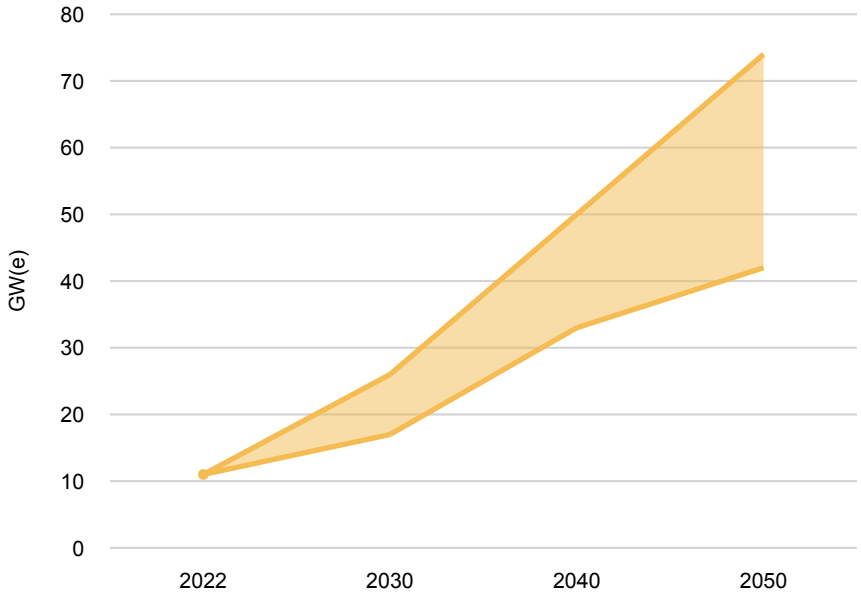


TABLE 26. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE SOUTHERN ASIA REGION, GW(e)

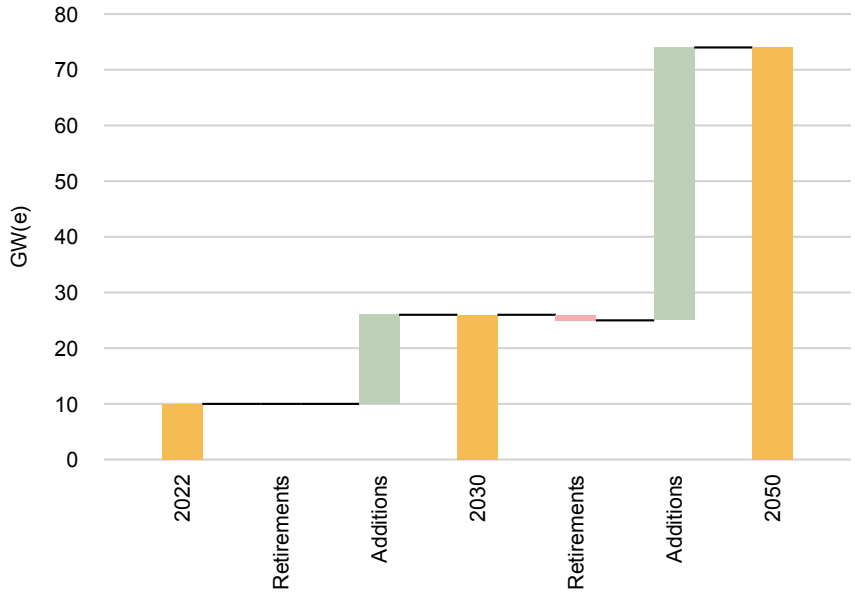
Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	647	1 127	1 127	1 806	1 806	3 014	3 014
Nuclear	11	17	26	33	50	42	74
Nuclear as % of Electrical Capacity	*1.7%*	*1.5%*	*2.3%*	*1.8%*	*2.8%*	*1.4%*	*2.5%*

Reactor Retirements and Additions

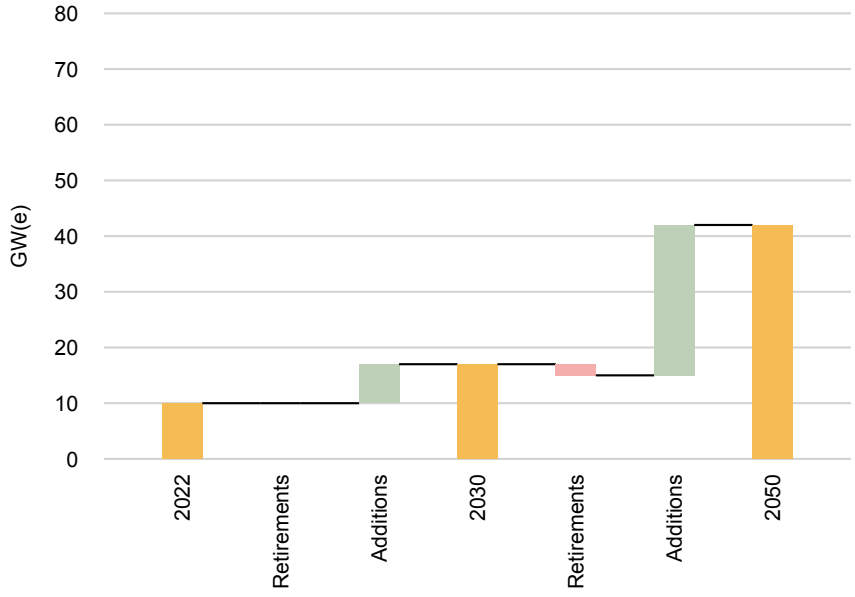
- In the high case, it is assumed that no nuclear electrical generating capacity will be retired by 2030 and that only about 1 GW(e) will be retired by 2050. This is expected to contribute to net capacity additions of about 16 GW(e) by 2030 and 49 GW(e) over the subsequent 20 years.
- In the low case, like in the high case, no nuclear electrical generating capacity will be retired by 2030. It is assumed there will be about 8 GW(e) of net capacity added by 2030. Between 2030 and 2050 it is expected that new reactors will add about 27 GW(e) of capacity and only a few GW(e) of capacity will be retired.

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

HIGH CASE



LOW CASE



Electricity and Nuclear Production Projections

- Total electrical production is projected to increase by 48% by 2030 and by more than threefold by 2050 compared with 2022 production.
- In the high case, nuclear electricity production is expected to increase by 170% by 2022 levels by 2030 and to increase about eightfold by 2050. The share of nuclear in total electricity production is expected to increase by about 5 percentage points.
- In the low case, nuclear electricity production is expected to increase by 78% by 2030 and to increase about fivefold by 2050. The share of nuclear in total electricity production is expected to increase by about one and a half percentage points.

FIGURE 50. NUCLEAR ELECTRICITY PRODUCTION IN THE SOUTHERN ASIA REGION

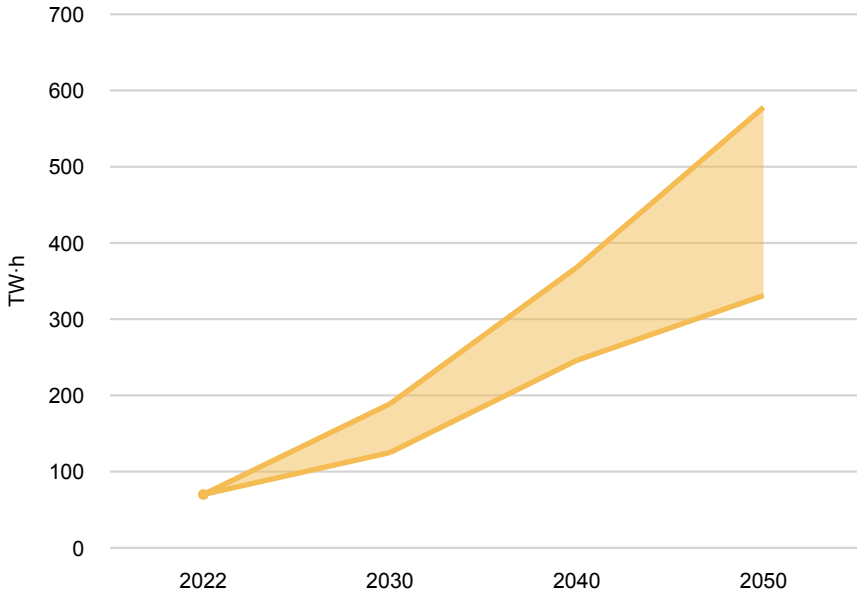


TABLE 27. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE SOUTHERN ASIA REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	2 397	3 556	3 556	5 303	5 303	7 253	7 253
Nuclear	70	125	189	246	368	331	578
Nuclear as % of Electricity Production	*2.9%*	*3.5%*	*5.3%*	*4.6%*	*6.9%*	*4.6%*	*8.0%*

Central and Eastern Asia

1 740

million people

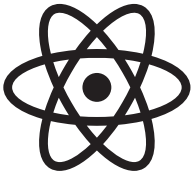
Energy Overview 2022

26.6%

of final energy consumed was electricity

10 584 TW·h

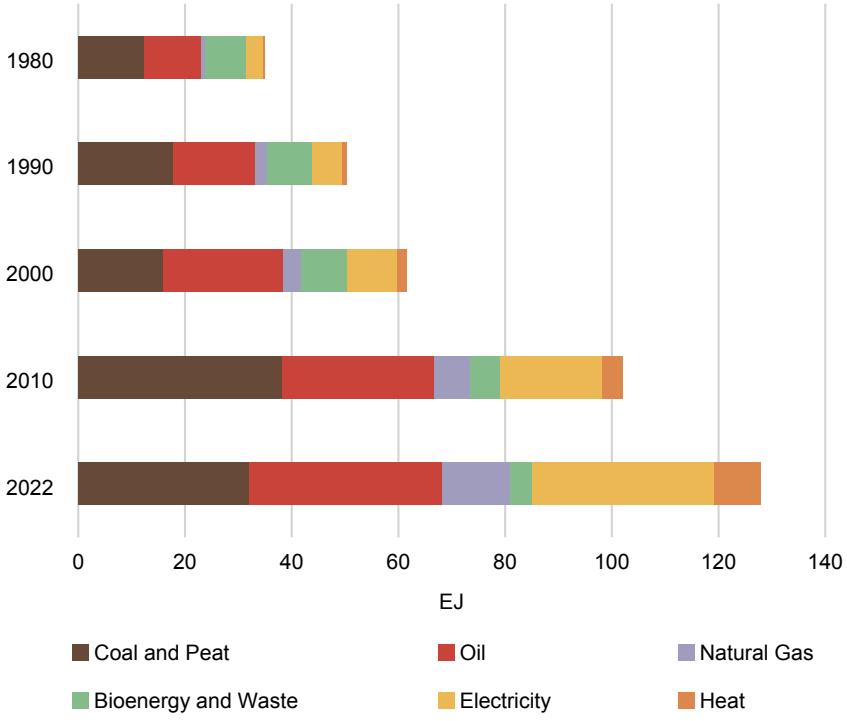
of electricity produced



6.0%

of electricity produced by nuclear

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



Final Energy Consumption

Since 1980 fossil fuels have dominated final energy consumption with a combined share that has remained around 65–70%.

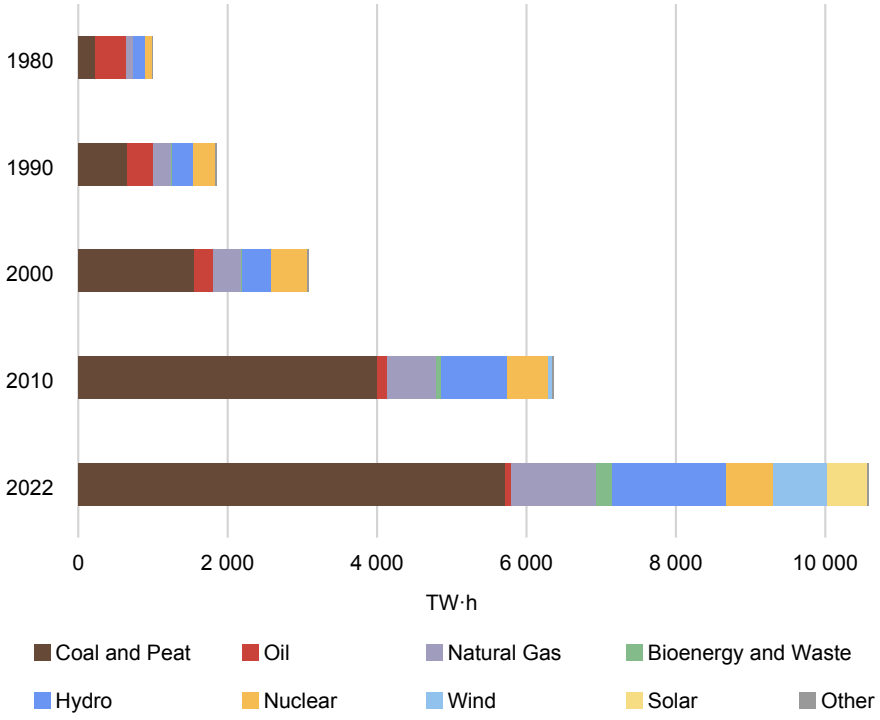
The share of natural gas has increased fourfold since 1980, whereas oil has maintained a relatively consistent share of about 30%. The share of coal was 28% in 2022.

The share of electricity has more than doubled since 1980, accounting for more than a quarter of final energy consumption in 2022.

The share of bioenergy and waste in final energy consumption has decreased by about 17 percentage points since 1980.

The share of heat has increased from less than 1% in 1980 to almost 7% in 2022.

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



Electricity Production

With a share of about 70%, fossil fuels — particularly coal — have remained dominant sources of electricity production since 1980.

The share of coal has increased more than 35 percentage points since 1980. The share of natural gas increased from 1980 to 1990, and then declined to about 10%. Of all fossil fuels, the share of oil has experienced the most significant change, decreasing from about 42% in 1980 to below 1% in 2022.

Hydro was the largest contributor of low carbon electricity, accounting for 14% of total production in 2022. Its share has remained relatively stable over the past 40 years. In recent years, the share of solar and wind has increased rapidly, rising from less than 1% in 2010 to almost 11% in 2022.

The share of nuclear increased between 1980 and 2000 but has since declined, falling to about 6% in 2022.

Energy and Electricity Projections

- Final energy consumption is expected to increase by about 10% from 2022 levels by 2030 and by about 15% by 2050, at an average annual rate of approximately 0.5%.
- Electricity consumption is expected to grow at a faster rate of about 1.7% per year. Electricity consumption is expected to increase by about 60% from 2022 levels by 2050.
- By 2050 the share of electricity in final energy consumption is expected to increase by about ten percentage points from its 2022 share.

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

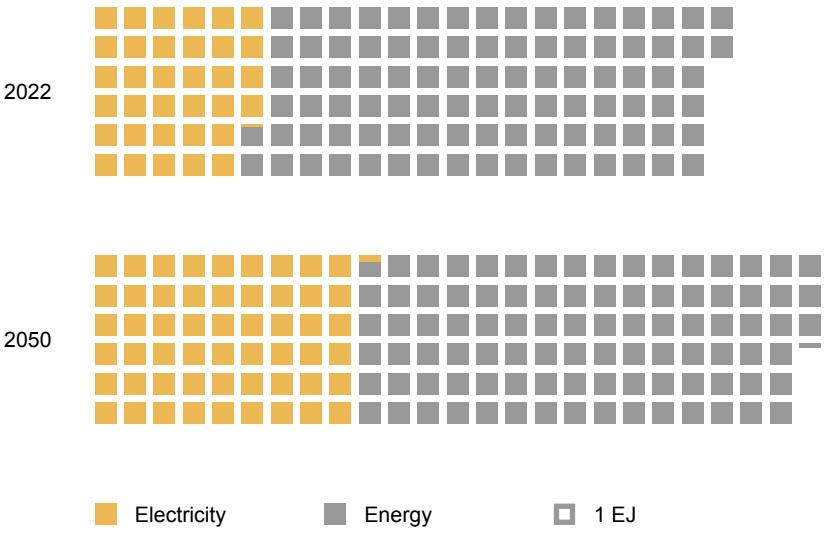


TABLE 28. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA, EJ

Final Consumption	2022	2030	2040	2050
Energy	128.0	140.2	144.7	147.2
Electricity	34.1	39.6	47.9	54.3
Electricity as % of Energy	*26.6%*	*28.2%*	*33.1%*	*36.9%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is expected to increase by about 17% by 2030 and by almost 70% by 2050.
- In the high case, nuclear electrical generating capacity is projected to increase by about 76% by 2030 and to almost quadruple by 2050 compared with 2022 capacity. The share of nuclear in total electrical generating capacity is expected to increase by almost 4 percentage points by 2050.
- In the low case, nuclear electrical generating capacity is projected to increase by 40% by 2030 and more than a double by 2050 compared with 2022 capacity. The share of nuclear in total electrical generating capacity is expected to increase slightly by 2050.

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

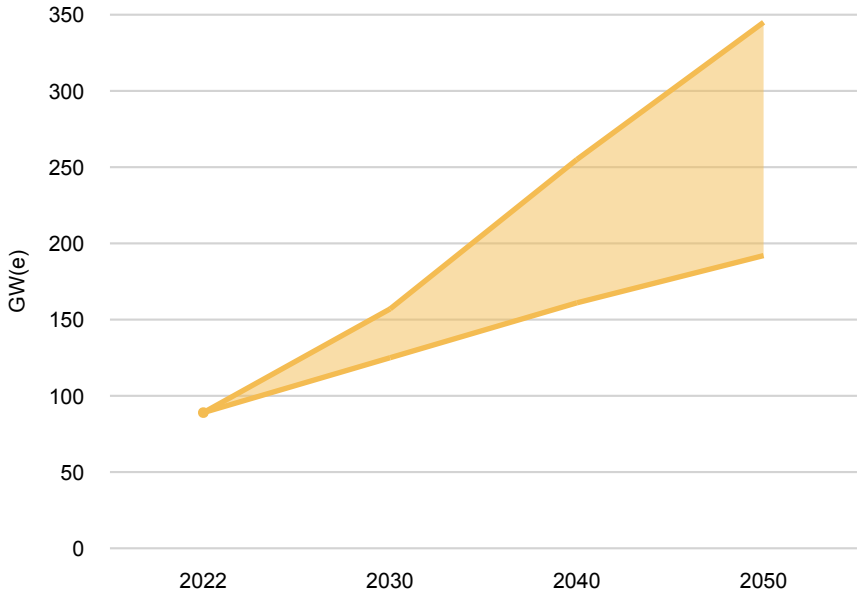


TABLE 29. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA, GW(e)

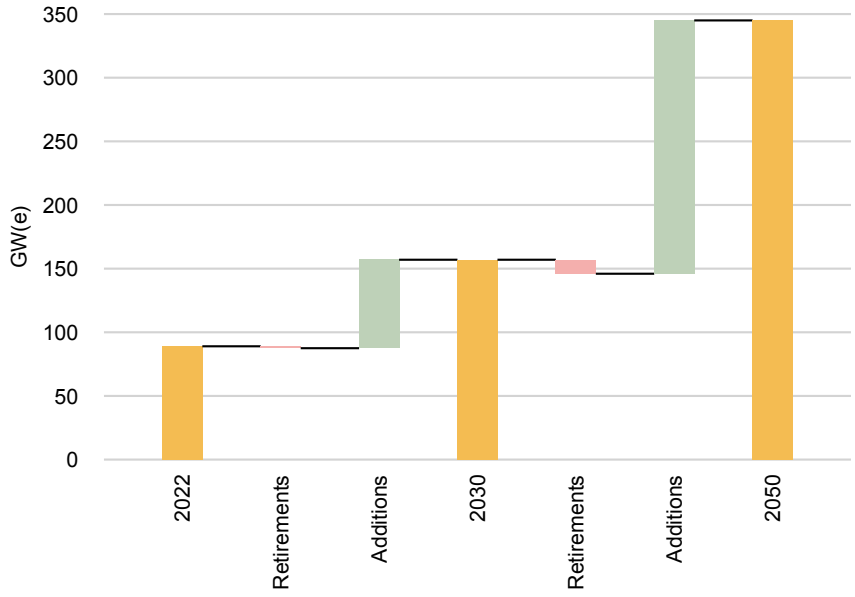
Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	3 139	3 678	3 678	4 671	4 671	5 324	5 324
Nuclear	89	125	157	161	255	192	345
Nuclear as % of Electrical Capacity	*2.8%*	*3.4%*	*4.3%*	*3.4%*	*5.5%*	*3.6%*	*6.5%*

Reactor Retirements and Additions

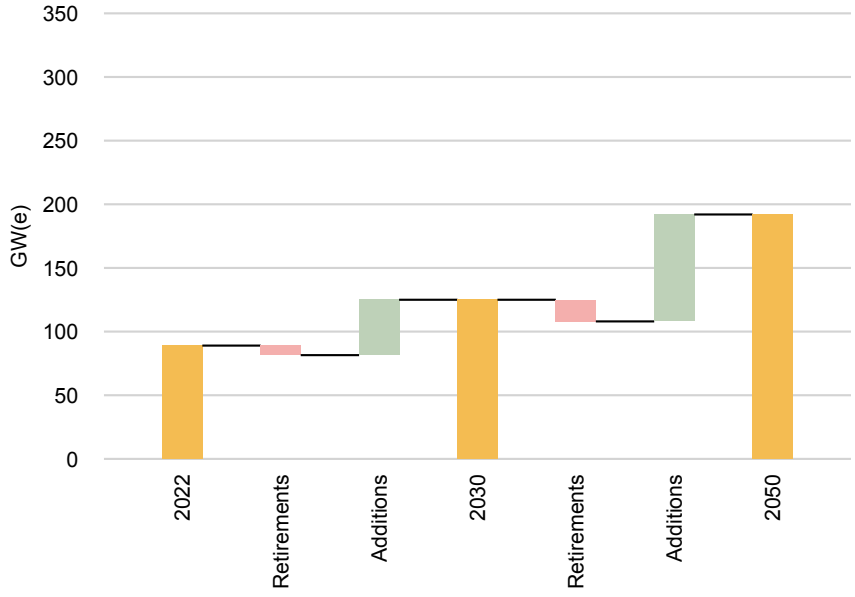
- In the high case, it is assumed that less than 2% of the 2022 nuclear electrical generating capacity will be retired by 2030 and 15% will be retired by 2050. This is expected to result in net capacity additions of about 68 GW(e) by 2030 and about 188 GW(e) over the subsequent 20 years.
- In the low case, it is assumed that about 8% of the 2022 nuclear electrical generating capacity will be retired by 2030, while new reactors will add about 50% capacity. Between 2030 and 2050 net capacity additions of about 67 GW(e) are expected.

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

- Total electricity production is projected to increase by 57% by 2050.
- In the high case, nuclear electricity production is expected to almost double from 2022 levels by 2030 and to undergo a 4.5-fold increase by 2050. The share of nuclear in total electricity production is expected to increase by about 11 percentage points.
- In the low case, nuclear electricity production is expected to increase by about 50% from 2022 levels by 2030 and by almost 280% by 2050. The share of nuclear in total electricity production is expected increase by almost 5 percentage points.

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

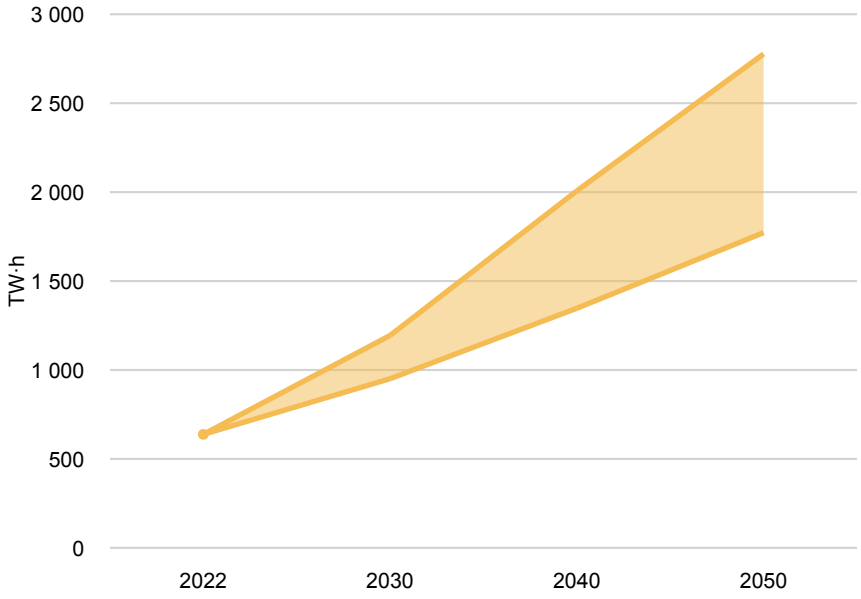


TABLE 30. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE COMBINED REGIONS OF CENTRAL AND EASTERN ASIA, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	10 584	12 101	12 101	14 632	14 632	16 576	16 576
Nuclear	638	951	1 194	1 347	2 007	1 772	2 777
Nuclear as % of Electricity Production	*6.0%*	*7.9%*	*9.9%*	*9.2%*	*13.7%*	*10.7%*	*16.8%*

South-eastern Asia

678

million people

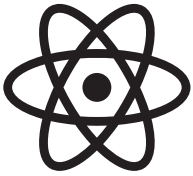
Energy Overview 2022

19.0%

of final energy consumed was electricity

1 153TW·h

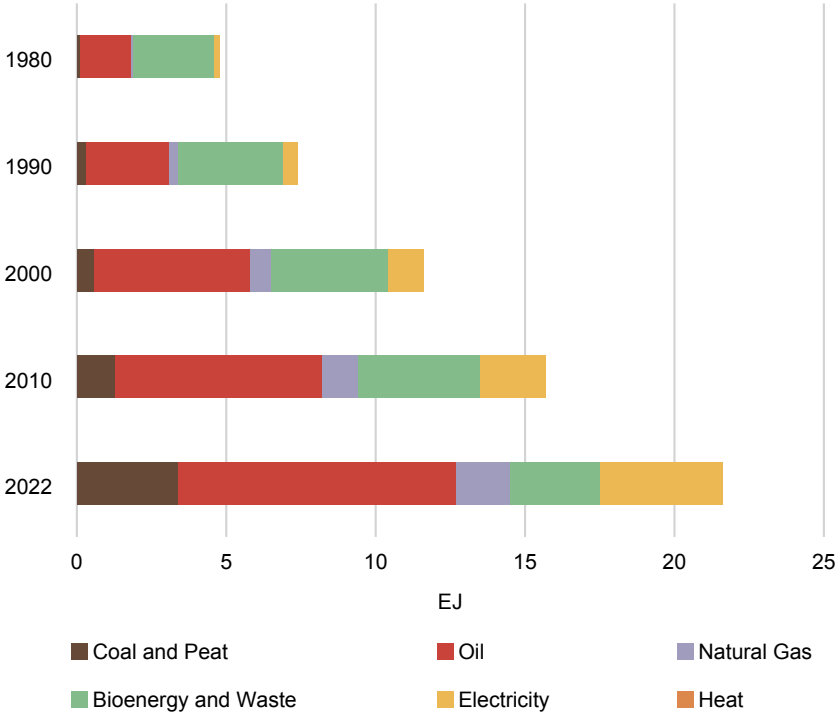
of electricity produced



0%

of electricity produced by nuclear

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



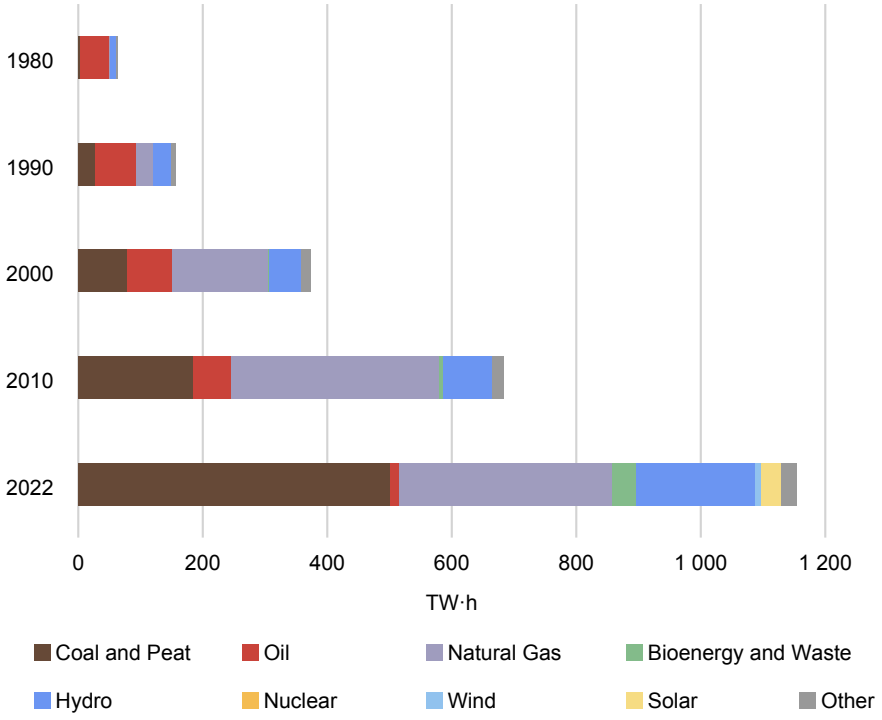
Final Energy Consumption

From 1980 to 1990, bioenergy and waste accounted for the largest share of final energy consumption.

Since 2000, fossil fuels have dominated final energy consumption, with oil having the largest share at about 43%. The share of coal has gradually increased over the past 40 years, reaching almost 16% in 2022, an increase of 14 percentage points. The share of natural gas has quadrupled since 1980, reaching about 8% in 2022.

At 19% in 2022, electricity's share has increased fourfold since 1980.

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



Electricity Production

With a share of about 80% over the past 40 years, fossil fuels have remained dominant sources of electricity production.

The share of coal has increased 31 percentage points since 1980 and reached about 43% in 2022, whereas oil's share has declined by some 70 percentage points to about 1% in 2022. The share of natural gas has increased about 30 percentage points since 1980.

Hydro remains the largest contributor of low carbon electricity, accounting for 16% of total electricity production in 2022. The share of 'other' sources (mainly geothermal) increased by about 1 percentage point between 1980 and 2000, but has since fallen, reaching about 2% in 2022. Solar and wind have recently begun contributing to electricity generation, accounting for slightly below 4% in 2022.

Energy and Electricity Projections

- Final energy consumption is expected to increase by about 21% from 2022 levels by 2030 and by 60% by 2050, at an average annual rate of approximately 1.7%.
- Electricity consumption is expected to grow at a faster rate of 3.8% per year. Electricity consumption is expected to almost triple by 2050.
- By 2050 the share of electricity in final energy consumption is expected to increase by about 14 percentage points from its 2022 share.

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

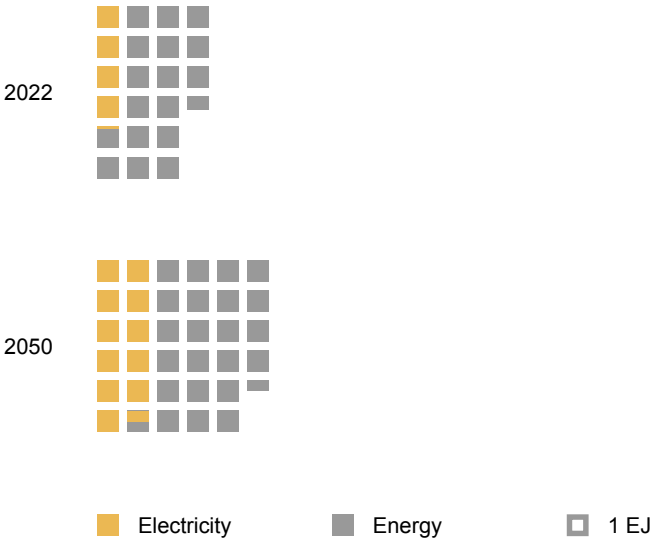


TABLE 31. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE SOUTH-EASTERN ASIA REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	21.6	26.2	29.0	34.5
Electricity	4.1	6.0	8.5	11.5
Electricity as % of Energy	*19.0%*	*22.9%*	*29.3%*	*33.3%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is expected to increase by about 46% by 2030 and to almost triple by 2050.
- Total electricity production is projected to increase by 63% by 2030 compared with 2022 production levels and to more than triple by 2050.
- In the high case, nuclear reactors are projected to be operational by 2040 and by 2050 nuclear electrical generating capacity is expected to increase by by an additional 10 GW(e). The share of nuclear in total electricity production is expected to reach about 2.5%.
- In the low case, nuclear reactors are also projected to be operational by 2040 and by 2050 nuclear electrical generating capacity is expected to triple compared with 2040 capacity. The share of nuclear in total electricity production is expected to reach about 0.7%.

TABLE 32. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE SOUTH-EASTERN ASIA REGION, GW(e)

Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	313	458	458	671	671	928	928
Nuclear	0.0	0	0	1	1	3	11
Nuclear as % of Electrical Capacity	*0.0%*	*0.0%*	*0.0%*	*0.1%*	*0.1%*	*0.3%*	*1.2%*

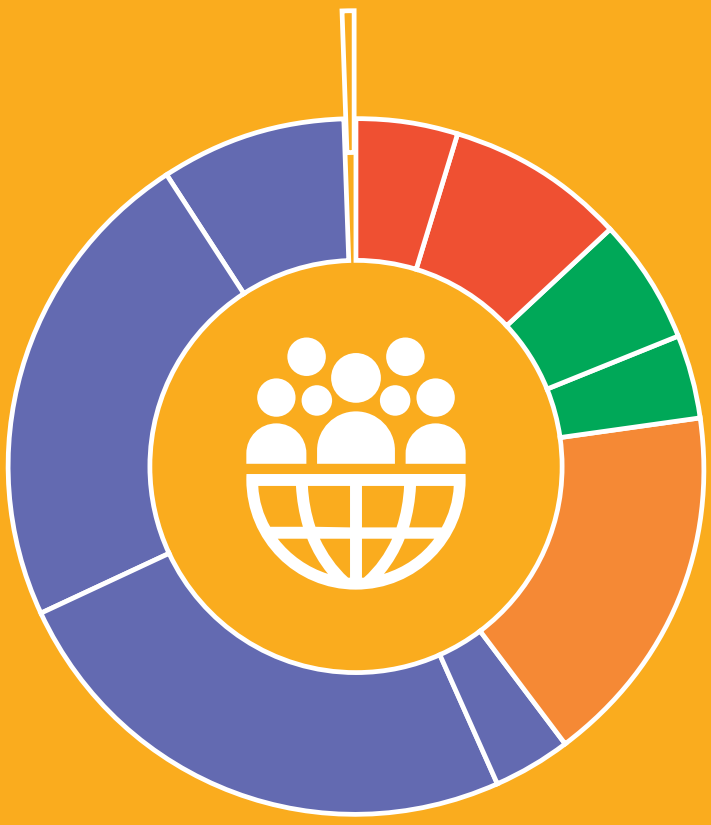
TABLE 33. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE SOUTH-EASTERN ASIA REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	1 153	1 880	1 880	2 612	2 612	3 496	3 496
Nuclear	0	0	0	7	7	24	87
Nuclear as % of Electricity Production	*0.0%*	*0.0%*	*0.0%*	*0.3%*	*0.3%*	*0.7%*	*2.5%*

Oceania

45

million people



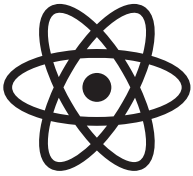
Energy Overview 2022

22.0%

of final energy consumed was electricity

307 TW·h

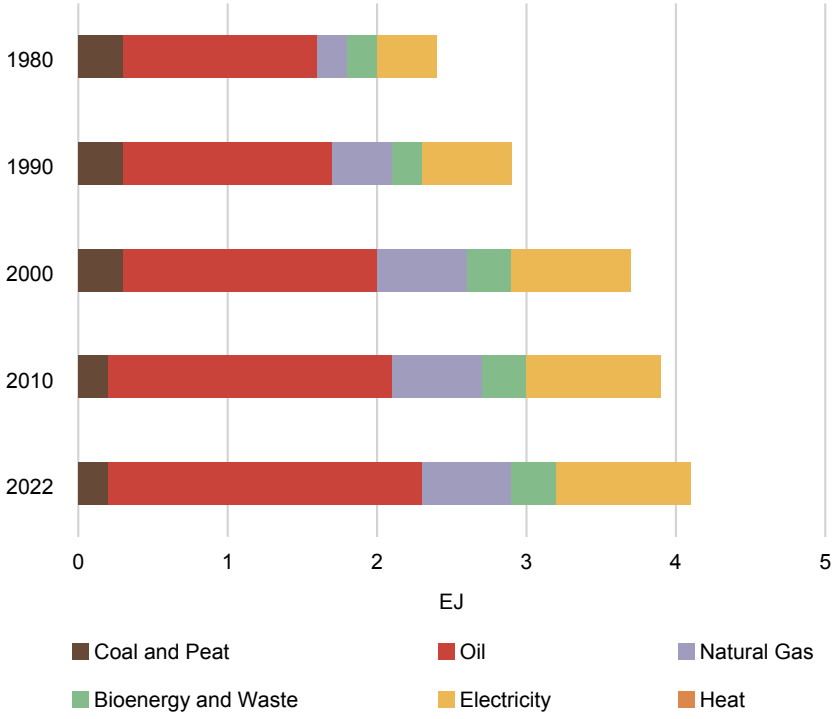
of electricity produced



0%

of electricity produced by nuclear

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



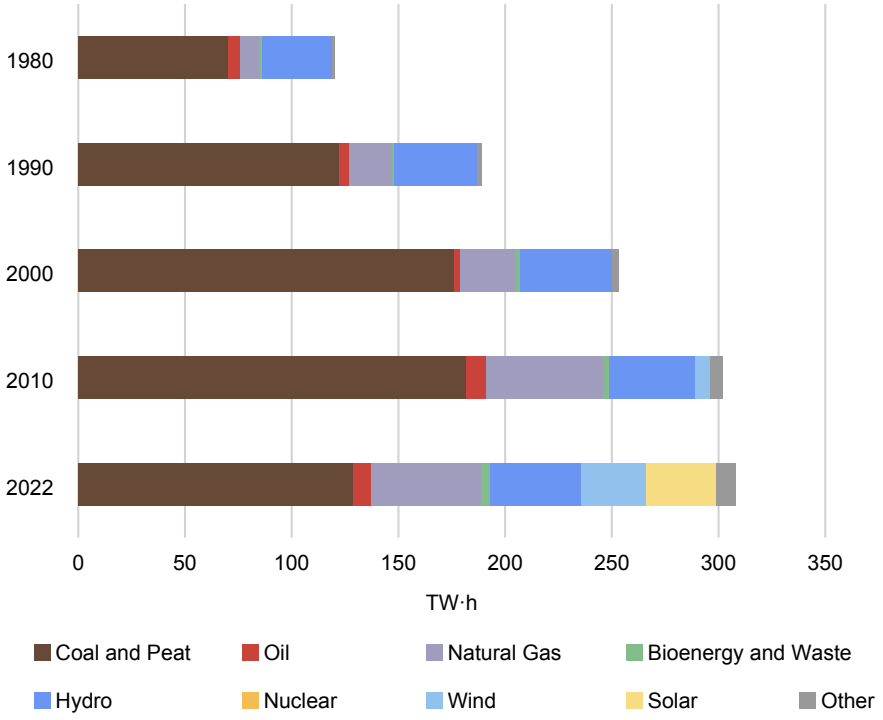
Final Energy Consumption

Since 1980 fossil fuels have continued to dominate final energy consumption, although there was a gradual reduction in their combined share from 76% in 1980 to 69% in 2022.

Oil has the largest share of all the fossil fuels, having remained at about 50% since 1990. The share of natural gas has remained at about 15% since 1990, whereas coal's share has declined by almost 5 percentage points during the same period.

The share of electricity is more than one fifth of final energy consumption, an increase of 8 percentage points since 1980.

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



Electricity Production

With a share of more than 70%, fossil fuels — particularly coal — have remained dominant sources of electricity production over the past 40 years. From 1980 to 2010 their share increased some 10 percentage points and then declined by 19 percentage points to 61% by 2022.

The share of natural gas has more than doubled since 1980, whereas oil's share has fallen by half. The share of coal increased from almost 60% in 1980 to almost 70% by 2000, and then fell to about 42% by 2022.

The share of hydro has declined by more than half since 1980, reaching about 14% in 2022. The combined share of solar and wind has rapidly increased from 0.1% in 2000 to about 21% in 2022.

Energy and Electricity Projections

- Final energy consumption is expected to increase by 12% from 2022 levels by 2030 and by almost 15% by 2050, at an average annual rate of approximately 0.5%.
- Electricity consumption is expected to grow at a faster rate of about 1.3% per year. Electricity consumption is expected to increase by about 44% by 2050.
- By 2050 the share of electricity in final energy consumption is expected to increase by about 6 percentage points from its 2022 share.

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

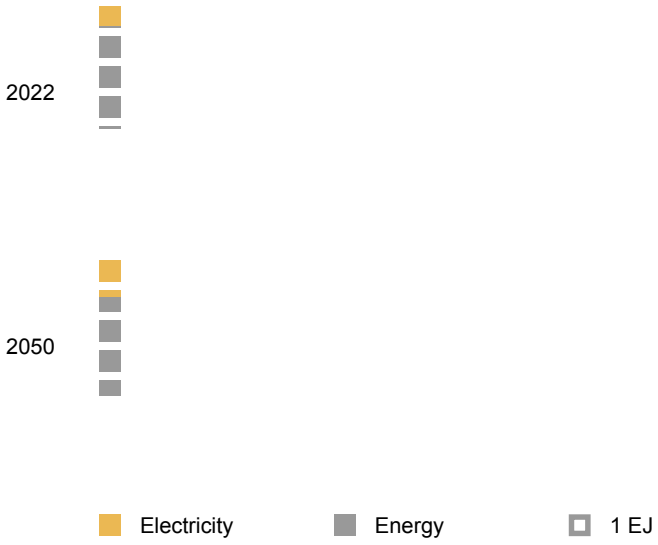


TABLE 34. FINAL CONSUMPTION OF ENERGY AND ELECTRICITY IN THE OCEANIA REGION, EJ

Final Consumption	2022	2030	2040	2050
Energy	4.1	4.6	4.6	4.7
Electricity	0.9	1.1	1.2	1.3
Electricity as % of Energy	*22.0%*	*23.9%*	*26.1%*	*27.7%*

Nuclear Electrical Generating Capacity Projections

- Total electrical generating capacity is expected to increase from 2022 levels by about 57% by 2050.
- Total electricity production is projected to increase by about 7% by 2030 and by about 32% by 2050 compared with 2022 production levels.
- In the high case, nuclear power is projected to generate electricity by the middle of the century. The share of nuclear in total electrical generating capacity is expected to reach about 1%.
- In the low case, nuclear power is not projected to be introduced into the electricity generation system.

TABLE 35. TOTAL AND NUCLEAR ELECTRICAL GENERATING CAPACITY IN THE OCEANIA REGION, GW(e)

Electrical Capacity	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	113	114	114	131	131	177	177
Nuclear	0.0	0	0	0	0	0	2
Nuclear as % of Electrical Capacity	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*1.1%*

TABLE 36. TOTAL AND NUCLEAR ELECTRICITY PRODUCTION IN THE OCEANIA REGION, TW·h

Electricity Production	2022	2030		2040		2050	
		Low	High	Low	High	Low	High
Total	307	328	328	365	365	405	405
Nuclear	0	0	0	0	0	0	14
Nuclear as % of Electricity Production	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*3.5%*

REFERENCES

[1] INTERNATIONAL ENERGY AGENCY, World Energy Outlook 2022, IEA, Paris (2022), https://www.iea.org/reports/world-energy-outlook-2022

[2] UNITED STATES ENERGY INFORMATION ADMINISTRATION, International Energy Outlook 2021, U.S. Department of Energy, Washington, DC (2021).

[3] UNITED NATIONS DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS, 2020 Energy Balances, United Nations, New York (2023).

[4] INTERNATIONAL ENERGY AGENCY, "World Energy Balances (Edition 2022)", IEA World Energy Statistics and Balances (database), https://doi.org/10.1787/enestats-data-en

[5] UNITED NATIONS DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS, World Population Prospects 2022, United Nations, New York (2022).

[6] OECD NUCLEAR ENERGY AGENCY, INTERNATIONAL ATOMIC ENERGY AGENCY, Uranium 2022: Resources, Production and Demand, OECD Publishing, Paris (2023).

[7] INTERNATIONAL ENERGY AGENCY, Nuclear Power in a Clean Energy System, IEA, Paris (2019), https://www.iea.org/reports/nuclear-power-in-a-clean-energy-system

[8] INTERNATIONAL ENERGY AGENCY, Net Zero by 2050: A Roadmap for the Global Energy Sector, IEA, Paris (2021), https://www.iea.org/reports/net-zero-by-2050

[9] UNITED NATIONS DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS, Statistical Yearbook, United Nations, New York, (2022).

[10] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Power Reactors in the World, Reference Data Series No. 2, IAEA, Vienna (2023).

[11] UNITED NATIONS DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS, International Recommendations for Energy Statistics (IRES), Series M No. 93, United Nations, New York (2018).

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