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Energy-Saving Technologies: Analysis and Prospects for Development in Kazakhtan and Foreign Language

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Abstract

This article describes the experience of foreign countries on energy consumption, energy intensity and energy efficiency. The rating of countries on energy efficiency is given. The indicators influencing the measurement of energy efficiency are presented. Indicators of energy efficiency by sectors of the economy are given. There is a mechanism for implementing energy efficiency in Kazakhstan for various sectors of the economy: the energy sector, the industrial sector, the housing and communal services sector, and the transport sector. The statistical data of the main indicators of energy efficiency, energy intensity and energy consumption are given. The main measures of administrative and economic regulation and promotion of energy saving are considered: control over the use of energy resources, provision of tax benefits, state subsidies and subsidies for energy saving, provision of concessional lending and guarantees, introduction of a flexible tariff system, use of renewable energy sources, programs aimed at Popularization of energy saving among the population.

Keywords: energy efficiency, energy intensity, energy consumption, energy.

INTRODUCTION

The strategy of increasing the level of energy saving and energy efficiency is one of the key directions in the sphere of economy [1]. Energy efficiency occupies an important place among the main tasks of our time. Almost all countries have set themselves the goal of becoming less energy intensive, consuming less energy and reducing greenhouse gas emissions. According to the forecasts of the International Energy Agency (IEA), humanity will face two global threats in the next quarter of a century. This is a shortage of energy resources and an ecological catastrophe. Today, for many countries, the problems of energy conservation are particularly acute, despite the fact that the energy intensity of world GDP has decreased by 2 times in the last 30 years [2]. Growing every year, the generation and consumption of energy in the world create the necessary conditions for accelerating scientific and technological progress, which allows to improve the economic situation and leads to an increase in the well-being of people. But at the same time, increasing volumes of energy consumption require more and more volumes of hydrocarbon raw materials, whose reserves are not unlimited. Therefore, today, the issue of rational use of energy resources is topical. The solution of tasks related to the planning, forecasting and implementation of various administrative impacts in the field of energy efficiency should be based on the more successful experience of leading foreign countries.

METHODS

Member States guarantee that by December 31, 2020 the energy performance of all new buildings will correspond to those of buildings with minimal or zero energy consumption [3]. The so-called goal "20-20-20" means that primary energy consumption will be reduced by 20% in 2020, 20% will be the share of energy received from renewable sources, and carbon dioxide emissions will be reduced by 20% [4]. ACEEE - American Council for Energy Efficient Energy - made a rating of energy efficiency of the economies of the world (Figure 1).

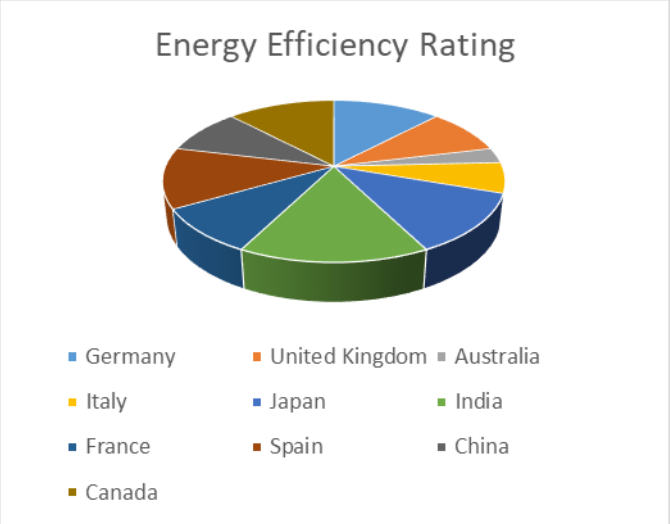

Figure 1. Energy Efficiency Rating of Countries.

Impressive success in terms of the efficiency of energy expenditure has been achieved by Germany. So, the authorities of this country do not give permission for the construction of any building, unless the architectural design does not provide for thermal insulation that meets the requirements of state standards. Increasingly widespread here, as well as in many other developed countries, are traffic sensors that are installed in corridors and rooms that react to the presence of people in them: if the room is emptied, the light in it automatically turns off.

Germany is a recognized world leader in energy and resource saving, despite the fact that the share of alternative energy sources is about 16%, while in Austria this figure reaches 70% [5]. In accordance with the German Law on the Use of Renewable Energy for Heat (Erneuerbare Energien Wärme Gesetz) by 2020, the share of alternative sources for heat production should increase from 6.6 to 14%.

The US Government, in partnership with the private sector, seeks to develop a set of technologies at home and abroad that should be gradually introduced by the second half of this century. They include new biological fuels from non-food crops, clean coal technology, the commercialization of hybrid cars with rechargeable batteries, hydrogen fuel cell technology, more efficient and safer nuclear systems, and nuclear fusion technologies.

Instruments of financial regulation are applicable mainly to energy producers. In Connecticut, under the terms of the financial program that encourages an "energy efficient business", companies that have decided to increase energy efficiency can count on a significant discount from energy sales companies, as well as interest-free credit for the introduction of new technologies [6]. In the USA, when implementing energy-saving measures, tax privileges are granted. When regulating the tariff formation of energy companies, the fuel component is completely transferred to the consumer [7]. Tariffs for electricity depend on the level of reliability of power supply provided for by the contract: with the consumer's agreement to switch off during the network congestion period, tariffs for it are reduced.

The US Measurement and Verification Guide contain more specific material on the methods proposed by the IPMVP protocol. The guide, as noted above, has the main objective - to promote the development of state energy service performance contracts (ESPC), therefore, for the most part is oriented towards the public sector. Also, this manual offers a wide range of techniques and guidelines for the application of measurement and verification methods for such common activities as (Figure 2)

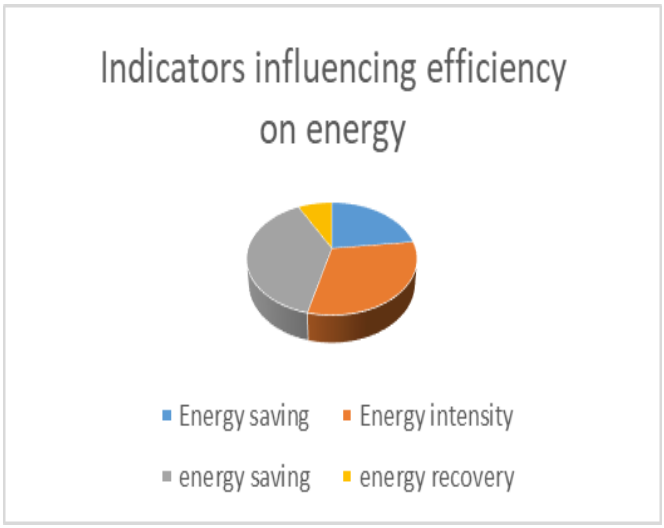

Figure 2. Indicators influencing on the measurement of energy efficiency in the US.

Brazil is a pioneer in the use of ethanol through the processing of sugar-containing crops. According to the report of the non-governmental Foundation Hart Energy Consulting, global biofuel use will double by 2015, and Brazil will remain the world's largest exporter of both fuel and raw materials. In China, an entire industry has been set up to use solar energy to heat water, yielding annual revenue more than 3 billion dollars.

Simultaneously with the development of measures for energy conservation, Japan is actively working on the development of solar energy (solar energy). To date, 1 watt of solar-powered energy costs 140 Japanese yen, this figure in 1980 was 30,000 Japanese yen. From this ratio, it can be seen how work is actively and productively carried out in this direction. The Japanese government set the task to equip 1 million dwelling houses with solar panels for 2010. The Japanese approach is a special case of a global approach to solving large-scale economic problems in countries with developed market economies [8, p.19]. In Japan, a program is being implemented to create technologies for the production, storage, transportation and use of hydrogen, within the framework of which three types of filling stations have been developed, using various methods of producing hydrogen. In 2010, the number of cars on hydrogen fuel cells should be about 50,000 units, by 2020 their number will reach 5 million. To service these cars, 4,000 hydrogen filling stations will be opened.

All the above technologies show that most countries are constantly developing and improving energy-saving technologies.

Recently, there has been a clear interest in solar cell in the world, although its current cost is three to four times higher than the cost of traditional energy. Solar cells are particularly attractive for remote areas that do not have connections to a common power system. The advanced thin-film technology used for the production of photovoltaic cells is much cheaper than crystalline silicon technology and is actively being introduced into large-scale commercial production. The leader in the creation of photovoltaic power plants is Spain. The Spanish company SunPower Corp (SPWR) will soon build three more photovoltaic power plants in La Mancha, with a total capacity of 21 MW power plants.

In South India, Sri Lanka, Bangladesh, Morocco, Kenya, South Africa and a number of other countries, solar cell is widely used to provide housing not included in the power supply system. Among renewable sources wind power is one of the first places. So, in the USA in 2006 the total installed capacity of wind power plants was 9149 megawatts. Thanks to the latest technological achievements, the competitiveness of wind power is constantly growing, which ensures the growth of its production. The first wind energy market was formed in Denmark in the nineties of the last century. Then the example of Denmark was followed by Germany. Currently, permanent and active markets have formed in Spain, Italy, France, Britain and India.

The development of energy supply in Denmark is regulated by national programs. The energy plan for 2001-2030 is aimed at reducing costs for energy production and improving the

environment. Economic stimulation of energy saving is widely developed. Various kinds of subsidies are provided:

-investment subsidies when prices increase for heat energy consumers when transferring district heating systems to work from CHP plants and biomass plants,

- Subsidies to the device in areas with district heating systems of such systems in residential buildings built before 1950. The subsidy usually covers 30-50% of the total cost [9]. Investment grants are allocated for the construction and repair of heating networks, compensating for 30-60% of capital investment.

At the same time, it should be noted that Denmark occupies a leading position in the world on the introduction of many types of energy-saving technologies, which allows, during the last 20 years, keeping the annual volume of energy consumption unchanged. At the same time, over the years, the country's GDP has grown more than 1.5 times. Denmark's experience is actively used by many European countries, China and the United States.

In Finland and Sweden, technology is actively working with the use of soapstone. This material has special physical properties - eight hours absorb heat and sixteen hours it gives. It is based on the development of thermal batteries, which are installed in the basement of the house, and with the help of a ventilation system, heat is supplied throughout the building. The use of soapstone is cost-effective when there is a difference between daytime and nighttime electricity tariffs.

Also in the world, the direction of energy on a small scale has become widely developed. Each district of European cities creates its own energy supply systems, which almost eliminates losses in the transportation of energy. As a rule, in small-scale power engineering such innovations are the result not of state decisions, but of private initiative. As a rule, the main consumer of heat and electricity in most countries is the housing and communal complex.

An important direction of energy saving is energy saving, which is achieved by almost 50% due to the savings in electric lighting. In this regard, since 2009, the UK has banned the use of incandescent lamps. This country was the first to require its citizens at the legislative level to replace incandescent lamps with fluorescent lamps. This initiative did not cause a protest among the population, although the cost of a conventional incandescent lamp is 10 times lower. It is expected that the consumption of electricity will decrease significantly, since such fluorescent lamps consume 5 times less energy than conventional ones, and their lifetime is 10 times longer.

At the same time, the UK has achieved the EU's adoption of a pan-European ban on the sale of incandescent lamps in the retail network. According to the economic calculations, after the replacement of incandescent lamps, the countries will annually save from $ 5 billion to $ 8 billion. This initiative was supported at the legislative level by their countries not only in the European Union, but also in Australia, New Zealand, the United States and Canada.
In recent years, one of the most promising directions that can qualitatively change the situation that has developed in the energy market, in many countries is the transition to hydrogen fuel. Interest in the use of hydrogen as an alternative fuel is manifested abroad for more than a decade. However, only now this interest is embodied in long-term development strategies and specially created for their implementation of large national and transnational programs, as well as public-private partnerships aimed at achieving an innovative breakthrough in the field of energy.

In Norway, the main principle of the formation of the price for electricity is the reflection of its market value. High resource prices provide a faster return on energy-saving measures. In Switzerland, investors investing in the construction of buildings with low energy consumption, receive a state subsidy of 50 thousand euros [9].

In the People's Republic of China, an integrated approach to solving energy conservation problems is used. The annual investment is about 200 billion yuan for the development of electrical networks. Much attention is paid to the development of smart grids ("smart grid"). Such systems reduce technical losses in the transmission of electrical energy and allow the customer to interact with the resource-supply company, and also enable the consumer to choose a tariff plan. Reducing the cost of paying for energy consumption from the use of these systems is estimated at 10% [9]. A special role in energy saving is assigned to alternative energy sources.

In Scandinavia, Sweden and Denmark was participating in this process. Iceland has a joint venture to promote the use of hydrogen as a transport fuel, with the participation of the government and academic institutions.

One of the most important areas of energy saving in Western Europe is the introduction of effective energy-saving technologies in the industrial and municipal spheres. Typically, the following technologies are used:

- General technologies for many consumers associated with the use of energy: variable speed motors, heat exchangers, compressed air, lighting, steam, cooling, drying, etc.;
- More efficient energy production, including modern boiler houses, cogeneration (heat and electricity), as well as trigeneration (heat, cold, electricity);
- -Alternative sources of energy.

One of the most common energy-saving technologies with great potential for improvements in housing construction is boiler houses. Modern technologies can significantly reduce energy consumption, reduce maintenance costs, and improve efficiency. In addition, the replacement of the boiler room often allows you to switch from environmentally dirty and expensive coal or fuel oil to cheaper and cleaner fuels, such as gas or wood pellets.

The Government of Kazakhstan sets quantitative targets in terms of increasing energy efficiency and energy efficiency based on energy intensity indicators. So, the program "Energy Saving 2020" sets goals to reduce energy intensity of GDP by 30% by 2015 and by at least 40% by 2020 from the level of 2008. We bring to your attention the "Review of the state

policy of the Republic of Kazakhstan in the field of energy saving and energy efficiency".

At present, the country is beginning to implement a new development strategy "Kazakhstan-2050", the main goal of which is to enter Kazakhstan in the number of the 30 most developed countries of the world by 2050. A new course of development should lead to the formation in Kazakhstan of a competitive and knowledge-based model of the economy. With the adoption of Kazakhstan "Strategy" Kazakhstan 2050 "and the Concept of transition to a" green "economy, the country has chosen a fundamentally new way of development of society.

According to the Concept, a key role will be played by the direction of the state policy to reduce the impact on the environment, resource saving and the achievement of a high level of the quality of life of the population.

One of the central moments in the gradual transition to a green economy is energy efficiency. At present, in terms of energy intensity of GDP, Kazakhstan is among the countries with the highest values. According to experts of the Charter, in Kazakhstan there are significant opportunities to increase energy efficiency in industry, energy, housing and communal services and transport.

Since 2012, a number of legislative acts have been adopted in Kazakhstan, defining the basic requirements in the field of energy efficiency, as the main document is currently the law "On energy conservation and energy efficiency". The Government of the Republic of Kazakhstan also set a goal to reduce the energy intensity of GDP by at least 40% by 2020 from the level of 2008.

Energy accounts for about 47% of the total consumption of primary energy resources. At the same time, there is a high share of wear in the energy sector of the generating and grid equipment, which results in a low efficiency of electricity generation and a relatively high loss in electrical networks.

Most of the strategies implemented in Kazakhstan for the development of economic sectors (industry, construction, agriculture, transport) do not take into account the intersectional segment, requirements for suppliers and consumer demand, they are not aimed at forming a complete logistics chain of product creation and distribution, the effective functioning of which largely determines the success Implementation of the proposed strategic measures [11, p.81]. Distinguish the following sectors of energy efficiency (Figure 3).

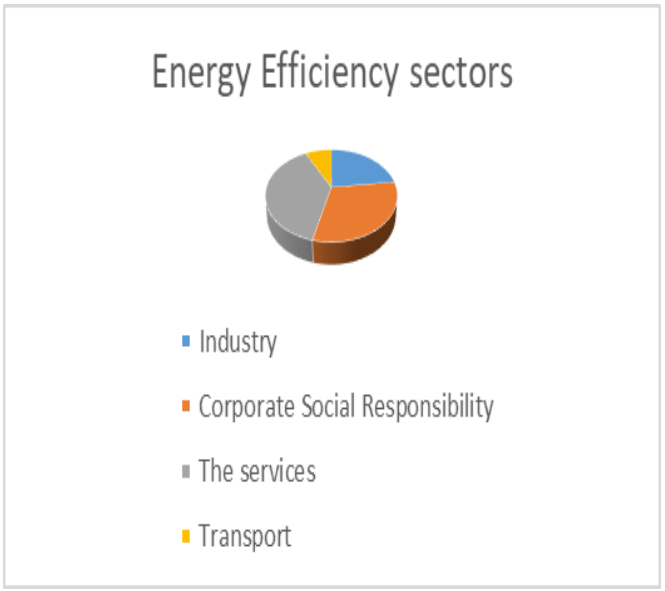

Figure 3. Energy Efficiency by Sector in the Republic of Kazakhstan

In the industrial sector, the high level of energy consumption is due, first of all, to the activities of such energy-intensive industries as oil and gas, metallurgy and mining. At the same time, the technical condition of the equipment and the problem of reducing the loading of enterprises significantly affect the efficiency of the industry. A number of legislative restrictions on energy consumption in industry have not yet yielded positive results. The analysis of the approved norms of energy consumption in industry showed that they are inapplicable to the working conditions of some enterprises, especially in the mining and metallurgical and coal mining sectors [12-16].

In terms of housing and communal services, most of the existing housing stock consists of apartment buildings with central heating on the basis of boiler houses or CHP. For district heating networks, the current state of the infrastructure is characterized by low efficiency and significant heat losses. On average, residential buildings in Kazakhstan consume three times more energy per unit area than in the Nordic countries. A high level of heat loss is mainly associated with outdated equipment, as well as lack of proper repair [17-25].

The transport sector accounts for 17% of the total consumption of the country's primary energy resources, while the technical condition of a part of the fleet of vehicles and the quality of the fuel used, have a significant impact on specific fuel consumption and emissions of harmful substances. The transition to new fuel quality standards, the introduction of modern navigation and information systems will improve the energy efficiency of the transport sector and increase the capacity of the transport system.

We consider it advisable to implement the following provisions for improving energy efficiency in the main energy-consuming sectors of Kazakhstan's economy (Table 1).

Table 1- Mechanism for implementing energy efficiency improvements in Kazakhstan

№	Sectors	Recommendations
	Services sector	1. Development of experience in attracting investments in the modernization of obsolete infrastructure in the sectors of production, transmission and distribution of electricity in order to minimize losses. 2. Amendments to the legislation in terms of providing reliability and quality of electricity supply, providing for increasing the degree of responsibility for non-compliance with the requirements for the quality of electricity, both by electricity producers and electric grid companies, and by large consumers of electricity. It is also recommended to work out the issues of certification of electricity. 3. Development and adoption of the state program for the modernization and development of electric grid companies (RECs) with the definition of required investments and their sources that take into account the main tasks of the industry: reducing losses, improving the reliability and quality of electricity supply, setting requirements for REC owners by the terms of their achievement in tariffs. 4. Consideration of the possibility of introducing mechanisms for paying for reactive power by large consumers of electricity and giving preferences to electric grid companies to reduce losses, to stimulate measures to compensate for reactive power, and to reduce electricity losses in electric networks. 5. Development of incentive mechanisms for energy saving by introducing changes in the rules and procedure for the formation of tariffs.
2	The industrial sectors	1. Strengthening of state control and organization of monitoring of the implementation of energy saving plans, compiled on the basis of the results of energy audits. 2. Assistance in compliance with ISO50001 - Energy management by large industrial enterprises. 3. Review or abolition of the approved norms for energy consumption, due to their inapplicability to some industrial enterprises. 4. Review existing standards for industrial equipment in order to promote the application of the best technological solutions in the field of energy efficiency, including modernization and construction of new industrial facilities. 5. Development and implementation of various mechanisms of state incentives (voluntary programs, subsidies, soft loans, tax incentives) for industrial enterprises in order to support energy saving and energy efficiency measures. 6. Training and retraining of personnel on the basis of the departments of profile institutes and universities in the field of energy saving and energy efficiency, conducting professional trainings, as well as programs for qualification and retraining.
3	Housing and utilities sectors	1. Toughening energy efficiency requirements for new and existing buildings and allocating sufficient resources to monitor compliance with legal requirements, as well as building codes and regulations. 2. Strengthening the role of author and technical supervision over the progress of construction of buildings and structures. 3. Introduction of a system of quarterly heat consumption in new buildings to encourage end-users to regulate their level of heat consumption; Continued installation of automatic control systems for heat consumption and house heat meters in existing multi-apartment buildings. 4. Encouraging regional and local authorities to develop targeted energy efficiency programs to meet audit requirements and to introduce special criteria for energy efficiency in public procurement procedures. 5. Development and implementation of financial mechanisms for end-users, stimulating the attraction of investments in the modernization of existing buildings to increase their energy efficiency. 6. In the heat and gas distribution sector, it is necessary to establish long-term tariffs at an economically reasonable level, which provides an investment component for modernization and energy efficiency. 7. Strengthen the process of developing and adopting common minimum energy efficiency standards for energy-consuming products within the framework of the Eurasian Economic Union. 8. Creation of necessary conditions for support of regional / local authorities in the development and implementation of projects for highly efficient street / urban lighting; The introduction of incentives in the form of grants or subsidies to facilitate the rapid introduction of energy-efficient street lighting throughout the country.

4	Transport sectors	1. Performance of the assessment of the quality of urban planning, elements of transport infrastructure and traffic management. It is necessary to create a system of indicators for the energy efficiency of the transport sector at the national and regional levels. 2. Strengthening the state control in terms of the quality of motor fuel supplied to the market. 3. Introduction of a set of measures that regulate and stimulate accelerated 4. Introduce tax and financial incentives to support the use of energy-efficient cars and vehicles. 5. Increase requirements for relevant government agencies and agencies to improve the quality of services, efficiency, accessibility and comfort of existing public transport systems in order to create alternatives to the use of private cars in urban areas. 6. Introduction of navigation and temporary systems in order to optimize the transport logistics sector and improve the energy efficiency of freight transport (including railway transport).

The introduction of all the above measures contributes to more effective development of energy efficiency in Kazakhstan.

DISCUSSION

The transport sector accounts for 17% of the total consumption of the country's primary energy resources, while the technical condition of a part of the fleet of vehicles and the quality of the fuel used, have a significant impact on specific fuel consumption and emissions of harmful substances. The transition to new fuel quality standards, the introduction of modern navigation and information systems will improve the energy efficiency of the transport sector and increase the capacity of the transport system.

CONCLUSION

The introduction of all the above measures contributes to more effective development of energy efficiency in Kazakhstan.

When implementing measures to save energy and improve energy efficiency, it is worthwhile to rely on more than 40 years of foreign experience, adapting mechanisms to national conditions. So, for example, when subsidizing energy conservation, a real assessment of the effect is needed and the population's control over the activities carried out. It should be noted that none of the energy-efficient areas can be realized without the interest of the owners of residential premises, therefore one of the top-priority measures should be informational and educational work among the population on the need for energy saving. Lack of motivation inhibits energy saving to a large extent. Also, relatively low tariffs significantly increase the payback period of energy-saving measures. It is necessary to overcome the identified barriers, which allows to improve both the economic and environmental situation in the country.

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