

NEWEST INNOVATIVE TECHNOLOGIES IN ELECTRIC POWER INDUSTRY

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Abstract- This paper analyzes innovative technologies in the world electric power industry. It lists methods for safe energy production. The methods of using waste in different countries of the world are shown. The innovative methods in the global field are indicated. An effective mechanism for protecting the environment can be an environmental tax. Such taxes include motor fuel taxes; energy fuel: electricity, transport taxes. Such economic measures can serve to protect the environment and stimulate innovation. The effectiveness of economic measures depends on the efficiency of power plants. However, a some of difficulties must be taken into account, one of which is weather conditions.

Keywords: Innovation, Technology, Production, Biogas, Waste, Energy Loss.

1. INTRODUCTION

In the energy sector, one of the main factors is an information technology. Depending on the complexity of production, a large automation of processes is required. Electricity experts believe that at present there are a number of serious problems that reduce the effective operation of all energy systems.

Aging equipment can lead to technological accidents. An acute problem of electric networks is an excessive increase in voltage and this violates the intermittent operation mode. The introduction of innovative technologies and automation of the electric grid complex is the main need. When equipment is updated, there is an increase in the reliable operation of systems, reduced maintenance costs, and fuel is used economically.

Automation technology ensures environmental protection. The technical condition of all units must be managed centrally. A thermal power station and a hydroelectric power station can operate efficiently if their equipment is regularly updated. Regular monitoring using data centers reduces the number of points of failure. One of the information tasks is the automation of technological processes and at the same time regularly monitor installed equipment. In the field of energy distribution and energy conservation, first of all, it is necessary to use the concept of "smart energy saving networks". "Smart energy saving networks" reduces technical losses in the process of power transmission,

eliminates malfunctions of the automatic operation mode. This first step requires the use of information-automated accounting information. With the emergence of a free market for electricity resources, increased attention to the industry from strategic investors. Energy companies are faced with the task of increasing investment attractiveness, and this solves information technology.

In each country, the integration of market-based energy mechanisms is being actively discussed. This approach leads to the integration of commercial heat metering, which is supplied to all energy resources and automated calculations with consumers. The increase in humanity requires more electricity and this requires even more fuel. The main trend in the development of the energy field in the XXV century is the implementation of new technologies that will best meet the needs of a growing population and at the same time have less impact on the environment. Modern electric power industry develops by means of machine methods of energy conversion. The thermal energy from the combustion of fuel is converted into mechanical energy of rotation, and then in the electric generator into electrical energy. The main directions of modernization of coal and gas generation facilities, increasing the efficiency of research on the chemical energy of fossil fuels, less environmental impact on energy are main factor in the energy sector [1].

2. MAIN CURRENT TECHNOLOGIES IN DEVELOPMENT OF ENERGY

Currently, in some countries, at the legislative level, only natural gas and steam power plants are used to use natural gas. Despite sophisticated combustion technologies, coal remains one of the main fuels. For gas-fired power plants, threshold technologies are the main direction for increasing efficiency, while for coal-fired plants, the most promising technologies are those for increasing the thermodynamic parameters of the steam-turbine cycle - temperature and steam pressure. Supercritical steam parameters have already been implemented in modern steam turbine power plants, which make it possible to obtain a coefficient of performance in power plants of 45-46%. In the European Union, the United States, Japan, China, and South Korea, electricity generation from solid fuels and reducing CO₂ emissions have been created.

In Russia, a fifth of the electricity is generated at coal-fired power plants. Reducing the emissions of coal plants, cleaning, recycling, burial of combustion products requires an extremely large amount of investment, almost 10% of the generated energy. Therefore, for coal generation, reducing the amount of fuel burned is of great importance. All companies strive to constantly improve the efficiency of their power plants through the introduction of new technologies. Of course, carbon dioxide capture must be isolated from the atmosphere and converted to valuable products. High-quality plastics are made from carbon dioxide. A general technological scheme has been created in Russia, on the basis of which waste processing takes place.

This process simultaneously reduces the environmental impact. In some countries of the world in Germany, Denmark, China, the United States is used for domestic purposes and in public transport, biogas is used. In Finland, the world's first biofuel plant was built. In Russia, this bio-source is in perspective. According to D. Medvedev, Chairman of the Government of the Russian Federation, "Russia has a significant resource potential: it is waste from the timber industry and agriculture". The "Luchki" power plant in the Belorussian region, which has mastered the processing of beets, has reduced energy costs by 30%. Of course, this industry must be developed. In Russia, the implementation of the processing of biomass into biomethane with the production of thermal and electric energy has begun. With the help of recycling organic waste, bioenergy is developing. After the 1970s, humanity decided that energy could be saved through self-restraint (Turn off the lights, leaving!). Currently, the main way is to prevent possible energy and environmental crises and introduce innovative technologies.

Innovation in the energy sector is international in nature and of course global trends. With the support of any state, a major technological breakthrough in the energy sector can be achieved. The reserves of the planet's natural resources are limited. They are ending. Generating electricity from the remainder is very difficult. With the improvement of technology and new alternative ways, you need to create quality innovation.

World innovations solve different problems. Such tasks can be listed as follows:

1. Creation of safe energy production
2. Analysis of smart innovation
3. Develop energy transmission over distances with minimal losses
4. Create safety conditions for living organisms
5. Smart power system controls with smart technology

The development of new technologies in the near future may lead to a complete rejection of hydrocarbon resources. Energy experts predict that by 2020 it will be possible to increase the reduction of non-traditional methods in the energy sector to 15%. Currently, there are many proposals in the world for obtaining energies by a non-standard method. For example, Google Corporation has proposed a project to generate energy through a completely new design of a kite-airplane.

The power of this device is 600 kW and this energy meets the needs of a standard apartment building. Japanese experts offer a new way with which you can transfer energy over distances without wires. Innovation allows you to unite different countries and of course you can achieve the following tasks:

1. Paying attention to the environment using new technologies will provide an increase in the percentage of oil production from old and new wells
2. To build hydroelectric power stations on the high seas with salt water
3. Create devices that work with solar radiation
4. Use wind power. The latest developments are used to create new types of engines that can accumulate electricity
5. Due to the difference in pressure and fresh water (osmosis effect) create osmosis.

These indicated directions for generating electricity are currently being developed in different countries of the world (Germany, Sweden, Italy, Spain, China, etc.).

Currently, the following innovations are key to energy:

1. The use of fracking (shock waves) to extract energy from the earth at depths of up to 1,500 m uses a shock wave.
2. Replacing gasoline with biofuels.
3. Using the physical properties of hydrogen, the development of atomic energies.

Features of the development of energy in different countries can more effectively improve the extraction of natural resources. In Russia, oil remains the main resource for generating electricity. The level of development of technology and life depends on the price of oil and the latest technology. Innovations used in various industries (for example, in the automotive industry) can reduce oil consumption (biogas, etc.). The mining method is based on various technologies. The oxidation of oil by various bacteria accumulates and reduces quality. The development of LED production can significantly reduce the amount of oil used in the electricity industry. Specialists all over the world are studying new developments and really find useful innovations for humanity.

3. EMISSIONS OF CARBON DIOXIDE IN ENERGY PRODUCTION

Of course, all of these methods in the energy sector should be used in a safe environment for a living organism. These methods should not be environmentally friendly and harmful. Environmental issues have become global. Increases in planetary temperature, climate warming affects different spheres of human life. Economic needs, culture, in the world are very dependent on the ecology of the environment. In the northern hemisphere of the earth, the temperature increased by 0.6°C. Scientists from different countries predict temperature increases from 1.5°C to 5.8°C in the next century. Atmospheric pollutants are greenhouse gases, hydrocarbons, fluorine, nitrogen, chlorine, carbon dioxide, etc. [2].

This problem can be solved by the efforts of the entire world community. All countries of the world should strengthen the direction of reducing greenhouse gas emissions into the atmosphere. Many scientists around the world are studying this problem. W. Oates, V. Bautol, Melnikova, Kuznetsova and others are intensely involved in the problem of environmental protection [3, 4].

There are some areas of human activity in which greenhouse gases are released. Human economic activity has a significant effect on the chemical composition of the atmosphere and the concentration of various substances changes. In the greenhouse gas there is water vapor, carbon dioxide methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons, hexafluoroses. Beside all of these, only water vapor poses no danger to air pollution. Carbon dioxide is the main source of climate change. Climate warming is due to CO₂. This process is 64%. Carbon dioxide is mainly emitted into the atmosphere during production transportation, during the processing of fossil fuels, and during the burning of biomass.

Nitrous oxide N₂O appears in the chemical industry. Global warming of 6% is due to N₂O gas. Greenhouse gas sulfur hexafluoride SF₆ occurs in the atmosphere when used in electrical insulation. This gas is stored in the atmosphere for a very long time and absorbs infrared light. The increase in greenhouse gas in the atmosphere is associated with the daily use of fuel by mankind. It has been proven that greenhouse gas emissions per day are greater than the generation of gas, coal and oil over a thousand years. Scientists' forecasts show that if nothing is done, then global carbon dioxide emissions will increase 4 times over 125 years [5].

The most impact on atmospheric air is produced by production processes and electric power transmission. Therefore, the problem of the interaction of electrical objects, and environmental protection is global [6, 7]. Reducing greenhouse gases is a major challenge in every country. Mostly the atmosphere is filled with industrialized countries. Germany ranks sixth in air pollution. The USA, Russia, China are more industrialized countries and, of course, emit more carbon dioxide. Motor transport is one of the main sources of air pollution. In Germany, 20% of the carbon dioxide emissions of air are from motor vehicles [6].

Earth's climate change today is a threat to humanity. Therefore, conferences, summits are held at the international level, climate pollution issues are discussed. In 1998, in the city of Kyoto (Japan), a protocol was signed by several industrial countries, which provides for a trade mechanism and mechanisms for the clean development of industry. This protocol states that by December 31, 2012 the EU should have reduced greenhouse gas emissions by 8% compared with 1990. Germany is one of the leading countries in Europe and this protocol states that greenhouse gas emissions into the air from 2008 to 2012 should be reduced by 21% [7]. Analysis of the dynamics of greenhouse gas emissions in Germany shows that in the period 2002-2012 decreased significantly.

The use of wind energy in Germany is the largest and it is estimated that using wind in 2020 will produce 149 billion kW of electricity and this will provide up to ¼ of the total energy consumption in the country [8]. Using biomass in 2012 in Germany received 5.8% of all energy used, hydropower 3.3%, solar energy 4.6%, due to the use of waste 0.8%. Germany is second in the world in wind power generation after the United States. Thus, it is possible to break down energy sources into classification:

1. Wind power
2. Solar power plants
3. Tidal power plants
4. Aero hydroelectric power station (condensation of moisture from the atmosphere)
5. Geothermal Energy
6. Thunder Energy
7. Controlled thermonuclear fusion, which requires the generation of electricity by converting a heavier atom into lighter atoms.
8. Hydrogen energy is not profitable
9. Space power. It is located near the earth's orbit or on the moon. Photovoltaic cells
10. Wave energy. The use of sea wave energy.

An example of a chart analyzing the dynamics of greenhouse gas emissions in Germany for 2002-2012 is shown in Figure 1 [9].

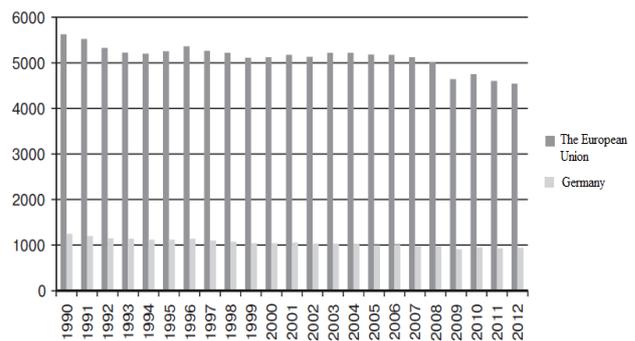


Figure 1. Gas emissions in Germany and the EU countries (in million tons) [9]

In the structure of greenhouse gas emissions, strings per sector are noticeable dominated by the energy sector. This is due to the specifics of the fuel and energy balance of Germany [10].

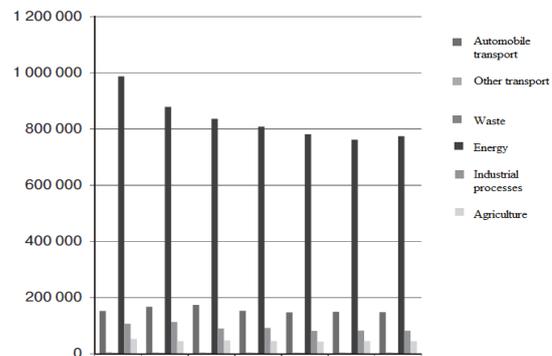


Figure 2. Greenhouse gas emissions by sectors of the German economy in 1990-2012 (thousand tons) [12]

For 1990-2012, greenhouse gas emissions were markedly reduced. The decrease is 21% as shown in Figure 2 [11].

The combination of these promising sources of electricity can significantly clean the globe of carbon dioxide. The search for new sources of energy continues and, of course, alternative energy is the most promising. In addition to these promising stations, there are still possible osmotic stations. In Toft (Norway), Statkraft Company has installed a plant that produces electricity by mixing salt and fresh water [8]. In the Norwegian reservoir, separated by a semipermeable membrane, the fluid is exchanged and equilibrium is reached, and in the second compartment the pressure increases, which starts the hydraulic turbine and electricity is generated. In this process, the membrane quickly fails. According to scientists, the potential of this innovation is 1600-1700 TWt/h, which is 10% of global electricity consumption.

Now, 13.3 billion tons of carbon dioxide are emitted annually into the atmosphere during electricity production. This is more than 40% of its global emissions. In other words, today 2/3 of electricity is produced through the combustion of hydrocarbons and is accompanied by the emission of carbon dioxide. Russia takes the 4th place in the world in terms of electricity generated - about 1,000 billion kWh per year. Over 70% is consumed in industry. In the structure of the fuel balance, the first place in the electric power industry is occupied by gas, followed by coal, hydropower of large hydroelectric power stations and nuclear energy [12].

An effective mechanism for environmental protection may be an environmental tax. Such taxes include motor fuel taxes; energy fuel: electricity, transport taxes (taxes on kilometers traveled, pollution charges, waste disposal fees, taxes on emissions of substances that cause global change, payments for the use of natural resources. Such measures can serve to protect environment and promote innovation. The effectiveness of economic measures depends on the efficiency of power plants. However, one may encounter a number of difficulties, one of which is weather conditions. Despite these factors, Germany is still a leader in green energy. Now it has half of all solar and almost a third of all wind installations in Europe.

In many countries around the world, decisions are being made to limit greenhouse gas emissions through government regulation or investing in new technologies. This is due to scientific evidence of the undesirable effects of global warming. For many regions of the world, rising temperatures on Earth will have serious consequences. It threatens with a shortage of drinking water, a drop in productivity, a violation of the ecological balance. Reducing greenhouse gas emissions can prevent global warming.

The problem of global warming has not only economic, but also foreign policy aspects. Greenhouse gas emissions and environmental pollution occur when burning fossil fuels. Therefore, the reduction of greenhouse gas emissions has the effect of reducing

emissions of nitrogen oxides, sulfur dioxide, heavy metals.

Reducing greenhouse gas emissions will also help preserve the environment and human health. As old equipment is replaced by new, more energy efficient, and becomes less energy intensive. The bulk of the economy will be the result of energy efficiency measures that will reduce energy consumption in the future [12].

4. CONCLUSIONS

The main volume of carbon dioxide emissions falls on the oil and gas sector, and then in the steel industry. In the oil industry, most of the emissions are due to methane leaks. Therefore, due to the high level of losses and low energy efficiency, large measures are needed in this sector. By improving energy efficiency, carbon dioxide emissions can be reduced. Such success can be achieved by using carbon capture and storage technologies. By using such technologies in the future, emissions of about 2 tons can be reduced.

REFERENCES

- [1] O.V. Sviderskaya, "Fundamentals of Energy: A Course of Lectures", 4th Ed., Acad. of Management, Minsk, Belarus, pp. 296, 2006.
- [2] <http://ecologyproblems.ru/11-ekologicheskie-problemy-zagryazneniya-atmosfery-vozdukh>.
- [3] W.J. Baumol, W. Oates, "The Theory of Environmental Policy", 1975.
- [4] W.J. Baumol, W. Oates, "Economics, Environmental Policy and the Quality of Life", 1979.
- [5] <http://www.vsp.ru/economic/2013/01/25/528657>.
- [6] A.V. Kuznetsov, "Germany: The Dynamism of the Economy, Shifts in Political Scene", Planet Year: Yearbook, M., Idea Press, pp. 278-291, 2011.
- [7] <http://de.exrus.eu/object-id5079b21b6ccc199c6900148d>, Exrus.eu.
- [8] <http://epp.eurostat.ec.europa.eu>, Eurostat database site.
- [9] www.webeconomy.ru/index.php?page=cat&cat=mc&mc=223&type=news&top_menu=free&sb=125&new_sid=1389.
- [10] <http://appsso.eurostat.ec.europa.eu/nui/show.do>.
- [11] Energy Efficient Russia, Main Conclusions, Company McKinsey, pp. 52-74, 2017.

BIOGRAPHY



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