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The Economy of the Countries of the World is Experiencing the Need for Nuclear Power Plants

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Abstract: This scientific article examines the sources on the need for nuclear power plants in the economies of the countries of the world. The existing nuclear power plants in the countries of the world, their capacity, the disadvantages and advantages of nuclear power plants, the role of nuclear power plants in the production of electricity, differences in the prices of electricity generated by them, the possibilities of achieving economic and social goals of low-cost sustainable development in the production of electricity using nuclear power are analyzed.

Key Words: nuclear power plant, energy production, renewable energy sources (wind, sheep, hydro), coal, gas, uranium, oil products, population, nuclear reactor, power units, Environmental Protection, ecology, economic efficiency, management efficiency.

INTRODUCTION. The world economy is making rapid development stages from year to year. The first reason is that at the heart of all economic development, of course, is the satisfaction of human needs. But we know that human needs are never limited, human needs always grow towards infinity. The second reason is that the population of our planet is increasing dramatically from year to year. According to the United Nations (UN), the population of the Earth will exceed 8 billion people by the end of 2022. Accordingly, we would like to pay attention to some statistical data, in 1804, the population of the earth was 1 billion, in 1927, 2 billion, in 1960, 3 billion, in 1974, 4 billion, in 1987, 5 billion, in 1999, 6 billion, and in 2011, 7 billion people. Remarkably, it took 123 years for the world's population to grow from 1 billion to 2 billion. It took 12 years for the population of our planet to increase to the last 1 billion people. It can be seen that the population of the earth is increasing dramatically.

As the population of the earth is increasing, their needs are also increasing accordingly. Science and technology are being developed by world scientists in order to effectively meet human needs. As a result of the development of science and technology, the economy of the countries of the world is developing. For the effective development of the country's economy, regular and high-quality electricity supply is necessary. No country's economy can develop without electricity. Electricity generation and supply to consumers are separated by their own characteristics. At the same time, the production of electricity requires a large amount of non-renewable energy sources (natural gas, coal, oil products, etc.). This causes the cost of electricity production to increase. Renewable energy sources, namely the "green four" energy (solar, wind, hydro, and nuclear energy) are needed for low-cost electricity generation.

Today, there is a real need for nuclear energy in the development of the economy of the countries of the world. Currently, more than 25 percent of the electricity produced in the world is provided by nuclear power

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plants (NPP). That's why today, based on the innovations and possibilities of modern science and technology, scientists confirm that nuclear energy will be the main energy source that is convenient and relatively clean in the next ten years. Construction of nuclear power units based on the goals of peace in the world, creation of new technologies in the production of electricity, and scientific research are constantly being carried out for the economically effective development of the country. We can see this in the developed countries of the world. That is, it can be seen that the economy of these countries is on the path of efficient and safe development in any country in the world where electricity production is developed. Due to the development of the world economy, it is predicted that the demand for electricity will increase dramatically in the coming years. Experts prove that one of the solutions to complex issues such as ensuring sufficient energy balance in the world, mitigating climate changes, and reducing environmental problems is to increase the size of nuclear power based on modern technologies. NPP is a part of green energy. We are referring to the green four, water, sun, wind and atom. Nuclear energy allows to drastically reduce the emission of SO2 into the environment. It is recognized that the development of nuclear energy in the world is influenced by the task of reducing the anthropogenic load on the environment. It is assumed that they can be solved by transitioning to a "green" economy.

From the point of view of the development of the country's economy, nuclear power plants have a number of unique features that affect their attractiveness. Nuclear energy development programs always define long-term commitments of the state and investors. Therefore, the financial risks and future obligations arising from nuclear activities are always in the focus of the countries of the world. Building, operating and monitoring nuclear power plants requires long-term capital expenditures. The nuclear industry sector requires extensive infrastructure and highly qualified personnel. This uses limited natural resources and helps ensure security of supply.

Analysis of literature on the topic. The development of nuclear energy, through which the production of electricity for economic sectors, always requires the creation of modern research and educational infrastructures, as well as comprehensive legal and institutional frameworks. It creates a need for high-level technological, modern information technology, economic and management knowledge. In addition, it requires the formation of programs that bring macroeconomic and social benefits in the field. Low-cost sustainable development in the production of electricity with the help of atomic energy has a high chance of achieving economic and social goals.

Currently, most of the French nuclear reactors are built under license from the Westinghouse Corporation, but when France took it from the United States, the nuclear power plant construction project was renamed Framatome (France-America-Atome). As the United States has increased the lifetime of nuclear power plants from 40 to 60 years and plans to extend it even to 80 years, France is now increasing their operating hours [1].

The most important energy company in France and the largest operator of nuclear power plants in the world became EDF (Électricité de France), a corporation (85% owned by the state EDF Corporation. It is the customer of all nuclear power plants in the country and 20 nuclear power plants outside its borders and operator. Thus, EDF is a producer and supplier of electricity and has a special position in the field of nuclear energy production [2]. At the same time, he not only manages French nuclear power plants, but is also their monopoly owner [3]. EDF Corporation also actively offers services for the construction and reconstruction of nuclear facilities and disposal of spent nuclear waste to other countries.

The weakness of France's nuclear energy is that, unlike Russia, it has no uranium deposits on its territory, and therefore all uranium is imported. It is mined there in fully or partially controlled Orano (Areva) enterprises, the main of which are located in Kazakhstan, Canada and Nigeria [3]. Uranium is also imported from Australia and Russia (mainly under long-term contracts), and its enrichment is carried out

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only on the territory of the country. But this industrial company, like the EDF (Électricité de France) corporation, faced serious problems: Orano (Areva) for a long time could not finish the construction of the third power unit of the Olkiluoto NPP in Finland, which began in 2005. The construction of the NPP was carried out with a ten-year delay and at a price that was three times higher than the original contract of 3.2 billion euros [4]. This had a negative impact on the image of the company.

According to experts, the lack of a national strategy for the development of nuclear energy, which should ensure the mandatory extension of the operation of all existing nuclear power plants until 2030, prevents the introduction of innovations in the French nuclear industry. Considering that the construction period of the reactor is 7-8 years, the construction sites should be commissioned by the end of 2022 [5].

Deployment of flexible nuclear power helps balance renewables and contributes to their continued growth, increasing overall renewable capacity [6]. Adding nuclear power to the clean energy mix will create new jobs in all clean energy technologies.

At the global level, it seems there is a social consensus for reducing nuclear power in the long-term. However, countries with a higher share of nuclear power are of the opinion that the electricity market cannot bear the rapid decrease in nuclear power as it would lead to a sharp increase in overall power generation costs. Therefore, the status of countries with operating NPPs varies depending on the priority with regard to the advantages and disadvantages of nuclear power. For example, Germany has a firm policy to close existing units, while some countries including the US are either constructing new units or completing previously suspended construction projects [7].

Currently, nuclear power largely contributes to domestic power supply in South Korea, which is the main reason why this discussion is of such significance. Despite the geographical connection to the Asian continent, the power supply system in South Korea is isolated like an island because of the extraordinary political and military situation; namely, the division of the Korean peninsula. South Korea also imports about 95% of its primary energy as it lacks in natural resources [8]. Given this situation, nuclear power became an attractive alternative option to support rapid economic development. With such a historical and social background, nuclear power has played an important role in the South Korean domestic power supply sector. After the decision to introduce nuclear power in 1970, South Korea built and began to operate its first 600 MW NPP in 1978. Since then, there was a steady expansion of nuclear power. As of 2017, there were a total of 24 NPPs located in the four regions, but only 17 NPPs were in operation due to maintenance and suspension. Moreover, 5 NPPs were under construction (units 4, 5 and 6 of the Shin-Kori NPP, units 3 and 4 of the Shin-Hanul NPP) and an additional 4 new NPPs (units 1 and 2 of the Chunji NPP, units 1 and 2 of the Daejin NPP) were scheduled to be built at that time. Under this policy of nuclear expansion, South Korea's share of nuclear power in 2016 accounted for 21.8% of total installed capacity, and 30.0% of total electricity generation, the second highest ratio after coal-fired power among all available power sources [8]. However, South Korea's nuclear policy is currently experiencing a rapid change following the inauguration of the new government in 2017, as it has decided to pursue a nuclear-free policy in the long-term. The new government plans to reduce the number of NPPs from 24 in 2017 to 28 in 2022, 18 in 2031, and 14 in 2038 [9]. It has also clearly stated that the share of nuclear power in total electricity generation would be reduced to 23.9% by 2030 (in 2017, nuclear generated about 30% of the country's electricity), and would be replaced by renewables and liquefied natural gas (LNG) [10].

Liao et al. [11] analyzed Taiwanese WTP for nuclear power. The authors divided the respondents into two groups based on whether they supported the increase or decrease in nuclear energy's share in electricity generation, and elicited each group's mean WTP for its preferred policy. Respondents who supported the increase and decrease in nuclear energy's share in electricity generation was 223 and 241, respectively, and similar to each other. The median WTP of each group was USD 146.31/year and USD 164.85/year,

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respectively, which are also similar to each other. Based on these results, the authors concluded that Taiwanese did not support any dramatic increase or decrease in nuclear power, and claimed that the share of nuclear power should be maintained for a while.

Yun et al. [12] investigated whether people's image of an NPP, their perception of safety, and scientific background related to their WTP for reducing risk in a nuclear power plant. Results showed that the mean WTP for all the respondents was about USD 17.014/month. After dividing the samples into several groups, the results showed that people with a higher scientific background and a good image of NPPs tend to have lower WTP. On the other hand, no clear relationship was found between the safety level and mean WTP.

Park et al. [13] analyzed Koreans' WTP for replacing nuclear power and fossil energy with renewable energy. It was found that each individual household was willing to pay USD 85 on average, and this figure corresponded to USD 16.1 billion of renewable energy value in South Korea. Further, it also turned out that a person who was younger, lived further from a NPP, a householder, and those with higher income preferred renewable energy to others.

Lee et al. [14] estimated people's WTP for replacing traditional energy sources such as coal-fired and nuclear power with renewable sources in Korea. The study results showed that Korean consumers were willing to pay an additional USD 3.3/month and USD 3.0/month on their electricity bill for replacing nuclear and coal-fired power with renewables, respectively. If these amounts are aggregated with total WTP for installing new photovoltaic capacity annually at the national level, then 372 MW of nuclear power and 339 MW coal-fired power can be substituted every year. The authors concluded that although there is a huge increase in Korean consumers' WTP for renewable energy, it is still lower than countries such as Japan, the UK, the US, and Italy.

Pre-development costs are the expenditure before the building phase of a nuclear power plant. They include research and development of the plant site, setting up necessary governmental bodies and streamlining the law. These costs will be mostly incurred by the government. Expenditures that had already been incurred amounted to $33.2 million (including operational costs of the Turkish Atomic Agency (TAEK), research and core activities, grants for investment in construction and assembly, power plant and nuclear waste location analyses) [15].

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Additionally, alternative uses of fossil fuels, such as for heating or transport fuels, can cause large swings in electricity pricing. Adding nuclear energy to this mix has been shown to reduce price volatility and cause system-wide electricity price savings for consumers [17], attributable to long-duration fuel cycles and 24-houra-day operation. One study showed a reduction in weighted-average wholesale electricity prices by as much as 10% [17].

In addition to job creation and economic growth, nuclear power plants may help protect consumers from volatile electricity prices [17, 18, 19]. Nuclear energy is not always the lowest cost energy source on a levelized cost of energy (LCOE) basis [9]; however, once power plants are constructed, nuclear energy

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has very low variable costs. This means that nuclear energy may reduce wholesale electricity price volatility in a way that is not often captured in an LCOE analysis. For example, traditional energy generation sources rely on regular availability of fossil fuels, such as gas and coal, and the variability of renewable generation can result in mismatches between electricity generation and demand. Both dependencies can result in large wholesale price swings.

Nuclear power plants have lower fuel costs but higher operating and maintenance costs than coal power plants. Operations and maintenance (O&M) costs are very variable for NPPs, depending on such factors as plant size and age, but on average they account for 20% of the total costs per year, Deregulation of electricity markets has helped in introducing best practices in reducing O&M costs throughout the industry, while maintaining or improving high safety standards [20].

According to French experts, the electricity produced by NPP is the lowest in Europe. Therefore, the "peaceful atom" is often the cause of controversy. The cost of electricity per kilowatt-hour in France (16.9 cents) is almost twice as low as in Germany (31.47 cents). That is, if we compare the prices, the cost of one kilowatt of electricity in the nuclear industry is much lower than in wind power plants, biofuels and solar panels [21].

According to the opinions of experts and scientists mentioned above, it can be understood that the role of NPPs in the development of the country's economy is important. That is, we can see that the electricity produced by NPP is cheap, ecologically clean, and it is possible to provide regular electricity to economic sectors. But in addition, it is necessary to take into account the long construction period, the complexity of controlling the processes of its use, and the existence of personnel problems in providing the industry with mature specialists.

It embodies the technological features of the use of nuclear energy in the production of electricity, which has its own advantages and disadvantages. Therefore, it is necessary for countries to bear the inherent risks of using nuclear power in the production of electricity. This means that not only the use of modern technologies, but also the acceptance by the population and society and the adoption of the law on the use of atomic energy are necessary.

Research methodology. In this scientific article, the world's economy needs nuclear power plants, scientific study and comparative comparison, statistical data study, economic comparison, analysis, logical thinking, scientific abstraction, analysis and synthesis, induction and deduction methods are widely used.

Analysis and results. The use of nuclear power plants in the field of electricity generation has increased significantly over the past decade. At the same time, most of the nuclear power plants in the world have significantly improved their technical and economic performance. The improvement of the technical condition of the existing nuclear power plants in the world, as well as the work done by them to increase their power generation capacity from year to year, increases the possibilities of increasing competitiveness in the field.

"Obninsk" NPP was the first in the world to be put into commercial use on June 27, 1954. Since April 2002, "Obninsk" NPP ceased its activity and is now registered as a historical monument complex.

To date, there are 440 nuclear reactors (power units) producing electricity around the world (as of July 2022). Of these, 201 nuclear reactors (power units) have stopped operating, while 54 nuclear reactors (power units) are under construction. Table 1 lists the 40 countries in the world with nuclear power plants.

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Table 1. Countries with nuclear power plants in the world

№	Countries	№	Countries	№	Countries	№	Countries
1	Austria	11	Germany	21	Mexico	31	Turkey
2	Argentina	12	Egypt	22	The Netherlands	32	Ukraine
3	Armenia	13	India	23	UAE	33	Finland
4	Bangladesh	14	Iran	24	Pakistan	34	France
5	Belarus	15	Spain	25	Russia	35	Czechia
6	Belgium	16	Italy	26	Romania	36	Switzerland
7	Brazil	17	Kazakhstan	27	Slovakia	37	Sweden
8	Bulgaria	18	Canada	28	Slovenia	38	South Korea
9	Great Britain	19	China	29	USA	39	South Africa
10	Hungary	20	Lithuania	30	Taiwan	40	Japan

Source:https://ru.wikipedia.org/wiki/%D0%A1%D0%BF%D0%B8%D1%81%D0%BE%D0%BA_%D0%90%D0%AD%D0%A1_%D0%BC%D0%B8%D1%80%D0%B0

Table above lists the countries with nuclear power plants in the world. Today, in most of these countries, electricity is produced by nuclear power plants, and in some of them they are being built. In addition, some countries have several NPPs. But even so, we can see that the demand for electricity is increasing sharply in some countries. European countries can be mentioned as an example. Because the energy sources needed for the production of electricity are unevenly distributed around the world. Information on nuclear power plants with the highest capacity in the world is presented in Table 2.

Table 2. Nuclear power plants with the highest capacity in the world

№	Name of the NPP	tate where the NPP is located NPP capacity	NPP capacity
1	Fukushima I and II	Japan	8 814 MW
2	Kashiwazaki-Kariwa	Japan	7 965 MW
3	Zaporozhye	Ukraine	6 000 MW
4	Yongwan (Yeonggwang)	South Korea	5 875 MW
5	Nord	France	5 460 MW
6	Paluel	France	5 320 MW
7	Cattenom	France	5 200 MW
8	Bruce (Bruce County)	Canada	4 693 MW
9	Ohi	Japan	4 494 MW
10	Wintersburg	USA	3 942 MW

Source:https://aem-group.ru/mediacenter/informatoriy/rejting-samyix-moshhnyix-aes-v-mire.html

According to the data in Table 2, information on the 10 nuclear power plants with the highest capacity in the world is presented. In this table, we can see that Japan (Fukushima I and II, Kashiwazaki-Kariwa, Ohi)

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and France (Nord, Paluel, Cattenom) have more than 3 NPPs. Fukushima I and II NPP (8,814 MW) is the world's largest power plant.

While studying information about the possibilities of NPP, we would like to briefly touch upon the work being carried out in the countries of the world.

Currently, a total of 99 reactors operate in 62 nuclear power plants in the United States, producing 19.5 percent of the country's total energy. The last reactor in the USA was put into operation in 1996 at the Watts Bar NPP.

France is the second country in the world in terms of the number of nuclear power reactors. France gets 75% of its electricity from nuclear power thanks to a long-standing policy based on energy security. France is the world's largest exporter of electricity due to its very low production costs, earning more than 3 billion euros annually. About 17% of French electricity is produced by nuclear power plants.

By 2020, China's nuclear power will include 17 operating reactors located in 49 nuclear power plants. Along with wind and solar power, as well as the modernization of coal-fired power plants, nuclear power is designed to solve the problem of air quality in China's industrial areas.

A total of 11 power units operate in 38 operating nuclear power plants in Russia: 20 power units with reactors of the VVER type (including 13 VVER (VVER (water-water power reactor) - one of the most successful branches of the development of nuclear power plants, widespread in the world) -1000 power unit etc. The total installed capacity of all power units is 29 GW.

In South Korea, 4 PHWR-type reactors and 20 PWR-type reactors are used, 1 PWR-type reactor (Kori-1", in 2017) was decommissioned.

15 nuclear power plants with 4 power units are operating in Ukraine. One of them is the Zaporozhye NPP, which has 6,000 VVER power units with a total installed capacity of 6 MW, and is the largest in Europe. In terms of the number of power reactors (all types of VVER), Ukraine ranks 10th in the world and fifth in Europe.

Today, there are 19 fully privately owned power units in Canada. 18 of them are managed by public enterprises and private companies in "Ontario" and 1 in "New Brunswick". There are also 6 decommissioned power units.

There are many 'old' nuclear power stations in the UK which have now closed. However, 14 more reactors are operating, including Heysham, the UK's largest nuclear power station, with a total capacity of 8,883 MW - 18.9% of the country's electricity.

8 nuclear power plants (9740 power units) with a total capacity of 3 MW operate in the Kingdom of Sweden. 40% of the total share of electricity in Sweden is provided by NPP.

Germany is the largest producer of electricity in Western Europe. One third of the country's electricity is produced by 18 nuclear power units with a total power of 21,249 MW.

In Spain, nuclear power began to develop in the seventies of the last century. Spain's first nuclear power plant "Jose Cabrera" was put into operation on July 14, 1968, with a water reactor (pressurized water reactor) with a capacity of 153 MW. All nuclear power plants were built by the American corporations "Westinghouse" and "General Electric". Currently, 7 power units are operating.

Before the Fukushima disaster, Japan had 54 operating nuclear reactors (the third in the world after France and the USA, and the first in Asia). Japan's nuclear power plants produced about 30 percent of the country's electricity. In December 2013, it was officially decided to close all six Fukushima-1 units. At the

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end of 2017, Japan's nuclear power generated 3.61% of the country's electricity. As of 2020, Japan has 17 nuclear power plants and 40 nuclear reactors.

There are 7 nuclear power plants (22 power units) in the Republic of India with a total capacity of 6240 MW. It provides 3.4% share of total electricity in India.

In Belgium, half of the country's electricity is produced by 7 nuclear reactors, i.e. 37% by nuclear power plants.

Switzerland has 5 nuclear power reactors and produces about 40% of the country's electricity. At the same time, more than half of the electricity is produced by hydroelectric power plants.

Brazil's nuclear power industry is developing, two units of Angra NPP are currently operating in the country. Their share is 3% in the total volume of produced electricity.

Information on reserves of energy resources available in the countries of the world is presented in Table 3.

Table 3. Reserves of energy resources available in the countries of the world

Natural resources	Brief description of energy resources
Oil	Reserves are 270-300 billion tons of oil equivalent. Annual consumption exceeds 3.5 billion tons. It is considered promising for the next 30-50 years.
Natural gas	Reserves are 279 billion tons. Annual consumption is 2400 billion m^3. It is considered promising for the next 30-60 years.
Coal	Reserves are 10 trillion tons. Annual consumption is approximately 5 billion tons. It is considered promising for 200 years or more.
Uranus U^{238}	Proven world reserves are 5.4 million tons. Annual consumption is 67 thousand tons. It is believed to last 700 years or more.

Source:BP Global Statistical Review of World Energy, 2016. URL: http://www.bp.com

If we look at the data presented in Table 3, energy resources (oil, natural gas, coal and uranium U238) are indicated. We can see that "uranium U238" is the most promising state in terms of energy resources. Therefore, we can see that in the future the production of electricity is directly related to nuclear power plants.

Due to the increasing population of the country, the demand for electricity is also increasing. Table 4 lists the countries with the highest population in the world.

Table 4. Population situation in the countries of the world (Top 20).

№	Name of countries	The population is growing (thousand people)	Share in the world, %	№	Name of countries	The population is growing (thousand people)	Share in the world, %
1	China	1 458 368	18,14	11	Japan	126 230	1,57
2	India	1 424 460	17,72	12	Ethiopia	122 142	1,52
3	USA	337 364	4,20	13	Philippines	113 966	1,42
4	Indonesia	282 384	3,51	14	Egypt	107 977	1,34
5	Pakistan	232 478	2,89	15	Vietnam	100 113	1,25
6	Nigeria	219 868	2,73	16	Congo	96 602	1,20

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7	Brazil	217 498	2,71	17	Turkey	88 088	1,10
8	Bangladesh	169 694	2,11	18	Eron	86 586	1,08
9	Russia	146 079	1,82	19	Germany	83 805	1,04
10	Mexico	133 460	1,66	20	Thailand	70 785	0,88

Source:https://www.worldometers.info/world-population/population-by-country/

Table 4 shows the countries with the largest population in the world. According to this, China (18.14%), India (17.72%), and the USA (4.20%) are in the first place in the world with the largest population.

As a result of the rapid increase in the population of the country and the increasing demand of people for a better life, the demand for electricity is increasing year by year. At the same time, the production of electricity by thermal power plants and nuclear power plants is increasing year by year.

Indicators of electricity production by countries of the world are shown in Table 5.

Table 5. Electricity production by countries of the world (TVt.hour)

№	Name of countries	2000 year	2010 year	2015 year	2020 year	The difference between 2020 and 2000	The ratio of 2020 to 2000
Countries that produce the most amount of electricity							
1	China	1,356	4,208	5,860	7,798	6,442	5,7 м
2	USA	4,053	4,378	4,317	4,262	0,209	105,1
3	India	0,562	0,975	1,358	1,557	0,995	2,8 м
4	Russia	0,878	1,038	1,068	1,096	0,218	124,8
5	Japan	1,068	1,171	1,059	1,011	-0,057	94,7
6	Canada	0,606	0,603	0,658	0,648	0,042	106,9
7	Brazil	0,349	0,516	0,582	0,614	0,265	175,9
8	Germany	0,577	0,633	0,648	0,572	-0,005	99,1
9	South Korea	0,290	0,500	0,553	0,571	0,281	196,9
10	France	0,540	0,569	0,580	0,533	-0,007	98,7
Countries that produce the least amount of electricity							
1	Nigeria	0,015	0,026	0,032	0,040	0,025	2,7 м
2	New Zealand	0,039	0,045	0,044	0,044	0,005	112,8
3	Portugal	0,044	0,054	0,052	0,053	0,009	120,4
4	Romania	0,052	0,061	0,066	0,056	0,004	107,7
5	Uzbekistan	0,047	0,052	0,059	0,065	0,018	138,3
6	Kuwait	0,032	0,057	0,068	0,075	0,043	2,3 м
7	Colombia	0,043	0,061	0,079	0,076	0,033	176,7
8	Czechia	0,065	0,086	0,084	0,081	0,016	124,6
9	Chile	0,040	0,060	0,067	0,084	0,044	2,1 м
10	Algeria	0,028	0,048	0,052	0,088	0,06	3,1м

Note: 1 terawatt (TVt) = 1,000,000,000 kilowatts (kW)

Source:yearbook.enerdata.ru/world-electricity-production-statistics.html developed by the author based on data.

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This table shows the electricity production indicators of the countries of the world for the years 2000-2020. In particular, among the countries that produce the most electricity, China produced 1,356 TWt of electricity in 2000, and by 2020, it has increased by 5.7 times and produced 6,442 TWt of electricity. By 2020, India is generating 2.8 times more electricity than in 2000. USA – increased by 5.1%, Russia – increased by 24.8%, Japan – decreased by 5.3%, Canada – increased by 6.9%, Brazil – increased by 75.9%, Germany – decreased by 0.9%, South Korea - increased by 96.9%, in France - decreased by 1.3%. If we look at the countries producing the least amount of electricity, by 2020 compared to 2010, Nigeria will increase by 2.7 times, New Zealand will increase by 12.8%, Portugal will increase by 20.4%, Romania will increase by 7.7%, In Uzbekistan - increased by 38.3%, in Kuwait - by 2.3 times, in Colombia - by 76.7%, in the Czech Republic - by 24.6%, in Chile - by 2.1 times, in Algiers - by 3.1 times. It can be concluded from this that as much as the power production capacity has increased, their economy has also grown to the same extent.

Efforts to use NPP have also started in the countries of Central Asia. Because there are enough uranium deposits in Kazakhstan and Uzbekistan to use nuclear power plants. Information on energy resource reserves in the countries of Central Asia is shown in Table 6.

Table 6. Energy resource potential of Central Asian countries [22]

Countries / year		Coal* billion tons.	Petroleum* million tons.	Gas* billion. m^3	Ratio** thousand tons	Hydroelectric power *** billion kW.s/y	REC**** billion. kW.s/y
Kazakhstan	2000	34,1	2760	1841	601	27	66
	2020	34,1	2760	1841	601	27	66
Kyrgyzstan	2000	1,34	11,5	6,54	-	52	-
	2020	1,27	1,2	6,2	-	99	-
Tajikistan	2000	0,67	5,4	9,2	-	317	18,4
	2020	1,0	10	10	-	317	18,4
Turkmenistan	2000	-	75	2860	-	2	-
	2020	-	75	2860	-	2	-
Uzbekistan	2000	2	350	2000	83,7	15	-
	2020	2	350	2000	83,7	15	-
Central Asia	2000	38,11	3261,9	6716,7	684,7	413	84,4
	2020	38,37	3205,2	6716,2	684,7	460	84,4

* given the volume of renewable reserves approved for coal, oil and natural gas;

** World Energy Council (WEC) rated proven uranium reserves with production costs up to 30 doll/kg;

*** Hydropotential-cost-effective. Uzbekistan-technical hydropotential;

**** REC-renewable energy sources.

Analyzing the data presented in Table 6, the largest coal reserves in Kazakhstan are 34.1 billion tons. The largest oil reserves are in Kazakhstan - 2760 million tons, followed by Uzbekistan - 2 billion tons. tons, oil reserves -350 million. tons. In terms of gas reserves, Turkmenistan ranks first with 2860 billion cubic meters, followed by Uzbekistan with 2,000 billion cubic meters and Kazakhstan with 1841 billion cubic meters. m^3. In terms of uranium reserves, Kazakhstan ranks first with 601.0 thousand tons, followed by Uzbekistan with 83.7 thousand tons, and the rest of the republics do not have uranium reserves. In terms

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of hydroelectric power, that is hydroelectric power stations, the Republic of Tajikistan is in the first place with -317 billion. kWh, in second place the Kyrgyz Republic in 2020 -99 billion. kW. hours. In terms of renewable energy sources, first of all in the Republic of Kazakhstan 66 billion kWh per year/hours of electricity is generated. In second place in the Republic of Tajikistan is 18.4 billion kWh. hours of electricity are generated.

Today, work on creating a legal basis for ensuring the safety of the use of nuclear energy is in full swing in Uzbekistan. Necessary research work has been started in the area around Tuzkon lake. In addition to Uzbek and Russian specialists, international experts are also participating in engineering work and research. The main task is to fully meet all the requirements of the IAEA (International Atomic Energy Agency) on ensuring the safety of the site where the NPP is being built in Uzbekistan.

Information about the advantages and disadvantages of using nuclear power plants in the energy network is shown in Table 7.

Table 7. Advantages and disadvantages of nuclear power

Advantages	Disadvantages
1. It provides reliable service in ensuring energy independence in the country. 2. A wide opportunity will be created to meet the needs of the economy and population. 3. Problems with energy resources will be prevented. 4. Cost savings are achieved in the supply of energy resources. 5. The amount of greenhouse gases released into the air will decrease. 6. Serves in the formation of a competitive environment in the field of electricity production. 7. The energy problem in industrialized areas will be completely eliminated.	1. There will be complications in the disposal of nuclear waste. 2. Long-term organization of the construction process of nuclear power plants. 3. The complexity of attracting foreign investors in the construction of nuclear power plants. 4. High risk level of nuclear power plants in the region 5. Existence of problems in the formation of personnel reserves at nuclear power plants. 6. A large number of controversial opinions in society regarding nuclear power plants

Source: created by the author.

According to the calculations of experts working in the field of atomic energy and scientific research, the first fusion power plants will appear by 2050. After that, economic sectors and the population will have an almost unlimited source of energy. This will undoubtedly cause a real revolution in the nuclear industry.

The economic goals of sustainable development require that the full costs of a given technology be taken into account in the price of its product. The nuclear power sector has come a long way in this direction, and its current costs reflect the full integration of the environmental and social burdens associated with nuclear power generation. Therefore, by reducing external costs for all technologies and energy sources, nuclear energy can increase the competitive environment in the industry. However, this may take some time.

Conclusions and suggestions. In the development of atomic energy is the creation of a controlled thermonuclear reaction. On this basis, the reactors required for the construction of nuclear power plants

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will be much safer from the point of view of radiation. But it should be noted that it can be very expensive.

Atomic energy is one of the fastest growing sectors of the modern economy. The main advantages of nuclear power plants, compared to other types of energy resources, include their safety and minimal impact on the environment. Nuclear energy positively solves many environmental problems. Taking into account the reduction of non-renewable energy reserves in the field of energy production, the use of nuclear power plants is the only way to reliably provide humanity with the necessary energy for the future.

In the future, the economic sectors and the population will be provided with reliable sources of energy as they continue to develop nuclear energy. It is always necessary to assess the risks that may arise in the development of nuclear energy. Including:

- macroeconomic risks;
- social risks:
- operation risks:
- clear definition of limitations that cannot be eliminated by legislation;
- political risks.

Regarding these risks, it will be necessary to strictly define all the requirements of the IAEA (International Atomic Energy Agency), and to increase the control of the mechanisms of compliance with the established norms.

It is necessary to create a legal and institutional framework for the regulation of nuclear energy in the countries that are newly building nuclear power plants, to ensure the transparency and openness of the nuclear power program to the public, to pay attention to the results of the conclusions of international experts when defining the areas where nuclear power plants will be built, and to develop mechanisms for providing the sector with qualified personnel. For this, it is necessary to do the following:

- to ensure environmental protection and protection of people from radiation in the use of atomic energy;
- organization of a safe and economically efficient nuclear fuel cycle;
- long-term supply of nuclear energy with nuclear fuel;
- safe implementation of work related to spent fuel, i.e. disposal;
- development of special programs (design, design, environmental) for the development of science and technology of atomic energy;
- Increasing the financial resources of international organizations to support the construction of NPP and its operation.

When organizing international scientific conferences by the IAEA in the countries of the world, publishing their results and making clear conclusions about them, having openly and transparently studied the situation of nuclear power plants in each country.

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