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# KARACHACHANAK DEPOSIT GAS CONDENSATE – PERSPECTIVE RAW MATERIAL FOR PETROCHEMISTRY

**Abstract.** Any condensate is obtained after a gaseous substance passes into a liquid due to a decrease in pressure or temperature. In the bowels of the earth there are not only gas, but also gas condensate deposits. When pressure and temperature decrease as a result of well drilling, gas condensate is formed - a mixture of liquid hydrocarbons separated from gas.

Knowing amount sloppy cheese, delivered Karachaganak processing complex on consequent conversion in accordance with passport quality cheese with brought on contents faction before $C_{19}$ and the other factor, on under development methods possible to calculate output base faction, used for reception of the goods products on full scheme to conversion cheese.

**Keywords**: gas condensate, oil and gas chemistry, gas and condensate fields, product pipelines, field, raw materials.

## INTRODUCTION

The main raw materials of petrochemical enterprises for the production of a whole range of products: ethanol, solvents, polymers, synthetic rubber, components of high-octane gasolines are a wide fraction of light hydrocarbons and liquefied hydrocarbon gases.

Gas condensate is a natural liquid mixture of hydrocarbons with a high boiling point, the chemical formula of which contains five or more carbon atoms in the molecule, located in the bowels of the Earth and contained in the composition of the extracted natural gas, oil fields, and also in the form of independent gas condensate deposits. Gas condensate is also formed as a by-product during the operation of gas equipment during the processing and transportation of natural gas, and also accumulates in the equipment of internal combustion engines operating on gaseous fuels. Gas condensate raw materials are used for the production of motor fuels, as well as in the chemical industry.

Gas condensate obtained directly from the well is unstable, but after deep cleaning of any kind of impurities and degassing, it will eventually become stable. As for unstable gas condensate, it is characterized by high pressure of saturated vapors of light hydrocarbon fractions, and this gas condensate is delivered to the consumer via special condensate lines by means of its own high pressure.

By its qualities and application, gas condensate is similar to oil, and in some aspects even surpasses it. An important advantage of gas condensate feedstock, affecting the cost of commercial products, is the lack of the need to dispose of heavy residues, and these are expensive processing processes that require significant capital and operating costs.

Gas condensate can be used as a raw material for the production of gasoline, diesel and jet fuel, and in the petrochemical industry producing high value-added goods [1].

An important role belongs to light hydrocarbons of the C2 - C5 fraction, which are contained in natural and associated gas, as well as in gas condensate fields in sufficient quantities for their processing. Previously, these fractions were considered a by-product after stabilization of the gas condensate and were not always widely used.

## MAIN PART

The analysis of the raw materials from the Karachaganak gas condensate field revealed a number of unique properties of gas condensate.

The gas condensate of the Karachaganak field is characterized by a very heterogeneous fractional and chemical composition. As the pool deepens, gas condensate becomes heavier and, in the plantar zone (about 5,200 m), the fractional composition practically corresponds to the product mixture of sulfur oils.

During the development of the field, an interesting pattern has been revealed of changes in the composition and properties of gas condensate along the height of the reservoir, which poses certain difficulties in its processing and in predicting the yield of marketable products. In addition to the noted anomalies in the change in the component composition of the condensate along the height of the productive zone, anomalies are also characteristic of the Karachaganak condensate in the chemical composition of the base fractions. For example, gasoline fractions of Karachaganak gas condensate are characterized by a low content of naphthenic and a high content of paraffin hydrocarbons, which makes it difficult to use them as feedstock for catalytic reforming. In the head gasoline fractions, an unusually high content of total sulfur (up to 1% wt.), Including up to 0.6% by weight of mercaptan. In naphtha and kerosene-gas oil fractions, the total sulfur content gradually increases, while the mercaptan content decreases [2].

Anomalies were also noted in the distribution of aromatic (alkyl aromatic) hydrocarbons, which indicates the impossibility of producing aviation kerosene due to the high aromatics content in fractions 120-2300C [1]. However, the low aromatics content in the heavy fractions suggests that the Karachaganak condensate vacuum gas oil fractions are good raw materials for catalytic cracking. The use of this installation allows you to get additional volumes of gasoline and diesel fuel.

The distribution of aromatics and total sulfur in kerosene-gas oil fractions (CGF), which are abnormal compared to conventional oils, showed that CGF fractions from Karachaganak condensate have cetane numbers of 52-54 points, while the content of aromatic hydrocarbons is 21-22%, while in conventional oils - 30-35% of the mass. When using conventional hydrotreating technology, diesel fuel grades of environmentally friendly and export conditions are quite achievable, in which the aromatic content is strictly standardized to no more than 20%.

In the initial period of operation of the complex for processing stable Karachaganak gas condensate, a number of problems have been identified, caused by the peculiarities of its composition, in particular its instability. The main problems encountered in the processing of mercaptans containing gas condensates are due to the high reactivity of mercaptans and the instability of the fractional composition [3].

These features must be considered when sorting, mixing and developing stabilization schemes, preparing and processing various types of raw materials. Considering the prevailing circumstances, a number of technological installations for the preparation and processing of the gas condensate of the Karachaganak field have undergone changes and improvements.

As studies and experience show, the following indicators are recommended for processing Karachaganak gas and condensate feedstock: the content of gas components (C4) is no more than 2%; hydrogen sulfide content - not more than 0.01%; saturated vapor pressure at 380 ° C - not more than 33.25 kPa.

Due to the instability of the raw materials, it is necessary to include stabilization units in the preparation scheme; these requirements are quite feasible while observing the process technology.

Studies [4,5], including pilot plants, provided the creation of a scientific basis for the development of integrated schemes for preparing (stabilizing) gas condensate for transportation at a refinery and processing it to produce a wide range of high-quality motor fuels and valuable petrochemical raw materials.

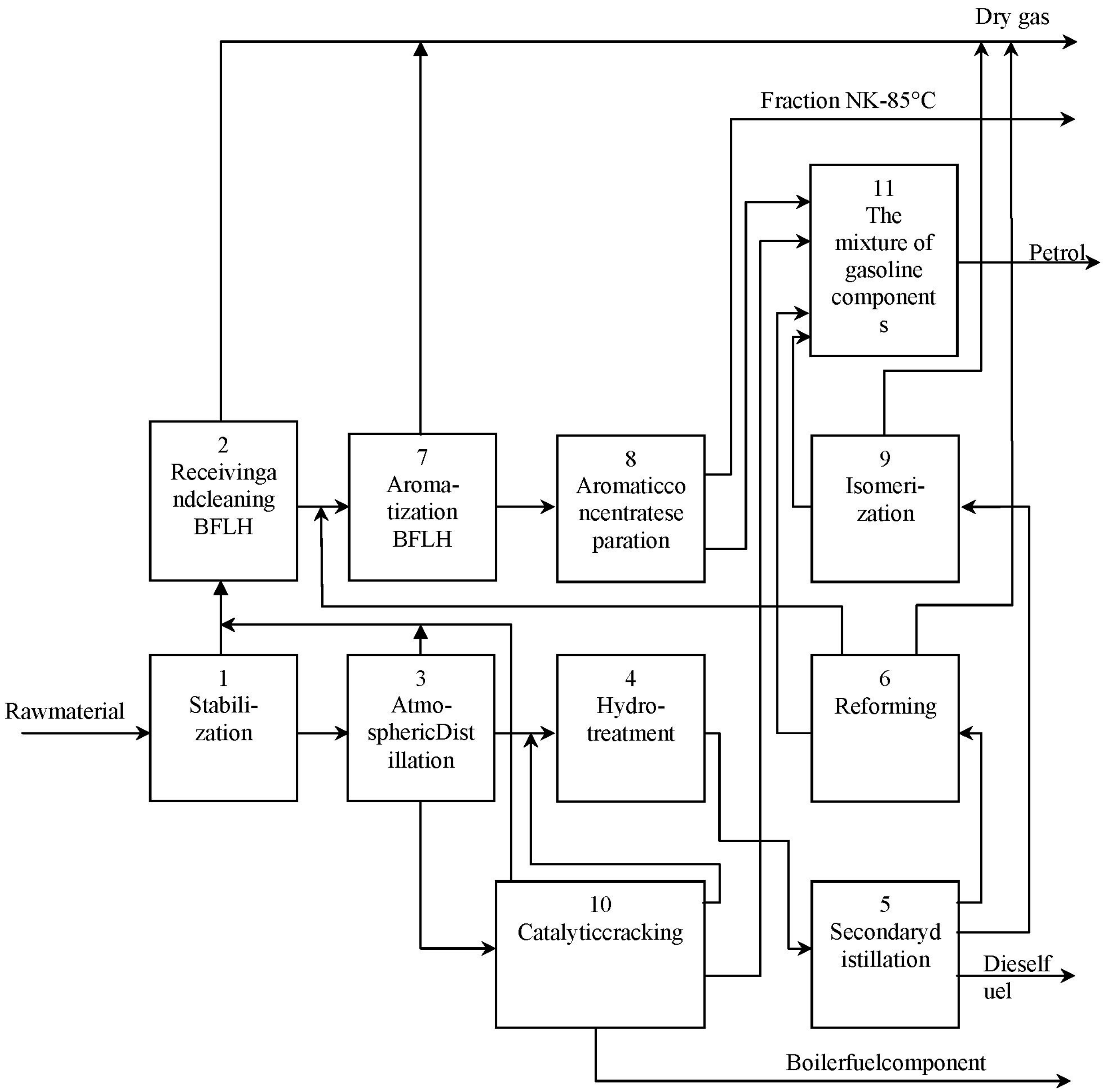


Figure 1 - The scheme of processing gas condensate field Karachaganak

Unstable gas condensate (feedstock) (1) is stabilized in a stabilization column. The stabilization gases are purified (2) from sulfur compounds and stripped by oil absorption method to produce fuel gas and a wide fraction of light hydrocarbons (NGL). Atmospheric distillation of (3) stable condensate is carried out in a distillation column to obtain n.k. fractions. - 230, 230-3500C and residue boiling above 3500C. A mixture of fractions - 230, 230-3500C is subjected to (5) hydrotreating at a pressure of 2.3-3.5 MPa and a temperature of 310-3800C. From hydrotreating products in the column of secondary distillation (5) fractions of n. - 70, 70 - 180, 180 - 3500C. Fraction n. - 700C is subjected to isomerization (6) at a pressure of 2.0 MPa, a temperature of 2700 ° C in an environment of hydrogen-containing gas, a space feed rate of 1.5 h at the catalyst containing 0.28 - 0.32% of platinum to produce a component of high-octane gasoline. A wide fraction of light hydrocarbons is subjected to aromatization (7) on a high-silicon zeolite catalyst containing elements of the VIII, IIB, IIIB groups, at a pressure of 0.3-0.7 MPa, a temperature of 500-6000C, the flow rate of the feed of 1.5-2.0 h -1 to obtain a concentrate of aromatic hydrocarbons, which is divided into faction n. - 850C, and 85 -kk [5].

Hydrotreated gasoline fraction 70-1800C is directed to catalytic reforming (9) in a hydrogen-containing gas at a pressure of 2.0 - 2.2 MPa, temperature 480-4900C on catalysts containing 0.33 - 0.52% platinum, 0.03- 0.08% tungsten, 0.01-0.02% rhenium, 0.28-0.32% fluorine, to obtain a component of gasoline and a component of a broad fraction of hydrocarbons, which is mixed with the raw material of stage (7).

Catalytic cracking (10) of the residue from the distillation of gas condensate boiling above 3500 ° C is carried out in a fluidized bed of a zeolite-containing catalyst at a temperature of 500-510 ° C and a pressure of 0.09-0.10 MPa. The cracking products are separated in a fractionation column into dry and liquefied gas (a component of the broad hydrocarbon fraction entering stage 2), gasoline (fraction n. -1950 C), light catalytic gas oil (fraction 195-3500C) and heavy catalytic gas oil (fraction above 3500). Light catalytic gas oil is fed to the Hydrotreating in a mixture with diesel fractions from the stage of atmospheric distillation (3).

Target products are prepared as follows. Mix (11) in the balance of the product (isomerization) (9) fraction n. -700C, fraction 85 –kk. the product of aromatization (7) of a broad fraction of light hydrocarbons, the product of catalytic reforming (6) of fraction 70-1800C, the gasoline fraction of catalytic cracking (10). And get high-octane gasoline with an octane rating of 94-97 by the research method. A hydrotreated 180-3500C fraction is used as a commercial low-sulfur diesel fuel. Heavy catalytic cracking gas oil is used as commercial fuel oil. The fraction n.k.85 with stages of separation of products of aromatization of a wide fraction of light hydrocarbons (8) is directed to the production of benzene [6].

## CONCLUSION

In oil refineries, gas condensate is used as a raw material for the production of low-octane types of gasoline and special anti-knock additives are used to increase the low octane number. In addition, this product is characterized by a very high pour point and cloud point, in connection with which it is used mainly in the production of fuel "summer" species. Much less often gas condensate is used as diesel fuel, since in this case additional dewaxing is required. As a result of gas cleaning, condensate is pumped through special pipelines, and placed in special tanks, where it will wait for its transportation.

In the process of gas condensate processing, the main directions are petrochemical and fuel. High-quality gasoline, diesel, jet and boiler fuel are made just from gas condensate. As a result of petrochemical processing of gas condensate, olefins, aromatic hydrocarbons and other monomers (small molecules) are obtained, which are used in the production of synthetic rubbers, fibers, plastics and various types of resins.

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## КАРАЧАХАНАК ЖАБДЫҚТАРЫНЫҢ ГАЗ КОНДЕНЦИЯСЫ – ПЕТРОХИМИЯ ҮШІН ПЕРСПЕКТИВТІ ШЕШІМ МАТЕРИАЛДАРЫ

**Аннотация.** Кез-келген конденсаттан газ тәрізді зат қысыммен немесе температураның төмендеуіне байланысты сұйықтыққа түскеннен кейін алынады. Жер қойнауында газ ғана емес, газ конденсаты да бар. Ұңғыманы бұрғылау нәтижесінде қысым мен температураның төмендеуі кезінде газ конденсатын пайда болады - газдан бөлінетін сұйық көмірсутектердің қоспасы.

$C_{19}$ дейінгі фракциялардың және басқа көрсеткіштердің келтірілген құрамы бойынша шикізат сапасының құжатына сәйкес Қарашығанақ өңдеу комплексінің кезекті өңдеуге шығаратын тұрақсыз шикізатының мөлшерін біле отырып, толық сызба бойынша тауарлы өнім алу үшін қолданылатын базалық фракциялардың шығымын есептеуге болады.

**Түйін сөздер:** газ конденсатын, мұнай және газ химиясы, газ және конденсат кен орындары, өнім құбырлары, кен орындары, шикізат.

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## ГАЗОКОНДЕНСАТ МЕСТОРОЖДЕНИЯ КАРАЧАГАНАК – ПЕРСПЕКТИВНОЕ СЫРЬЕ ДЛЯ НЕФТЕХИМИИ

**Аннотация.** Любой конденсат получается после перехода газообразного вещества в жидкое из-за снижения давления или температуры. В недрах земли существуют не только газовые, но и газоконденсатные залежи. Когда давление и температура снижаются в результате бурения скважины, образуется газовый конденсат - смесь жидких углеводородов, отделившихся от газа.

Зная количество неочищенного сырья, доставленного Карачаганакскому перерабатывающему комплексу при последующей конвертации в соответствии с паспортным качеством сырья с доведенной по содержанию фракции до С19 и другим фактором, по разрабатываемым методам можно рассчитать выходную базовую фракцию, используемую для получения схемы конверсии товарной продукции в полном объеме.

**Ключевые слова**: г*азовый конденсат*, нефтегазохимия, газоконденсатные *месторождения*, продукто-проводы, *месторождение, сырье*

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# INNOVATION IN THE USE OF FUEL AND ENERGY RESOURCES OF THE COUNTRY

**Abstract.** The issues of the current state, the problems of prospects for the development of the fuel and energy complex of the Russian Federation. in particular the oil and gas industry. The factors that determine the need for innovative development of the branches of the fuel and energy complex are analyzed. The use of high-tech services in the fuel and energy sector is proposed as a basic element of this development. The authors emphasized the need to increase energy efficiency and reduce the energy intensity of the economy to the level of developed countries and consistently limit the load of the fuel and energy complex on the environment and climate by reducing pollutant emissions, discharging polluted wastewater, as well as greenhouse gas emissions, reducing waste production and energy consumption. Also, promising ways of innovative development of the fuel and energy complexes of Kazakhstan were proposed.

**Keywords:** innovations, fuel, resources, efficiency, ecology, mining.

## INTRODUCTION

The fuel and energy complex consists of many separate spheres of economic activity, but all of them are combined into a single complex and are inextricably linked. The sphere of the extraction of fuel and energy minerals is fundamental for the fuel and energy complex. It is extensive and covers extraction as traditional hydrocarbons, including oil, gas, coal, peat, or shale. The main tasks in the field of extraction of fuel resources are the renewal and accumulation of reserves through exploration and development of new deposits. Manufacturing industries include all processes and systems for transforming primary fuel and energy resources into marketable products for their subsequent consumption or further transformation, and it is this area that produces the product with the highest value added in the fuel and energy sector. Problems of energy development, ensuring energy security as a basic element of sustainable and dynamic development of the economy of any state are constantly in the focus of attention of both specialists and the world community. Despite the efforts of a number of countries to increase capacities in the nuclear power industry and the use of renewable energy sources, the dominant position in the structure of consumption of primary energy resources will remain until 2030 for energy carriers of organic origin and will amount to 85%. At the same time, in their total volume, the first place still holds and in the future will hold coal, the second - natural gas, the third - oil.

## MAIN PART

Especially great importance is the fuel and energy complex in the Republic of Kazakhstan (RK). First, in the climatic conditions of Kazakhstan, the provision of fuel and electricity to the economy and the population becomes a vital factor in the existence of entire regions. Secondly, the huge reserves of natural fuel resources provide Kazakhstan with a large part of the proceeds from their exports. Thirdly, today the fuel and energy complex is a huge enterprise consisting of a large number of oil and gas enterprises. Many large enterprises of the complex are city-forming. They provide not only employment for the majority of the population, but also a significant share of revenues to local budgets.

As a rule, the main factors determining the degree of use of any energy source are its estimated reserves, net yield of useful energy, cost, potential hazardous environmental impacts, as well as coal, social effects and impact on industry, ensuring the filling of budgets of all levels. In addition, the fuel and energy complex has a high state security in the republic. Each energy source has advantages and disadvantages, as a result of which the development and consumption of these sources in the world energy sector are significantly different.

Economic management of natural resources in various countries of the world. The mining industry (including oil and gas) is a leading sector of the global economy. According to the British newspaper Financial Times, this sector today ranks first in the world in terms of the capitalization of the largest companies, including the extractive industry itself (without oil and gas) in fifth place among global industries, following the banking sector, the oil and gas industry, the pharmaceutical and computer industries. (picture 1).

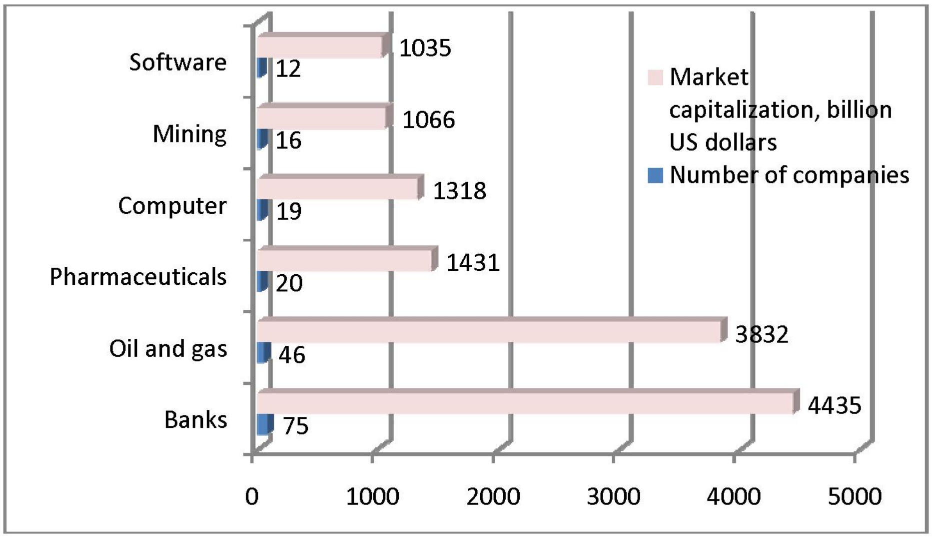


Figure 1 - Capitalization Levels of Leading Sectors of the Global Economy

In recent years, there have been intense discussions on the goals and nature of the modernization of the economy, with an unchanged focus on moving away from resource-oriented growth and the earliest possible transition to the knowledge-intensive nature of economic development.

The demand for coking coal in world markets is significantly expanding, which is associated with an increase in the production volumes of steelmaking companies in the Asian region (especially the rapidly developing steel industry in India and China) [16; 46].

RK is moving in line with the global upward trend in coal consumption, which can be called a jerk to coal. The fuel energy industry existing in Kazakhstan is based on the implementation of the model “extraction of the energy carrier — its transportation — burning at the power plant — energy production — storage of waste”. Each stage in this chain is associated with a set of problems that are objectively exacerbated when the output of marketable goods is increasing.

Thus, high injuries and accident rates of Kazakhstani mines are well known, as a result of which not only economic but also huge social and political losses of society take place. In recent years, accidents claiming the lives of dozens of miners have become uncommon for the country.

Modern methods of coal mining are characterized by a large-scale anthropogenic impact on the ecology of the mining regions, aggravated by the ongoing development of the industry. In addition, the situation is exacerbated by increasing the pace of coal production in the most earthy and open way.

In addition, rail transport of coal is limited by high transport tariffs, reducing its competitiveness in distant markets. The growth of tariffs for electricity due to the high energy intensity of mining production has a negative impact on the competitiveness of coal.

Incineration of coal delivered to a thermal power plant (TPP) objectively leads to the accumulation of a significant amount of ash waste and the occupation of large areas of the earth's surface beneath dumps. The ecological situation in the areas of large and medium-sized thermal power plants deteriorates significantly over time, and the living environment degrades. Recently, progressively, in scientific circles and in the press, there has been a progressive proposal to build a thermal power plant on the sides of open cuts and to create coal-energy complexes with commercial products - electricity, transporting which to remote markets is incomparably more efficient than coal transportation. The implementation of this idea will solve some of the problems listed above.

In various sectors of the economy, the indicator of increasing energy efficiency can be:

• in the industrial sector:

• reduction of energy consumption per unit of output;

• in the housing and utilities sector:

• reduction of heat consumption per square meter of heated housing; reduction of fuel consumption at generating plants (gas, fuel oil, coal, etc.); reduction of electricity consumption per person; reduction of losses in electric, heating networks;

• in the transport sector: reduction of fuel consumption by passenger transport (air transport, rail transport, urban and intercity passenger vehicles) per person-kilometer, and personal transport per fuel-per-kilometer ratio [1, p.27].

Given that global energy consumption is constantly growing, we believe that it is necessary to consider in more detail the role and prospects for energy saving in solving this problem. Today in our country one of the solutions to the energy crisis is the introduction and use of alternative energy sources. According to experts, 70% of energy consumption comes from factories, the remaining 30% is spent by the population, while in Europe the share of energy consumed by industry is 40%. However, it is necessary to take into account the trend of growth in energy consumption with the growth of the economy.

Despite the fact that the Republic of Kazakhstan belongs to the group of countries with strategic hydrocarbon reserves, and the energy intensity in Kazakhstan is the highest in the world, the issue of energy saving and energy efficiency remains relevant. In order to solve these problems, the Energy Saving 2020 Program was developed, where one of the main priorities is the modernization and improvement of the energy efficiency of the country's industry and large-scale promotion of energy saving among the population.

Among the main tools that allow for the transition and successfully implement an innovative development model, it seems appropriate to highlight the following:

1. Creation of a center of innovative technologies based on the principles of a private-state partnership to solve systemic research and production problems of the development of the fuel and energy complex, as well as the development of an engineering center for power engineering for the development and manufacture of leading samples of innovative equipment, its testing and certification.

2. The introduction of innovative development programs of joint stock companies with state participation.

3. Technological platforms in the energy sector, which will combine leading universities, research institutes, design, engineering and service companies, manufacturers of equipment and energy companies.

4. Innovative territorial clusters.

The main components and features of the energy of the future:

• use of unconventional and renewable energy sources - solar, wind, water flows, geothermal heat, biomass, ocean and sea water;

• decentralization of energy production - obtaining commercial energy from local and individual sources (solar panels, mini wind turbines, heat pumps, etc.), through which you can carry out not only self-contained power supply, but also transfer surplus to the total grid;

• introduction of energy and resource saving technologies (both industrial and domestic) - widespread implementation of measures for the conservation and efficient use of energy and resources (heat, water, full utilization of residual streams), reduction of electricity losses, steam, water, any heat, etc. ; reducing the amount of industrial and domestic waste;

• transfer of motor vehicles (cars, trucks, public) to non-hydrocarbon fuels and electricity, as well as the development of new economical modes of transport, such as monorail, magnetic cushion and others;

• extensive use of Smart Grid technology (smart network), based on the principles and methods of standardizing the interoperability of power equipment and information technology.

It is assumed that in their development energy technologies can move in the directions shown in Table 1.

Table 1 - The main directions of development of energy technologies

| Directions | Technology |
|---|---|
| Motorization | Energy efficient vehicles. New materials (composites). Hybrids, electric transport. Transportation on hydrogen fuel cells. Gas for transport. Biofuels of the second and third generations. |
| Electrification | Distributed thermal generation (micro CHP). Wind power plants (scaling and cheapening). Thermal power (coal) installations with supercritical steam parameters. Gas-steam power plants with coal and biomass gasification. Direct converters of solar energy into electricity. Solar hubs. $CO_2$ capture and disposal at thermal power stations. Decentralization of generating capacity. Intelligent Smart Grid power system. Superconductivity. Energy storage and storage systems. |
| Industrialization | $CO_2$ capture and disposal. Production of hydrogen, synthetic fuel. |
| Urbanization | AktiveHouse and PassiveHouse technologies, resource-efficient cities. Heat pumps. Solar heating. |
| Extraction of fossil fuels | Non-traditional mining technologies (from shale, bituminous rocks) oil and gas. Deep water mining technology. Production on the Arctic shelves. Cheaper gas transportation technologies. |
| Note - these works [6; 7] | |

Some of these technologies have already come close to becoming commercial and used on an industrial scale. Other green technologies with great potential need to be improved and should be considered for the long term.

Today, the local executive bodies of all regions and cities have developed and are implementing comprehensive plans for energy conservation in the areas of housing and public utilities, industry, training, and transport as part of an energy saving program. The implementation of the programs is based on the state policy of energy saving and in the future it will allow to work out a list of tasks related to the energy security of the country. In turn, the implementation of renewable energy projects (RES), contributes to the formation of the foundations of a "green economy". Therefore, in order to effectively address this task, the energy conservation policy should cover all regions and sectors of the economy.

CONCLUSION

Summing up the above, it should be noted that the development and implementation of programs aimed at energy saving and energy efficiency contributes to the development of the production of electric and thermal energy from environmentally friendly and inexhaustible sources of free energy, including renewable energy technologies. So one of the important tasks of the FIID program of Kazakhstan and the development of its "green economy" is to increase the non-commodity export potential of Kazakhstan.

Traditional energy, based on fossil energy, is technologically, economically and environmentally unsound in meeting the growing needs of the global economy.

Today, mankind has a choice: either to address threats to energy security, internationally agreed solutions will be worked out and consistently implemented (this is not a local or national problem, but a global problem), or the struggle for resources will not result in solving the energy problem and above all for the main resource - energy.

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## МЕМЛЕКЕТТІҢ ОТ-ЭНЕРГЕТИКАЛЫҚ РЕСУРСТАРЫН ПАЙДАЛАНУДАҒЫ ИННОВАЦИЯЛАР

**Аннотация.** Қазіргі жағдайы, Ресей Федерациясының отын-энергетикалық кешені, оның ішінде мұнай-газ саласының даму перспективалары туралы мәселелер қаралды. Отын-энергетикалық кешен салаларының инновациялық даму қажеттілігін анықтайтын факторлар талданады. Отын-энергетикалық секторда жоғары технологиялық қызметтерді пайдалану осы дамудың негізгі элементі ретінде ұсынылады. Авторлар энергетикалық тиімділікті арттыру және экономиканың энергетикалық қарқындылығын дамыған елдер деңгейіне дейін төмендету және қоршаған ортаға және климатқа ластаушы заттар шығарындыларын азайту, ластаушы ағынды суды шығарып тастау, сонымен қатар парниктік газдар шығарындыларын азайту, қалдықтар мен энергияны тұтынуды азайту жолымен үнемі шектеу қажеттігін атап өтті. Сондай-ақ Қазақстанның отын-энергетикалық кешендерін инновациялық дамытудың перспективалық жолдары ұсынылды.

**Түйін сөздер:** инновациялар, отын, ресурстар, тиімділік, экология, тау-кен өнеркәсібі

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## ИННОВАЦИИ В ИСПОЛЬЗОВАНИИ ТОПЛИВНО-ЭНЕРГЕТИЧЕСКИХ РЕСУРСОВ СТРАНЫ

**Аннотация.** Рассмотрены вопросы текущего состояния, проблемы перспективы развития ТЭК РФ. в частности нефтяной и газовой промышленности. Анализируются факторы, определяющие необходимость инновационного развития отраслей топливно-энергетического комплекса. В качестве базового элемента такого развития предлагается использование высокотехнологичных услуг в отраслях ТЭК. Авторами подчеркнута необходимость повышения энергоэффективности и снижения энергоемкости экономики до уровня развитых стран и последовательное ограничение нагрузки топливно-энергетического комплекса на окружающую среду и климат путем снижения выбросов загрязняющих веществ, сброса загрязненных сточных вод, а также эмиссии парниковых газов, сокращения отходов производства и потребления энергии. А так же предложены перспективные пути инновационного развития топливно-энергетических комплексов Казахстана.

**Ключевые слова:** инновации, топливо, ресурсы, эффективность, экология, добыча

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