



Energy Safety – New Technologies and Prospects

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DoI: <https://doi.org/10.5281/zenodo.11092364>

Abstract

Energy safety and energy-safety technologies are a fairly broad concept. These include new or improved technological processes characterized by a higher efficiency of fuel and energy resources. The issues are expected to be considered in this order: non-renewable energy sources and ways to build economical sources of electricity.

Keywords: Oil Reserves, Oil Production, Gas Reserves, Gas Fields, Gas Production, LNG, Coal Reserves, Uranium Reserves, Nuclear Generation.

1. Introduction

The development of technology in our time occurs at a tremendous speed, so the world needs a large amount of energy resources, but despite this, energy sources such as oil, gas, coal are used in the same way as before. Renewable energy sources are capable of uninterruptedly providing people with environmentally friendly and virtually inexhaustible energy, but these energy sources are nevertheless not developing at the required speed due to the high cost and complexity of conversion plants. Therefore, the development and calculation of all energy sources is of great importance. Before considering and developing alternative energy sources, you need to become familiar with sources that are not alternative. But first of all, I would like to introduce you to our country's strategy for the coming years. Turkmenistan, as the whole world knows, is very rich in natural gas and oil reserves.

2. Oil and Gas Reserves

In 2021, Turkmenistan produced 83.8 billion m³ of natural gas, 54.8% of which was exported. The report of Sh. Abdurakhmanov states that natural gas production in 2022 compared to 2021 was exceeded by 112.7%, which in turn amounts to 94.4 billion m³ (02/10/2023 Meeting of the expanded Cabinet of Ministers). Also, in 2021, 8.6 billion tons of oil were produced in our country, and in 2022, 8.3167 billion tons (02/09/2024 Meeting of the expanded Cabinet of Ministers). The general plan for natural gas and oil production in Turkmenistan is indicated in the table below:

Table 1. (02/09/2024 Meeting of the expanded Cabinet of Ministers)

Year	Natural gas (billion m ³)	Oil (million tons)
2022	72,9874	8,7333
2023	75,4195	8,7336
2024	77,7629	8,7338
2025	79,3998	8,7354

In the distant 30s, I.V. Michurin said: “We cannot wait for favors from nature; taking them from her is our task.” From the very beginning of civilization, people-built canals, connected rivers, then tried to turn these rivers back and drained the swamps. It took many years to understand that “natural sources are not endless”, you need to treat them very carefully, and also replenish them.

Table 2. Oil reserves can be presented in detail as follows. (Data from “Annual Statistical Bulletin 2022” 2023)

№	Country	Reserves (billion barrels)
1.	Venezuela	303,8
2.	United Arab Emirates	258,6
3.	Iran	208,6
4.	Canada	170,3

If you provide a table on oil production, it will look different than the previous one (Table 1.2)

Table 3. (data from “Annual Statistical Bulletin 2022” 2023)

№	Country	Production (barrel/day)
1.	USA	11887
2.	Saudi Arabia	10591
3.	Russia	9756
4.	Iraq	4453

Official and expert forecasts when analyzing the prospects for oil prices include in the cost of oil all marginal costs, that is, everything that needs to be spent on exploration and development of a new field. According to their calculations, the cost (marginal cost) of oil ranges from 80 to 110 dollars and therefore “the price cannot be lower than 90.” In connection with the COVID-19 epidemic in 2020, oil prices fell catastrophically around the world, which led to a crisis in countries that replenished their GDP exclusively through sales of oil. At the moment, the price per barrel of oil (statistics as of November 10, 2020) does not exceed \$41. In 2022, after most countries began to recover from the epidemic, the price of oil increased and amounted to approximately \$70 to \$80 per barrel (2023 statistics).

Natural gas is a mixture of gases formed in the depths of the Earth during the decomposition of organic matter. Gas belongs to group 23 sedimentary rocks and is a mineral. It is located in layers and in the bowels of the earth is in a gaseous state - in the form of separate accumulations (gas deposits) or in the form of a gas cap of oil and gas fields. It can also be dissolved in oil or water. Under normal conditions, which are 101.325 kPa and 0 °C, natural gas is only in a gaseous state. Basically, it is a mixture of methane CH₄ with a small amount of nitrogen N₂ and carbon dioxide CO₂ - that is, the quality of the gas is similar in composition to the gas that is released from swamps.

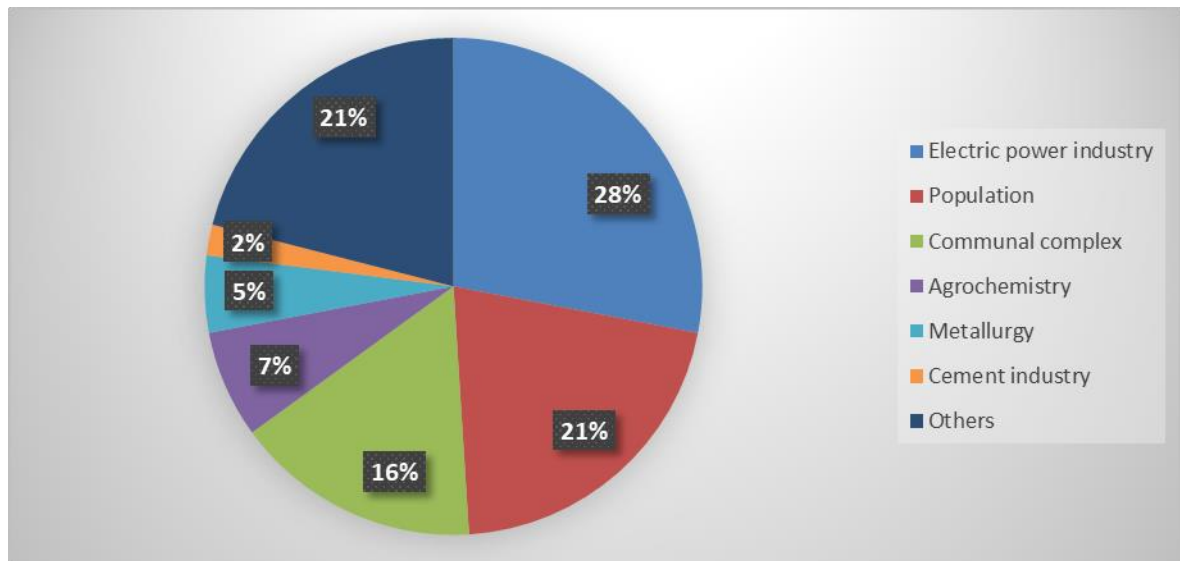


Figure 1. Natural gas consumption structure (vseonefti.ru 2022)

Gas is considered a clean fuel. When burning gas, only carbon dioxide and water are formed; carbon dioxide emissions are almost two times less than when burning coal and 1.3 times less than when burning oil.

Table 4. Large gas fields (Statistics 2023, newspaper "Arguments and Facts")

№	Country	Proven reserves (trillion m ³)
1.	Russia	48,9
2.	Iran	34,07
3.	Qatar	23,8
4.	Turkmenistan	15,3

Table 5. List of countries by gas production (https://journal.tinkoff.ru 08.08.2023)

№	Country	Production (billion cubic meters/year)
1.	USA	751
2.	Russia	642
3.	Iran	227
4.	Qatar	183
5.	Canada	174

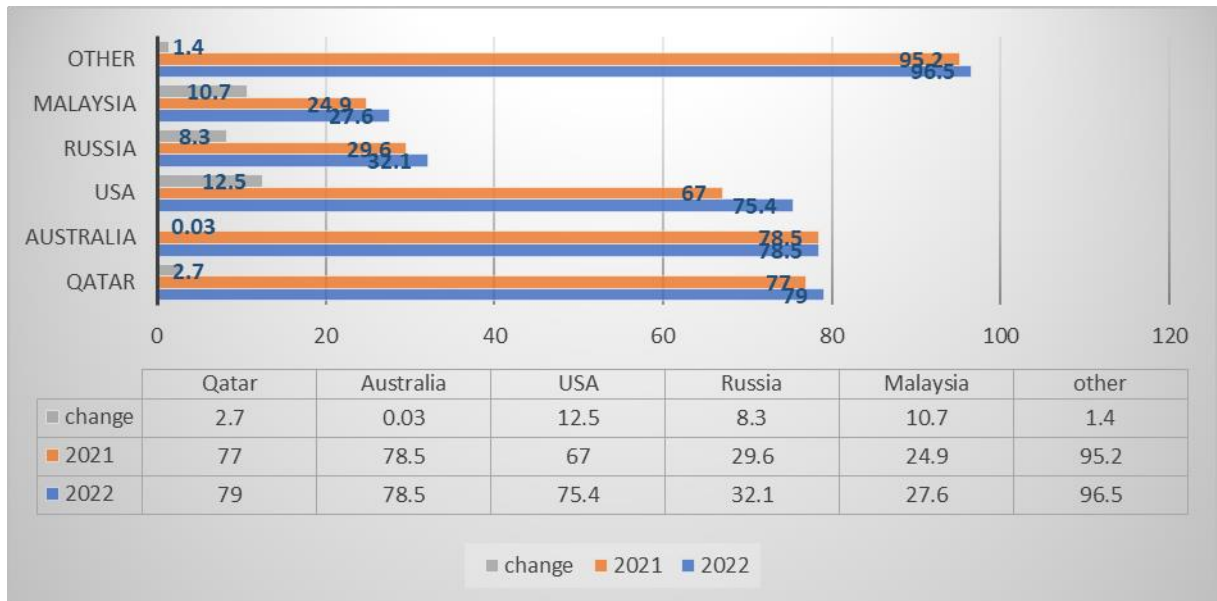


Figure.2. Largest LNG exporters in the world (billion tons) (GIIGNL, 2023)

As mentioned above, 2020 was one of the most difficult years for the global economy. The crisis also affected natural gas prices. Statistics from 2020 show that the price of natural gas per 1000 m3 is approximately \$32, while in 2019 in the territory of the former USSR it was \$60 per 1000 m3, and in Europe the price per 1000 m3 could reach \$230. In 2023, natural gas prices in Europe ranged from \$700 to \$800 per 1000 m3.

3. Coal reserves

Coal is a concept that can be viewed from different angles and take on many meanings. Its main varieties are used in the energy sector - hard coal and anthracite. The main reserves of coal were formed on the planet when ancient plants had already developed the ability to form solid tree trunks, and various fungi and molds had not yet acquired the ability to decompose wood. As organic substances decomposed without oxygen, they turned into coal, and those buried at the greatest depth turned into anthracite. Younger brown coal formed from small bog plants in a later period and continues to form today from buried peat.

Table 6. World Coal Reserves (Statistical Review of World Energy 2022)

№	Country	Coal reserves million tons	Brown coal reserves million tons	Total coal reserves million tons	%
1.	USA	108501	128794	237295	26,62
2.	Russia	49088	107922	157010	17,61
3.	China	62220	52300	114500	12,84
4.	Australia	37100	39300	76400	8,57
5.	India	56100	4500	60600	6,80

With the advent of alternative energy sources, coal consumption has decreased several times. For example, over the past 20 years, domestic coal consumption has decreased by more than 40%, and coal exports have increased almost 6 times since 1997. At the moment, the price of coal on the world market is \$64 per ton (March 10, 2020).

4. Uranium reserves

Currently, 33 countries operate nuclear power plants. As of January 2023, it is estimated that there are 413 power reactors in the world, with a total capacity of 387 GW. Over the past 20 years, nuclear power capacity has increased by 10%. Nuclear energy in nuclear power plants is converted into electrical energy. Nuclear engines are also being created, which are used, for example, in submarines. The main radioactive material used to produce nuclear energy is uranium.

Based on uranium content, 5 types of ores are distinguished: very rich ores (over 1% uranium); rich (1–0.5%), middle (0.5–0.25%), ordinary (0.25–0.1%) and poor (less than 0.1%). From ores containing 0.01–0.015% uranium, it is extracted as a by-product.

Table 7. Countries are the leaders in uranium reserves (According to the World Nuclear Association (WNA 2022))

№	Country	Thousand tons	%
1.	Australia	1664,10	29
2.	Kazakhstan	745,30	13
3.	Canada	509,00	9
4.	Russia	507,80	9
5.	South Africa	322,40	6
6.	Niger	291,50	5
7.	Brazil	276,80	5
8.	China	272,50	5
9.	Namibia	267,00	5
10.	Uzbekistan	130,10	2

Table 8. Countries with nuclear generation (Wikipedia statistics 2023)

№	Country	Number of reactors	Reactor power MW	Electrical energy generation GWh
1	USA	93	99648	809358,57
2	France	56	63130	382402,75
3	China	55	45518	330122,19
4	Russia	37	28448	1955535,15
5	Republic of South Korea	25	23833	138809,35
6	Canada	19	13554	94853,85
7	India	19	6255	40740,49
8	Ukraine	15	13701	78144,26
9	Japan	10	36476	65681,92
10	Great Britan	9	8923	51032,09

Although security fears remain, this has not caused some countries to abandon plans to build nuclear power plants to complement existing hydro, coal and oil-fired power plants. But in a

number of developing countries there is a lack of access to fossil fuels, so nuclear energy is perceived there as an effective and economical way to generate electricity.

5. Conclusion

We can no longer imagine our life without modern technologies that require a certain amount of electrical energy. In this article, we looked at non-renewable energy sources that have a detrimental effect on air, water quality, land, etc. on ecology and at the same time on all living organisms inhabiting our planet. Currently, more and more attention is being paid to alternative energy sources, while the disadvantages are reduced and the efficiency of technologies that facilitate the conversion of renewable sources into electrical energy is increased.

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