



ATLAS  
OF NEW  
PROFESSIONS AND  
COMPETENCIES  
IN KAZAKHSTAN

ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN

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# ENERGY



MINISTRY OF LABOUR AND SOCIAL  
PROTECTION OF THE  
REPUBLIC OF KAZAKHSTAN



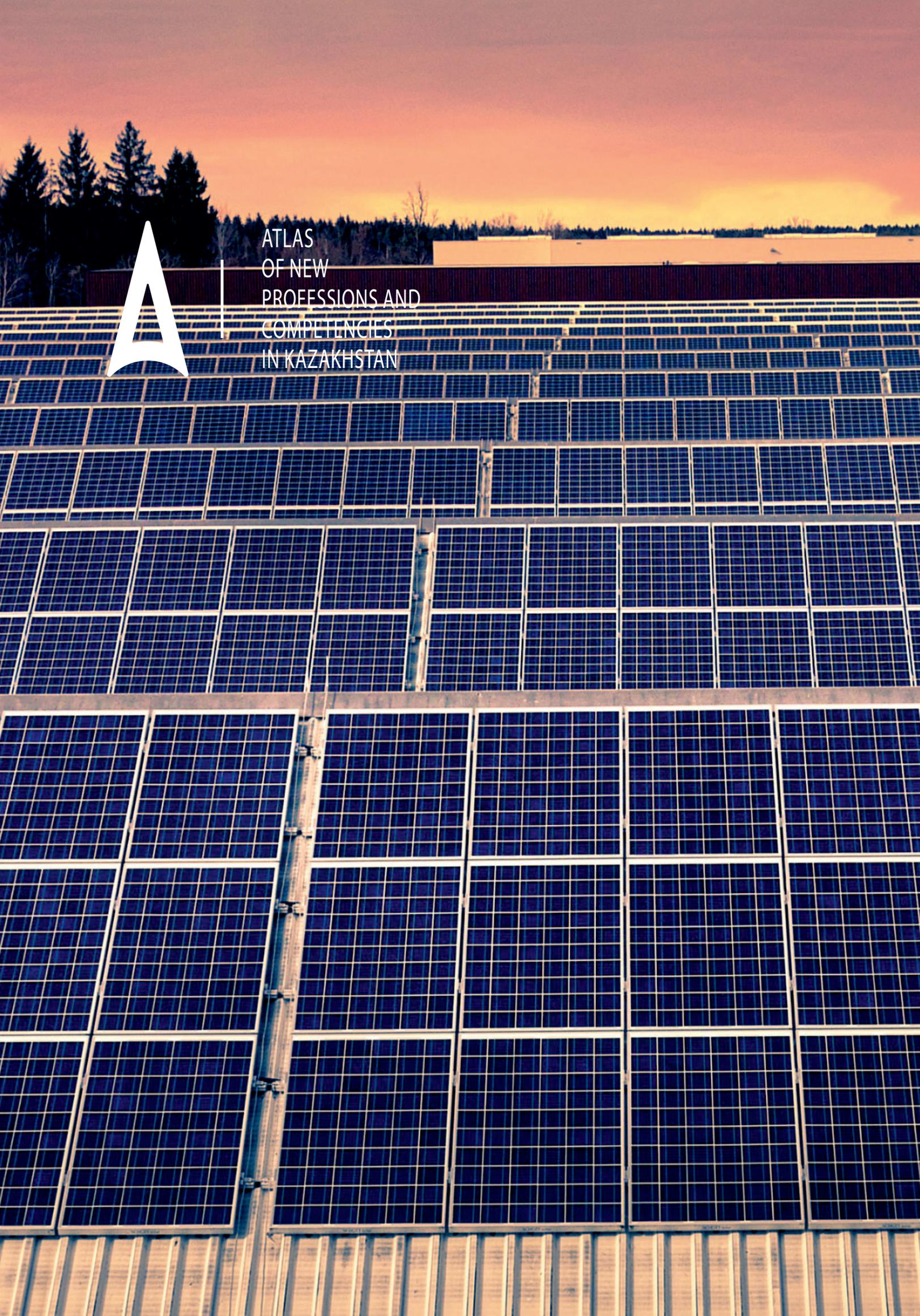
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ПАРЫҚАЙ МЕСТ



ATLAS  
OF NEW  
PROFESSIONS AND  
COMPETENCIES  
IN KAZAKHSTAN







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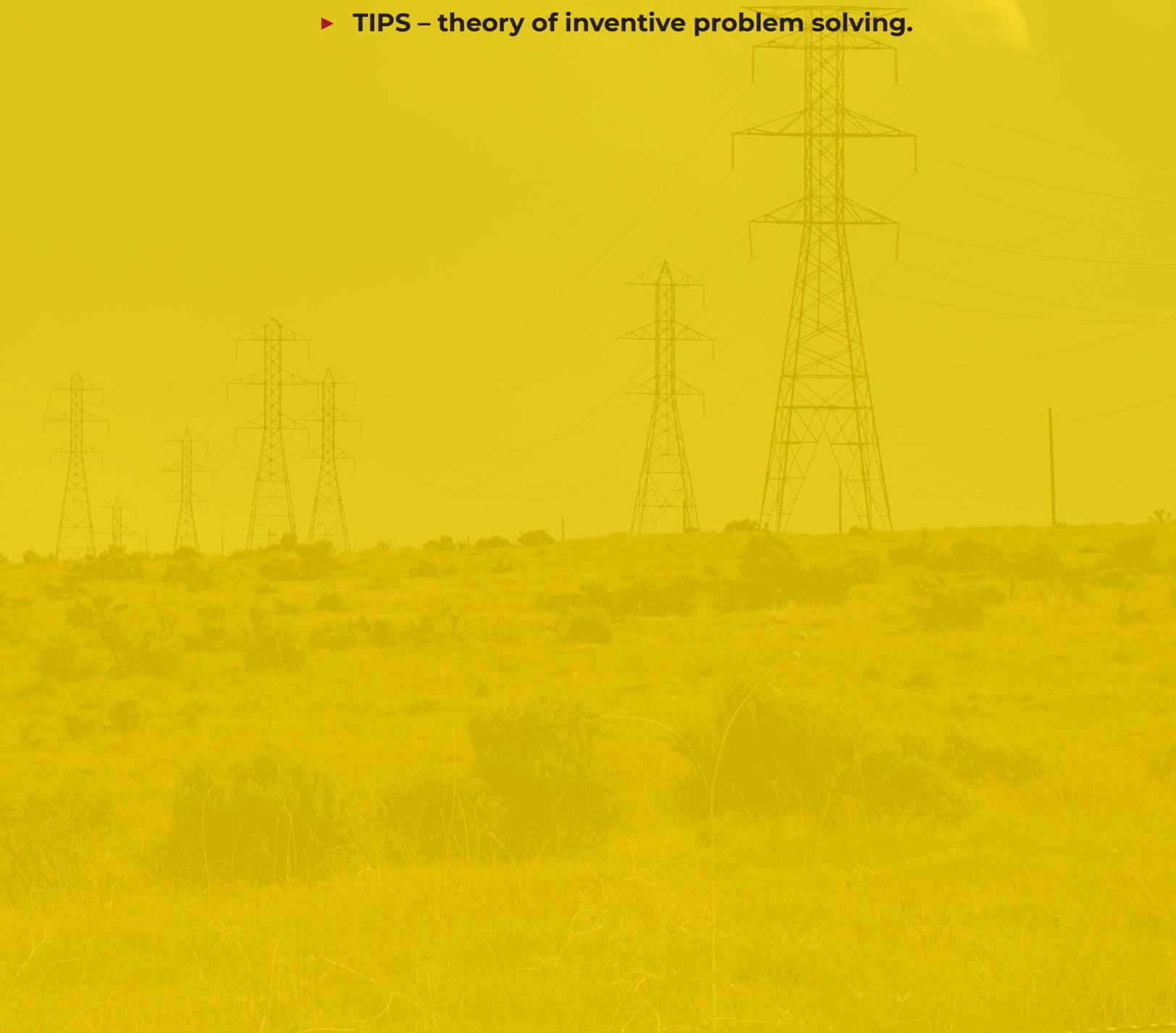
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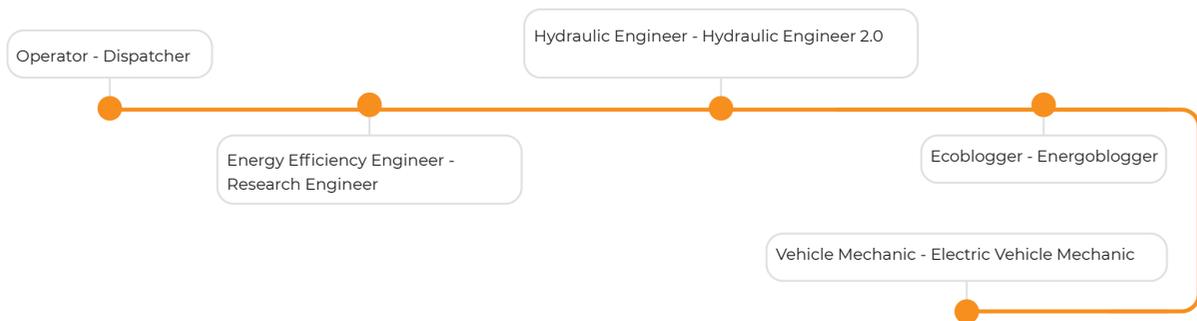
# LIST OF ABBREVIATIONS

- ▶ **BPS – bioelectric power station.**
- ▶ **CAD – computer-aided design system.**
- ▶ **CHP – combined heat and power plan**
- ▶ **DE – decentralized energy.**
- ▶ **EAEU – the Eurasian economic Union.**
- ▶ **GDP – gross domestic product.**
- ▶ **IAEA – international atomic energy agency.**
- ▶ **ICT – information and communication technologies.**
- ▶ **NCE "Atameken" – national chamber of entrepreneurs "Atameken".**
- ▶ **REC – a regional energy company.**
- ▶ **RES – renewable energy sources.**
- ▶ **SMBs – small and medium-sized businesses.**
- ▶ **SPP – solar power plant.**
- ▶ **SSCP – super-supercritical parameters of steam.**

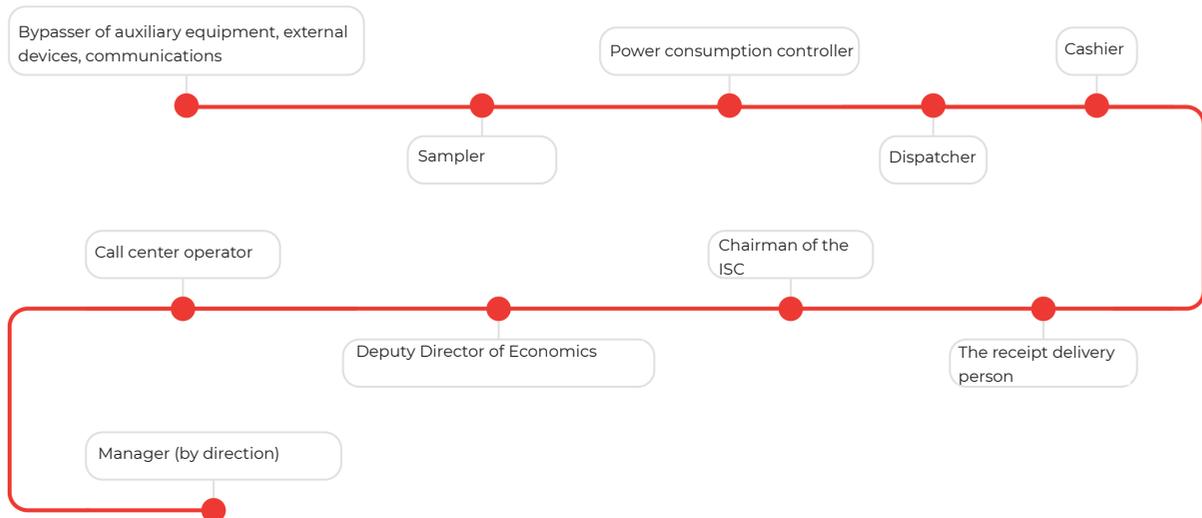
- ▶ **TNC - transnational company / corporation**
- ▶ **TPP – thermal power plant.**
- ▶ **TIPS – theory of inventive problem solving.**



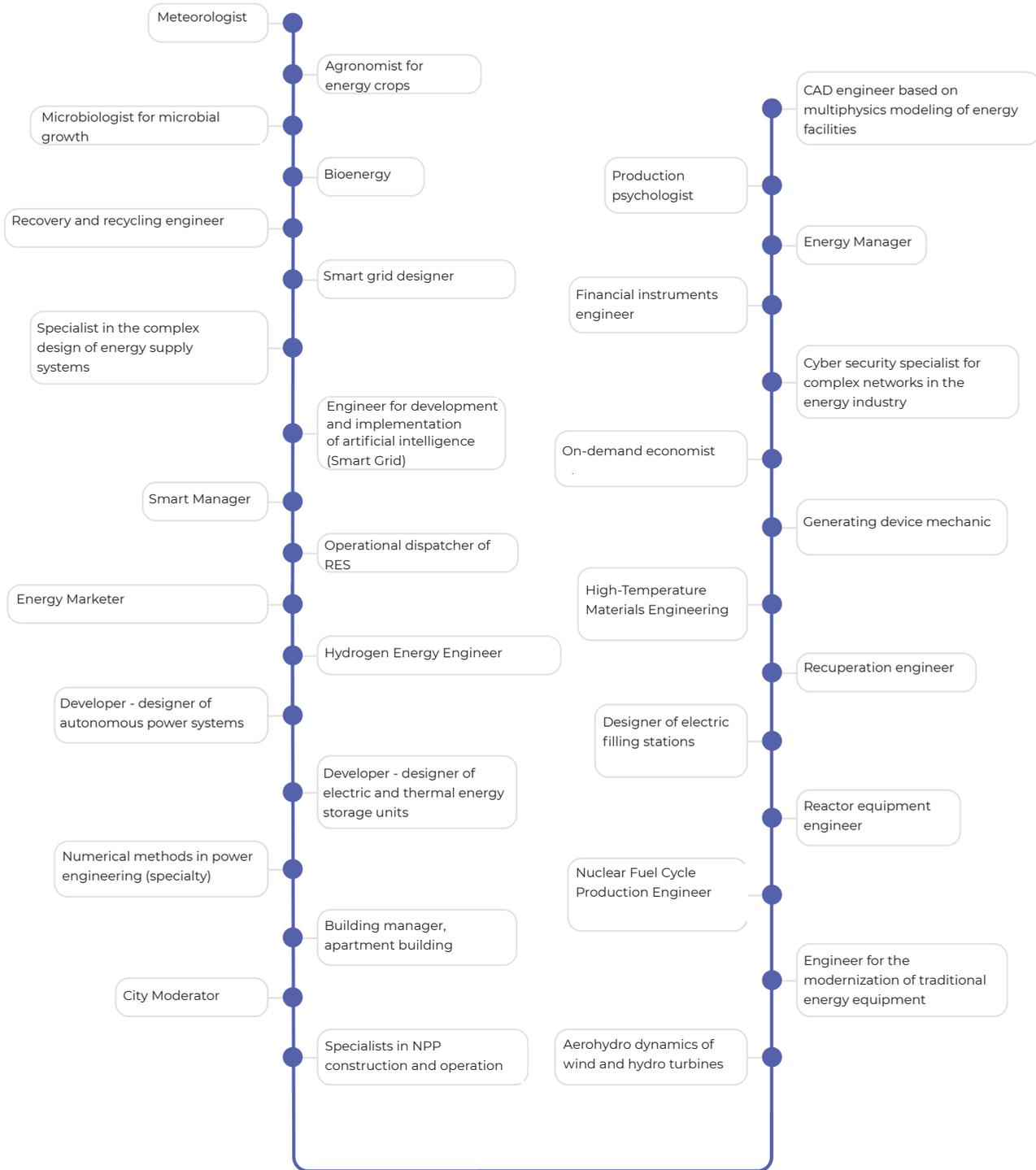
## Transforming professions in the energy industry



## Disappearing professions in the energy industry



# New professions in the energy





A

NAVIGATING  
THE ATLAS  
OF NEW  
PROFESSIONS

1.





## NAVIGATING THE ATLAS OF NEW PROFESSIONS

---

In the rapidly changing modern world, the labor market is also changing rapidly. Some professions arise and become popular, while other professions are less popular and become a thing of the past.

I'm sure you've asked yourself some questions:

- ▶ Who to become?
- ▶ Which job should I choose?
- ▶ Which profession – traditional or new - is better to master?

**Y**ou may have asked your family and friends for advice, searched the Internet, and collected feedback from friends.

You were given various tips:

- ▶ follow your dream to find your favorite thing,
- ▶ or continue the family labor dynasty,
- ▶ or choose a prestigious, well-paid job.

Each option is good in its own way, but not so easy to achieve. A prestigious job will attract many people, and the competition for training and then for a job will be high. Ultimately, you will get an incentive to develop, but not all of them will achieve the desired result. To get a high income and career success, you must be prepared for difficult challenges and a lot of competition. Continuing your family business is definitely a good choice that your family expects and encourages you to make.

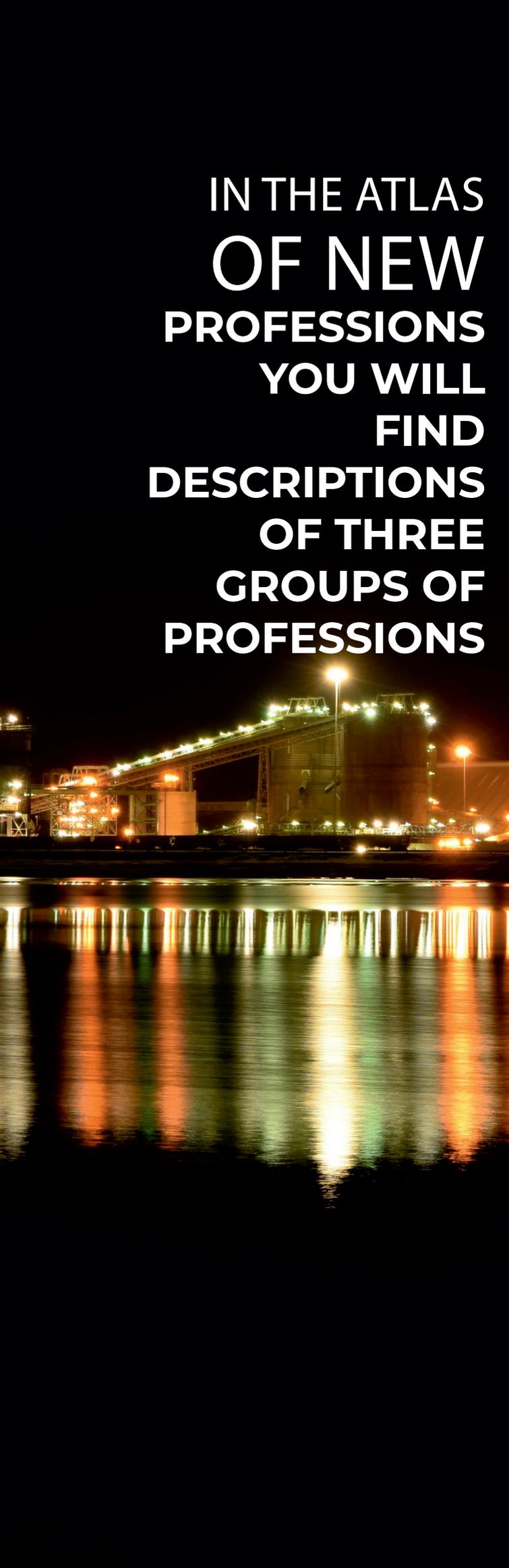
However, this may not be your calling at all, and you will not be inspired by the secrets

professional skills that your loved ones are willing to share so generously with you. What if you find a profession that will be in demand for years to come, will allow you to realize yourself and will be in demand in the labor market, and your friends and parents will be proud of your choice?

Today, this choice can be made with the help of our Atlas of new professions.

**THE ATLAS OF NEW PROFESSIONS IS A COLLECTION OF PROFESSIONS THAT, ACCORDING TO EXPERTS IN EACH INDUSTRY, ARE ALREADY IN DEMAND AND WILL APPEAR IN THE NEAR FUTURE. THE FUTURE SO CLOSE TO US IN THIS ATLAS IS DEFINED FOR 5-10 YEARS.**

The materials of the presented Atlas of professions are based on the use of a methodology for predicting the future based on a technological Website. Technological foresight allows you to determine which work skills are most in demand with the development of advanced technology and broad innovations.



IN THE ATLAS  
OF NEW  
PROFESSIONS  
YOU WILL  
FIND  
DESCRIPTIONS  
OF THREE  
GROUPS OF  
PROFESSIONS

***NEW  
PROFESSIONS***

– professions that do not officially exist yet, but are likely to appear in the near future.

**TRANSFORMING  
PROFESSIONS**

– transforming professions- are already existing professions and specialties that are highly likely to change significantly.

**DISAPPEARING  
PROFESSIONS**

– disappearing professions include those which are highly likely be out of demand in the near future.

## HOW TO DETERMINE

- ▶ new,
- ▶ transforming,
- ▶ and disappearing profession?

Changing old professions or creating new ones depends on what technologies will develop and what trends will determine future scenarios.

### TRENDS ARE

– strong, stable processes of change in society and the economy. They, together with scientific progress, generate innovative technologies. The use of new technologies in enterprises changes the process of work execution.

Modern machines, machines and equipment begin to perform some of the operations without the help of people, and thus show what production tasks and with them professions will disappear – so there is a list of disappearing professions.

On the other hand, innovative technologies and mechanisms set new labor challenges and put forward new requirements for employees.

Industry experts analyze these changes and form a vision of what new professions will be needed. This is how leading trends, along with scientific progress and

technology, change labor tasks and set the goals for the future. production challenges, which leads to a change in the composition of professions. Of course, the description of the new profession is a forecast, not a detailed job description.

The best specialists in each industry, selected as experts, jointly assess the development and define new tasks and competencies needed by future specialists. After studying the description of new professions, you can form your own personal idea of what professions and employees will be in demand in the future and make your choice.

**B**y becoming a specialist of the future, you will fill your work with concrete content and create an image of a new profession.

### THE TASK OF OUR ATLAS

– to help you determine the direction of choosing and understanding the knowledge and skills that are definitely needed for your future work.



# WHAT WILL HAPPEN WITH PROFESSIONS CHANGING AND DISAPPEARING?

**M**ost of the transforming professions are in demand at the present time, but in order to maintain their relevance, specialists already need to master new skills required by new technology, new risks and opportunities in the industry.

The name of professions may not change, but the level of qualification requirements within the profession changes. This class of professions is useful for those who already have an education and plan to improve their qualifications.

You may be working in these professions or would like to learn them, and you need to consider in which direction you should develop your skills. Also, specialists need to pay attention to disappearing professions.

## THERE ARE TWO MAIN REASONS FOR THE DISAPPEARANCE OF PROFESSIONS:

1. automation - in the context of digital technologies development: both manual labor professions and some simple knowledge labor professions will be reduced – they will be automated;
2. the loss of the need for labor results or services also leads to the fact that the profession gradually disappears; in the near future, such professions as accountant, translator, estimator, librarian, travel agent, waiter, miner, miner, etc. may disappear.

# C OMPETENCIES OF THE FUTURE

## THE ATLAS OF NEW PROFESSIONS HAS BEEN PREPARED FOR EIGHT INDUSTRIES

To make it easier for you to work with the Atlas of new professions we have built it according to the universal model.

**R**e-forecasting of all industry - specific professions  
The Atlas contains six main trends that have the greatest impact on changes in the industry and the economy as a whole.

### LEADING TRENDS:

1. Spreading the introduction of robots and smart systems;
2. Expanding the scope of digitalization and big data;
3. Depletion of natural reserves of raw materials;
4. Strengthening of environmental standards and development of recycling;
5. Manifestation of new labor requirements in Y and Z generation employees;
6. Changing consumer preferences of the population.

**A**ll professions are based on a number of competencies that will form the basis of professional skills in the near future

### BASIC COMPETENCIES:

1. System thinking.
2. Cross-industry communication skills.
3. Environmental thinking.
4. Lean manufacturing.
5. Ability to manage processes and projects.
6. Client tolerance.
7. Programming. Robotics. Artificial intelligence.
8. Creativity.
9. Multilingualism and multiculturalism.
10. Self-development and adaptability.

**F**or the convenience of working with Atlas materials, you can use filters that will help you find and select professions faster. (QR code for going to the site).

### FILTERS GROUP PROFESSIONS BY DIRECTION:

1. Industry (8 industries).
2. New. Transforming. Disappearing.
3. Trends.
4. Competencies.

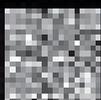


# ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN



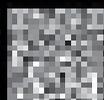
## MMC

A set of related industries and stages of the production process from the extraction of raw materials to the production of finished products: ferrous and non-ferrous metals and their alloys.



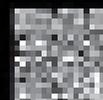
## Energy

The economy sector that generates, converts, distributes and uses all types of energy resources.



## Oil and gas

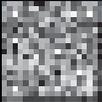
The economy sector engaged in the extraction, processing, storage and sale of natural minerals - oil and related petroleum products.





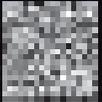
### Mechanical Engineering

The economy sector that designs, manufactures, maintains and disposes all kinds of machines, technological equipment and their parts.



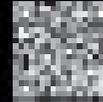
### Agriculture

Economic sector that focuses at production, storage and processing of food (food products) and raw materials for a number of industries.



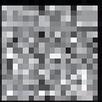
### IT

The economy sector aimed at finding, collecting, storing, processing, transmitting and providing useful information through technical means.



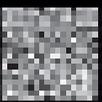
### Transport and Logistics

The economy sector carrying passengers, as well as the management system for the purpose of optimization.



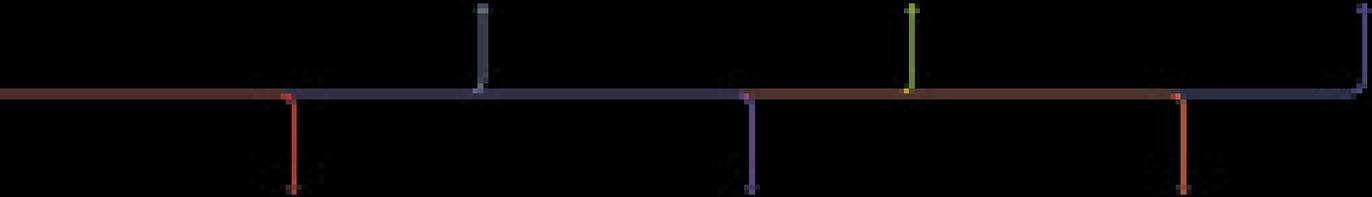
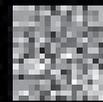
### Tourism

An industry that organizes trips (travels) to another country or area other than the place of residence to get acquainted with the lifestyle, gastronomy, nature, etc.



### Construction

The economy sector that designs, creates buildings, structures, as well as performing their major and current repairs.





# ENERGY INDUSTRY IN THE ECONOMY OF KAZAKHSTAN

2.





## ENERGY INDUSTRY IN THE ECONOMY OF KAZAKHSTAN

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Energy has always been the "fuel" for the economy, and its importance is growing with increasing industrialization. Most of the territory of Kazakhstan is located in an unfavorable climate zone, so both businesses and ordinary people need fuel in the literal sense.

The task of power engineering is to meet the needs of the national economy and the population in heat and electricity, as well as the export of electricity to the countries of the near and far abroad. The energy industry is a set of systems that transform primary energy: minerals, natural energy, and artificial raw materials into secondary energy: electrical and thermal. The share of the energy sector in the country's GDP is 1.6%. The energy sector is not only of strategic importance for the economy of Kazakhstan, but also creates more than 100 thousand jobs.

Energy production comprises the sequential steps of:

- ▶ transportation of resources and energy carriers to generating power plants;
- ▶ conversion of energy into secondary energy;
- ▶ energy distribution and transportation to the end user.

Electricity production in Kazakhstan consists of 138 power stations with an installed capacity of 21,902 MW. Kazakhstan has large reserves of energy resources (oil, gas, coal, uranium) and is an energy power.

Kazakhstan has the most widespread coal-fired power industry. It accounts for 70% of electricity generation and practically all heat energy. Kazakhstan's hydroelectric power industry ranks second in terms of electricity generation. It accounts for 14.6%. Coal-fired, gas-fired, oil-fired, and hydroelectric power are traditional energy sectors. In total, these sources generate more than 19 GW of

energy.

Heat and power industry globally prevails among traditional types, coal generates 46% of the world's electricity, gas – 18%, and about 3% – by burning biomass, oil is used for 0.2%. In total, thermal power plants provide about 2/3 of the total output of all power plants in the world. About 70% of Kazakhstan's electricity is generated from coal, 15% from hydro resources, 10% from gas and 5% from oil.

Heat power engineering is a branch of technology that converts heat into other types of energy, mainly mechanical and through it into electrical energy. The basis of modern energy is made up of thermal power plants (TPP), which use chemical energy from organic fuel for this purpose.

In Kazakhstan, there are 2.5 thousand heat supply sources that generate about 90 million tons of electricity. Gcal. The resulting heat is distributed to end users over networks with a length of 11357.9 km in a two - pipe calculation. Of these networks, 27.5% are in a dilapidated state, and 27.9% need to be replaced. This results in losses of 16.9% of the total amount of energy released to the consumer. The main volume of electricity in Kazakhstan is generated by about six dozen power plants that run on coal (Ekibastuz, Maikuben, Turgay and Karaganda basins), gas, and fuel oil.

Kazakhstan also has significant water resources capable of generating up to 170 billion kWh per year. Economically efficient water resources are concentrated mainly in the East (Gorny Altai) and in the South of the country in the Irtysh, Ili and Syrdarya rivers. The largest hydroelectric power stations in the country are: Bukhtarma, Shulbinskaya, Ust-Kamenogorsk (on the Irtysh river) and Kapchagayskaya (on the Ili river). They provide 10% of the country's electricity needs. Kazakhstan plans to increase the use of water resources in the medium term.

Along with traditional energy, Kazakhstan is actively developing energy that generates energy from traditional and alternative sources. The main sources are solar power plants (SES), wind power plants (WPP), small hydroelectric power plants with a capacity of less than 25 kW (HPP), and biomass-based power plants (bio-power PLANTS). Their share is still small (just over 5%), but it is constantly growing. Alternative power plants have a lower capacity than conventional power plants.

Electric networks in Kazakhstan consist of substations, distribution devices and power lines with a voltage from 0.4 kV to 1150 kV. The national electric network of Kazakhstan provides communication between regions within The country and the energy systems of neighboring countries (Russia, Kyrgyzstan, Uzbekistan's). In addition, the national grid transfers electricity from producers to wholesale consumers.

The largest organization that provides electricity transmission in Kazakhstan is KEGOS JSC. It serves inter-state power lines and transmission lines that provide

electricity from power plants with a voltage of 220 kV or more. Electricity distribution at the regional level is carried out by 21 regional energy companies (RECs) and more than 100 small energy transmission organizations. RECs transmit energy to retail consumers and provide connections within the region. Energy transmission organizations also transmit electrical energy through the power grid to wholesale and retail consumers or supply organizations. Energy supply organizations buy electricity from energy producing companies and resell it to final retail consumers.

The number of employees in the energy industry is about 151 thousand people. In the Republic's industrial output, the production, transmission and distribution of electricity is 5% on average over 5 years, and the share of the number of people employed in this sector is 16.5% on average over 5 years. The total number of employees in the main activity of the power generation, transmission and distribution sector has been decreasing over the past 5 years, while the volume of output has been steadily growing. This happens both by increasing the efficiency of labor resources and by modernizing production.

In the industry, there is a shortage of employees in a number of categories:

- ▶ heads of specialized departments (production, service, transport, construction, and others);
- ▶ professionals in the field of technology;
- ▶ electrical engineer;
- ▶ assistant engineers;
- ▶ machinery in industry and

- production;
- ▶ ICT operators and technicians;
- ▶ working on the electricians;
- ▶ electronics and communications (ICT) workers.

In the coming years, the need for the number of qualified specialists may increase dramatically due to the implementation of new projects. In 2025, it is planned to create a common electricity market of the Eurasian economic Union. The power industry of Kazakhstan will also have to seriously prepare for this. In the country's strategic development plan until 2020, one of the main goals in the energy sector is to create a vertically integrated company with a nuclear fuel cycle. This means that dozens of specialists in nuclear reactors and power plants, protection and non - proliferation of nuclear materials, electronics and automation of physical installations are being trained.

According to international experts, by 2100, the share of oil and coal in the world's fuel and energy resources will be 2.1% and 0.9%, respectively, nuclear power will reach 10% of the market, and more than 25% of the world's electricity will be generated by the sun. There will be a consistent reduction in the use of coal and a shift to cleaner energy production. The development of nuclear energy is promising for Kazakhstan, but social acceptance is an important condition for its development. In order for nuclear power to arise in any country, society must accept it. The Only nuclear power plant in Kazakhstan was located in the city of Aktau with a fast neutron reactor with a capacity of 350 MW. The nuclear

power plant was in operation in 1973-1999. At the present moment, nuclear energy it is not used in Kazakhstan, despite the fact that the country's uranium reserves (according to the IAEA) are estimated at 900 thousand tons. The main deposits are located in the South of Kazakhstan (South Kazakhstan and Kyzylorda regions), in the West in Mangystau, in the North of Kazakhstan (semizbay locality).

In 2010, in order to increase energy capacity, Kazakhstan and Russia reached an agreement on the construction of an atomic power plant, which is opposed by the anti - nuclear movement Nevada-Semipalatinsk.

The global energy sector is shifting towards renewable energy sources (RES), but the pace of this process is not fast enough to compensate for the growth of the world economy and population. The problems of energy saving and alternative energy sources are relevant for the Republic of Kazakhstan, the issues of "green" energy have become one of the strategic directions of the national economy, as a component of energy resources supplied to the domestic market and as an additional source of income. The country has launched 100-megawatt solar stations in the Kapchagai district not far from Almaty, in the city of Saran, Karaganda region, and in the village of Burnoye, Zhambyl region.

Today, there is a 50-megawatt wind station in Zhambyl region, a 45 - megawatt station in the city of Yerementau, and a 42 - megawatt station in Mangistau region. The first 100-megawatt wind farm was put into operation near the capital.

It is necessary to consider the

directions of development of the energy industry from different time perspectives. In the near future, the development of environmentally friendly and efficient technologies for the processing of organic fuels (oil, coal, gas), in particular, on the basis of steam - gas installations and deep coal processing methods, is of the greatest relevance. At the same time, organic fuel will remain a priority energy source.

In the future, there will be an active introduction of renewable energy sources and the development of efficient methods of energy conversion and storage, including fuel cells. These technologies have already begun to be implemented, but a radical change in the structure of the global energy system as a result of the displacement of coal and its replacement with non-carbon sources will occur after 2050. Nuclear power will play a key role in combining with solar power, hydropower, and eco-friendly biofuels.

Modern energy is already in the process of digitization. Digital technologies are actively penetrating the energy sector, enabling more efficient analysis and management of energy production, transportation, and consumption. With changes in the structure of labor demand, a reduction in unskilled workers is expected. Mid - level specialists will be in demand, as well as specialists of the highest level of qualification. Among the

most promising and popular specialties today are specialists in ensuring cybersecurity of energy enterprises, Adjusters and controllers of power networks for distributed energy, specialists in the design of digital power systems, and digital control systems for energy facilities. The global change in energy development poses new challenges to the educational system. Only by changing the approach to education can we prepare highly technical personnel for the future energy sector. The academic community should re-Orient the education system to the needs of the economy. The state's task is to restore channels for turning fundamental knowledge into products and create incentives for business and education.

Businesses should be encouraged to innovate, and educational institutions should be encouraged to partner with manufacturing. It is important to move from forecasting to the formation of educational programs for the needs of future energy.

BRANCH OF THE ECONOMY, WHICH CARRIES OUT THE DESIGN, CREATION (ERECTION) OF BUILDINGS, STRUCTURES, FACILITIES, AS WELL AS CARRYING OUT THEIR CAPITAL AND CURRENT REPAIRS.

EVERY YEAR THEY STUDY AT 28 INDUSTRY-SPECIFIC UNIVERSITIES IN KAZAKHSTAN

1 400

Number of graduates in the industry

105 тыс.

Number of employees in the industry

## HEAT

87,9 MIL.GCAL

2 457 HEAT SUPPLY SOURCES

11,4 THOUSAND KILOMETERS - LENGTH OF HEATING NETWORKS

Total	Thermal power plants	Hydroelectric power plants	
103.14 billion kWh	87,7%	12,3	
Total power 19 GW	Condensing ES		
	Heat and Power Plant		
	Gas-turbine power plant		
	2,3%		
For operation (types of fuel) are used			
70% from coal	14.6 - from hydro resources	10.6 of gas	4.9 of oil

## THE TOTAL LENGTH OF PUBLIC POWER GRIDS IN RK

1150kV

1,4 Thousand kilometers

500kV

8,3 Thousand kilometers

330kV

1,8 Thousand kilometers

220kV

20,2 Thousand kilometers

110kV

44,5 Thousand kilometers

35kV

62 Thousand kilometers

6-10kV

204 Thousand kilometers



THERE ARE LARGE LOSSES IN TRANSMISSION AND DISTRIBUTION - 21.5%

## RES CAPACITY DATA:

19 WES	31 SES	137 HPP	3 BIOES
283,8 MW	541,7 MW	222,2 MW	2,42 MW

## 10 MOST POWERFUL POWER PLANTS IN KAZAKHSTAN

- |   |   |   |
|---|---|---|
| <b>01</b> EKIBASTUZ SDPP-1<br>4 000 MBT | <b>02</b> AKSU POWER PLANT (ERMAKOVSKAYA GRES)<br>4 000 MBT | <b>03</b> BATUROV ZHAMBYL STATE DISTRICT POWER PLANT<br>1 230 MBT |
| <b>04</b> EKIBASTUZ SDPP-2<br>1 000 MBT | <b>05</b> BUKHTARMINSKAYA HPP<br>738 MBT                    | <b>06</b> SHULBINSKAYA HPP<br>702 MBT                             |
| <b>07</b> KARAGANDA CHP-3<br>670 MBT    | <b>08</b> KARAGANDA SDPP-2<br>663 MBT                       | <b>09</b> CHPP-2 MAEK<br>630 MBT                                  |
| <b>10</b> TPP-3 MAEK<br>625 MBT         |   |   |



# WHAT AWAITS THE ENERGY INDUSTRY OF KAZAKHSTAN?

3.





## 3.1. EXPERT OPINIONS

### 3.1.1.



**ANATOLY  
BORISOVICH  
NIKIFOROV**

Deputy chairman of the production  
board of Astana-Energy JSC

— Anatoly Borisovich, please tell us what 3-4 key events over the past 5 years, in Your opinion, have had the greatest impact on the energy sector of Kazakhstan?

— In the period 2008-2015, the TA - RIF program was implemented in exchange for investment, which consisted in the fact that at first partially, and then all the net profit with depreciation, each generation had to be invested in the reconstruction of equipment. During this period, a large - scale renovation was carried out at many stations in Kazakhstan due to such infusions.- new systems have been introduced into the technology. This was a good boost for businesses. The traditional generation industry is also affected by the "green energy" policy, which is implemented through the settlement and financial center. In other words, all green energy is distributed between traditional generation, we buy at the green tariff, and sell at our current tariff. As a result, organizations go to a loss, because we can buy more green energy and not take this into account in the calculations.

— The second important question that I would like to get an answer to: in your opinion, as an expert, in the energy production chain, where can we expect such a technological breakthrough in the near future?

— To be honest, there won't be any special changes in the next 5 years. It is no secret that all our thermal power plants have exhausted their reserves, and therefore the main power equipment requires modernization and reconstruction. Changes will

depend on the sources of investment of this modernization.

Now there are new developments on turbine equipment, where in the same ha - barites from PT-80 you can make PT-100, and you can also increase the steam capacity. Therefore, a technological breakthrough can only be expected when there is a source of funding. For example, we at our station do not think about developing such projects until we see funding. However, to be ready, we are already conducting preliminary work.

— Do you think there are risks of changing the structure of energy consumption?

— Everything will depend on the programs that are being implemented in parallel in Kazakhstan for industrialization and development. If we talk about the near-term prospects, generation is required only in cases where there are consumers.

— What subjects and events will play a key role in the next 10 years?

— I think we should not forget about our staff. At the moment, the trend is not the most positive. In my opinion, the cadres that are prepared at our UNIVERSITY come to work quite raw. At the same time, we have significantly lost the mid - level institutions and vocational schools that we used to have. That is, specialists come and immediately want to be managers, not even being able to work with their hands and not understanding the entire production technology. Also, some of the specialties that were previously in demand have dropped out of the training

program. So training of personnel for Kazakhstan's energy sector it is very lame both in universities and in professional institutions.

— Please tell me, if you had a lot of money, what would be the main problem in the energy industry you would solve?

— I would allocate it to create an institute or research center that would systematize all new technologies for non - traditional energy production. If we had such an organization in Kazakhstan that accumulated and adapted new technologies to modern needs, it would bear fruit in the long term.

— If you had an unlimited amount of money, what energy sector would you invest in?

— If as an investor, then returning to energy storage systems that would allow you to be maneuverable. Studying this practice, we can see that there is an environmental and economic effect, the reliability of the energy system. I would also like to add that it is important for Kazakhstan to consider such an industry as hydropower. According to our research, the potential of our rivers is quite large. Again, I understand that now there are no necessary institutions such as Kazhydromet that could predict or design this, study the hydrology of rivers. On the other hand, this is not only electricity, but also large water reserves for Kazakhstan. It can be used for irrigation of land, which would help the development of the agro-industrial complex. Therefore, this area should be developed in Kazakhstan.

## 3.1.2. EXPERT OPINIONS

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**NURMAGAMBETOV  
ZHANDOS  
DEMESINOVICH**

Managing director for strategy and development of KEGOC JSC

— Zhandos Demesinovich, what 3-5 key events in the energy sector recently with profound effect that have greatly affected it?

— First, I would like to note that in 2015 the program "national Plan - 100 concrete steps" was adopted. This is an administrative decision that launched reforms in the electricity market of Kazakhstan and we are currently implementing these reforms.

In particular, the 50th step is the introduction of the "single buyer" model, which implies equal energy prices for consumers in industrial regions, as well as centralized purchase of electricity capacity through the most competitive purchasing mechanism.

Secondly, there has been a crisis in the country in recent years, and the government is very responsible in addition to tariffs, this is the second vector of development of the state's economic policy, which restrains the growth of prices.

All consumers and all market participants do not receive enough money for modernization and investment. This is an important event that has had a negative impact on the industry over the past 5 years, but has a positive impact on the economy. On the one hand, we are modernizing, on the other hand, there is containment. In other words, companies do not receive enough money, and the industry is not being re-invested.

The third is the adoption of the law "on support for the use of renewable energy sources".

Kazakhstan's energy structure has started to change, RES are rapidly developing and demonstrate high economic indicators.

— In your opinion, in which part of the technological chain of energy is an innovative breakthrough expected?

— I believe that the consumption sector, as well as the generation sector and, to a lesser extent, the transmission sector, are more susceptible to reform. The transmission sector has a well-developed infrastructure for the electricity grid in Kazakhstan. In the generation sector, we use a technology that was laid down in the Soviet era, and it is outdated. Currently, alternative energy is being actively developed: solar and wind. At the price, the alternative is already comparable to traditional coal - fired power. Therefore, the future is definitely for alternative energy.

However, it should be remembered that in Kazakhstan we will not be able to fully switch to alternative energy sources, since they produce only electric energy, and we also need heat. We live in conditions when we need a lot of heat energy in winter, and this is a serious argument that traditional thermal power plants will not be abolished in the near future.

— Is it likely that the structure of energy consumption will change in the next 10 years?

— First of all, we forecast an increase in electricity consumption among the population in cities. This is due to the fact that

the population is increasingly using household appliances, gadgets, computers, etc. I would like to note that we have not seen a decrease in energy consumption by the population over the past 20 years.

There is also a new segment that consumes a significant amount of electrical energy: data management, so-called "processing centers", farmers, and mining. We see their growth, and their contribution to consumption will only grow. However, this type of consumer is very much tied to the price of the virtual currency. If the exchange rate, such as bitcoin, falls slightly, then consumption immediately stops, because it is not economically feasible to generate this currency.

— Due to these changes in the energy market, what specialists do you think will be required in the near future?

— First of all, it is digital management of the power system and cybersecurity. In my opinion, we should expect a shortage of specialists in these sectors.

— How do you predict what major events will take place in the energy sector in the next 10 years?

— I have very high expectations for hydrogen. If the whole world uses hydrogen for energy storage, I believe this will be a key step in the industry. Currently, research on the use of hydrogen is being actively conducted. The use of hydrogen as an energy storage device will create an opportunity for Kazakhstan to increase the



autonomy of its own power system.

Currently, in order to achieve energy demand, we have to transfer excess capacity to Russia and Central Asian countries and get energy from there if we have a shortage. If the hydrogen technology for accumulating electricity finds application, it will be cost - effective and generally available. It is only a matter of time, this technology will come to Kazakhstan and we should focus on it today.

— If you were provided with significant investment funds, what technologies would you invest in?

— If we talk about our company, we would now invest in "green energy", definitely. That is, in energy storage systems, in the generation path based on hydro-energy.

Kazakhstan has a fairly large potential for small hydroelectric power. By developing this

direction, we will not only provide Kazakhstan has cheap energy, but we will also help our agriculture. This will improve the conservation of water resources and improve field reclamation.

— Please tell us what qualities are currently used to select specialists in the energy sector?

— I don't have a clear answer to this question. At present, we often see that we are interviewed by specialists who are very poorly versed in the basics of energy. Unfortunately, these are all the shortcomings of our modern Kazakh education. Therefore, at present, when selecting specialists, I am beginning to note the flexibility and willingness to change in employees, good knowledge of information and communication technologies, and knowledge of languages. If a candidate has these qualities, we will quickly teach and finish them, because many of the tasks we are currently solving are not standard and require rapid adaptation and adjustment on the part of

### 3.1.3. EXPERT OPINIONS

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KAPENOV  
NURLAN  
NURGALIEVICH

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Chairman of the board of directors  
of the Kazakhstan Solar Energy  
Association

Dear friends and colleagues, the year 2009 can be considered the beginning of active development of alternative energy in Kazakhstan. It was then that the first law on renewable energy was adopted. Individual, small stations began to be built. However, the jump occurred after the state adopted a change in legislation, which introduced fixed tariffs for renewable energy sources. Accordingly, it became interesting. International and local investors have started developing and implementing these projects since 2014.

From this moment, a strong opposition to the traditional electric power industry began. But many believed that renewable energy is bad. The first argument was that RES is an expensive equipment. At that time, solar electricity cost 34 tenge per kW, wind power-22 tenge per kW, and this was expensive for Kazakhs compared to the tariffs of traditional power plants. Traditional ones cost no more than 7 tenge per kW on average.

In Kazakhstan, such a cheap cost of electricity is due to the fact that those power stations that generate electricity are mainly coal - fired power plants (more than 70% in Kazakhstan). We got them from the Soviet era, they were built in the 60s and 70s. Today, these power plants account for more than 50%. Low tariffs due to the fact that coal is cheap. Second, they do not need to make any return on investment.

Another argument is that RES is unbalanced. In Kazakhstan, there is no maneuverability of capacities, that is, these are

capacities that can quickly produce or reduce unplanned electricity. In other words, in order for a coal-fired power plant to connect an additional power unit, it needs almost a day to generate the necessary energy.

This problem has not yet been resolved. Accordingly, RES, being a volatile source of energy, only worsened this problem of imbalances in the energy system.

To date, our company KEGOG for energy balancing buys it in Russia, and we pay a lot of money for this. There is such a thing as "energy security", and every country should be able to provide for itself in extreme circumstances. Now other Central Asian countries have been able to achieve this, and we are still dependent on Russia.

And now, since Kazakhstan has adopted the concept of transition to a "green economy", our President has set indicators.

In 2020 — 3%, in 2030 — 10%, in 2050-50% of the entire electric power industry should be generated from alternative sources, that is, those sources that will not create emissions into the atmosphere were considered. Also, having signed the Paris agreement and assumed international obligations, Kazakhstan was obliged to strive for these indicators. So far, we are going the right way and reaching this 3%.

Our next indicator is to reach 6% in 2025, and this is an intermediate indicator. However, I understand that we will not be able to do this because of the imbalance in the system. Without

man-made balancing capacities, we will not be able to achieve the desired indicators.

One of the reasons that has affected the power industry is that the government has forced traditional power producers to lower their tariffs. Therefore, the situation was such that they work at the cost level, some of them start working at a loss.

For example, last year they were left with a surcharge at the same level, and next year the RES increased by 2 times. Therefore, the law has changed, we have introduced such a concept as a "through tariff", that is, what kind of surcharge came for renewable energy, one in one, the same amount will be compensated. This concept will be implemented in the near future, in a few months.

To sum up, the first factor that influenced the electric power industry is the development of RES.

— We want to clarify! given the fact that we can't build hydroelectric power plants, then we need to build gas-turbine power plants that can provide the necessary power in a short time, right?

— I understand that this may be a hydroelectric power station, which will be built in the future, and a gas turbine power plant.

There may also be accumulations of the accumulator system. If, of course, it is economically feasible. And back to the last topic, the second factor is economy-restrictions during the transit of power in the past year. The



third reason, which is positive, is that system operators are implementing a lot of automation and digitalization tools.

— Let's move on to the next question. If you think of energy as a technological chain, where do you think the strongest progress is expected in the next 5-10 years?

— I think that due to the need there will be a breakthrough in the power generation. Of course, we need to make progress in the networks, but I do not know if this will happen. Will the authorities find the means and willpower to launch all this? In other words, you need to understand that all these improvements will definitely lead to an increase in the tariff.

— In your opinion, which of the renewable energy sectors is economically feasible to implement? What specialists do you think are needed now for the RES sector to develop actively? What happens if you accept the

ideal investment conditions and support the state?

— First of all, RES is developing steadily. On the technical side, there is an opinion that solar panels lead to new imbalances. KEGOG believes that wind energy should be developed more actively than solar energy. Because it can balance itself and, secondly, our solar energy is more developed than wind energy.

On the technical side, solar power is much easier, since wind power is unstable and forecasts are more difficult to make. It is almost impossible to predict what the wind speed will be in a couple of hours. I believe that in Kazakhstan, both the sun and wind should be developed evenly from renewable energy sources. There is potential for hydroelectric power plants, but investors are not so active here — these are the most complex technologies. If we talk about biogas, we have only a few cases of use. It is necessary to understand that biogas should be

used to extract waste from animal husbandry and agriculture, that is, this source of energy depends on human activity.

As for specialists, we have an acute shortage of personnel in Kazakhstan. There are no engineering specialties for renewable energy sources. We would like to see institutes train engineers in renewable energy today. Of course, it would be good if they trained professionals in narrow specialties. For example, we need solar power engineers. The students who came to us from abroad are not fully adapted to our energy system, and moreover, they have no experience, since the energy system of each country is unique, especially in our post-Soviet space. Therefore, it would be good if we were already producing engineers for green energy and alternative energy sources, which can already be used in operating wind, solar, and hydroelectric power stations in our country.

We are open to cooperation with universities. For example, our company cooperates with the Kazakh-German University and KazNTU. Satpayev.

I would also like to note that we need to develop more dispatching service. We need good meteorologists to get reliable forecasts.

— Can you remember the last two people you hired and didn't hire?" Why? What qualities are important to you, as an employer, by which you assess that this employee is attractive to you?

— First of all, knowledge of the English language is important for us, since foreign investors work with us. But this is not a mandatory factor. We take those employees who are ready to learn further and practice. In other words, we tell a person to be ready to work in production, to see how the station is being built and how this station will work. And those who are willing to work for 6 months in the steppe on the site, we will take them to work in the office. The second quality is to work at a fast pace.

— And the last question: in what sphere of the energy sector of the Republic of Kazakhstan would you invest money if you had unlimited amounts of it?

— A difficult question. In this situation, I would not invest in renewable energy in any case, as the risks are high.

Right now in the energy sector—as it turned out, all business projects are not profitable, and tariffs are regulated. If you choose from this sector, you need to manufacture local electrical equipment. But again, understanding the small capacity of our domestic market, this should be a production that is focused on ex-port. I mean, I don't see much prospects. So if there is such an item as "nowhere", then I choose this item

## 3.1.4. EXPERT OPINIONS

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### BEKMURATOV BEKSULTAN MAHANBETOVICH

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Chief executive officer for HR and Transformation, Member of the Management Board of National Atomic Company "Kazatomprom" JSC.

It is one of the largest socially oriented companies in Kazakhstan, for which the main value is people and improving their welfare. The company has always been an example of systematic work to improve the professional qualities of its employees.

At the moment, the Company is working to analyze the skills and specialties of the future, in order to prepare young specialists of the uranium industry to work in a period of globalization, digitalization and rapid technological changes.

It is worth noting that the digital transformation allows the Company to keep up with the times and even today stand on a par with advanced international uranium mining companies in terms of technical and technological equipment.

— Tell us what changes are waiting for employees of the nuclear holding company in the future?

— We can definitely say that the future direction of development of production processes is determined through the prism of digitalization, robotics, ecology, green energy, efficient and careful management of production assets.

— What transformation of specialties is expected for employees of the production unit in the future?

— Our specialists have a high level of competence in the nuclear industry on the world stage. At the same time, new global trends dictate the need to restructure the

thinking and development of certain skills of employees in production areas. According to international research, the main directions of professional development are defined. For example, multiculturalism multilingual skills, multi-industry communication skills, ability to work with people and customer orientation. Also included in the list of areas are the ability to manage projects, work in a mode of high uncertainty and rapid change of task conditions, and the ability to create art.

**S**pecial mention should be made of professional development in terms of programming and working with IP- artificial intelligence, systems thinking, lean manufacturing skills, environmental thinking, as well as critical thinking, attention management, and emotional intelligence.

In turn, our company pays great attention to improving not only hard skills, but also soft skills, as this synergy gives a significant boost to the development of our industry.

Standard thinking in terms of developing the skills of production personnel is shifting towards the harmonious development of supra-professional competencies.

— What direction of development in the production sphere are you already focused on?

— Our development priorities are focused on global trends. For example, the use of artificial intelligence in production, Big data analysis, unmanned control, as well as the use of digital technologies that increase production efficiency. The issues of environmental friendliness and transparency of activities, improvement of management skills of superprofessional companies of production personnel, compliance with safety and labor protection of our employees remain important. In addition, we focus on efficient and careful management of production assets, as well as on improving approaches to R & D.

— Which specialties, in your opinion, will disappear, and which will appear in the near future?

— With the development of digitalization and robotization, routine production specialties will disappear. At the same time, there will be many new directions of transforming specialties in the field of the above - mentioned global trends. For example, we are actively developing specialties in such areas as artificial intelligence technology, data management, and unmanned control. In addition, it is worth noting such new specializations as predictive Analytics engineer, recycling technologist, and others.

## 3.1.5. EXPERT OPINIONS

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**KOZHABAYEV  
KHAYRULLA  
BAIDILDAEVICH**

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Chairman of the Board  
of Kentau Transformer Plant JSC

— Khairulla Baidildaevich, in your opinion, what 3-4 major events over the past few years have strongly affected the energy industry of Kazakhstan?

— The energy industry has been affected by several events over the past 5 years. First, the active development of renewable energy, wind and solar energy, these areas have begun to develop actively.

Secondly, it is the opening of a transformer plant in Uralsk, which is also an important event, since about 80% of the transformer networks are worn out and need to be changed, and many capacities are already outdated. The normal service life of power equipment is 25 years, and ours have been used since 1960-70.

Third, there is now a transition from oil - fired to dry transformers, which are used in urban substations. This type of transformer is more environmentally friendly, requires less operating costs and is more fire-safe.

— Does your company plan to expand its production volume in the next 10 years and produce not only transformers, but also switch to the production of components for generating stations?

— We have a R & D Department that is engaged in design development, where pilot tests are currently taking place to master the production of power generators. We also work with solar panels, which consist of 50% of our equipment.

— What specialists will your company need in the next 3-5

years?

— Today we do not have enough engineers, designers, Munich technologists. Also, there are no competent IT specialists, because we have now installed processing machines that run on computer programs.

— In your opinion, how much does the lack of such specialists hinder the company's development?

— Personnel is the main problem of the company, they need to be developed, they need to be trained, gradually adapted to the production process, and this takes time. We also have, for example, an engineering staff, some specialists come to us with higher education, and there are those whom we ourselves have prepared. We have working specialties that future specialists study in our Kazakh-German Polytechnic College.

**THE COLLEGE OPENED IN 2012 AND CURRENTLY HAS 830 STUDENTS WHO ARE GUARANTEED 100% EMPLOYMENT AFTER GRADUATION.**

If we return to the question itself, it is the creative thinking of employees in General that is lacking. They have both an education and they do their job well.

**HOWEVER, I THINK WE IN THE EDUCATION SYSTEM ARE NOT TAUGHT TO MAKE DECISIONS, THEN EMPLOYEES HAVE TO OUR COMPANY ALWAYS ASKING YOU WHAT TO DO, AND FOR THIS REASON WE PLAN TO CREATE A SEPARATE TRAINING CENTER AT THE PLANT WHERE WE WANT**

**TO INTRODUCE ONE SUBJECT – TRIZ (THEORY OF INVENTIVE PROBLEM SOLVING).**

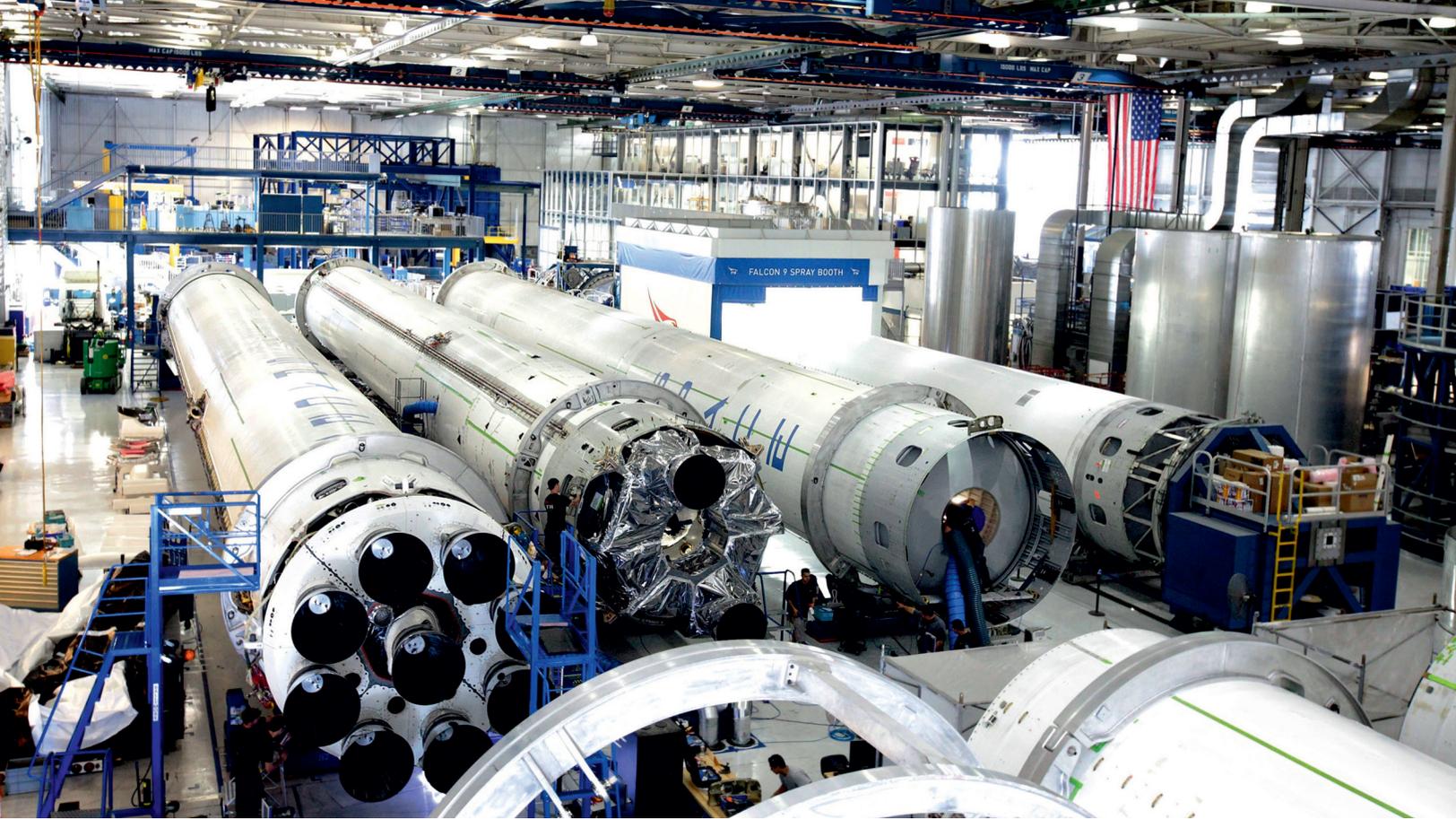
— If we talk about energy in such a chain as energy generation, transportation, and distribution – where do you think the greatest scientific and technological progress is expected in the near future in 5-10 years?

— Scientific and technological progress, I think, will be primarily related to the IT direction. For example, mobile applications for monitoring the state of TRANS-formers: oil level, temperature, etc. Such applications have already been developed in Russia, and I hope that they will soon appear in our country as well.

I also think that in the future, gas generators and Autonomous gas boilers will be developed, which are installed in multi-storey houses that no longer need thermal power plants, since these boilers generate not only heat, but also electricity.

— If you had an unlimited amount of money, what would be the main problem in the energy sector of the Republic of Kazakhstan that you would solve with this money?

— First of all, I would take up hydroelectric power. We have mountain rivers, and I would put a lot of hydroelectric power stations on the route of these rivers. After all, these rivers just flow, and they could give us energy. The prospects for hydropower are much better than for solar and wind energy. Because there is a constant flow and there are no fluctuations.



Second, I would change all the transformers that are available in factories to energy-saving transformers. This investment would be justified in 1-2 years, depending on consumption. This direction is very important in the development of energy saving systems in Kazakhstan.

— And the last question, similar to the previous one. if you had an unlimited amount of money, what direction would you invest your money in?

— I would invest in machine building and IT. Due to the current situation in the country and around the world, such areas as IT will only develop. For example, delivery services, i.e. logistics, are also growing. Consequently, even more energy will be consumed.

I would also like to add that there is one problem. We now want to transfer one College nearby, and there is a state program "Zhas Maman".

Such colleges have been allocated 3 billion tenge for the program throughout Kazakhstan, and they want to buy machine - building machines for this money. They do not understand that this is a waste of money, because after buying these machines, students will not be able to start using them themselves, because they need consumables, and this is also a lot of money. I suggest that they do not spend money on this, because our company already has machines, and it is better to create a training room or center where students can come, and our employees will show them how to work on production equipment. Let these investments be used to buy expensive computers and programs, so that students can get good theoretical knowledge in the first years of their studies, and come to us for practice in the last year.

## 3.1.6. EXPERT OPINIONS

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### KIBARIN ANDREY ANATOLIEVICH

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Associate professor, head of Thermal Power Engineering Department, professor of "Almaty University of Energy and Communications".

— Andrey Anatolyevich, you are one of the leading experts in Kazakhstan, who knows both the industry and training in the field of energy, Please tell us what key events, in your opinion, have become the most significant over the past 5 years in the energy industry?

— If possible, I would like to start with the fact that until 2009, the energy sector of Kazakhstan was in a difficult situation, since resources were practically not included in the renovation and modernization of equipment. In 2009, when marginal tariffs for electricity production were introduced in the regions of Kazakhstan, the second revival began. This moment has changed very seriously, modernizing the energy sector, and many large energy companies, such as Kazakhmys and ERG, have been able to renovate equipment. In fact, we are now dealing with restored energy, although time is passing again, and the equipment is getting old again.

The second important event I would like to mention the changes that are related to the creation of the market capacity for traditional energy. This was quite a serious impetus for development, since additional investments appeared not as working capital for the company's development, but as funds that will allow investing in the development of production. Previously, there were no such opportunities.

Third, in 2009, the law on support for renewable energy sources was released. Of course, there are many difficulties associated with

the introduction of renewable energy. But it is still developing. Large systems with a capacity of 50-100 MW are being developed. Another question is that I have some doubts that we will reach the level of 50% in the use of renewable energy sources by 2050. There are several explanations for this.

First, traditional energy related to coal prevails to a large extent. today, more than 70% of electricity is generated from coal-fired thermal power plants. This can't be changed quickly. In addition, we lack a reserve of electrical capacity. This is very important for renewable energy to work, we do not have such a reserve.

We have been saying for many years (the last 10-15 years) that we need to develop nuclear energy. Here, of course, there are many doubts related primarily to the culture of maintenance, operation and reliability of equipment. In other words, the public is not confident that it will be safe and secure. If we overcome this barrier, then Kazakhstan has a huge potential in this.

Due to the fact that the South of Kazakhstan is located in a high seismic zone, the construction of nuclear power plants is not safe there, and as for the Northern regions of Kazakhstan, it is quite feasible there. Moreover, nuclear power plants are allowed to generate a significant amount of electric energy at an affordable price. Although the construction of a nuclear power plant is not a cheap option, it will later be much cheaper to get electricity from there than from the traditional one. Because Kazakhstan has its

own raw materials, the ability to produce fuel.

— Do you think it is possible to do the following on our coals: it is clear that the efficiency of the plants themselves may be low, but if we move towards environmental friendliness, will we be able to bring the use of coal fuel to clean (eco - friendly) technologies in Kazakhstan?

— Perhaps. There are certain prerequisites for this. First, at Nazarbayev University, work is being carried out on burning fuel in a fluidized bed, this technology is not new, but it has not yet been sufficiently developed.

This technology can significantly reduce emissions of harmful substances, and in Europe this technology has been used for a long time. If this technology comes to Kazakhstan, I think that we will be able to safely use solid fuel even within the thermal power centers that are located practically in the city.

The second possibility is based - WAN in a more distant prospect is the gasification of coal. To date, many technologies have been developed, but so far they do not pay for themselves.

For example, in Russia, research is more focused on the so-called "in-cycle coal gasification", that is, gasification reactors that are located directly at a thermal power plant. But there are a number of problems related to the calorific value of gas, and we need to solve the issues of the high cost of this whole process and our own needs.



— If you imagine the entire energy industry, in your opinion, in the next 5-10 years, where can we expect significant technological progress in this chain?

— If we are talking about energy saving, then the energy sector is exactly the sector in which there is something to save. The internal needs of heating and boiler plants are large enough.

In some cases, the actual consumption of resources for their own needs exceeds even the standards, which, I must say, are very loyal. Even if we take the old design standards, we are significantly exceeding them. It is necessary to fight against this, absolutely. This is all due to the fact that inefficient equipment is currently being used. They are certainly reliable, but, by modern standards of energy efficiency, they do not meet the requirements. In addition, if we consider the generation of electricity in Kazakhstan, most of the thermal power stations are heat and power plants. But the fact is that there are very few regions in Kazakhstan where thermal power plants work efficiently. That is, many thermal power centers have a specific fuel consumption for electricity supply exceeding 300-350g per kW / h. CHP for its technology needs to work more economically than the GRES. This is due to the fact that we are underutilizing the opportunities for heat consumption. In other words, we have few heat consumers. This is due to the fact that the production base has changed, many large producers have left

the cities and, accordingly, this worsens the operation of heat and power plants.

— In your opinion, in the near future, where will we need more personnel in the energy sector and in what direction?

— The fact is that the energy industry in Kazakhstan is not evenly distributed, the most popular energy, electricity, heat, of course, in the North and East of Kazakhstan. Industrial enterprises, thermal power plants, and large - scale GRES are concentrated there. But if we say that we will also develop gas energy, and if KAZ-Munaigas sees this as a prospect and provides support to the energy sector, then South Kazakhstan will also need highly qualified energy specialists.

— In your opinion, how promising is hydropower in Kazakhstan?

— To date, there is no such specialization in the classification, and almost nowhere are hydroelectric power networks being prepared. In earlier classifications of higher education specialties, hydropower was.

If we talk about hydroelectric power, then from the point of view of specifics, I would not say that they are very different from the power plants of thermal power plants. In other words, HPP generators differ from generators of thermal power plants, but, in General, the technology is the same. As for hydroelectric power stations, this is not an energy problem, of course, but a construction problem — the complexity of building a

hydroelectric power station. We need to create separate educational programs as part of a large training program.

Unfortunately, we do not own the sources of major rivers. Since water resources are unstable, I see the point in building counter-regulators on rivers after large hydroelectric power plants. In other words, these are small stations with a capacity of 30-50 MW that will deal with regulation issues. For example, the KAP-Chagai HPP has the ability to operate at almost any load, but due to the fact that the yield is not always large, and there is a lower weight, its capacity is always limited.

Even now, its installed capacity is lower than the design one. And if we use counter-regulators, we can significantly increase both the regulated capacity of the station and its capacity.

— Could you create such a gradation in terms of training power engineers for various purposes for traditional and alternative energy?

— It will be difficult for me to answer for all these types of energy, but, in my opinion, the training of power engineers is related to the technology of the equipment that is used. If the equipment is highly technical and has a high degree of automation, then on the one hand, training is difficult because the specialist must master complex automation systems, and on the other hand, it is easier, because there is no sense in using manual labor, which we must already prepare

for. Therefore, if we are talking about the training of heat power engineers for thermal power plants, this is the most difficult process in education, since many aspects, both theoretical and practical, are affected here.

Regarding the repair component of equipment, then the level of knowledge should be quite high. Therefore, I would build the following gradation:

- ▶ the most difficult thing is traditional heat power engineering,
- ▶ traditional electric power industry is in second place,
- ▶ next – gas turbine installation specialists,
- ▶ and in the last place – alternative energy.

— If we develop production or equipment design in Kazakhstan, do we have a base and will we be able to deploy it in the near future?

— Depends on which part. If we take the gas-turbine structure, I doubt that we will be able to catch up and overtake America and Europe. Certainly, we have experience in the oil and gas sector, we have the Kaztur - boremont plant, which uses modern technological equipment. If you follow this path, then, accordingly, you will need specialists. In other words, from the point of view of repairs, this should be developed.

As for biomass, the development of modern fuel-burning devices in Kazakhstan is gaining momentum, and many scientists are working on these issues.

Therefore, this direction should be supported and developed further.

— In your opinion, what new professions can appear in the field of energy?

— If we talk about the near future, there will be new professions in the electric power industry, of course. Our University has such an educational program - "Digital electric power".

Today, there are distribution networks that have digital substations. In other words, they need a specialist who knows computer technologies and a number of software products that the system itself runs on.

Starting from 2020, we plan to launch a new educational program "energy Audit and energy management" within the framework of the "electric power and electrical engineering" class. We have chosen this direction because energy efficiency issues are very important. We will also need new engineers - managers for modern equipment that would take into account all its specifics. I would also like to note that we will need specialists in the field of renewable energy sources who should know some of the specifics of traditional energy. Here, too, it will be necessary to transform the educational program



## 3.2.

### THE INDUSTRY FORECAST

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The foundations of "future energy" are being laid today. They are formed in scientific research and new processes in production, discussed by specialists and become part of training programs. the future is formed every day, and the energy of human thought eventually turns into the energy of large machines and convenient personal devices.

We can "anticipate" the future of our energy sector by getting a lot of personal assessments from domestic experts. Our experts are qualified — more than half of them have been working in the industry for more than 15 years, and another 13% have experience from 10 to 15 years. The average length the age of the experts

surveyed is 13 years, which is optimal for understanding the current problems and prospects of the industry development. Therefore, the forecasts made by experts combined knowledge of technological innovations with understanding of the specifics of the real situation in the country and in the industry.

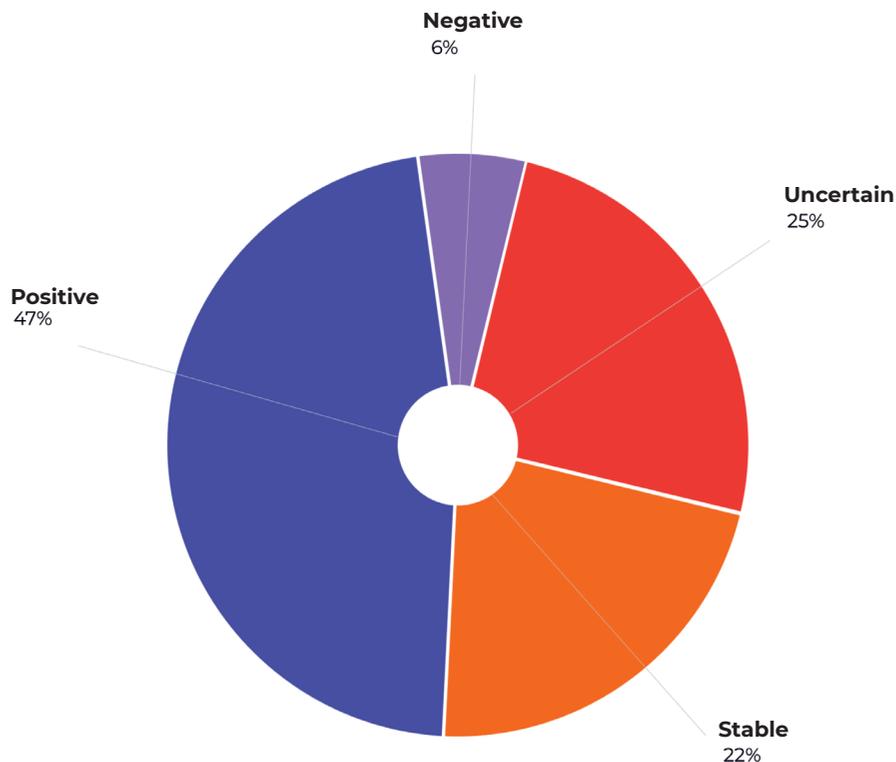
## THE FUTURE OF THE ENERGY INDUSTRY OF KAZAKHSTAN — THE PRINCIPLE OF REASONABLE SUFFICIENCY

In assessing the future development of the energy sector of the republic in the near future, experts agreed that Kazakhstan's energy sector will develop under the influence of various factors.

The future development of the energy industry is viewed by 47% of experts as positive growth, 22% as stable processes without changes, 25% - can not give a definite answer, and 6% - negatively.

Figure 3.1.

### *Assessment of the future development of the energy industry in Kazakhstan (% of expert responses).*

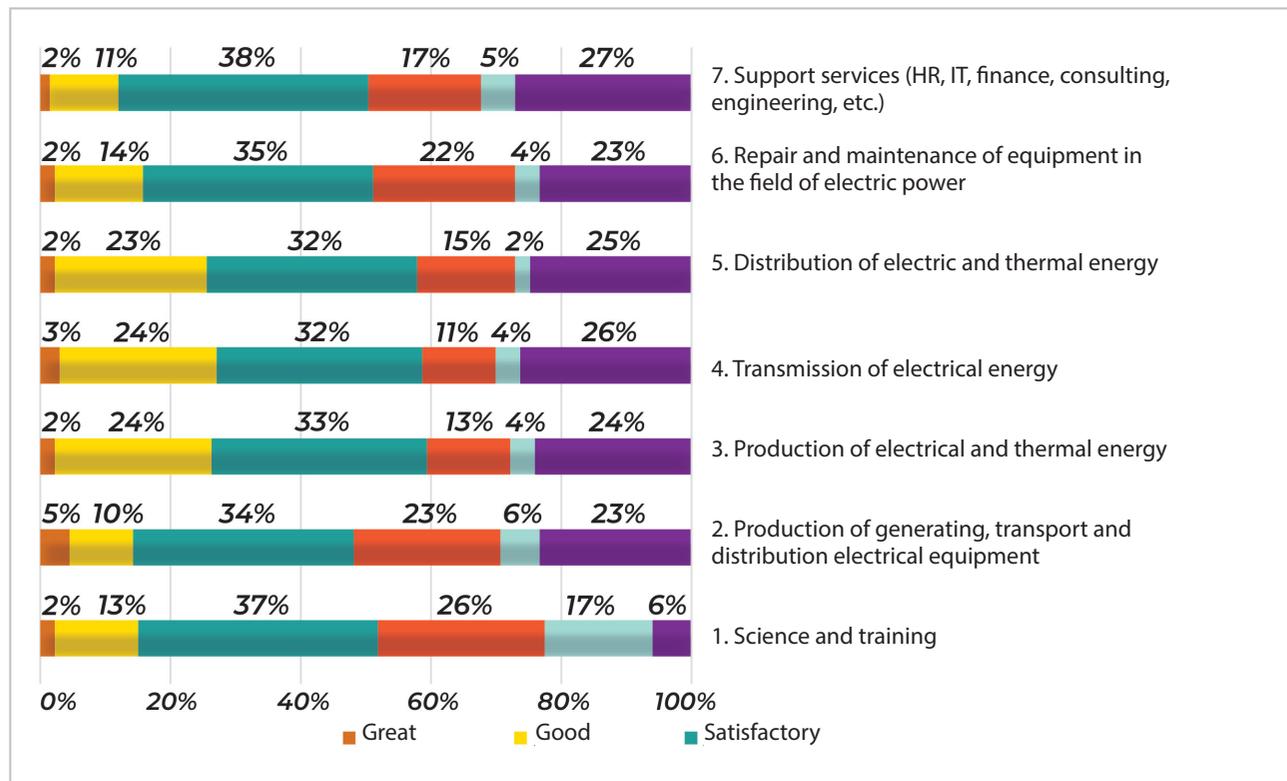


Experts have shown moderate caution in assessing the prospects for the development of the industry. According to their estimates, the situation is good in the field of electric power transmission - the average score among those who gave the rating is 3.15 according to the 5 – point system.

The greatest crisis is observed in the field of science and training for the industry - the average score among those who gave the rating is 2.56 on a 5-point system. The weighted average score for the entire process chain was 2.91.

Figure 3.2.

**Assessment of the current state of the stages of the technological value chain of the industry.**



The satisfactory state of all technological processes makes it necessary to carefully select priority development zones. According to industry experts, the industry is most strongly affected by: high wear and tear of equipment in the industry (50%), high losses in heat and electricity transmission (30%). More than 70% of experts believe that Russian science and education can initiate changes in the industry. Growth zones of the domestic economy the development of monitoring and data processing

technologies and new technologies for energy transmission and distribution are important for the energy industry. According to experts, this is where the main investment and management efforts of the next period should be directed.

According to the experts' responses, the following areas are most likely to be invested: in the main technological process of energy generation (27.4%), in the field of energy transmission and

distribution (18%), in the field of ERP production management (13.4%), and in the field of equipment repair and maintenance (11%).

**WE WILL ACTIVELY RESPOND TO RISKS AND LOOK FOR THE MOST SUCCESSFUL SOLUTIONS FOR A TECHNOLOGICAL "BREAKTHROUGH INTO THE FUTURE".**

## BIG ENERGY POLICY

Energy production and consumption are inextricably linked to politics. Energy is the basis of economic development and ensures the quality of life of the population, so energy interests are at the heart of state policy. At the same time, the development of energy depends on political attitudes, adopted laws and established norms.

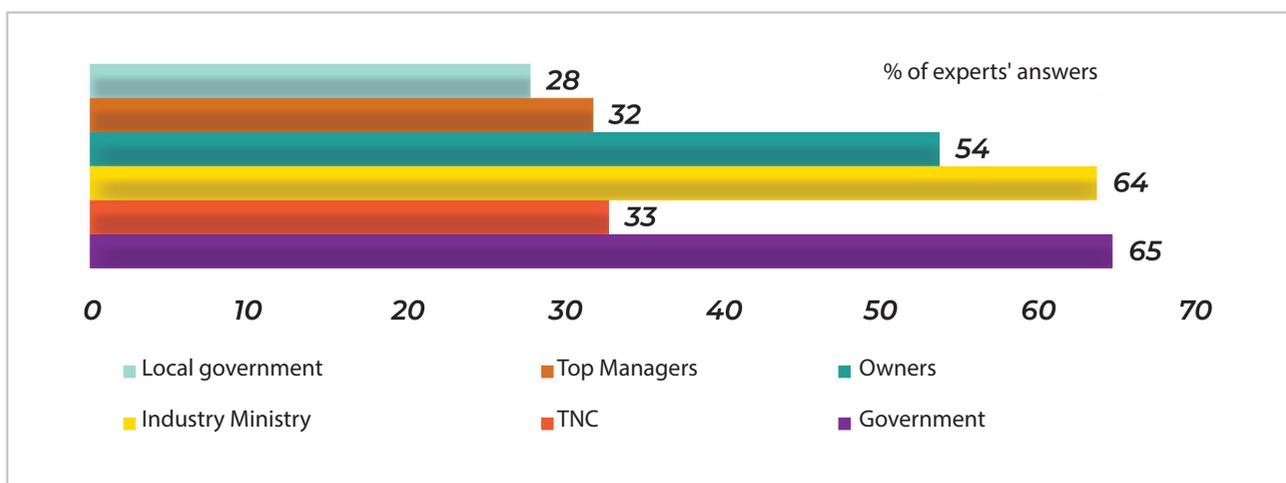
Today, we see how international agreements are changing the situation on the global energy market, and national governments are trying to control the distribution of energy resources in society.

According to experts, the following types of political risk are most likely for the domestic energy industry in the future: price instability (44%) and energy policy uncertainty (32%).

Experts note that state bodies have the greatest influence on the development of the electric power industry in the Republic, and the higher the level, the greater the influence. Figure 3 shows that TRANS - national companies, owners, and top managers have the same impact, but not as strong.

Figure 3.3.

**Assessment of the power of influence of the main participants in the energy market.**

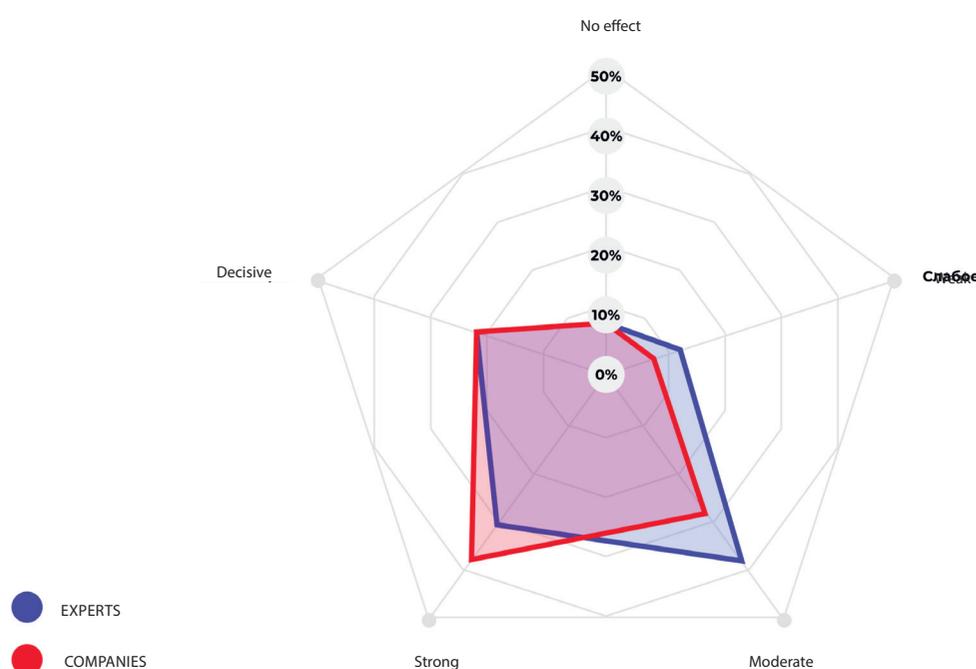


The growing problems of energy security, which is important for every state, contribute to maintaining the strong influence of the state on the industry. However, it is important for our country to involve local communities and industry associations in solving energy problems. It is

necessary to further encourage the involvement of experts and specialists in the joint creation of the future, since at the moment they note the dominance of the state and owners in achieving their goals, and they assign a secondary role to themselves as specialists and performers.

Figure 3.4.

**Assessment of the impact of experts and companies on the development of the industry.**



The majority of experts assessed its impact on the future of the energy sector in Kazakhstan as moderate. The weighted average score of all experts is 5.89. The impact of manufacturing companies on the future of Kazakhstan's energy industry is currently assessed as strong.

The weighted average rating score for companies is 6.75 points, which is much higher than the assessment of personal influence of experts.

To build a fair and secure energy future in the country, it is necessary to develop a new paradigm of interaction between power structures with civil society on the energy agenda.

It is important to actively involve civil society organizations to conduct public examinations, study public opinion, develop recommendations, formulate public requests, and so on.

## THE FUTURE HAS ALREADY ARRIVED. GREEN ENERGY IS ALREADY WITH US.

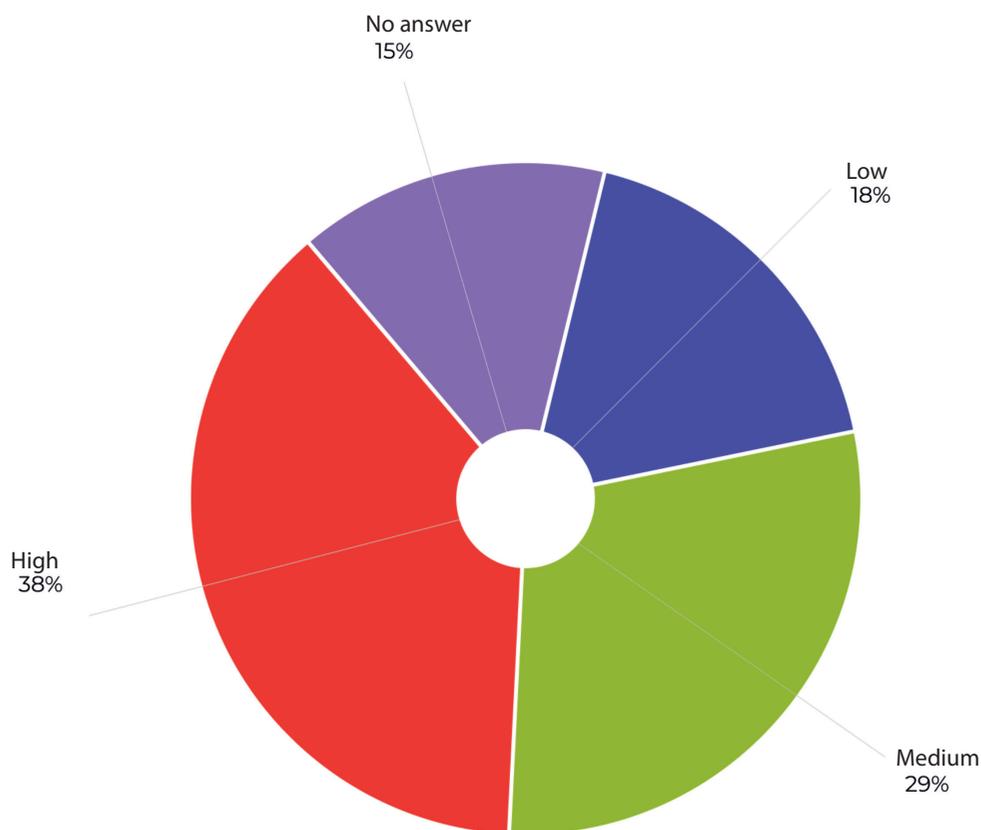
The future of global energy will depend on the future economy. In the coming decades, it will combine non - industrial, industrial and post - industrial types of production. It is the structure of the future economy that will determine the demand for different energy sources. According to the country's strategy, the share of green energy should be 50% of the total energy production. Today, the entire RES balance of Kazakhstan accounts for 1.8-2% of the total generation volume.

By 2025, this figure is expected to reach 6%.

Of all the experts who participated in the survey, 37% work with non - renewable sources, 29% of experts work with renewable sources, and 34% of experts work with both sources. Thus, green energy has already become a part of the daily life of the industry. In addition, every third expert considers climate change and environmental problems to be the leading risks of the domestic energy industry.

Figure 3.5.

### *Probability of alternative energy development in Kazakhstan.*



The industry considers it promising to get new opportunities in the field of construction of generating stations in alternative energy (29%).

The potential of alternative energy is estimated even higher than traditional energy. Only one in five experts supports the prospects of building new generating stations and coal/gas/oil-fired power plants. Green energy will help maintain a balance between production and the environment.

Environmental requirements are becoming stronger on the part of the state and society. The growth of environmental requirements strongly affects the modern energy sector and will become dominant in the coming decades.

Experts note that the leading areas are:

- ▶ Waste management, categorization (sorting) and reduction,
- ▶ Efficient use of resources,
- ▶ Environmental monitoring of

energy industry facilities,

- ▶ Reduce emissions of pollutants (NO<sub>x</sub>, SO<sub>x</sub>, CO, dust/soot/fine particulate matter).

The development of green energy needs to be provided with qualified personnel. In the current ones projects are mainly occupied by foreign specialists in both engineering and management departments. To shape the future of green energy, it is necessary to have a unified national plan that embodies the ideas of foresight.

The government, business, specialists, residents, scientists and teachers should unite in creating the future green economy. Alternative energy is an important and diverse problem. We must analyze its current achievements and shortcomings and look more boldly into the far horizon of foresight.

## WILL GO TO THE ENERGY INDUSTRY, LET THEM TEACH ME

Serious problem for the development of the industry is the lack of personnel to support current activities.

In the energy sector, there are not enough employees of many working professions, as well as

engineers. According to experts, the shortage of human resources is one of the three most significant risks.

Lack of personnel seriously hinders the development of the industry-this assessment was

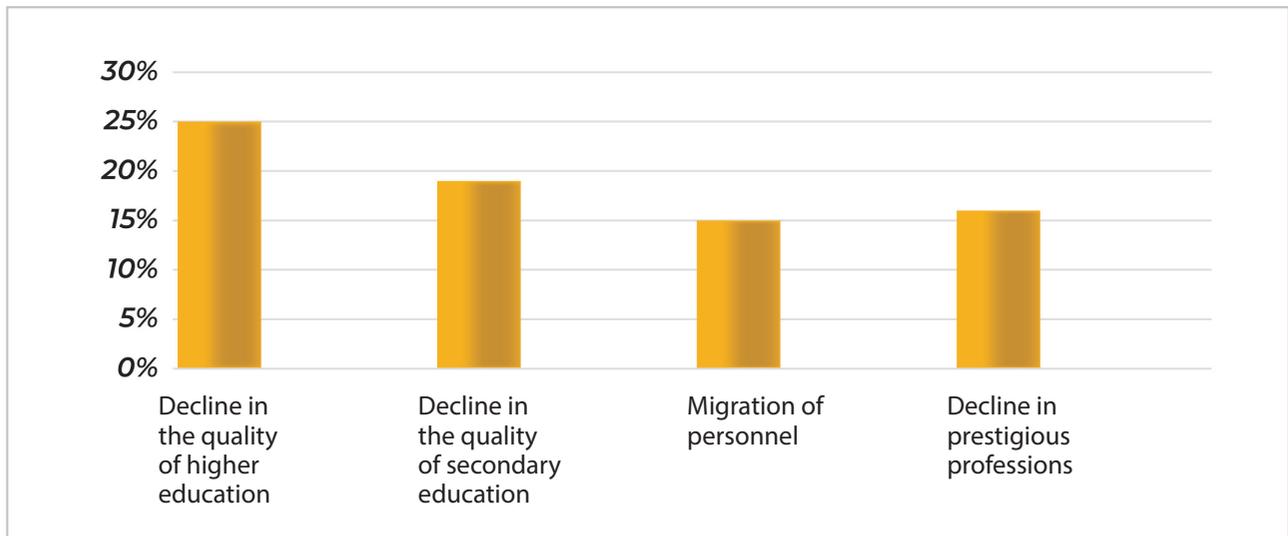
given by 42% of experts. Energy companies not only lack personnel, but also suffer greatly from the low qualification of new workers. Insufficient qualification of the labor force is also one of the three most significant problems in the development of the industry. This is the opinion of every third

professional in the energy sector.

Experts named 78 specialties and qualifications whose competencies have deteriorated over the past 3 years. The energy industry is most in need of qualified, professional electricians, heat power engineers, as well as workers and engineers.

Figure 3.6.

**Reasons for the deterioration of staff competencies (% of responses).**



The decline in the quality of the labor force is caused by various factors.

employees deprives the industry not only of personnel, but also of unique experience in working at domestic enterprises.

Experts note that in recent years, training in higher and secondary education in the energy sector has significantly deteriorated, so the basis for the reproduction of domestic workers has been undermined.

When people leave, they take their knowledge away and don't have time to pass it on to new employees.

The reasons for the decline in the qualification of employees and the fall in the level of professional competencies in the industry are:

The best specialists were able to find work in the global labor market of the energy sector. Migration of the most qualified

- ▶ Lack of necessary specializations in higher education Institutions,
- ▶ Lack of full-fledged industrial practice of students,

- ▶ Many private companies are not interested in training personnel on their own base,
- ▶ Employees responsible for personnel development have low professionalism, incompetence, and lack of ability to work in a team,
- ▶ There is no professional continuity, and the appointments of top managers are politicized.

Problems with personnel in the industry are of a neglected nature, and the industry's personnel policy lags far behind the ideas of modern work.

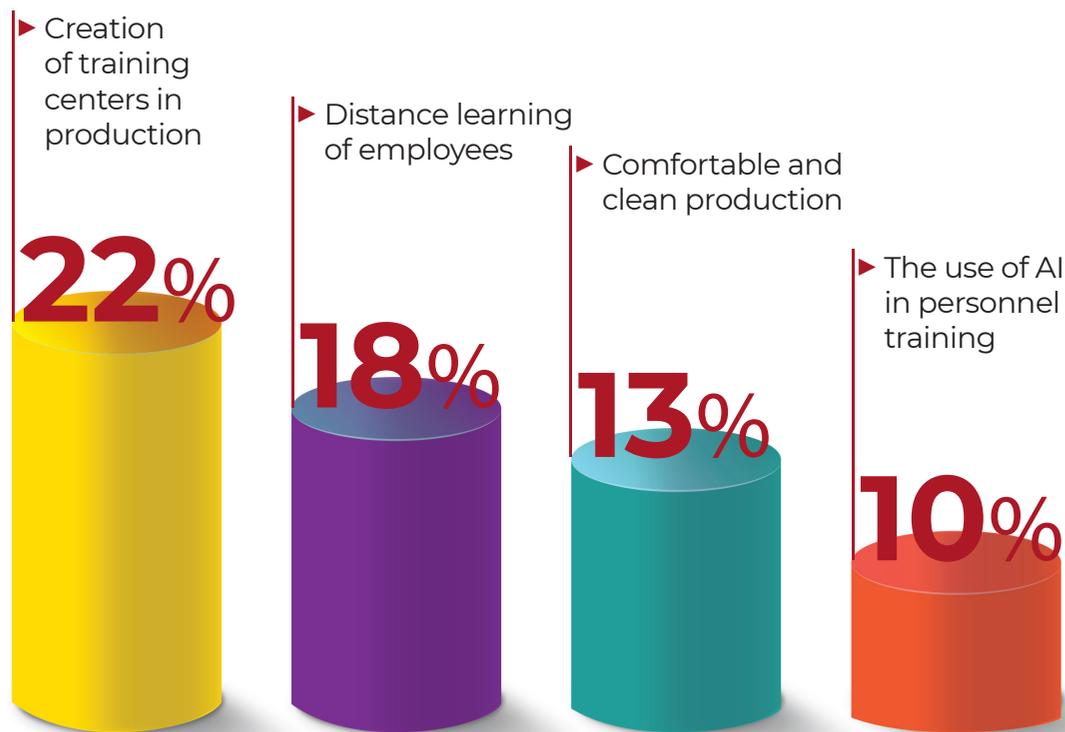
Previously, it was believed that "all the work-you are good, choose your taste", but now a lot has changed. When choosing to work in the energy sector, future specialists present new requirements.

Today, when choosing a profession, young people demand more, a job and a stable salary.

A new generation of employees has entered the market, who want to see their work as the best part of life: interesting, prestigious, creative, respected in society and ensuring well-being.

Figure 3.7.

**Conditions for training new generation employees (% of expert responses).**



Employees of the new generation (generation Y, Z, Millennials) want to get practical knowledge directly at the production site, possibly in special training

centers of corporations. They will be trained using modern remote technologies, and artificial intelligence will help them discover their talents and



correctly build a professional career. Attractive and comfortable conditions must be created in the workplace that allow developing

the employee's potential and meeting modern expectations.

## «SMART ENERGY» KAZAKHSTAN

«Smart Power» of Modern Energy of Kazakhstan is already actively using the tools of digitalization. Today we have experience of the first application of artificial intelligence. We can say that the world and domestic energy sector is actively learning and soon the work of enterprises and our everyday life will be provided by "smart energy".

According to experts, the forecast for the creation of "smart energy" in Kazakhstan is based on several breakthrough directions.

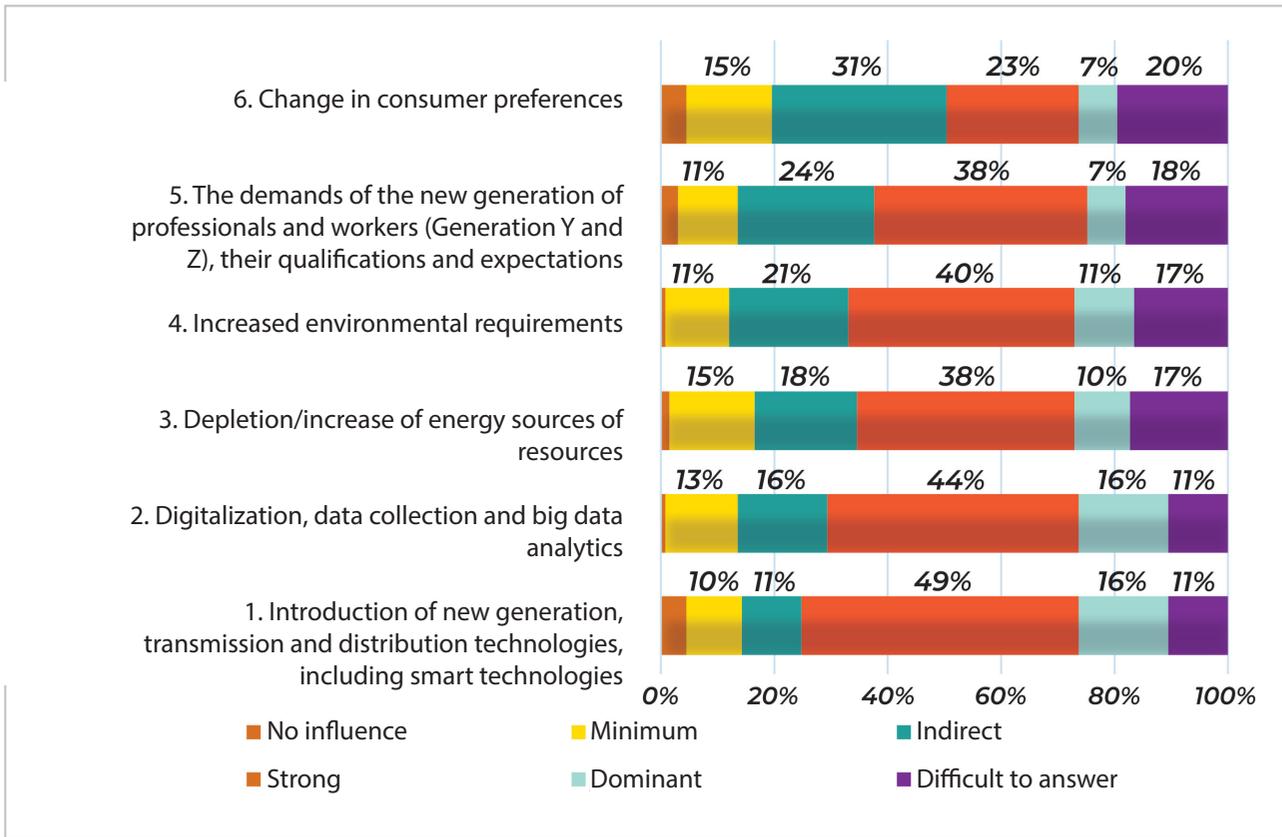
The main breakthrough is expected in the field of

monitoring and data processing, according to 56% of experts. Promising areas of digitalization of production processes are also the sphere of energy transmission and distribution (43%), production management (ERP) (39%) and the main technological process (41%).

Innovations in the energy sector are aimed at improving the technologies of production, delivery and storage of electricity. New opportunities are opening up for managing energy systems of various scales through the introduction of "smart" networks and digital substations, the

Figure 3.8.

**Assessment of the impact of major trends on the future of the energy industry.**



development of consumer services and commercial accounting solutions.

In Kazakhstan, digitalization is expected to have a strong impact in the collection and processing of big data (60% of estimates), as well as in the introduction of new technologies for power generation and distribution (65%).

The majority (56%) believe that businesses industries ready to support innovation, however, among Professional and a lot of skeptics who think domestic energy unprepared for the innovation.

In the development of "smart energy" in Kazakhstan, promising directions are the introduction of

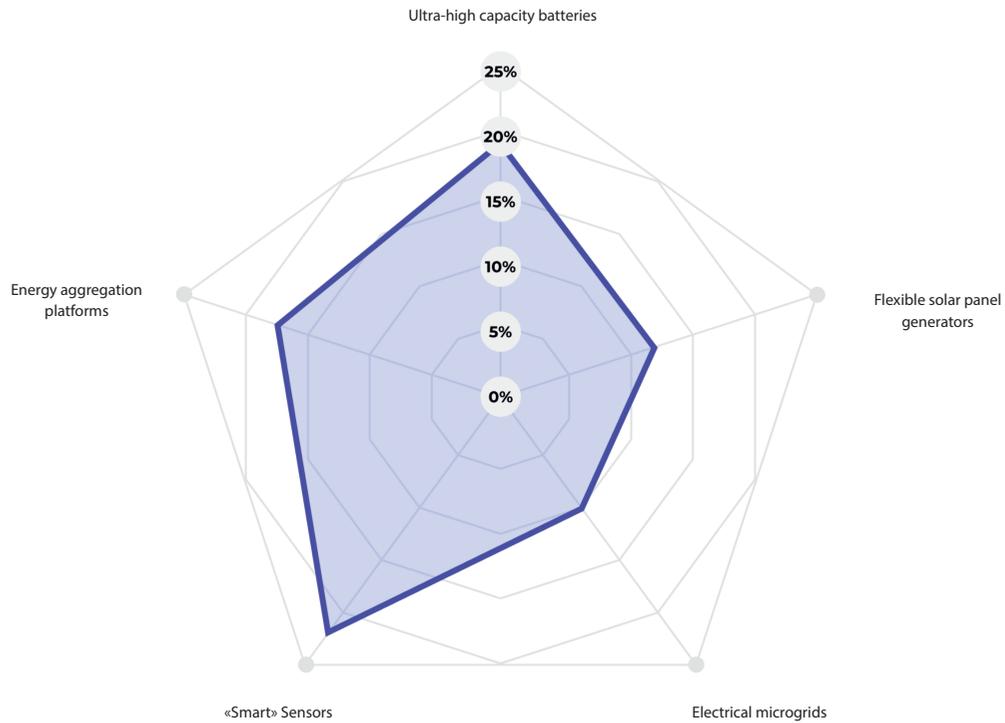
sensor devices (smart sensors), the transition to ultra - high-capacity accumulators and electric microgrids.

Experts also consider it important to use the energy aggregation platform and flexible solar panel generators.

In the near future, our energy sector will be managed by artificial intelligence that plans production. Control and automation of generation, transmission and consumption of energy will be carried out using "smart systems", and technical documentation and accounting will be carried out in electronic forms based on the principles of blockchain.

Figure 3.9.

## Assessment of the development of energy technologies based on «smart systems».



## THE NEW «ENERGY CIVILIZATION»

«In the next 25-30 years in the energy sector does not expect a technological revolution (for example, the development of cheap thermonuclear fusion or gravity), although major technological breakthroughs are expected.

A real revolution is taking place in the social sphere, modern energy is connected to all spheres of life

in society. This integration is based on completely new principles of interaction "nature-society-man" and the energy-environmental-economic approach is already gaining strength.

The industrial economy created an energy civilization whose growth was based on the organization of large systems and man was only an element of the machine system.

In the near future, non-industrial production will finally be formed, where human creative activity is provided and served by self-organizing energy systems.

A new energy civilization is emerging that uses all the possibilities of energy and artificial intelligence for harmonious, non-destructive interaction with the surrounding world. Improving technologies and technical achievements are not aimed at generating more profit, but at better organizing the development of people and communities.

The new energy civilization uses sophisticated real-time energy management systems using decentralized sources. It ensures the integration of energy into the technosphere, develops energy conservation and reduces non-rational consumption. In the new energy civilization, development depends on social norms and human behavior, not on generation capacity or

technological innovations. Every third Kazakh expert points to the growing risks of climate change and environmental problems that are so important in the new energy civilization. Domestic experts are seriously concerned about the problems of depletion and depletion of energy resources, and they see several promising directions for ensuring the energy of the future.

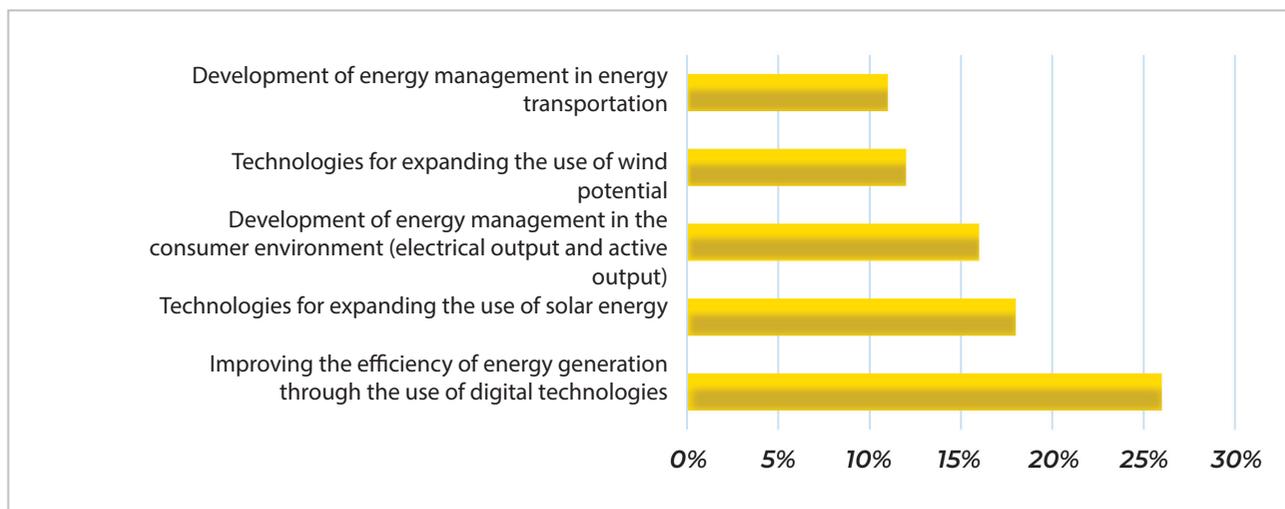
Energy efficiency will be improved by introducing digital technologies that will control rational production and consumption.

Experts believe that it is possible to rationalize consumption and even export electricity from the Republic. To develop exports, it is necessary to harmonize the technical, administrative and social norms of the closest partner countries in the EAEU and create a single electricity market.

In the near future, changes in the behavior of energy consumers

Figure 3.10.

**Energy development based on the greening of energy production.**



will increase. It is expected that consumers will significantly reduce energy consumption by implementing energy management (28% of expert estimates), and an increase in electricity consumption by individuals will occur due to the mass appearance of electric cars and trucks (17%).

Experts also point out that it is becoming legal for consumers to use energy produced in compliance with environmental standards. Already, some consumers are willing to pay for energy from alternative sources (23%).

The future of the energy industry is

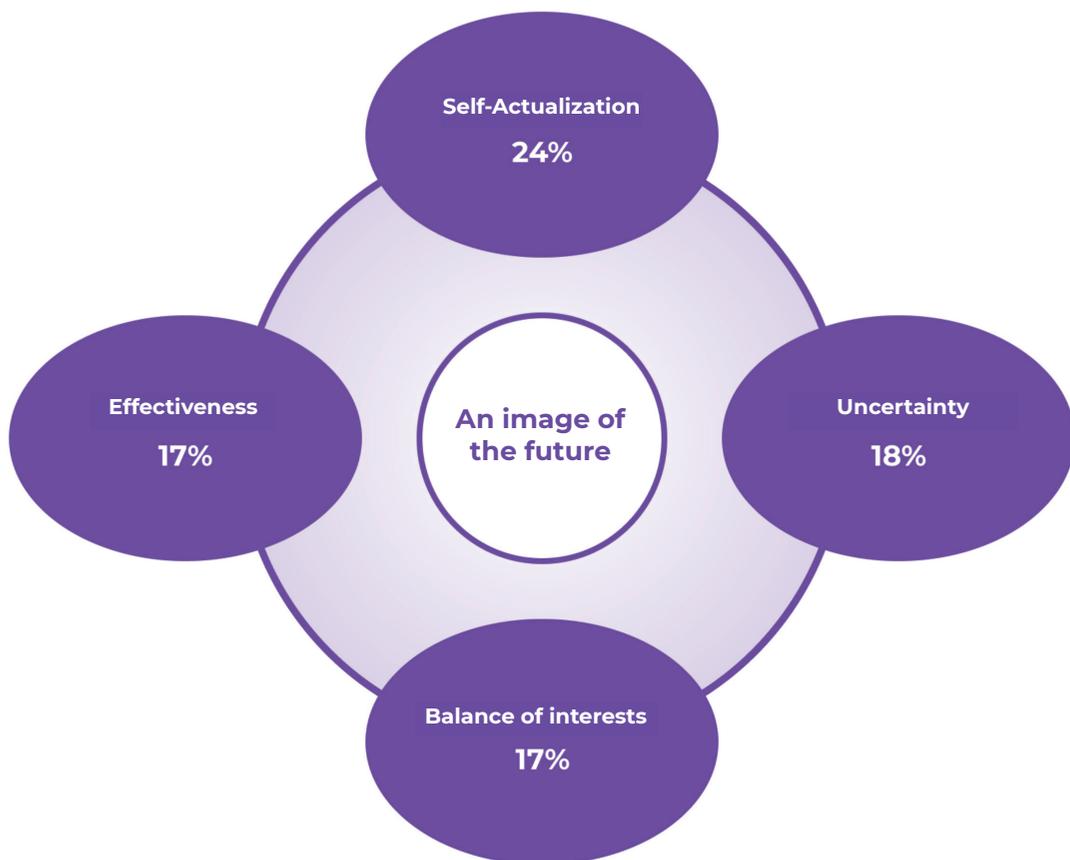
being created by the joint efforts of a community of interested people: workers and specialists, owners and public figures, government officials and international organizations.

Now the expert community is forming the first image of the future. The values of employee' self - realization, production efficiency, and ensuring a balance of interests play an important role in this process.

The uncertainty of the future is growing, but it opens up the possibility of creating an amazing and responsible new energy civilization.

Figure 3.11.

**Shaping the image of the future by energy experts.**



## THE FIGURES SERVE PEOPLE THE PROJECTS BRING TOGETHER THE PROFESSION .

Innovations in the energy sector lead to demand for certain professions or competencies. Experts named the most popular qualifications in the industry. First of all, our energy sector needs people who can work with digital and IT technologies.

The industry needs IT engineers, relay protection engineers, and power engineers with knowledge of computer design.

Describing the qualifications of the future, experts most often mentioned the following components: digitalization, automatization, IT technologies, alternative energy, etc.

The competence profile of future energy specialists includes:

- ▶ the ability to process large data and conduct analysis,
- ▶ the ability to program,
- ▶ skills of complex service of "smart equipment»,
- ▶ skills for interacting with cyber systems,
- ▶ digitalization skills: the ability to translate various processes into quantitative indicators (figures).

To obtain the necessary competencies, specialists in the future energy sector must have the main skill-the ability is an important ability, as well as the ability to work in conditions of uncertainty and resistance

to stress. Initiatives and good communications are expected from the future energy worker. It is important to be able to "work with digital" and know IT technologies, but computers and digital serve employees in solving their production tasks.

**F**uture energy tasks will become more complex, and the employee must be able to perform functions from different technological processes

There will no longer be specialists of the same profile, tasks from different professions will be combined in separate projects, and the employee will need a special type of thinking skill.

Systems and analytical thinking are especially important in the energy sector, as it allows employees to see all the relationships in the production, transmission, and consumption of energy. And when innovations change the technological process, employees must be able to transform the system and work in it.

The current system, for example, does not imply that the consumer can be both a generator and a seller of energy. Now this is changing and the employee needs to master the skills of flexible planning (Agile methods)



and creating internal projects in the organization.

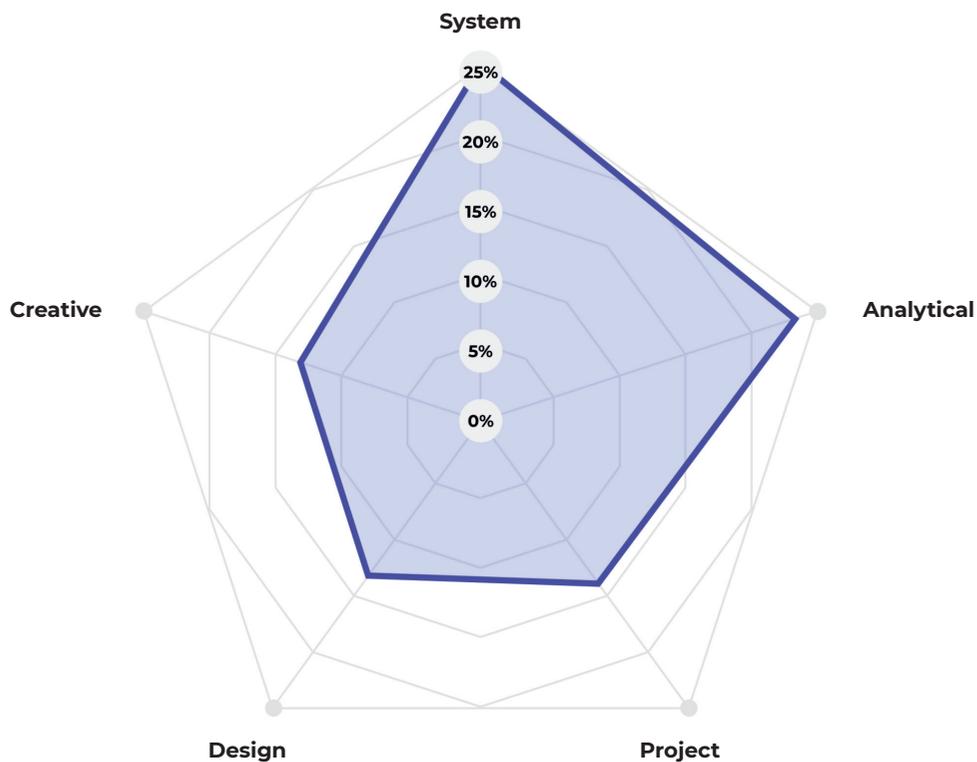
**THE MAIN TRENDS OF ALL CHANGES IN THE ENERGY SECTOR ARE THE INTRODUCTION OF DIGITAL TECHNOLOGIES AND THE INTEGRATION OF ENERGY INTO ALL SPHERES OF LIFE.**

Therefore, the most popular professions will be at the intersection of energy and programming, energy, and ecology, energy, and social

communications.

Cross-functional interaction and project management also become a mandatory part of the work. The more the energy sector develops, the more important the people working in it are for our society. In the energy sector, technological breakthroughs turn into leading technologies within 20-30 years. New competencies are already being formed and we don't have much time to turn them into future energy professions .

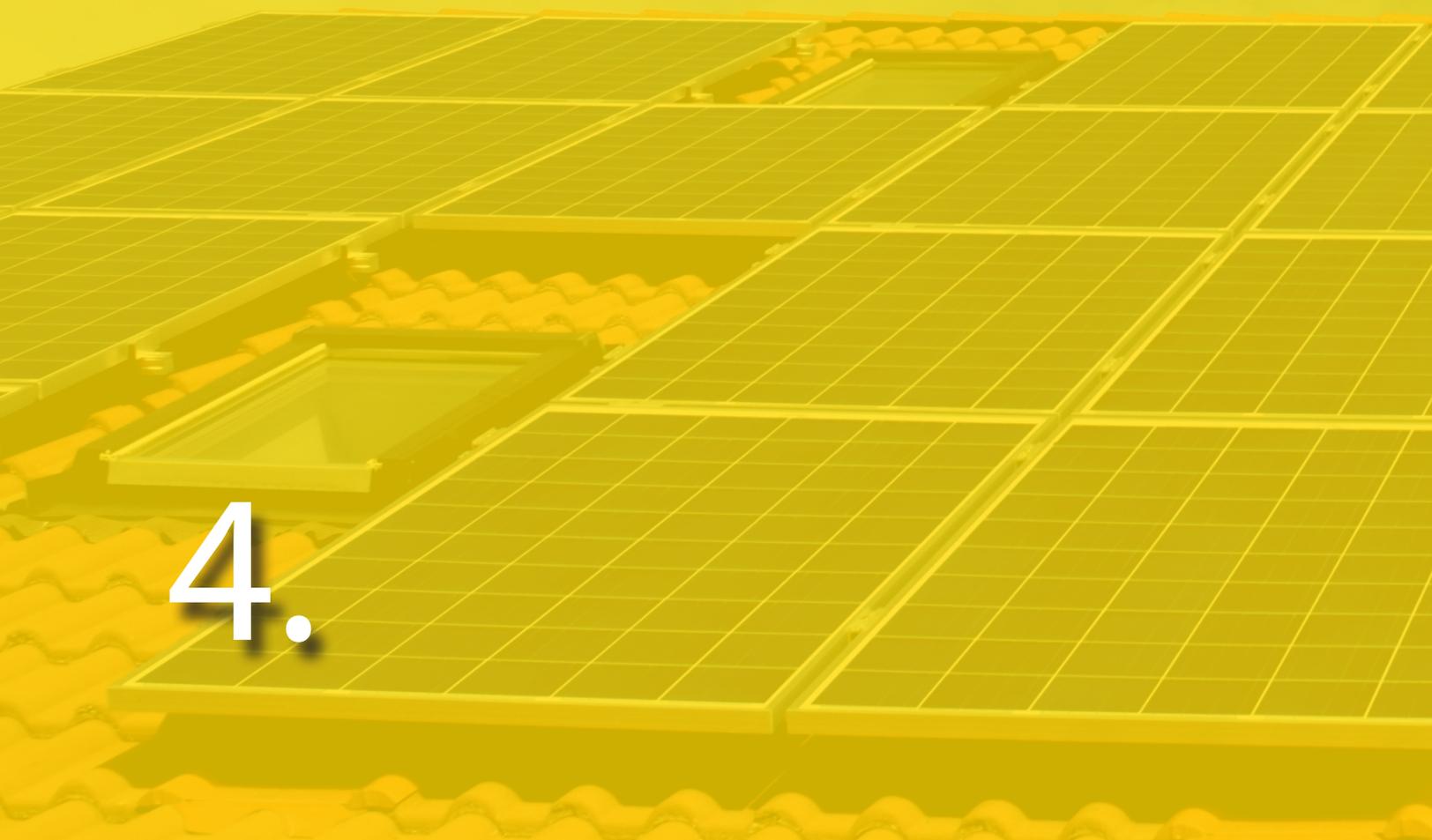
Figure 3.12. **Thinking styles that will be in demand in the future.**



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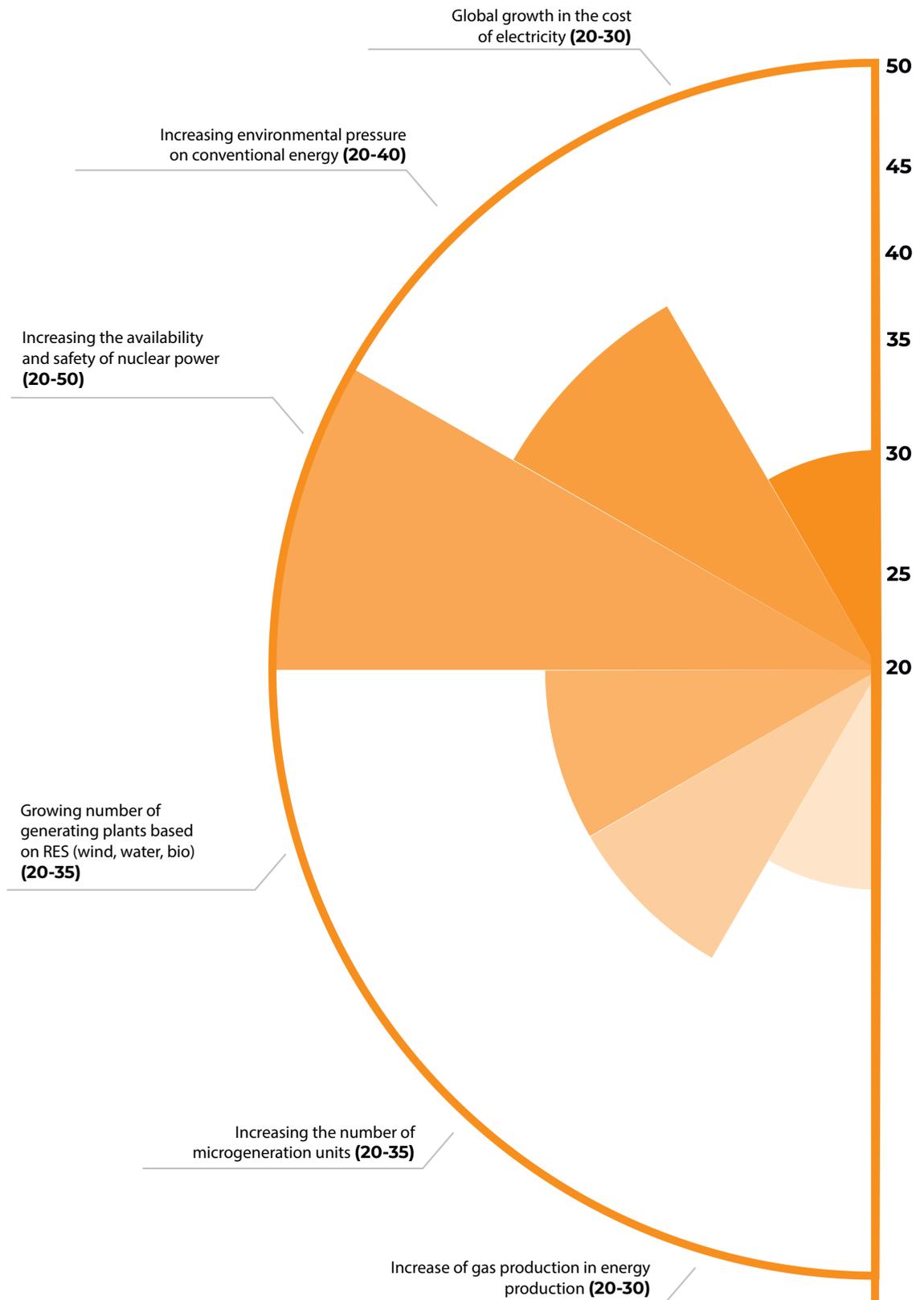
TRENDS THAT SHAPE  
THE FUTURE  
OF THE ENERGY  
INDUSTRY  
OF KAZAKHSTAN

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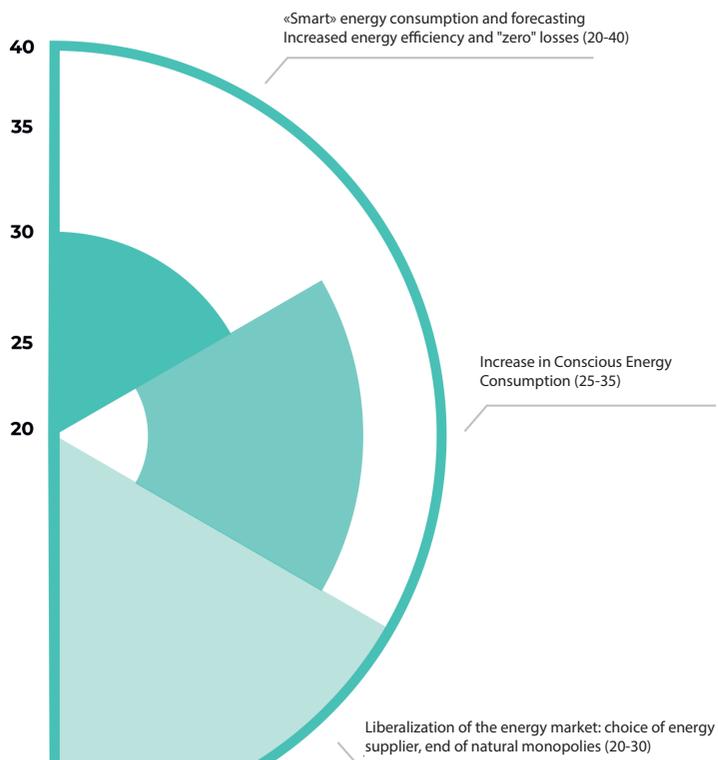
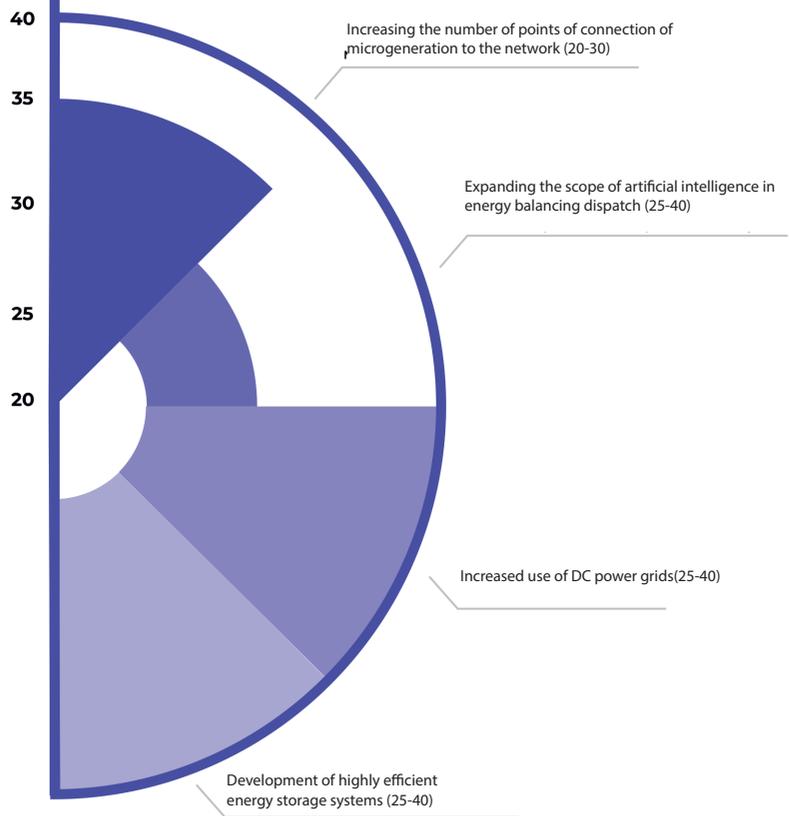


# Map of trends in the energy industry of Kazakhstan



## 1. New Energy Sources: Microgeneration and New Fuels

## 2. New Energy Sources: Microgeneration and New Fuels



## 3. «Smart» energy consumption and forecasting



## TRENDS THAT SHAPE THE FUTURE OF THE ENERGY INDUSTRY OF KAZAKHSTAN

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Research shows that the energy industry has a growing long-term demand for its products, which is an inertial industry, since it requires high investments investment costs.

Changing the structure of energy production is a slow, lengthy process that does not allow you to respond flexibly to changing situations. The specifics of the energy sector of the national economy require huge investments. Therefore, six global

trends have an indirect impact on the industry. It is mainly expressed in the implementation of local technological solutions that increase the efficiency of power plants and electric networks and increase the efficiency of management processes.

## 4.7.

### NEW SOURCES OF ENERGY: MICROGENERATION AND NEW FUEL

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#### 1 TREND GLOBAL GROWTH IN THE COST OF ELECTRICITY

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One of the first questions that was raised by experts of the energy industry was formulated as follows: "When will the era of cheap energy end in Kazakhstan?". According to the General recognition of experts in Western countries, the era of "cheap" energy has passed.

However, Kazakhstan continues to maintain a policy of low prices in spite of the global trend to increase the cost of electricity and heat.

In Kazakhstan, one of the lowest prices for electric power is 17-28 tenge. And in Germany, the price for 1 kW / h varies from 0.244 to 0.345 Euros (approximately 120-170 tenge).

The reason for the trend is that if earlier one barrel was spent on getting 100 barrels of oil, now the world average of 1 barrel allows you to get only 5. Western Countries have reduced the energy capacity of their national income by a quarter. Their response to the rise in prices-

the "explosion" of energy-saving technologies has become a source of energy raw materials. There is no doubt that one of the most important components of the energy development strategy should be the rational use of fuel and energy resources.

In Kazakhstan, the increase in electricity tariffs is proceeding at a moderate pace.

Experts believe that the fight for tariff growth will be one of the cornerstones of Kazakhstan's social policy.

On the one hand, the increase in tariffs is necessary to modernize the industry infrastructure and capacity, on the other hand, the increase in the cost of electric power will immediately hit the population and energy - intensive industries: oil refining and metallurgy.

Experts note that Kazakhstan will introduce a gradual differential increase in the price of energy.

## 2 TREND

# INCREASING ENVIRONMENTAL PRESSURE ON TRADITIONAL ENERGY AND ITS RESPONSE: CLEAN COAL AND INCREASED EFFICIENCY.

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In Kazakhstan, about 70% of electric energy is generated on the basis of

coals. Kazakhstan's coal reserves are huge. Despite the fact that environmental organizations talk about high pollution from coal - fired thermal power plants, Kazakhstan should not abandon its use.

The main problem with coal - fired power plants is the high emission of harmful substances into the environment, but instead cheap electric energy.

One of the ways to solve this contradiction is a set of technologies that are beginning to develop in the traditional energy sector. According to experts from the higher school of Economics (RF), they can be grouped into the following groups

1. clean coal,
2. power units on super-top-critical parameters of the steam,
3. maneuverable generating the installation of a combined heating of the gas and steam cycles, Microtus,
4. Autonomous microturbine power plants.

### CLEAN COAL TECHNOLOGY.

This is a collective term that describes a set of technologies that provide a multiple reduction in emissions of pollutants. Technologies are selected individually for each power plant. It is based on such solutions as hydrogenation, gasification, fluidized bed, and other

### POWER UNITS DESIGNED FOR SUPER - SUPERCRITICAL STEAM PARAMETERS.

The role of coal as a key energy source is increasing against the background of increasing energy consumption in developing countries, many of which are deprived of oil and gas reserves and cannot afford to import these expensive energy resources in large quantities. However, most coal-fired thermal power plants have a low coefficient of efficiency — 35-40%). Increasing the efficiency of coal-fired thermal power plants to 45-47%, and in the future to 52-55%, will reduce the specific amount of harmful emissions into the atmosphere per unit of power and reduce the cost of energy produced. This can be achieved through the widespread introduction of power plants designed for

super-super-critical steam parameters (SSCP), that is, for a pressure of more than 30 MPa and a temperature of more than 560°C. By 2015, the European Union's Thermie energy program plans to create a coal-fired power unit with an efficiency of about 55%, designed for steam parameters of 37.5 MPa and 700-720°C.

#### **MANEUVERABLE GENERATING UNITS WITH COMBINED GAS AND STEAM CYCLES.**

As energy consumption increases, the problem of managing peak loads in power grids and minimizing the risks of cascading accidents is being updated. Hydro-accumulator and hydro - power plants can quickly change the generated power over a wide range and cover peak loads. But the first ones are not enough yet and, in addition, their use is associated with additional energy losses, and for the construction of the second ones, natural resources are largely already exhausted.

At modern thermal power plants, steam turbine generating units are mainly used. Much more maneuverable are gas-turbine ones, in which the turbine blades rotate not by steam, but directly by the fuel combustion products. Moreover, minutes pass from starting and reaching full power to stopping the gas turbine, and hours pass for the steam unit. Gas

turbine installations have a disadvantage — high specific fuel consumption per unit of generated electricity. You can reduce fuel consumption by creating a single combined-cycle unit. In such a plant, the residual heat of the natural gas combustion products that have passed through the gas turbine is used to produce water vapor that drives the steam turbine.

The efficiency of such an installation reaches 55-60% (for a gas turbine, it does not exceed 35%).

#### **AUTONOMOUS MICROTURBINE POWER PLANTS.**

It is advisable to combine generation facilities and consumers into a single energy system in regions with a high population density and developed industry. In sparsely populated areas, which are quite a lot in Kazakhstan. Especially relevant for such territories are cogeneration plants that produce both electricity and hot water for district heating and hot water supply. For small mini-CHP plants in areas of decentralized energy, as well as for backup power plants at strategic sites, it is advisable to use microturbines with a capacity of up to several megawatts, which are capable of operating on various types of combustible gas and liquid fuel. The electric efficiency of microturbine power plants is

25-30%, and the fuel utilization rate (depending on the degree of waste gas heat conversion for water heating) is 70%. Low - power microturbines (tens of kilowatts) are considered to be the most promising. Compared to generators

based on diesel or gas - piston internal combustion engines, these units have greater maneuverability, lower levels of harmful emissions, and a longer service life.

## 3 TREND GROWTH IN THE NUMBER OF GENERATING STATIONS BASED ON RENEWABLE ENERGY

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According to the world wind energy Association by 2050 capacity (wind power stations) Wind farms will provide a third of the world's total energy consumption. Wind power is especially developing dynamically in Asian countries-in India and China, where wind power plants with a total capacity of more than a thousand MW are installed. Some countries are already close to this indicator. In Spain, the total capacity of hydroelectric installations has increased almost 7 times over the past ten years. By the beginning of this century, the country plans to increase them eight times.

Currently, the share of RES in electricity production in Germany, it reached 25% (after the Fukushima-1 accident, it is planned to bring this level to 40% by 2020 and to 80% by 2050. By this time, the figure will reach 85% in Denmark. Speaking about the potential of wind energy, it should be noted that according to the data of the European energy Association, in 2012, European countries overcame the conditional

barrier of 100,000 MW only at the expense of wind installations.

By 2100, the share of oil and coal in the global fuel and energy balance will be 2.1% and 0.9%, respectively, thermonuclear energy will occupy a tenth of the market, and more than a quarter of the world's electricity will be produced by the sun. The reason for these changes is the gradual decline in hydrocarbon production and the reorientation to the construction of cleaner energy facilities. However, there is an alternative expert opinion that one of the prerequisites for reducing the share of hydrocarbons in the world balance is the Paris climate agreements, which are based on the one of the main topics was the freezing of coal projects. Many banks and financial institutions have announced their refusal to invest in coal mining and energy. If the investor's preferences change, the share of hydrocarbons will reduce the rate of decline in the share of coal-hydrogen in the share of energy produced.

Traditional and alternative types of energy develop at different rates, exist simultaneously, and in the near period of 20-50 years, the process of transformation and dominance of one type of energy will not be achieved. Significant changes will follow with the advent of the era of widespread development of road transport on electricity and other energy sources that are not related to hydrocarbons, no earlier than 2030, so the maximum reduction in the share of hydrocarbons is predicted only by 2070.

Reducing the cost of energy obtained from alternative sources is necessary to achieve cost parity between energy from alternative sources and energy obtained by burning energy carriers. The cost of energy received from wind installations has decreased by an average of 40% over the past decades. In some countries, this indicator is close to the cost of electricity produced at power plants that operate in the country on fossil fuels. It should be noted that, despite all the achievements of renewable energy, one hundred percent transition to renewable energy in Kazakhstan is not considered by experts.

This is primarily due to the fact that traditional coal - fired power stations generate not only electrical energy, but also thermal energy. Given the climate in Kazakhstan with its harsh winters (up to -40C), thermal power plants provide the population and production not only with electric energy, but also with heat. Experts note that the development of renewable energy based on solar and wind is promising as an addition to traditional energy and is intended to provide energy to remote localities.

Promising technologies in solar energy are:

1. thin-film solar panels,
2. flat solar collectors,
3. hybrid solar-wind power new installation.

## 4 TREND INCREASED ACCESSIBILITY AND SAFETY OF NUCLEAR POWER

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**N**uclear power generates about 11% of the world's electricity and has a huge potential for development because nuclear

power plants are characterized by low carbon emissions into the atmosphere.

An important condition for the development of nuclear energy is social acceptance: for nuclear energy to emerge and develop in a country, society must accept it.

Nuclear power is one of the most cost-effective technologies that can meet the ever-growing demand for electricity, which also makes a huge contribution to achieving energy independence and security of supply. The number of partnerships and cooperation agreements in the entire nuclear energy production chain is increasing, helping to keep pace with high global demand.

#### **IV GENERATION REACTORS WITH A CLOSED NUCLEAR FUEL CYCLE (FAST NEUTRON REACTORS).**

Nuclear power is not completely waste-free. In the process of enriching natural uranium for fuel production, radioactive waste is generated during the processing of spent nuclear fuel (SNF). After special processing, they can be reused for power generation in generation IV reactors or fast neutron reactors. Switching to them may contribute to an overall reduction in the volume of radioactive waste.

Fast neutron reactors operate in a closed, practically waste-free, cycle. They can be used to "burn" the manufactured nuclear fuel of light - water reactors, use different fuel compositions, including a "mixture "of various isotopes of uranium and other elements

of similar quality, and thus diversify the «fuel basket».

#### **NUCLEAR DESALINATION COMPLEXES.**

Nuclear power is not completely waste-free. In the process of enriching natural uranium for fuel production, radioactive waste is generated during the processing of spent nuclear fuel (SNF). After special processing, they can be reused for power generation in generation IV reactors or fast neutron reactors. Switching to them may contribute to an overall reduction in the volume of radioactive waste.

Fast neutron reactors operate in a closed, practically waste-free, cycle. They can "burn" the manufactured nuclear fuel of light-water reactors, use different fuel compositions, including a "mixture "of various isotopes of uranium and other elements of similar quality, and thus diversify the «fuel basket».

#### **TRANSPORTABLE AND FLOATING NUCLEAR POWER PLANTS.**

There are many hard - to - reach places in the world that are not connected to the main power supply networks, for example, these are areas located beyond the Arctic circle. for the production of heat and electricity, they mainly use small thermal energy and isolated generation (power plants based on diesel generators). To reduce the dependence of such

territories on continuous supplies of fuel and spare parts transportable and floating nuclear thermal power plants of small and medium capacity that operate in an Autonomous mode for a long time can be an alternative technological solution.

Among the most promising and advanced developments in this area is the PATPP, or floating nuclear thermal power plant (a vessel that houses a pair of nuclear units and steam turbine installations, as well as a complex

of auxiliary coastal and hydraulic structures).

Such a station allows for the simultaneous production of heat and electricity and the production of fresh water. The technical solution of pates provides for a flexible power range (12-200 MW) and long-term Autonomous operation. Major repairs of the station are carried out at the ship repair plant every 10-12 years, current repairs, and fuel re-loading are carried out directly on the ship, alternately on each of the blocks.

## 5 TREND INCREASE IN GAS PRODUCTION FROM UNCONVENTIONAL SOURCES

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In 2009, the US has already overtaken Russia as the world's largest gas producer due to increased production of shale gas and coal seam gas.

The search for unconventional sources of gas is being conducted in China and Europe; however, the gas production procedures themselves are still being carefully analyzed.

During the foresight session, experts noted that Kazakhstan may also actively develop gas and fuel production from non-traditional sources. Experts agreed that gas production from coal can be organized in Kazakhstan, which will make

Central Kazakhstan a net supplier, not a gas consumer. During the foresight sessions, experts also discussed bio-gas technologies, as well as the production of bio-fuel from microalgae.

Microalgae production was considered as one of the promising models for Kazakhstan, since it allows remote villages / auls to organize the production of biofuels and thus organize the production of not only agricultural products, but also become a source of fuel for the transport industry of Kazakhstan. At the foresight session, the term energy villages were proposed in order to emphasize that the

development of non - traditional sources of gas and micro - wells can give an impetus to

the development of villages by involving them in the generation and production of new products.

## 6 TREND INCREASED NUMBER OF MICROGENERATION INSTALLATIONS

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Kazakh experts note that microgeneration is growing , and more and more objects that were not previously considered as elements of the generating system are beginning to be considered in this way. So, for example, houses from clean consumers become energy-safe-they consume a minimum of energy, save heat and electricity due to architectural and technological solutions, and thus contribute to the stabilization of the energy system.

introduced a poyament "the object of microgeneration». According to the document, the object of microgeneration is considered to be a facility for production of electrical energy, belonging legitimately to the consumer of electrical energy, the power device which in a technologically - connected to the electricity grid with voltage levels up to 1000 volts, funk - zoniruya including those based on renewable sources of energy.

In the future, houses will switch from energy-intensive to energy-active-they will generate energy. Cars, parking lots, electric poles, house windows, roofs, and even the person himself can also be considered sources of microgeneration.

Mini-and microgeneration technology belongs to the Field of de-centralized energy (DE), namely, to the field of distributed energy. According to THE Wade classification, small-scale or microgeneration is the production of electricity at or near the point of use, regardless of size, technology, or fuel – either off-grid or in parallel with the grid.

This technology represents the creation of your own power stations, at the level of a household or small enterprise, which allows you to solve a number of problems both for the end user and for the energy sector as a whole.

For example, in support of this trend, it should be noted that the Russian Federation has

## 4.2.

### ARTIFICIAL INTELLIGENCE (SMART GRID) IN THE DISPATCHING SERVICE AND OPEN NETWORKS

Smart power supply networks are necessary, first, to provide automatic control and management of the power system. Secondly, they allow you to automatically eliminate and often prevent emergency situations.

This increases the efficiency and reliability of networks, and the production and distribution of electricity becomes sustainable and economically profitable for both the producer and the consumer.

Smart grids become particularly necessary when renewable energy sources are introduced into the energy system. The power generated by them is mostly variable and depends on meteorological conditions. If you do not ensure the consumption of excess power, there is a risk of failure of the entire power system.

Thanks to smart grids, it is possible to quickly connect an additional load (for example, backup batteries) and prevent the situation when the generated power exceeds the consumed power.

#### THE COMPONENTS OF A SMART GRID ARE:

- ▶ ability to self-repair after power failures;
- ▶ possibility of active participation in the work of the consumer network;
- ▶ the network's resistance to physical and cybernetic interference by malicious actors;
- ▶ ensuring the required quality of transmitted electricity;
- ▶ ensuring synchronous operation of power generation sources and power storage units;
- ▶ emergence of new high-tech products and markets;
- ▶ improving the overall efficiency of the power system.

# 7 TREND

## IMPROVING THE NETWORK MANAGEMENT AND MONITORING STRUCTURE, INTRODUCTION OF SMART TECHNOLOGIES

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Demand for electricity has significantly outpaced existing grid capacity, which, along with an increasing number of decentralized generating enterprises, requires energy companies to improve their network management and monitoring structure by implementing smart technologies. Smart meters are an integral part of the broader movement to introduce smart technologies. The installation of smart meters has already begun in the USA and Europe, and Italy is the leader in the installation of such meters.

### TECHNOLOGICAL SOLUTIONS IN THE FIELD OF DISPATCHING AND CONTROL OF ENERGY DISTRIBUTION.

By using the building blocks of digitization, such as service platforms, smart devices, the cloud, and advanced Analytics, companies in the industry are able to increase the lifecycle of infrastructure assets, optimize power grid flows, and innovate customer-oriented products. New value pools can also be used "beyond the electrons" by using big data across sectors. As the sector continues to adapt to various transformations that are taking place, digitization should become the development of

new business models to respond to these shifts in the industry is a key priority, and can indeed support the development of new business models.

Digital technologies have a huge potential to drive growth in this sector and help provide exceptional value for shareholders, customers, and the environment.

### TO CREATE VALUE, FOUR TECHNOLOGY PACKAGES ARE CREATED:

1. Asset lifecycle management. Technological solutions can provide real-time remote control or predictive maintenance to extend the lifecycle or operational efficiency of assets and generation, transmission, or distribution infrastructure.
2. Optimization and aggregation of power systems. Power system optimization is possible through real - time load balancing, network management, and end - to - end connected markets provided by connected assets, machines, devices, and extended monitoring capabilities.

3. Integrated customer service. Innovative products and services with digital technologies related to energy production and management are combined into a comprehensive customer service.
4. Beyond the electron. Hyper personalized connected services beyond the electricity value chain that adapt to the consumer. Electricity is transformed from a commodity to an experience.



## 8 TREND DEVELOPMENT OF HIGHLY EFFICIENT ENERGY STORAGE SYSTEMS

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Electric and hybrid vehicles, as well as renewable energy sources, require highly efficient energy storage systems, the development of which is now a priority. Factors that affect the future potential of power systems include the fundamental parameters and construction technologies of

such systems, as well as the type of material used.

Fuel cells have the greatest potential due to their flexible power structure and the presence of membranes designed for use in specific, well - defined purposes.



## 4.3.

## "SMART" ENERGY CONSUMPTION AND FORECASTING

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### 9 TREND MARKET LIBERALIZATION, WHICH RESTRICTS THE ACTIVITIES OF LARGE ENERGY MONOPOLISTS AND LEADS TO COMPETITION

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The consumer should be able to choose the electricity supplier. In fact, the idea of international trade in electricity, which was supported by the European Commission and is now being implemented all over the world, should be a step towards creating

a continuous high - voltage network through which it will be possible to transfer energy generated from renewable sources from one country to another.

### 10 TREND IMPROVING ENERGY EFFICIENCY.

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Most developed countries are actively developing and implementing solutions to improve the energy efficiency of household appliances by controlling their minimum energy output and by introducing appropriate operating standards for an increasing number of household appliances.

Technologies aimed at reducing fuel consumption and reducing carbon dioxide emissions, such as energy control, green buildings, and clean transport, will prove to be key technological tools for improving energy efficiency and reducing CO2 emissions. This also includes technologies.

# T ECHNOLOGICAL SOLUTIONS IN THE ENERGY SECTOR.

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Technological solutions in the energy sector mainly belong to two large groups:

1. Improving the efficiency of traditional power plants. In this segment of technological solutions, elements of automation and control of production processes are used, which increase the efficiency of operations.- other installations. Introduction of technological developments that use technological solutions that modernize the traditional energy generation process. Technological solutions that reduce or neutralize emissions into the environment and waste processing technologies are also being actively implemented. At the same time, the main technological solutions already exist, and the emergence of breakthrough technologies is not predicted.
2. Improving the efficiency of power plants that use alternative energy sources. There are active developments to reduce the cost of energy generation and achieve parity with traditional sources. Research is being actively

conducted on the expansion of opportunities to use alternative energy sources. So, for example, we are looking for opportunities to use even weak wind to generate energy, and the heat released by the human body can already be used as an energy carrier for heating energy - intensive homes. In this segment, the phenomenon of breakthrough technologies that significantly change the process of generating energy from alternative sources is possible. Another important area is energy balance maintenance technologies. alternative energy sources do not provide continuous and uniform generation of energy, so the issue of storing excess energy produced for use in the period of its shortage is relevant. this problem is now being solved in two ways: the creation of a dispatching system and the distribution of energy between consumers in order to compensate for the lack of energy in one area with its excess in other parts.



## TECHNOLOGICAL SOLUTION IN NUCLEAR POWER<sup>1</sup>

### THE GENERATION IV REACTORS WITH A CLOSED NUCLEAR FUEL CYCLE (FAST NEUTRON REACTORS)

Nuclear power is not completely waste-free. In the process of enriching natural uranium for fuel production, radioactive waste is generated during the processing of spent nuclear fuel (SNF).

After special processing, they can be reused to produce electricity in generation IV reactors, or fast neutron reactors. The transition to them can contribute to an overall reduction in the volume of radio-active waste.

Fast neutron reactors operate in a closed, almost waste-free cycle.

They can "burn" the manufactured nuclear fuel of light-water reactors, use different fuel compositions, including a "mixture" of various isotopes of uranium and other elements of similar quality, and thus diversify the "fuel basket".

<sup>1</sup> <https://issek.hse.ru/trendletter/news/155390153.html>

## NUCLEAR DESALINATION COMPLEXES

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Nuclear power is not completely waste-free. During the enrichment of natural uranium for fuel production, during the processing of spent nuclear fuel (SNF), radioactive waste is generated. After special processing, they can be reused for the production of electricity in generation IV reactors or fast neutron reactors. Switching to them can contribute to an overall reduction in the volume of radioactive waste.

Fast neutron reactors operate in a closed, practically waste-free cycle. They can "burn" spent nuclear fuel from light-water reactors, use different fuel compositions, including a "mixture" of various isotopes of uranium and other elements of similar quality, and thus diversify the "fuel basket".

## TRANSPORTABLE AND FLOATING NUCLEAR POWER PLANTS

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There are many hard-to-reach places in the world that are not connected to the backbone networks. For example, these are areas located beyond the polar circle. Small-scale thermal power and isolated generation (power plants based on diesel generators) are mainly used to generate heat and electricity.

To reduce the dependence of such territories on continuous supplies of fuel, spare parts and service, transportable and floating nuclear thermal power plants of small and medium capacity that operate offline for a long time can become an alternative technological solution.

Among the most promising and advanced developments in this area is the pates, or floating nuclear thermal power plant (a ship that houses a pair of nuclear units and steam turbines-installations, as well as a complex of auxiliary coastal and hydraulic structures). Such a station allows for the simultaneous production of heat and electricity and the production of fresh water. The technical solution of pates provides for a flexible power range (12-200 MW) and long-term Autonomous operation. Major repairs of the station are carried out at the ship repair plant every 10-12 years, current repairs, and fuel re-loading are carried out directly on the ship, alternately on each of the blocks.

## TECHNOLOGICAL SOLUTION IN THERMAL POWER ENGINEERING<sup>2</sup>

### POWER UNITS DESIGNED FOR SUPER-SUPERCRITICAL STEAM PARAMETERS

The role of coal as a key energy source is increasing against the background of increasing energy consumption in developing countries, many of which are deprived of oil and gas reserves and cannot afford the massive import of these expensive energy resources. However, most coal-fired thermal power plants have a low coefficient of efficiency — 35-40%).

Increasing the efficiency of coal-fired thermal power plants to 45-47%, and in the future to 52-55%, will reduce the specific amount of harmful

emissions into the atmosphere per unit of power and reduce the cost of generated energy. This can be achieved through the widespread introduction of energy systems designed for super-supercritical steam parameters (SSCP), that is, for a pressure of more than 30 MPa and a temperature of more than 560°C. By 2015, within the framework of the European Union's energy program "Thermie", it is planned to build a coal-fired power unit with an efficiency of about 55%, designed for steam parameters of 37.5 MPa and 700-720°C.

### MANEUVERABLE GENERATING UNITS WITH COMBINED GAS AND STEAM CYCLES

As energy consumption increases, it is updated the problem of managing peak loads in power grids and minimizing the risks of cascading accidents. Hydro-accumulator and hydroelectric power plants can quickly change the power generated over a wide range and cover peak loads. But the first ones are still not enough and,

in addition, their use is associated with additional energy losses, and for the construction of the second ones, natural opportunities are largely already exhausted. At modern thermal power plants, steam turbine generating units are mainly used. Much more maneuverable are gas turbines, in which the turbine blades rotate

<sup>2</sup> <https://issek.hse.ru/trendletter/news/141133080.html>

not by steam, but directly by the products of fuel combustion.

Moreover, from starting and reaching full power to stopping the gas turbine, minutes pass, and the steam unit - hours. Gas turbine installations have a disadvantage — high specific fuel consumption per unit of generated electricity. You can reduce fuel consumption by creating a single steam unit. In

such an installation, the residual heat of the natural gas combustion products that passed through the gas turbine is used to produce water vapor that drives the steam turbine.

The efficiency of such an installation reaches 55-60% (for a gas turbine, it does not exceed 35%).

## A AUTONOMOUS MICROTURBINE POWER PLANTS

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It is advisable to combine generation facilities and consumers into a single power system in regions with a high population density and developed industry. In sparsely populated areas (for example, in Eastern Siberia and the far East of Russia, Australia, Canada, certain regions of Kazakhstan, etc.), local generation technologies are more profitable.

The electric coefficient of efficiency of microturbine power plants is 25-30%, the fuel utilization coefficient (depending on the degree of transformation of waste gas heat for water heating) — 70%.

Low - power microturbines (tens of kilowatts) are considered the most promising.

In comparison with generators based on diesel or gas - piston internal combustion engines, such installations have a greater maneuverability, a lower level of harmful emissions and a longer battery life. Microturbines of low power (tens of kilowatts) are considered the most promising. In comparison with generators based on diesel or gas - piston internal combustion engines, such installations have a greater maneuverability, a lower level of harmful emissions and a longer battery life.

Especially relevant for such territories are cogeneration plants that generate and electricity, and hot water for district heating and hot water supply.

For small mini-CHPPs in areas of decentralized energy, as well as for backup power plants at strategic facilities, it is advisable to use microturbines with a capacity of up to several megawatts, which are capable of operating on various types of combustible gas and liquid fuel.

## TECHNOLOGICAL SOLUTION IN THE SOLAR INDUSTRY<sup>3</sup>

### THIN-FILM SOLAR PANEL

Polysilicon solar panels are most often used in modern photovoltaics. With a sufficiently high energy conversion coefficient, they are expensive to produce and require a large amount of source material (mono- or polycrystalline silicon). Thin-film solar panels can be a more cost-effective alternative.

Thin-film solar panels are cheap flexible large-area solar cells in which a semiconductor (amorphous silicon or other materials) is deposited in a layer about thick 1 micron on a

substrate of glass or steel.

Such panels can be semi-transparent and transparent, function under diffuse radiation, and produce a higher total power (by 10-15%) than traditional mono- or polysilicon panels. You can buy them in rolls (like fabric or Wallpaper), place them on buildings and architectural forms, or on any electric-powered vehicle (planes, boats, cars, etc.).

### FLAT SOLAR COLLECTORS

Various technologies and solutions are used to generate solar thermal energy. One of the most common is vacuum-operated solar collectors, which account for more than 60% of the world's solar thermal energy. However, they must be installed - they can be installed at a certain angle to

reduce energy loss, and cleaning their working surface requires additional costs throughout the entire service life. It is possible to minimize costs thanks to flat solar collectors, which are characterized by a more optimal combination of price and electricity (investments, as a rule, pay off in five years).

<sup>3</sup> <https://issek.hse.ru/trendletter/news/152199934.html>

A flat collector is a heat-insulated metal box containing a black-painted plate of an absorber made of metal that conducts heat well ((most often it is copper or aluminum). The box has a glass or plastic lid — transparent or opaque, to reduce heat loss. Sunlight passes through the glazing and hits the absorber

plate. It heats up, and solar radiation is converted into thermal energy.



## HYBRID SOLAR AND WIND INSTALLATIONS

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In order to ensure stable energy generation within the annual and daily cycle, hybrid power plants using several renewable sources are being created.

The most popular today are solar and wind installations, which are a combination of solar panels with wind turbines and often up to-powered by a diesel generator

(automatically starts when the power generation level drops, for example, when there is no wind or sun at night). They are a more successful replacement for low-power gas turbine plants, fuel oil boilers and diesel generators, especially those located in the decentralized zone.

## TECHNOLOGICAL SOLUTION IN THE FIELD OF REDUCING HARMFUL EMISSIONS<sup>4</sup>

### EXTRACTION OF CO<sub>2</sub> FROM FLUE GASES IN THE CALCIUM-CARBONATE CYCLE

High cost of industrial installations, lack of universal infrastructure both significant energy and resource intensity constrain the active use of traditional methods for extracting CO<sub>2</sub> from flue gases. Against the background of these limitations, the technology of the calcium-carbonate cycle (CCC), which uses calcium oxide as a chemisorbent (a sorbent that forms a chemical compound when interacting with the absorbed substance), which is obtained from cheap and widely distributed calcium - containing limestones and Dolomites, has become a breakthrough.

The technical implementation of the method consists in moving the SO<sub>2</sub>-CaO bent between two

fluidized bed reactors, in one of which CO<sub>2</sub> is absorbed at a lower temperature, and in the other at a higher temperature, the decomposition of calcium carbonate occurs. The application of this technology is primarily focused on coal-fired power plants with high CO<sub>2</sub> emissions per unit of output. The use of CCC for the extraction of CO<sub>2</sub> from flue gases has a number of undoubted advantages, among them: the relative cheapness of the method, a significant reduction in the amount of oxygen required for the reaction, as well as acceleration of the carbon dioxide absorption process due to the high reaction rate.

### ENVIRONMENTALLY FRIENDLY RELEASE OF CO<sub>2</sub> USING ENZYMES.

When choosing a CCS mod, environmental friendliness and cost-effectiveness of the technology are of paramount importance. One of the most promising methods of CO<sub>2</sub>

extraction is the use of enzymes-organic substances of a protein nature. A key role in the enzymatic separation of CO<sub>2</sub> is assigned to carbonic anhydrase, which mimics the natural enzyme of

<sup>4</sup> <https://issek.hse.ru/trendletter/news/206229435.html>

human lungs, which captures and removes CO<sub>2</sub> from the blood and tissues. It catalyzes a chemical reaction between carbon dioxide and water, converting carbon dioxide into bicarbonate, which can then be processed into baking soda and chalk. For industrial

applications, the enzyme is immobilized with a solvent inside the reactor.

When the flue gas passes through the solvent, the enzyme converts carbon dioxide to bicarbonate.



## M EMBRANE SYSTEMS FOR CAPTURING CO<sub>2</sub> PRIOR TO COMBUSTION

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**T**echnologies for capturing CO<sub>2</sub> before incineration play a significant role in reducing carbon dioxide emissions and reducing the negative effects of global climate change. However, the use of traditional amine technologies increases the cost of electricity by 80% and its consumption by 25-40% of the indicators without the use of CCS technologies.

Among the available alternatives, the most promising is the use of use of membrane systems that

do not require serious investment in installation. The membrane allows condensing vapors (C<sub>3</sub>+ hydrocarbons and heavy; aromatic hydrocarbons; water) to pass through, but does not allow uncondensed gases (methane, ethane, nitrogen, and hydrogen) to pass through.

This method will significantly reduce the negative impact of carbon dioxide emissions on the environment and reduce energy costs.

## TECHNOLOGICAL SOLUTIONS IN THE FIELD OF DISPATCHING AND MANAGEMENT OF ENERGY DISTRIBUTION

By using the building blocks of digitization, such as service platforms, smart devices, the cloud, and advanced Analytics, companies in the industry are able to increase the lifecycle of infrastructure assets, optimize flows in electric networks, and innovate by targeting the customer. New value pools can also be used "beyond electrons" by using big data across sectors.

As the sector continues to adapt to the various transformations that are taking place, digitization

should be a key priority, and can indeed support the development of new business models to respond to these shifts in the industry.

Digital technologies have huge potential to drive growth in this sector and help deliver exceptional value for shareholders, customers, and the environment.

### FOUR THEMES ARISE FOR CREATING VALUE:

1. Asset lifecycle management. Technological solutions can provide real-time remote control or predictive maintenance to extend the lifecycle or operational efficiency of generation, transmission, or distribution assets and infrastructure.
2. Optimization and aggregation of power systems. Power system optimization is possible through real-time load balancing, network management, and end - to - end connected markets provided by connected assets, machines, devices, and advanced monitoring capabilities.
3. Integrated customer service. Innovative products and services with digital technologies related to energy production and management are integrated into a comprehensive customer service.
4. Beyond the electron. Hyper

personalized connected services beyond the electricity value chain that adapt to the consumer.

Electricity turns from a commodity into an experience.

## 1 ASSET LIFECYCLE MANAGEMENT

Asset lifecycle management includes technological solutions that provide real-time remote management or predictive maintenance to increase the lifecycle or operational efficiency of assets.

Some utilities are implementing projects and implementing technologies such as smart sensors for generation and distribution assets. However, many assets still lack data collection and transmission capabilities and are not connected to a Central platform.

learning algorithms can do a lot to improve efficiency and predictability." The motivation is clear: the US Department of energy found that 75% of failures are fixed by energy companies that have implemented preventive maintenance.

Operational recommendations can be obtained in real time using data received from connected devices, equipment, and plant sensors, and applying algorithms to this data. Plant managers can immediately identify actions that reduce production costs, and can also predict and prevent unplanned downtime. Engineers can be more productive by making more informed decisions; this may eventually lead to a smaller, more skilled workforce.

As an example, real-time Analytics helps businesses better understand the trade-off between asset life and revenue generation, since there may be times when it makes sense to work harder on a machine if the generator can take advantage of pricing advantages in a shortage environment.

Slight increase in the efficiency of generators, transformers, or lines power transmission will have an exponential effect after massing across the industry.

According to AutoGrid's CEO, "data is a cheap, clean, and unique resource that progresses over time. Machine



## **M**ANAGEMENT THE PERFORMANCE OF THE ASSETS

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**T**his digital initiative includes health monitoring, predictive forecasting, and reliability center maintenance, all provided by Analytics and robotics.

## **D**IGITAL FIELD WORKER

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**T**he goal of this digital initiative is to use digital technologies to improve the productivity and productivity of field workers by providing them with data and tools to improve performance. Electronic work packages can transform the final work cycle, from planners and planners to those responsible for data entry and reporting.

## **S**MART ASSET PLANNING

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**S**mart asset planning encompasses the use of predictive Analytics, machine learning, and robotics to improve capital project execution, including site and asset selection, installation, and decommissioning.

## 2 OPTIMIZATION AND AGGREGATION OF POWER SYSTEMS

This theme embodies the shift of the utility towards "Optimization", solving the problem of inefficiency and waste in the transmission and distribution network through a number of digital initiatives.

Network optimization has become possible thanks to load balancing in real-time mode-time management and network management, which is provided by connected devices and advanced monitoring capabilities.

Utilities will be able to receive the latest usage information from customers in real time, while customers will receive the latest price signals and tariffs. According to the Director of Group Strategy at Centrica, "data allows the network to be more efficient, reduce the amount of spare capacity in the system, offering more accurate optimization and flexibility in meeting requirements." The impact of this topic is transformational: the system can start sending the most cost-effective, reliable, and sustainable sources to meet demand, ensuring higher efficiency. The optimized grid of power systems goes beyond the deployment of an intelligent network (a new technology in the old management paradigm), combining the infrastructure

of an intelligent network with Analytics and intelligent devices, connecting the network to the client. At the same time, it also creates an efficient and well-functioning market by offering price signals that contribute to the correct behavior of market participants. In addition to increasing the return on existing investments in smart meters, mobile devices and social media tools will improve customer communication. Along with improved understanding, this creates a dynamic user interface where utilities can offer customers genuine value through additional services, providing the data base of integrated customer services.

Information about the optimized distribution grid can also be applied to system operators. As improved data will contribute to a better understanding of supply and demand, digital technologies can use demand information to reduce transmission congestion by distributing distributed resources, rather than connecting to remote resources via a transmission grid. An improved link between wholesale and retail prices can be established, allowing wholesale companies to take more real-time information into account when making price decisions. In General, digital technologies can increase the flexibility of the system by establishing this feedback loop.

## ENERGY AGGREGATION PLATFORMS

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In this digital initiative, the utility serves as an aggregator of locally generated energy. Energy aggregation platforms transfer small sources of distributed energy-renewable energy sources such as photovoltaic, wind, biomass, heat, and electricity, or diesel-to a single platform, allowing a cluster of generators to act as one large power plant. These platforms can both supply electricity when needed, and store any excess power, thereby balancing the power grid.

The platform's technology allows for more efficient integration of renewable energy sources into the energy system, since their changes are managed from a single Central control room.

A typical example of such a platform is a virtual power plant that combines renewable energy sources while avoiding the common pitfalls of lack of scale and predictability.

A virtual power plant allows you to optimize the system in accordance with the needs of the regional power system and can provide more economical than the supplied electricity. Investment decisions are made more efficiently, since they can be based on the additional capacity required.

## REAL-TIME DEMAND AND SUPPLY PLATFORM

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This digital initiative refers to monitoring and informing about current demand and supply loads combined with a discriminatory pricing structure.

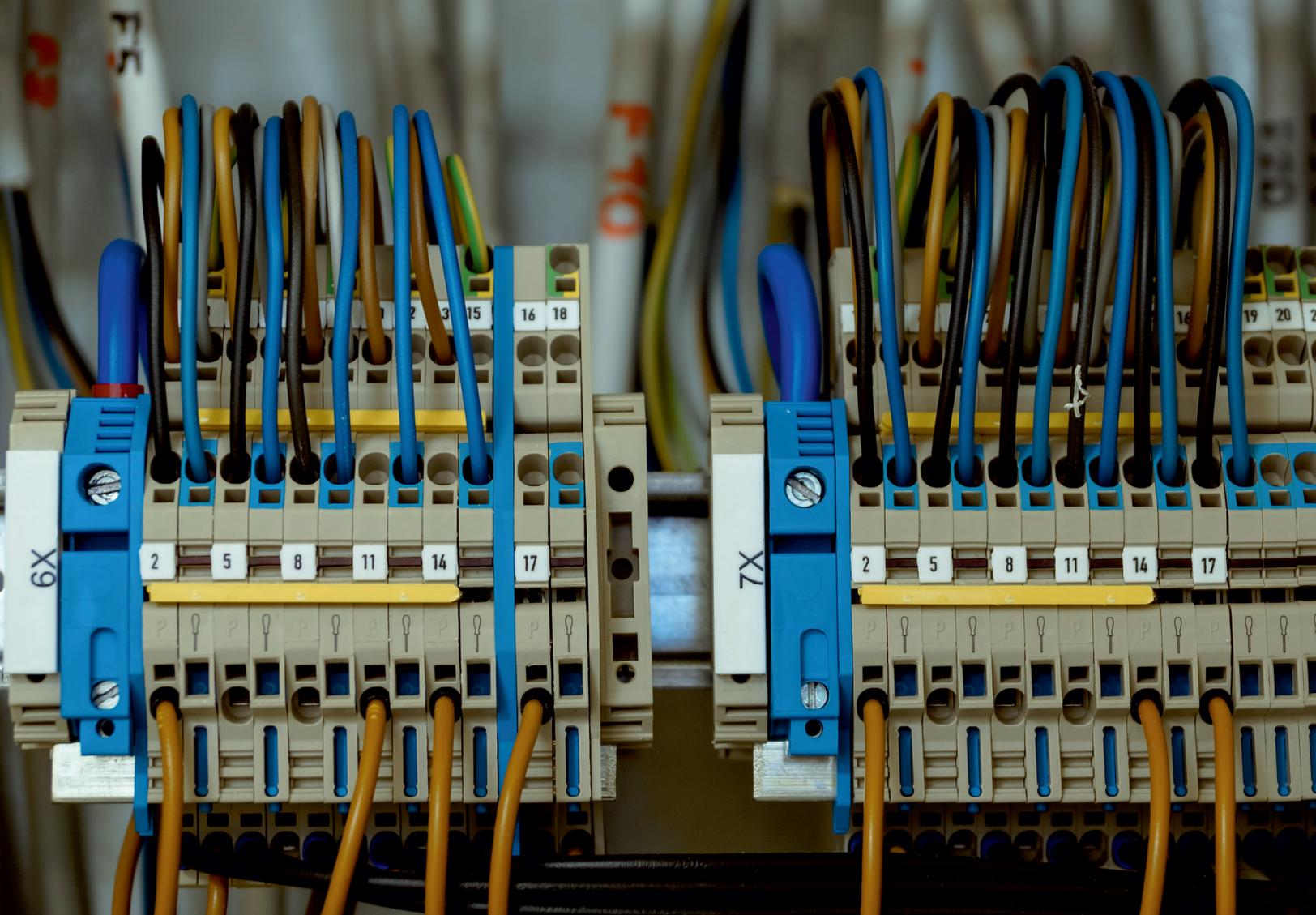
This takes into account fundamental behavior change through tariffs, localized price signals, and interconnectedness.

Repost Power in Australia allows consumers to sell electricity back to the grid by placing bids back

on the market, thereby turning residential properties into micro electric power stations.

Control is automated, so energy is sold to the grid at high prices.

Customers can be confident that they are getting the best price for excess electricity, and can reduce their usage to sell more back to the grid.



## NETWORK MANAGEMENT IN REAL TIME

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The function of this digital initiative is to regulate load changes in real time.

Such adjustments can also be made to increase or decrease generation and for conditions of

failure of the distribution system.

This allows two-way communication and operational signals with the market.

## CONNECTED AND COMPATIBLE DEVICES

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This digital initiative focused on the connection between the devices as well as on the collection and display of points of

energy consumption for the utility. They can then be connected in a distribution network.

### 3 INTEGRATED CUSTOMER SERVICE.

Electric power companies will move from "energy - oriented" to "customer - oriented", using the growing volume of data on customers to better understand their behavior.

There is a huge opportunity to develop innovative products and services with digital technologies, combined to provide an integrated customer service. Energy companies will begin to play a more important role in how consumers optimize their homes, choose tariffs, manage consumption and payments, and implement self - generation.

Consumers are beginning to expect choice, reliability, and personalized service that goes beyond the meter. A growing number of blue-chip vendors, such as Apple, Google, Samsung, and Verizon, are partnering with existing hardware and software vendors to develop integrated customer service. These players are well positioned to ensure smooth interaction with consumers across all channels and challenge the traditional utility model.

Digitally engaged customers have a higher potential value for utilities, as they are more likely to participate in energy management programs and trust (and be satisfied with) the services they receive. According to the group's Director of innovation, Iberdrola: "it is Important to invest in

comprehensive customer service offerings that may not have economic benefits at the moment, but will increase customer segmentation and improve loyalty and experience."

Success in this market will depend on the ability to provide customers with solutions that give them the flexibility to manage, monitor, and switch between different energy sources.

For example, Solar City, which leases distributed assets without initial charges, makes using Solar simple and affordable.

Accenture New Energy Consumer research in 2015, it showed that although only a few respondents (9%) had solar products in 2014, 55% considered buying or subscribing to solar energy in the next five years. The shared economy will contribute to the democratization of energy sources, as communities or local businesses will be connected to the platform to buy and sell electricity from each other, matching supply with demand at the micro level.

Integrated customer service is also related to how energy technology companies expand the ability of companies to self - generate, participate in demand

response programs, and apply a data - driven approach to consumption management.

A number of energy technology companies, such as Silver Spring Networks, AutoGrid, Tendril, Opower, and Hitachi, among others, offer data management platforms that incorporate these advantages. These companies benefit from conducting Analytics on the growing volume of smart meter data points to get real - time information about energy management.

Some companies, such as Comverge, Enablon, and C3 Energy, also use ideas from the behavioral Sciences to encourage energy users to use interactive portals and personalized tips to reduce their consumption and improve energy efficiency.

## INTEGRATION OF STORED ENERGY

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Technological solutions that allow the integration of energy storage devices into the network, including at home, are the focus of this digital initiative.

## INTEGRATION OF ENERGY SOLUTIONS

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Branded solution integrators will provide new services that will help customers not only optimize production and energy use, but also provide greater control and cost savin.

## ENERGY MANAGEMENT

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This digital initiative will see prosumers provided with the energy information displays and controls they need to manage generation, storage, and flow.

## DIGITAL CLIENT MODEL

Customers will increasingly interact with their electricity supplier through multiple channels, including the Internet, mobile and social networks. The customer experience model will be transformed with built-in customer Analytics in services that accelerate digital migration and improve customer interaction.

## 4 BEYOND THE ELECTRON

Now customers are beginning to develop "liquid expectations", believing that high-quality services in one industry should be linked and transferred to another.

Technology advances this expectation with sensor-rich objects, more intelligent devices, lower cloud computing costs, and increasingly seamless connectivity.

As statkraft's senior vice president for strategic affairs noted, " data-driven business models offer flexibility, improved margins, and the ability to deliver new value to

the existing customer base."

Electric power companies can look "beyond the boundaries of electricity" by providing a Hyper-personalized, connected service that adapts to changing consumers, businesses, and citizens.

As the supply of electricity is transformed from a commodity to an experience, it will be managed not by a single utility company, but by cross - industry partners - the key difference between this theme and integrated customer service.

## «LIVE» SERVICES

«Live» services describe cross-industry digital services that can be offered to consumers through a combination of sensors, the cloud, connected smart devices, and real-time Analytics to provide a new level of integrated interaction with consumers.

## INDUSTRIAL SERVICES

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As part of this digital initiative, business clients will be offered a range of engineering services, such as manufacturing and manufacturing processes, energy, energy, data protection, lighting, and security. All of them work on the same platform and are constantly developing using analytical data.



## MUNICIPAL SERVICES

It covers the full integration of services for citizens, such as transportation, emergency management, food, sanitation, waste management, and electricity.

Citizens will interact with service providers in real time and receive personalized services.

## EXAMPLES OF TECHNOLOGIES USED IN THE ENERGY INDUSTRY

### DIGITAL CONVERGENCE

In late 2017, the Arizona public service and Sunverge announced a pilot program to install battery-inverter units and energy management systems at home to "help balance the growing power level swings and dips in the solar energy generated by customers during the day."

Under the pilot's guidance, ten homes will be equipped with a 6.4-11.8 kW/h lithium-ion battery and an inverter unit. Another 65 customers will receive Sunverge energy management gateways, which centrally manage and optimize network distributed energy resources and, in turn, minimize electricity demand, maximize savings over time-varying tariffs, and provide demand response and other network services.

Sunverge aims to minimize customer participation in the sub - division; instead, they focus on keeping customers informed of how much they have earned.

The pilot gives stakeholders a "look into the future of the energy system", where supply and demand for energy are balanced "house by house", without sacrificing comfort.



## THE NEW SIDE OF ENERGY

In 2016, LO3 Energy launched Brooklyn Microgrid, a blockchain platform that allows participants to "generate, store, store, and sell energy locally."

Fifty participants installed smart meters equipped with blockchain technology that tracks the energy they generate and consume and automatically records contracts and transactions between neighbors.

The LO3 blockchain platform "activates the Internet of things in the local energy system, allowing you to generate market signals that will regulate and balance neighboring loads... and coordinate with a broader interconnected transmission network."

Brooklyn Microgrid also hosts community workshops to discuss how technology can go further and expand consumer choice.

Accenture's analysis shows that 69 percent of consumers are already interested in the energy trading market, and 47 percent plan to sign up for community-based solar projects. Many believe that Brooklyn Microgrid is the beginning of the future "prosumer".

## CHOOSING A NEW «GREEN» ENERGY

Founded in 2014, Arcadia Power's digital utility allows individual consumers to access clean energy regardless of where they live and without leaving their existing distribution network.

The company connects wind energy producers who generate renewable energy certificates (REC) with individual customers through a simple and user-friendly software application that tracks customer usage and impact and seamlessly processes payments for a traditional utility.

In recent years, Arcadia has added the ability for customers to access (and get credit for) public solar projects and receive (in States that allow retail competition) "price alerts" for alternative suppliers, which have saved customers an average of 17% on electricity bills.

The company also develops options for home energy efficiency and responding to demand.

As of August 2018, the company operates with more than 100 communal services and more than 175,000 customers nationwide.

## INTERNET OF ENERGY

In early 2017, the Rocky Mountain Institute and the Austrian blockchain company GridSingularity created the Energy Web Foundation.

Global non-profit activities are aimed at accelerating the development of blockchain solutions in the energy sector, including addressing issues such as demand control, tracking energy flows, market participation, and determining customer priorities in the market.

The group is currently developing an open-source public blockchain platform for the energy sector, while its subsidiaries (more than 80) are focused on creating industrial applications for blockchain technology.

## THINK GLOBALLY, INVEST LOCALLY

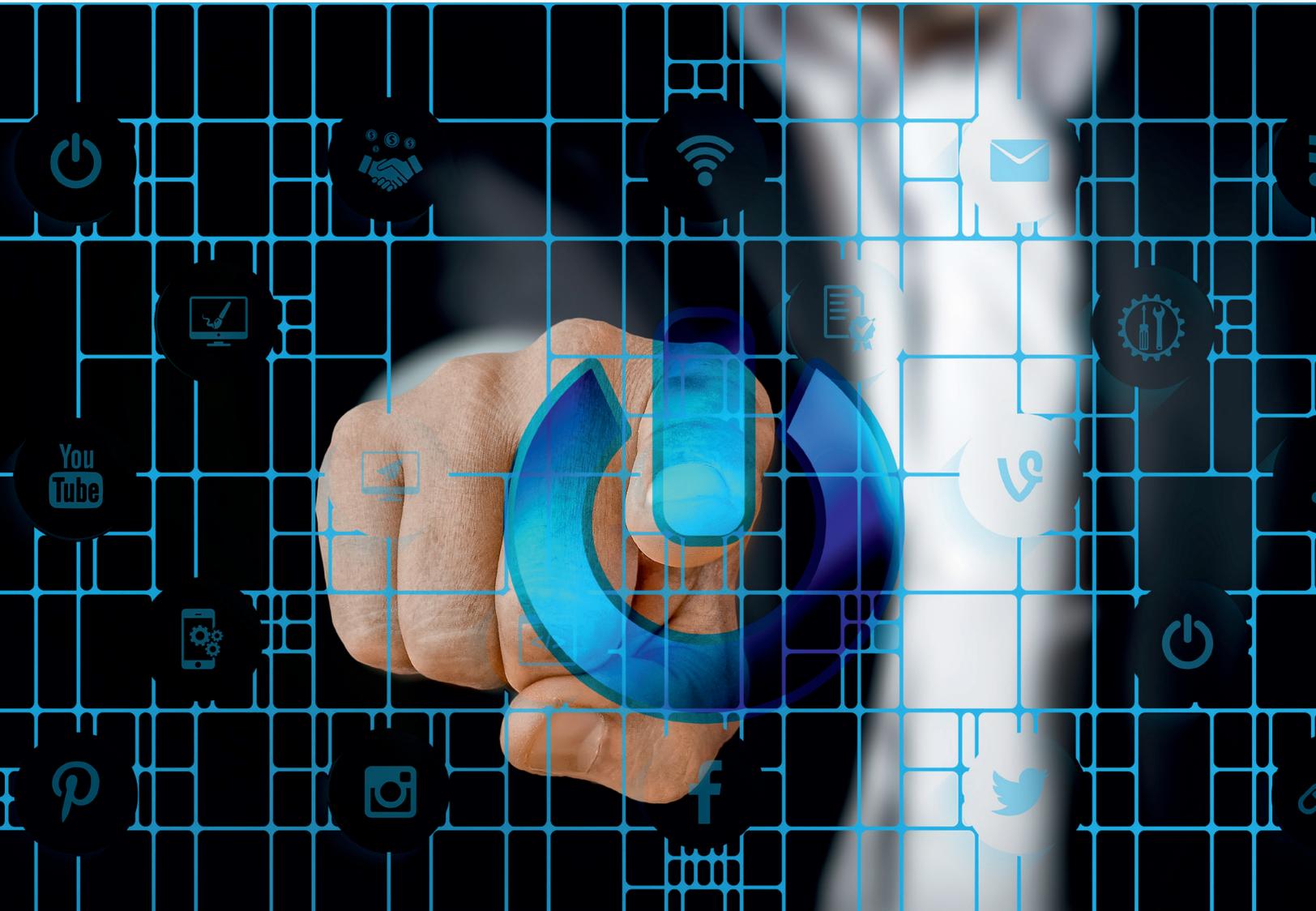
In 2015, Gridshare launched a crowdfunding platform for renewable energy sources to facilitate debt and equity financing for accredited investors. In early 2017 the company has received permission from the financial industry regulatory authority (FINRA) to expand its platform for non - credit investors and to reveal the financial power of a wider "crowd" of individual investors. Potential investors can view projects online and provide funding in exchange for shares or interest. Projects on the platform are currently limited to raising us \$ 1 million and usually combine crowdsourcing with other sources of funding. As of the end of 2017, GridShare was one of 36 crowdfunding platforms that collectively raised almost \$ 90 million.

## «SMART» GRID

The fluctuation in the generation of energy from renewable energy sources places special requirements on the energy supply system: the energy system requires sufficient capacity and flexibility to maintain and balancing markets for energy-dependent renewable energy sources. Connectivity is becoming a fundamental requirement for intelligent networks, and this interconnection of generators, consumers, networks, and storage is becoming a Central element of our future energy supply.

However, future networks require not only an efficient, secure, and cost - effective communications infrastructure, but also standards for data security, data protection, and system interaction.

Governments and market participants are looking for alternative solutions. For example, in the Netherlands, the recently presented draft of the Dutch climate agreement highlights the importance of managing demand, energy storage, and blockchain. In 2017, the electricity transmission network operator in the Netherlands, Tennent, launched its first pilot project using blockchain technology (which was also the first of its kind in Europe) using decentralized energy storage systems and blockchain technology to balance the network. In the experiment, the battery capacity of electric vehicles was used to stabilize the high-voltage network.



## IT-SECURITY

Many countries either already have or are actively implementing rules and regulations to improve the security of information technology systems. In practice, their implementation (not only for critical infrastructure) remains a challenge for many companies.

The operation of a secure power supply system must include adequate protection against threats to telecommunications and electronic data processing systems. Operators of critical infrastructure power plants must provide adequate protection against threats to these systems.

Some countries, such as Germany, have introduced special directories on information security. The German IT security catalog provides for the creation of an information security management system in accordance with DIN ISO/IEC 27001, as well as certification by an independent and authorized body. Experience will show whether such security directories can help establish adequate protection against threats to the ICT systems necessary for the secure operation of the network.



A

WHAT IS  
THE FUTURE OF THE  
ENERGY  
INDUSTRY  
OF KAZAKHSTAN?

5.



# THE FUTURE OF KAZAKHSTAN'S ENERGY SECTOR:

## TRADITIONAL ENERGY

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Traditional energy in Kazakhstan primarily includes coal – fired power plants-they generate up to 70% of energy and 100% of heat. Hydroelectric power stations also belong to the traditional energy sector. they generate up to 10% of electricity.

Nuclear power is a traditional energy industry, but there are currently no such facilities in the Republic of Kazakhstan.

# 70%

## COAL-FIRED POWER PLANTS

## CHEAP ENERGY

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A socially-oriented model. Energy is recognized as a basic human need, the availability of which is required provide the state. Such a social institution for energy supply has been made possible by complex mechanisms for attracting investment and state guarantees and subsidies for enterprises of renewable generating stations and networks.

High infrastructure availability of energy encourages the development of energy-intensive enterprises and households.

But at the same time, the low price of energy for consumers reduces the overall level of consumption culture and develops wastefulness.



# 4 MAIN ECONOMIC FACTORS

10%

SUN  
AND THE WIND

## ALTERNATIVE ENERGY

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Non-traditional energy includes: small hydroelectric power plants, wind, solar, geothermal, hydrogen, thermonuclear bioenergy, as well as fuel cell installations.

Since 2014, Kazakhstan has been actively developing solar and wind energy. In 2020, they generate 3%, and by 2030, they will generate 10% of Kazakhstan's electricity.

## EXPENSIVE ENERGY

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Business-oriented model. The high price of energy and, as a result, a significant net income of electric power companies - getice allow the industry to dramatically increase the number of modern renewable generating stations, corresponding not only to environmental requirements (absence of harmful emissions and waste production), but also ergonomic requirements (no - danger to human health and the environment, the absence of accompanying physical-hee - economic changes on the landscape, climate and biogenesis - for example, humming vitrostone walk, the relocation of insects and small animals, creating uncharacteristic vortex and magnetic flux). High cost and the environmental value of electricity has increased the rationality of its consumption - from the development and implementation of "smart" accounting systems in all spheres of life to the rejection of energy consumption for "non - effective" purposes and needs of both the population and enterprises.



# SCENARIOS FOR THE DEVELOPMENT OF ENERGY IN THE REPUBLIC OF KAZAKHSTAN

## THE SCENARIO OF CHEAP ENERGY

Under the scenario of cheap electricity, the Kazakh industry will not carry out energy modernization (it is cheaper to pay for energy than to buy new equipment), which means that despite the low price, energy consumption will be higher, and this will also negatively affect the competitiveness of products. Energy companies will also not have the funds to renew fixed assets due to lack of profit. Given the great wear and tear of Kazakhstan's power generating devices, in a few years they will begin to fail, and Kazakhstan will face a shortage of energy, interruptions in power supply, primarily in residential buildings.

## EXPENSIVE ENERGY SCENARIO

If the first scenario is chosen: the scenario of expensive energy, then the industry of Kazakhstan will be absolutely uncompetitive. Drivers of Kazakhstan's economy: the oil and gas industry and metallurgy are very energy-intensive, which means that Kazakhstan's products will become much more expensive. Taking into account the low energy efficiency of Kazakhstan's economy as a whole, this means that domestic production will become more expensive than that of competitors. The population will also be in a difficult situation. Energy tariffs will increase significantly, not everyone will be able to afford to pay for heat, and given the significant duration and temperature indicators of winter in a large area, there will be social discontent.

## 2035 DIFFERENTIATED ENERGY PRICE SCENARIO

The future of Kazakhstan's energy sector is formed at the junction of these two models. Kazakhstan now has a cheap energy model and will switch to a moderately expensive one by 2030. The transition will be made through a differentiated approach to pricing. The differentiated approach will be based on three pillars: who consumes (subjects of consumption), when it consumes (day, evening, and night tariffs) and what it consumes energy for (target tariff).

Thermal power plants, gas turbine power plants, as well as 3-4 small nuclear power plants with a capacity of up to 400 MW will be built.

## HOW WILL KAZAKHSTAN'S ENERGY SECTOR CHANGE BY 2035?

1. From CHP to microgeneration and end-to-end energy:
  - ▶ Low-carbon technologies in thermal power plants.
  - ▶ Growth in the number of solar and wind generation.
  - ▶ Generation in metallurgy, agriculture, and construction.
  - ▶ Eco-generating villages.
  - ▶ Microgeneration of homes and residents.
2. Open networks and artificial intelligence dispatching:
  - ▶ A decentralized network with access from large and private sources.
  - ▶ Artificial intelligence in the service of energy balance and distribution.
  - ▶ Development of storage capacities in the amount of 300 MW.
  - ▶ Ekibastuz energy HUB, electricity Transit in Eurasia.
3. Smart consumption zero energy loss:
  - ▶ Smart monitoring of consumption in homes and businesses.
  - ▶ Basic rate and differentiated pricing.
  - ▶ The culture of consumption, competitions, and the establishment of best practices.
  - ▶ Choosing an energy supplier and choosing cheap or expensive energy.

# FROM THERMAL POWER PLANTS TO MICROGENERATION AND "END-TO-END" ENERGY.

## 3000 mW

must be introduced by 2026 to cover the growing demand for electricity.

Innovative technologies for complete processing of coal made it possible to obtain environmentally safe energy fuel. The use of these developments is not only - the co increased energy production against the background of a significant reduction in atmospheric emissions, and also allowed to obtain various metals and their alloys from coal and slag. Moreover, new methods of coal chemistry used in this type of coal processing are much cheaper than the metallurgical method and do not harm the environment. The spread of these technologies has solved the problem in Kazakhstan 1 billion tons of accumulated ash and slag..

## SMALL NUCLEAR POWER PLANTS UP to 400 mW

Gas turbine power stations will allow creating maneuvering capacities and saving up to 5 billion tenge per year on purchasing maneuvering capacities from abroad

An established sector of the maneuvering capacity on the basis of small nuclear energy closed nuclear fuel cycle and gas turbine power plants (and/or high - temperature gas reactors) and development of complex battery systems and energy storage (vanadium batteries, and liquid metal instead of wires or water) solved the problem of impermanence capacity renewable power generation and to optimize energy costs for the end user.

## METALLURGY, CONSTRUCTION, AND AGRICULTURE

Will become energy - generating industries, and they will have special divisions responsible for collecting, generating, and distributing energy.

The country has achieved full harmonization of traditional and alternative power generation, primarily through the introduction of hybrid generating systems: generation and distribution of electric and thermal traditional and alternative capacities is carried out with the maintenance of the consumption schedule, by combining centralized and Autonomous consumption based on consumer requests.

Energy has become a cross-cutting industry in Kazakhstan through the introduction of technologies for capturing energy released as part of ongoing physical and chemical processes in various sectors and spheres of the national economy (economy of the country).

One of the first through lines were:

- ▶ The combination of metallurgical and energy processes, the use of associated gases to produce energy
- ▶ processing of vegetable raw materials and biomass into energy
- ▶ design and construction of buildings principles of passive energy due to temperature difference of air flow, the use of weak mechanical movements, water, dust, by-product gases, movement of staff and visitors in office buildings, as well as by differences in ground potential at the time of personal depth (building Foundation with thermal deep collector).

Passive energy generation technologies allow generating energy not only for large enterprises, but also for individuals. Each resident of the country provides himself with the amount of energy necessary for personal consumption due to the capabilities (devices, technologies) of microgeneration implemented in the objects of daily life management. Smart eco-energy villages/settlements have become one of the new generating entities in Kazakhstan. The main characteristic of eco-energy settlements is a full-cycle, waste-free, environmentally friendly economy. Along with the cultivation of traditional agricultural crops in open ground and greenhouse complexes, eco-energy villages grow aquaculture and microalgae.

Plant waste, biomass, and microalgae are fully processed into energy to produce related / by-products such as plastics, building materials (pressed blocks and slabs). For energy production, not only bio-processing is used, but also various advantages of the terrain, features of climatic zones, implementing technologies of gasification, hydrogenation, transesterification and hydrothermal liquefaction.

The high efficiency of alternative energy production methods used allows eco-energy communities to be self-sufficient in energy and heat supply, as well as supply energy to the domestic and foreign markets of the country. The development of eco-energy settlements allowed us to develop the boundless territories of Kazakhstan, increase the availability of transport and energy infrastructure, and reduce urbanization.

The development of solar, wind, and hydro power required the creation of a sector of technological support – power engineering and service maintenance, and climate forecasting, which solves the problems of optimal use of various types of renewable energy generators depending on weather conditions.

## MICROGENERATION

Each object will potentially become a micro generation center: a car, the roof of a house, a bag or briefcase, etc.

## ECO-ENERGY VILLAGES

A new subject for generating electric and thermal energy.

They will change agriculture, provide deep penetration of energy and agricultural technologies.

This direction will give rise to a number of new professions by mixing the competence of power engineers and biologists.

## ENERGY

– is the engine of development of related industries

## SUMMARY:

*Generating centers will expand, there will be not only large thermal power Plants based on new low - carbon technologies, but also generating centers will be created in new industries: metallurgy, construction, agriculture, on the basis of biofuels and microalgae, eco-energy villages will be created, which will be centers for generating electricity and heat. and at the lower level, there will be a microgeneration system that will generate energy for its own consumption, reducing the load on the Central generating networks.*

*it is possible to switch to distributed networks – this is when each district generates heat and energy itself and thereby reduces the cost of energy transportation.*

# OPEN NETWORK AND DISPATCHING BY ARTIFICIAL INTELLIGENCE

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## EKIBASTUZ ENERGY TRANSPORT HUB

Was created in Soviet times. It allows you to transport energy between the Siberian region of the Russian Federation to the European part of the Russian Federation and Central Asia.

The integrated coal processing of the Ekibastuz fuel and energy complex has made Kazakhstan a leader in the generation and transit of electricity along the routes:

- ▶ Siberia-Europe,
- ▶ Siberia-Central Asia.

To ensure the smooth and efficient operation of this energy hub, Kazakhstan has built an open decentralized infrastructure power grid created on the principle of cells.

Kazakhstan will start making money on the transit and sale of cheap energy generated by coal-fired power plants based on clean coal technologies.

## ARTIFICIAL INTELLIGENCE

Dispatching will be given to artificial intelligence.

Dispatching and network balancing are carried out on the basis of artificial intelligence, which has access to the capacities of both classical generating thermal power plants and alternative energy sources, up to microgeneration. The network manages not only cross-country flows, but also redistributes internal energy flows according to the climatic characteristics of the population and the energy consumption schedules of industrial enterprises.

## FILLING NETWORKS FOR ELECTRIC TRANSPORT

The developed decentralized infrastructure network has given impetus to the development of a network of electric filling stations serving various types of electric transport and other energy-intensive devices and equipment used by end users and small retailers (electric scooters, mobile food courts, ice cream bins). Technologies of wireless pulse transfer of small amounts of energy allow charging small-capacity gadgets (mobile phones and tablets) at a distance of 50-100 meters from electric gas stations, remotely identifying the consumer and debiting payment from an individual account or making a credit in a personal energy balance.

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### SUMMARY:

*Open and decentralized electric network based on artificial intelligence. An open network allows you to take in excess energy from alternative sources of generation: from smart homes, new generating industries, and microgeneration. The electric grid becomes not only a transportation system, but also creates refueling systems in cities for private vehicles, as well as urban transport. The transport network becomes a transit system for the Eurasian space and allows you to sell surplus cheap energy abroad, thereby contributing to a new export product of Kazakhstan-electric energy.*

# II "SMART" CONSUMPTION AND ZERO ENERGY LOSS

All meters will be equipped with sensors for gathering information and elements of remote-control equipment for remote management. With the help of telemetry and telemechanics, are used to monitor and forecast energy consumption by residents and businesses. Already, 100% of the sensors installed in new homes have telemetry. By about 2025, metering devices in the secondary housing market will be updated, and data collection and processing will be automatic. People will be able to access data via their smartphone and control the operation of all energy measurement and control sensors and other utilities via their smartphone remotely.

Electric energy will be recognized as a basic human need and everyone will be guaranteed a minimum amount of energy for free consumption. The standard of energy balance of personal energy consumption by residents/ population has been introduced.

If the free energy consumption limit is exceeded, the accounting system applies a differentiated tariff depending on the time and purpose of energy consumption. Energy consumption will be an important factor in the education rate: cooking is cheaper, and surfing the Internet is more expensive. This approach to energy supply will change the culture of consumption to a conscious and rational model of energy consumption, and will encourage an overall reduction in energy consumption.

The management of houses has changed – energy supply facilities form the infrastructure of residential complexes taking into account social standards and modes of energy reproduction and energy consumption, which allows not only to reduce the cost of energy for residents, but also to reduce energy losses to zero.

In industrial enterprises and SMEs, energy management will become an object of planning and management. Data collection and processing will reduce losses. The introduction of new energy-saving materials will allow creating energy-efficient administrative buildings, reduce unnecessary heat losses during production, and also allow redirecting the side loss of energy to a useful channel.

## «SMART» SENSORS

All meters will be equipped with sensors for gathering information and elements of remote-control equipment for remote management

## ELECTRICITY AS A SOCIAL GUARANTEE

Every citizen will have a minimum free amount of electricity for consumption.

## ENERGY MANAGEMENT

Will become a mandatory profession for businesses. This specialist will allow you to manage and reduce energy losses in enterprises. capture and use it. There will be new types of KSK whose work will be built around the transformation of a residential complex into an energy-active house.

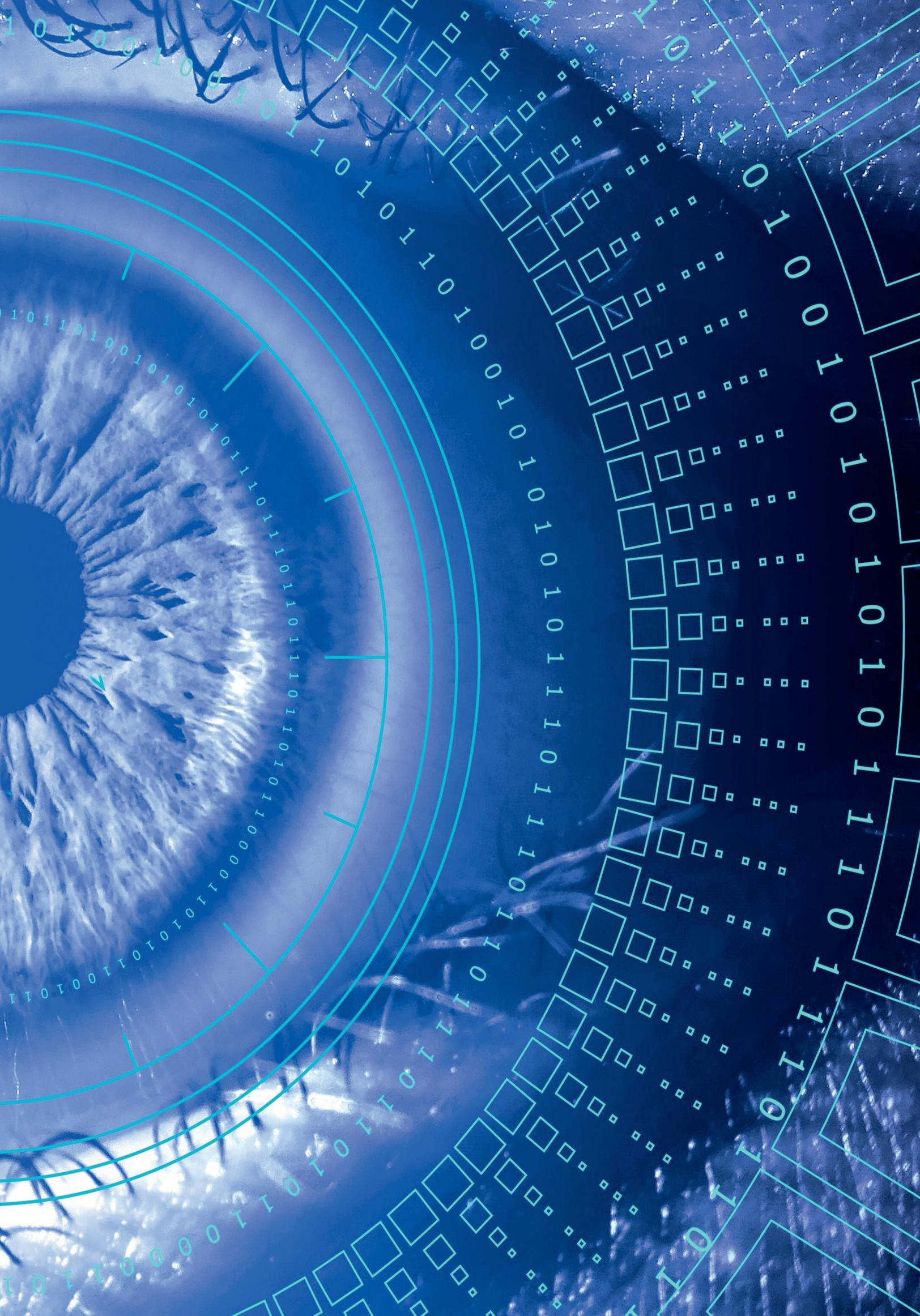
### SUMMARY:

*The revolution in monitoring energy consumption through the introduction of smart sensors based on telemetry and telemechanics will allow us to take a new look at the culture of consumption. It will be possible to determine the target energy consumption, introduce differentiated prices, and plan consumption in the medium term. enterprises will become energy efficient and reduce energy losses, which will generally have a positive impact on the economy.*

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WHAT TO STUDY  
FOR A SUCCESSFUL  
CAREER  
IN ENERGY INDUSTRY

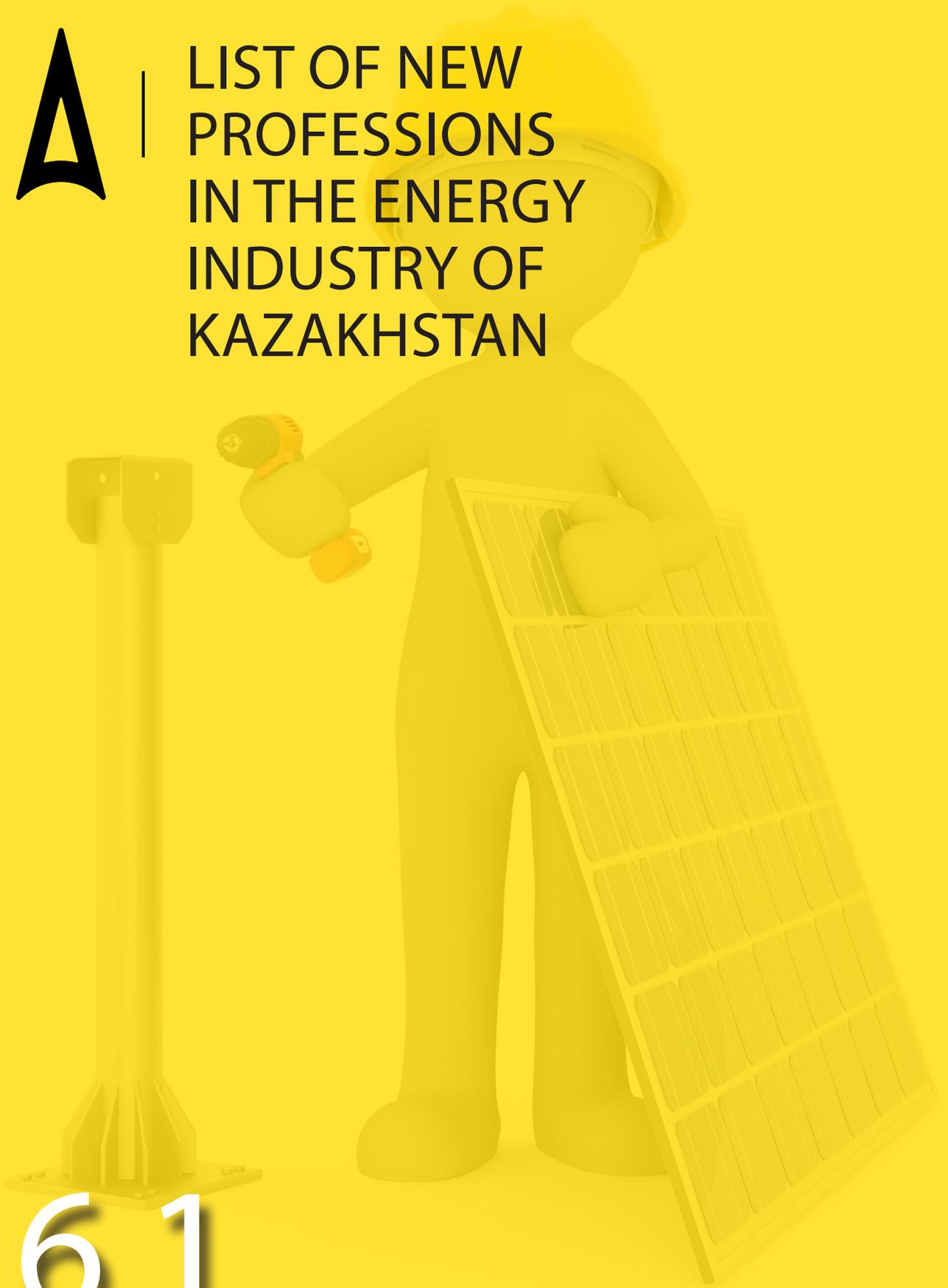
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A

LIST OF NEW  
PROFESSIONS  
IN THE ENERGY  
INDUSTRY OF  
KAZAKHSTAN

6.1.





**BIOLOGY AND ECOLOGY IN ENERGY**



Meteorologist



Agronomist for energy crops



Microalgae microbiologist



Bioenergy



Recovery and recycling engineer

**DECENTRALIZATION OF POWER GRIDS**



Smart grid designer



Specialist in the complex design of energy supply systems



Engineer for development and implementation of artificial intelligence (Smart Grid)



Operational dispatcher of RES



Numerical methods in power engineering (specialty)



Hydrogen Energy Engineer



Developer - designer of autonomous power systems



Developer-designer of electric and thermal energy storage units



Smart Manager



Energy Marketer

**ENERGY MANAGEMENT IN URBAN ENVIRONMENTS**



Manager of apartment buildings



City Manager



Specialists in Energy Management and Optimization



Engineer for the modernization of traditional energy systems



Aerohydrodynamic and hydrodynamic engineer

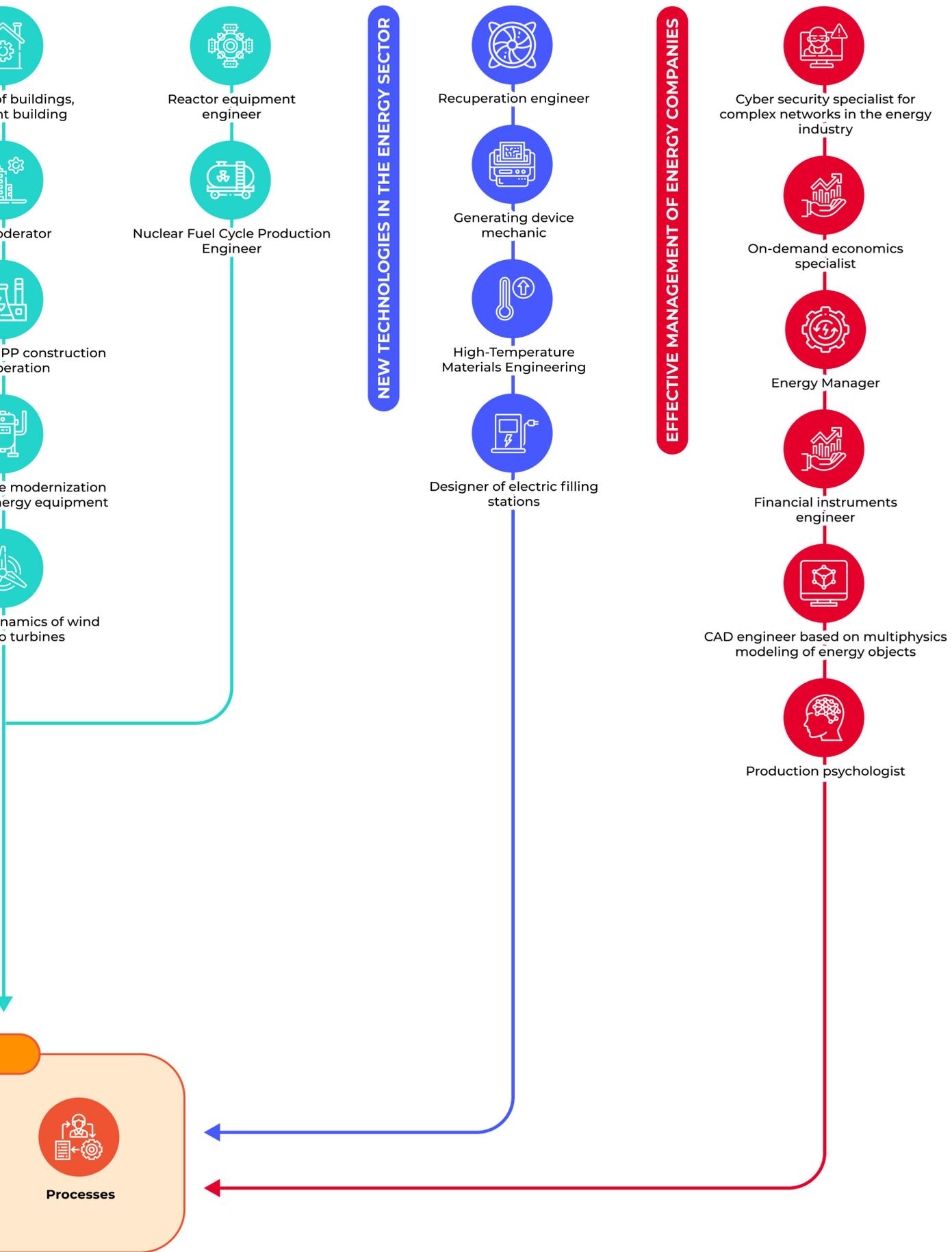
**PRODUCTION**



Employees



Equipment



# 1. BIOLOGY AND ECOLOGY IN THE ENERGY SECTOR

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## METEOENERGY SPECIALIST

HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new tasks: determining the need for balancing power due to weather changes, maintaining an ecological balance when placing generating power plants.

KEY  
competences

- ▶ Calculating the volume of generated energy based on the weather forecast.
- ▶ Calculation of the energy balance of the region; identification of excess / lack of energy.
- ▶ Prepare an opinion on the safety of the generating unit for the environment and its effectiveness in this location.

- ▶ The main difference between alternative energy and traditional energy is the uneven generation of alternative energy and the decentralization of energy generation points. Energy production from non-traditional sources depends on the time of day, weather conditions, and other factors. To meet the global energy balance, it is necessary to quickly enter the balancing generation capacity. One of the factors that determines how much Balancing energy needs to be introduced is the forecast of weather and climate factors: sun, wind strength and direction, temperature, etc. At the same time, installations for generating alternative energy are not absolutely environmentally safe. They can have a certain negative impact: increased noise, vibration, damage to agriculture, etc. The locations of alternative energy generation installations are of fundamental importance, since wind rose and darkening have a significant impact on the efficiency of installations.

TRENDS

- ▶ Increasing environmental pressure on traditional energy.
- ▶ Growth of the number of renewable energy generating stations.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Environmental thinking.
- ▶ System thinking.
- ▶ Ability to manage projects and processes.



**HORIZON**  
of appearance ▶ **2025**

**THE NOVELTY**  
of the professions

- ▶ Solving new problems: based on the natural and climatic conditions of the region, determining the optimal agricultural crops for energy production. ((The profession is new for Kazakhstan).

**KEY**  
competences

- ▶ Study of climatic and natural features of the region (soil science, climate science, etc.).
- ▶ Review of existing agricultural crops used for energy generation.
- ▶ Determining the optimal agrocrops for the region: which plants are more stable, will produce more biomass, and are most productive.

## AGRONOMIST OF ENERGY CROPS

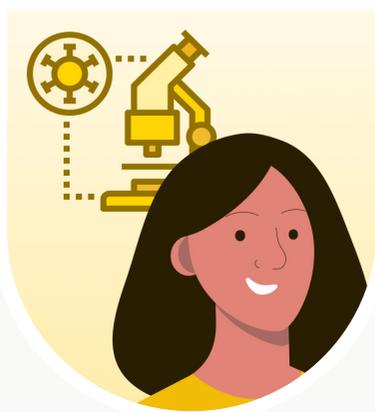
- ▶ One of the promising areas of alternative energy is the use of biomass. For this purpose, certain types of agricultural crops are used: Canary cane, corn, oats, millet, bodyak, mullein, and many others. Certain types of crops are suitable for certain natural and climatic zones, while others are completely inapplicable. Different crops are also used for different types of energy carriers: biomass, biodiesel, bioethanol, etc. To obtain high yields of the required crop, the knowledge and skills of relevant specialists are required.

**TRENDS**

- ▶ Growth of the number of generating plants in the renewable energy sector.
- ▶ Increase the number of microgeneration installations.

**SUPER PROFESSIONAL**  
skills and abilities

- ▶ Ecological thinking.
- ▶ Client orientation.



## MICROALGAE MICROBIOLOGIST

HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new problems: improving the characteristics of microalgae that absorb CO<sub>2</sub> and harmful boiler gases. (The profession is new for Kazakhstan).

KEY  
competences

- ▶ Study of the properties of microalgae that absorb CO<sub>2</sub> and harmful boiler emissions.
- ▶ Study of the climatic conditions of the region, the level and composition of local boiler emissions.
- ▶ Development of new microalgae stocks with improved properties: yield, fat content, and resistance to climatic and natural features of the region.

- ▶ Microalgae are a promising direction in the energy sector. With the development of biotechnologies, the development of microalgae becomes possible even in regions without a marine climate. Microalgae can absorb harmful emissions from coal-fired power plants and be a raw material for biofuels. The potential of microalgae has not yet been fully realized, new strains of increased yield, resistance to climate impacts, etc. Are being developed.

TRENDS

- ▶ Increasing environmental pressure on traditional energy.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Ecological thinking.
- ▶ Ability to manage projects and processes.



## BIOENERGY SPECIALIST

HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new tasks: obtaining biomass for energy production (the Profession is new for Kazakhstan).

KEY  
competences

- ▶ Creating technologies for generating energy from biomass.
- ▶ Determination of sources of biomass production.
- ▶ Adaptation of biomass production technology to new conditions.
- ▶ Selection of power plants that are optimal for obtaining energy from the applied biomass.

- ▶ Biomass is a renewable source of energy from animal and plant waste. Energy sources from biomass are very diverse: trees and herbaceous plants, crops and stubble of cereals, aquatic and marine plants, manure and waste water, landfills, etc. The specialist of the future will need to identify sources of cheap biomass replenishment, improve the efficiency of energy obtained from them, and adapt existing technologies and equipment to local conditions.

TRENDS

- ▶ Growth of the number of generating plants in the renewable energy sector.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Ecological thinking.
- ▶ Ability to manage projects and processes.
- ▶ Lean production.

▶ 1.5



HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Solution of new tasks: utilization of energy production waste with the extraction of a useful component or minimal emission of harmful substances.

KEY  
competences

- ▶ Audit of waste and secondary products of the energy company.
- ▶ Monitoring of emission-free waste disposal technologies.
- ▶ Choose and adapt technologies for your company.
- ▶ Control of regeneration and recycling processes.

## RECOVERY AND RECYCLING ENGINEER

- ▶ Energy companies, primarily coal plants, produce a lot of waste. The pressure on the environment is increasing. At the same time, the existing waste can not only be processed, but also generate additional income by producing products that are in demand on the market.

### TRENDS

- ▶ Increasing environmental pressure on traditional energy.

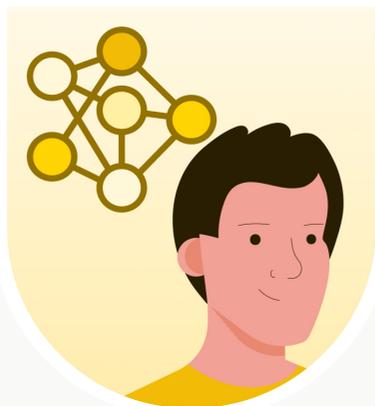
SUPER PROFESSIONAL  
skills and abilities

- ▶ Ecological thinking.
- ▶ Ability to manage projects and processes.
- ▶ Systems thinking.
- ▶ Client orientation.

## 2. DECENTRALIZATION OF POWER GRIDS

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## SMART GRID DESIGNER

HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Combining several areas of competence: IT, sociology, engineering systems.

KEY  
competences

- ▶ Definition of objects that are grouped in a network to solve current problems.
- ▶ Determine the output parameters of information needed to solve problems.
- ▶ Determine the location of sensors and other information transmission devices.
- ▶ Select the software for processing the resulting information.
- ▶ Continuous improvement of networks.

- ▶ The decentralization of power grids and the growth of energy consumption in the country lead to the fact that dispatching services are not always able to quickly cope with emerging situations. The dispatching system needs to be enhanced with digital intelligence solutions. In the world practice, the direction of creating "smart" networks "Smart Grid" has become widespread. Designing such networks and integrating them into existing dispatching systems will ensure efficient distribution, automation, and monitoring of energy transmission at all stages from the producer to the end user.

TRENDS

- ▶ Improvement of the network management and monitoring structure, introduction of smart technologies.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Ecological thinking.
- ▶ Ability to manage projects and processes.
- ▶ Systems thinking.
- ▶ Programming. Robotics. Artificial intelligence.



HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Integrated design of the power supply system with the possibility of combining traditional and alternative energy.

KEY  
competences

- ▶ Identification of possible sources of energy supply for the designed object.
- ▶ Preparation of a technical and economic justification for choosing a power supply source.
- ▶ Development of a differentiated energy supply project. energy sources (traditional and alternative).

## COMPLEX DESIGN SPECIALIST FOR POWER SUPPLY SYSTEMS

- ▶ One of the distinctive characteristics of future energy is the generation of energy from different sources for a single consumer. Heat from electric furnaces in the shop, kinetic energy from the operation of machinery, etc., all this can become a source of energy, which can provide part of their own needs, save on energy supply, and reduce the environmental burden. A specialist in this field will need to combine creativity and inventiveness to find energy sources "at hand" and, at the same time, have the engineering skills to assess the economic feasibility of such sources.

### TRENDS

- ▶ Improvement of the network management and monitoring structure, introduction of smart technologies.
- ▶ Improve energy efficiency.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Ecological thinking.
- ▶ Ability to manage projects and processes.
- ▶ Skills of artistic creation.



HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new problems: developing artificial intelligence.

KEY  
competences

- ▶ Analysis of incoming information about production and management processes.
- ▶ Development of artificial intelligence decision-making algorithms.
- ▶ Analyze and improve the performance of artificial intelligence.

## ENGINEER

### FOR DEVELOPMENT AND IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE

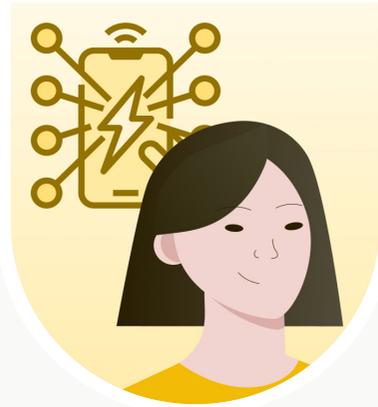
- ▶ Artificial intelligence can effectively solve a number of tasks in the industry. The list of them is constantly expanding. In the energy sector, the primary tasks solved by artificial intelligence are energy consumption management and grid dispatching. Artificial intelligence can process an unstructured amount of data and make decisions without relying on well - defined algorithms.

#### TRENDS

- ▶ Improvement of the network management and monitoring structure, introduction of smart technologies.

#### SUPER PROFESSIONAL skills and abilities

- ▶ Programming. Robotics. Artificial intelligence.
- ▶ Systems thinking.
- ▶ Cross-industry communication skills.



HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new tasks: improving the efficiency of organizational processes, labor productivity, and quality.

KEY  
competences

- ▶ Solving issues of Energy supply to individual objects (buildings, businesses, and neighborhoods).
- ▶ Analysis of energy tariffs, search for ways to optimize them.
- ▶ Using micro-networks for network communications: choosing ways to implement communications with maximum efficiency.
- ▶ Ensuring the exchange of information in the network about distributed resources in the network.

## SMART MANAGER

- ▶ The development of microgeneration technologies allows you to switch to Autonomous power supply to apartment buildings, businesses, and building complexes on a specific territory. This solves the security issues of energy supply in a separate territory. Increasing the number of such networks and improving their management efficiency makes it possible to create a global network of mutually connected micro-networks. If there is no energy in one of the micro-networks, consumers immediately switch to consumption from the neighboring micro-network. Covering the territory of the country with micro-networks and increasing their efficiency is the task of a new type of specialists.

### TRENDS

- ▶ Improvement of the network management and monitoring structure, introduction of smart technologies.
- ▶ Improved energy efficiency.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Programming. Robotics. Artificial intelligence.
- ▶ Systems thinking.
- ▶ Cross-industry communication skills.

▶ 2.5

## OPERATIONAL DISPATCHER OF RES



**HORIZON**  
of appearance

▶ 2025

**THE NOVELTY**  
of the professions

- ▶ Solving new problems: forecasting energy consumption.

**KEY**  
competences

- ▶ Knowledge of patterns of weather conditions in the near and middle horizon (up to 30 days).
- ▶ Knowledge of patterns of energy consumption by the population and businesses under changing weather conditions.
- ▶ Analysis of current weather conditions (2-3 days) and modeling the development of weather conditions affecting the generation of renewable energy in the 30-day horizon.
- ▶ Calculate the imbalance between available and required balancing capacities that need to be planned for traditional generating stations.

- ▶ Increasing the share of electricity generated by wind generators and solar panels increases the need for balancing capacities, since the production of these types of energy directly depends on weather and climate factors: the presence of wind, daytime, etc. the situation is complicated by the fact that it is difficult to predict how much energy will be generated even under favorable climatic factors (on a cloudy day, energy will be generated-less, and a strong wind blowing in the other direction, reduce the efficiency of the wind turbine, which is turned in the other direction). To ensure energy balance, it is necessary to know exactly how much energy will be needed by consumers. The more detailed this forecast is (for example, on a certain day, at certain hours, additional lights will be turned on due to overcast weather), the more efficient the use of balancing capacity will be. The RES operational dispatcher uses predictive models (AI) to assess the probability of favorable weather conditions for generating electricity at solar and wind generating stations. In fact, it predicts weather conditions for planning and evaluating electricity generation by RES substations. This will significantly improve the integration of RES into the energy system, since understanding the volume of energy production will allow traditional generating stations to plan their energy production taking into account the forecast fluctuations of RES.

### TRENDS

- ▶ Increase in the number of generating stations based on renewable energy
- ▶ Improve the management and monitoring structure of networks, introduce smart technologies.

**SUPER PROFESSIONAL**  
skills and abilities

- ▶ Systems thinking
- ▶ Analytical thinking

**Note:** it should be noted that experts have pointed out that this profession is characterized by monotony and requires self - control skills and the ability to concentrate for a long time. Therefore, it was noted that this profession may be interesting/respectful for women, since it takes into account their gender characteristics.



HORIZON  
of appearance ▶ 2030

THE NOVELTY  
of the professions

- ▶ New challenges: the identification of local perspectives of the energy market.

KEY  
competences

- ▶ Identification of new technological trends in the energy market.
- ▶ Determine the energy company's market strategy.

## ENERGY MARKETER

- ▶ The energy market of the future is more diverse than the current one. The use of various types of energy carriers, their combination, the emergence of new technologies, all these forces companies to develop a strategy that can adapt to conditions that are not typical for the modern energy market.

### TRENDS

- ▶ Liberalization of the market, which restricts the activities of large energy monopolies and leads to competition.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Client orientation.



## HYDROGEN ENERGY ENGINEER

HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new problems: using hydrogen and hydrogen-containing compounds for energy production. (The profession is new for Kazakhstan).

KEY  
competences

- ▶ Development of technologies for producing hydrogen and hydrogen-containing compounds.
- ▶ Development of equipment for economical production of hydrogen.
- ▶ Application of hydrogen energy technologies in enterprises.

- ▶ Hydrogen is currently the most environmentally friendly energy source that can be used without taking into account climate, weather, and other factors. Hydrogen energy now serves as a battery of excess electricity generated in the benefit of renewable energy generation plants. Excess energy is used to produce hydrogen, which will be used during periods when there is not enough electricity (dark, calm, etc.). The main task that needs to be solved is to reduce the cost of hydrogen production.

TRENDS

- ▶ Increasing environmental pressure on traditional energy.
- ▶ Development of highly efficient energy storage systems.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.



HORIZON  
of appearance ▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new challenges: designing Autonomous power systems for individual consumers.

KEY  
competences

- ▶ Overview of alternative energy sources.
- ▶ Calculate the required energy.
- ▶ Selection of a set of alternative energy production facilities.
- ▶ Preparation of a feasibility study for recommended power generation facilities

## DEVELOPER- DESIGNER OF AUTONOMOUS POWER SYSTEMS

- ▶ The energy industry is becoming less centralized. Large thermal power plants are being replaced by compact power plants, the entry barrier to the industry is gradually decreasing and may soon drop to one million dollars. Large enterprises and small localities will become energy producers. Work will be required to select a generation technology that meets local conditions and adapt it to a specific consumer.

### TRENDS

- ▶ Increase the number of microgeneration installations.
- ▶ Growth in the number of generating stations based on renewable energy.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ability to manage projects and processes.



HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ New tasks: development of energy generation systems.

KEY  
competences

- ▶ Research of electric and heat energy storage devices
- ▶ Applied research to improve the properties of energy storage systems (high-capacity accumulators, heat storage devices, flywheels, etc.).
- ▶ Design of electric and heat energy storage devices for specific objects.

## DEVELOPER-DESIGNER OF ELECTRIC AND THERMAL ENERGY STORAGE

- ▶ Energy production by heat and wind generators makes it relevant to develop systems for accumulating excess energy produced at peak capacity and using it during the period of highest demand. Energy production by non-core enterprises and small localities also increases the demand for energy storage systems. The designer needs to provide the most cost-effective way to accumulate energy based on the sources used, their quantity, consumption structure, storage time, and energy transfer distance.

### TRENDS

- ▶ Development of highly efficient energy storage systems.

### SUPER PROFESSIONAL skills and abilities

- ▶ Systems thinking.
- ▶ Ability to manage projects and processes.
- ▶ Lean production..



HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new tasks: dispatching a complex of traditional and alternative energy systems

KEY  
competences

- ▶ Training of neural networks that perform complex dispatching from traditional, atomic, and alternative energy.
- ▶ Calculate the cost of getting energy from various sources.
- ▶ Ensuring uninterrupted power supply.

## SPECIALIST IN NUMERICAL METHODS IN POWER ENGINEERING

- ▶ Kazakhstan's energy sector is diversifying. In addition to the prevailing thermal power plants, the share of energy from alternative sources is gradually increasing, and the issue of building nuclear power plants is being considered. At the same time, it is necessary to maintain a balance between the use of various energy sources and ensure uninterrupted power supply.

### TRENDS

- ▶ Improvement of the network management and monitoring structure, introduction of smart technologies.

### SUPER PROFESSIONAL skills and abilities

- ▶ Systems thinking.
- ▶ Ability to manage projects and processes.
- ▶ Programming/Robotics/Artificial intelligence.

# 3. ENERGY CONSUMPTION MANAGEMENT IN URBAN ENVIRONMENTS

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HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new challenges: advising residents on energy consumption.

KEY  
competences

- ▶ Studying the level of energy consumption of consumers used in everyday life: household appliances, heaters, electric tools, etc.
- ▶ Determination of optimal consumption regimes based on differentiated tariffs, energy consumption quotas, and specific household needs of residents of certain areas.
- ▶ Develop recommendations for using more cost-effective consumers, optimal time for using household appliances, etc.

## MANAGER OF BUILDINGS, APARTMENT BUILDINGS

- ▶ Rising energy costs lead to the need for differentiated and lean consumption. A consumer specialist can determine the period when energy tariffs for consumers are lower, and develop recommendations for lean consumption. There is a large selection of household appliances, but it is not always possible to assess the level of energy consumption. Recommendations for improving energy efficiency will be useful for apartment buildings. Therefore, the demand for the services of such specialists will grow.

### TRENDS

- ▶ Global growth in the cost of electricity.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.
- ▶ Lean production.



HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new problems: transforming the system thinking of the urban population in the field of energy consumption.

KEY  
competences

- ▶ Develop a concept for working with the population based on the adopted energy consumption policy.
- ▶ Development of projects for promoting energy efficiency.
- ▶ Development of measures to reduce the discomfort of residents from saving energy.

## CITY MODERATOR

- ▶ The cost of energy will increase. This is the trend of the modern world. Everyone will have to save energy: both businesses and individuals. For a part of the population, this may cause discontent. Specialists of the future will not only have to develop energy - saving concepts, but also work with the population, carry out explanatory work, reduce the population's stress, and develop com - Fort ways to save energy.

### TRENDS

- ▶ Global growth in the cost of electricity.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.
- ▶ Lean production.



HORIZON  
of appearance

▶ 2035

THE NOVELTY  
of the professions

- ▶ Solve new tasks: design and construction of nuclear power plants. ((The profession is new for Kazakhstan).

KEY  
competences

- ▶ Determination of power plant parameters in accordance with the technical specification.
- ▶ Development of NPP projects.
- ▶ Control of the NPP construction process.

## SPECIALIST IN NUCLEAR POWER PLANTS (NPP) CONSTRUCTION AND OPERATION.

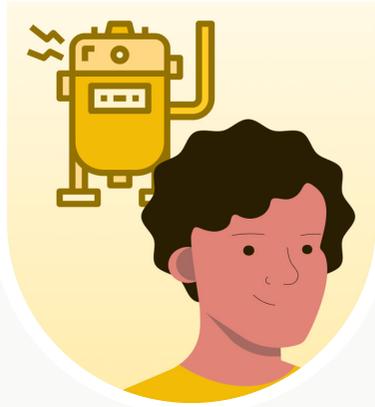
- ▶ Nuclear power is one of the most promising areas of future energy. Its main advantages are its relatively low cost and high-power output. The construction of nuclear power plants on the territory of Kazakhstan can provide the country with relatively cheap energy to meet growing needs.

### TRENDS

- ▶ Increasing the availability and safety of nuclear power.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.
- ▶ Ability to manage processes and projects



HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Allocation of existing tasks in a separate block, partial solution of new tasks: modernization and adaptation of equipment

KEY  
competences

- ▶ Adaptation of existing and new equipment for better compatibility with each other.
- ▶ Modernization and improvement of existing equipment, increasing its productivity, reliability, and availability.

## ENGINEER FOR THE MODERNIZATION OF TRADITIONAL ENERGY EQUIPMENT

- ▶ Different generations of equipment are used simultaneously at enterprises. The difference in technical characteristics leads to negative consequences. If the equipment of different technological divisions is combined into one technological chain, the possibilities of using the advantages of the new equipment are reduced. This is especially true for telemetry, digitalization of processes, and remote control. Outdated equipment requires additional operators who manually ensure its compatibility. This discrepancy will be corrected by certain specialists.

### TRENDS

- ▶ Increase energy efficiency

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Lean production.
- ▶ Ability to manage processes and projects.



HORIZON  
of appearance ▶ 2025

THE NOVELTY  
of the professions

- ▶ New challenges: maintenance of the turbines.

KEY  
competences

- ▶ Development of turbines.
- ▶ Operation of the turbines.
- ▶ Maintenance of turbines.

## AERO HYDRODYNAMICS OF WIND AND HYDROTURBINES

- ▶ Turbines are used in various energy sectors: thermal power plants, hydroelectric power plants, gas turbines, etc. With the spread of wind power, the demand for specialists engaged in maintenance and repair of turbines is increasing. Wind turbines have a wide range of capacities, and consequently a large list of turbines that require maintenance by qualified specialists.

### TRENDS

- ▶ Growth of the number of generating stations in the renewable energy sector.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Ecological thinking.



## REACTOR EQUIPMENT ENGINEER

HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new tasks: maintenance of reactors regardless of their type: nuclear, biomass, medical, space, etc.

KEY  
competences

- ▶ Diagnostics of reactor equipment.
- ▶ Development of measures for maintenance and modernization of reactors.

- ▶ The number of modifications to reactor equipment is increasing with the development of alternative and renewable energy technologies. A wide range of power plant capacities and energy production technologies means a wide range of reactor modifications. The variety and complexity of this equipment requires qualified specialists.

TRENDS

- ▶ Growth in the number of generating stations based on renewable energy.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.



HORIZON  
of appearance ▶ 2035

THE NOVELTY  
of the professions

- ▶ Solving new challenges: developing nuclear fuel. ((The profession is new for Kazakhstan))

KEY  
competences

- ▶ development of nuclear fuel manufacturing processes.
- ▶ control of technological processes for obtaining nuclear fuel.

## NUCLEAR FUEL PRODUCTION CYCLE ENGINEER

- ▶ The proposed construction of nuclear power plants on the territory of Kazakhstan will require supplying them with nuclear fuel. Such production is localized in several countries due to the complexity of the technology. Currently, we are developing technologies for obtaining nuclear fuel without complex uranium enrichment procedures. This will allow Kazakhstan to become fully independent in providing nuclear fuel.

TRENDS

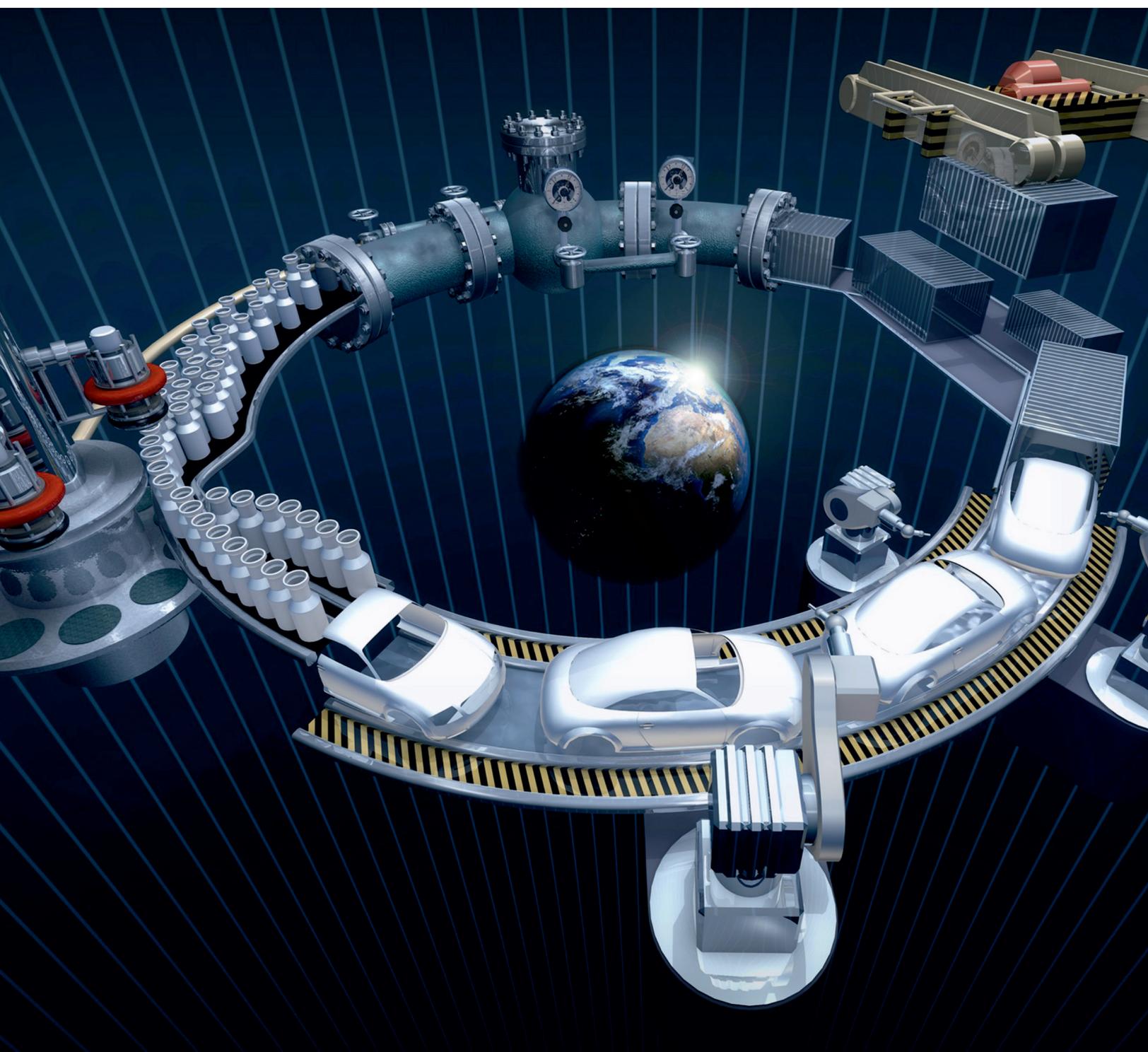
- ▶ Improving the availability and safety of nuclear power.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.

# 4. NEW TECHNOLOGIES IN THE ENERGY SECTOR

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HORIZON  
of appearance ▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new challenges: saving and using available energy in a useful way.

KEY  
competences

- ▶ Object audit: identification of sources of available energy (human body heat, solar heat, heat of working equipment, etc.), its assessment (volume and period of availability).
- ▶ Development of energy supply projects for the object: the amount of demand covered, the period of energy use (morning, evening, summer, production cycle, etc.).
- ▶ Selection of equipment for energy recovery

## RECOVERY ENGINEER

- ▶ Human activity leads to the production of a sufficiently large amount of heat. The human body emits heat constantly, and industrial equipment also produces a lot of heat that is not currently used. However, it can be used for heating residential buildings, industrial buildings, and agricultural facilities. Recuperation technologies are already being used to design homes in the West, called energy - safe. In the context of rising energy prices, recovery will have prospects for industrial and civil consumers.

### TRENDS

- ▶ Global cost of electricity.
- ▶ Increase energy efficiency.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.
- ▶ Ability to manage processes and projects.



## DESIGNER OF ELECTRIC FILLING STATIONS

HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new problems: designing electric filling stations.

KEY  
competences

- ▶ Development of projects for electric filling stations.
- ▶ Approval of conditions for obtaining the required amount of electricity.
- ▶ Control of the construction process of an electric filling station.

- ▶ The development of electric transport will require the expansion of the network of gas stations. The main issues that will have to be addressed by specialists are the provision of a large number of power-to-power plants, including in areas that are remote from major sources of electricity generation.

TRENDS

- ▶ Increasing environmental pressure on traditional energy.
- ▶ Development of highly efficient energy storage systems.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.
- ▶ Ability to manage processes and projects.



HORIZON  
of appearance ▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new problems: developing new materials and new ways to generate energy.

KEY  
competences

- ▶ Fundamental studies of changes in the physical properties of materials used in the
- ▶ production of power generating plants.
- ▶ Fundamental research in the field of energy generation.

## GENERATING DEVICE MECHANIC

- ▶ The restrictions imposed on traditional energy, the high cost of common alternative energy sources: wind and solar, force us to look for new energy sources, alternative, cheaper and environmentally friendly ways to generate it. This is an important area of the energy industry.

### TRENDS

- ▶ Growth in the number of generating stations based on renewable energy.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Ecological thinking.
- ▶ Ability to manage processes and projects.

▶ 4.4



## ENGINEER- TECHNOLOGIST IN HIGH-TEMPERATURE MATERIALS SCIENCE

HORIZON  
of appearance

▶ 2030

THE NOVELTY  
of the professions

- ▶ Solving new challenges: developing materials that are resistant to high temperatures (about 1000 degrees).

KEY  
competences

- ▶ Development of technologies for the production of materials that are resistant to high temperatures, gases, and aggressive environments.
- ▶ Development of protective materials to protect equipment and structures from high temperatures.

- ▶ Technological changes in the energy industry, such as the operation of power plants operating on super - supercritical steam parameters, etc., require the use of materials that are resistant to temperatures from 1000°C. The development of such materials can become one of the most promising areas for the industry.

TRENDS

- ▶ Increase energy efficiency.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Artistic skills.
- ▶ Cross-industry communication skills.

# 5. EFFECTIVE MANAGEMENT OF ENERGY COMPANIES

---



▶ 5.1



HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new challenges: protecting data on the network. (The profession is new for Kazakhstan).

KEY  
competences

- ▶ Testing network security systems, identifying weaknesses.
- ▶ Prevention of security systems.
- ▶ Network monitoring, early detection of security threats.
- ▶ Transmitting information about cyber-attacks to law enforcement agencies.

## CYBERSECURITY SPECIALIST FOR COMPLEX NETWORKS IN THE ENERGY INDUSTRY

- ▶ The development of digitalization and the increase in the amount of data stored on the network increase the number of attackers who want to cause harm. In the event of a cyber-attack on the global dispatching system, the energy supply of the region or the entire country can be damaged. Especially significant damage will be in the winter period, for enterprises of strategic importance, operating in a continuous mode. The fight against cyber-crimes will become part of the energy industry.

### TRENDS

- ▶ Improvement of the network management and monitoring structure, introduction of smart technologies.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Systems thinking.
- ▶ Programming. Robotics. Artificial intelligence.



## ON-DEMAND ECONOMICS SPECIALIST

HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Combination of diverse tasks: involvement of third-party specialists to solve non-professional tasks of energy enterprises; wide range of competencies
- ▶ in different industries: construction, legislation, procurement, engineering, etc.

KEY  
competences

- ▶ Identify the need for the necessary non-core skills.
- ▶ Development of technical specifications for contractors.
- ▶ Search for and attract contractors.
- ▶ Monitoring contractors' performance of tasks.

- ▶ Energy companies are large organizations that periodically require various non-core specialists to solve non-core tasks. To formulate technical specifications and communicate with potential suppliers, we need a wide range of specialists with knowledge in the energy sector, as well as in areas related to law, information technology, procurement, etc. This will ensure that a qualified supplier is selected and a quality service is provided.

TRENDS

- ▶ Improve energy efficiency.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Multilingualism and multiculturalism.
- ▶ Ability to manage processes and projects.
- ▶ Cross-industry communication skills.

▶ 5.3



**HORIZON**  
of appearance

▶ Exists in  
the NCC  
classifier.

**THE NOVELTY**  
of the professions

- ▶ Solving new tasks: determining the sources and level of energy loss of a specific object. (The profession is present in the NCC, but is not widespread enough in the Republic of Kazakhstan: the training in this specialty is conducted only in two colleges in Kazakhstan).

**KEY**  
competences

- ▶ Study of the level of energy consumption and energy loss of the object using metro-logical equipment.
- ▶ Study of energy consumption and energy loss of the object using project documentation and physical calculations.
- ▶ Determining the sources and causes of energy loss.
- ▶ Preparing a report for an object that describes the level, sources of energy loss, and compliance/non-compliance of the object.

## ENERGY MANAGER

- ▶ The increase in the cost of electricity leads to the need to save money. The simplest and most painless way to save money is to reduce energy loss. This will require an audit of buildings and equipment units to identify losses, i.e., energy consumption without its useful use. The specialist must have metrological devices, work with documentation, and perform calculations. The results obtained will be used to develop measures that reduce losses and save money for companies and individual consumers.

### TRENDS

- ▶ Global Cost of Electricity
- ▶ Increase in Energy Efficiency.

**SUPER PROFESSIONAL**  
skills and abilities

- ▶ Multilingualism and multiculturalism.
- ▶ Ability to manage processes and projects.
- ▶ Cross-industry communication skills.





## FINANCIAL INSTRUMENTS ENGINEER

HORIZON  
of appearance

▶ 2027

THE NOVELTY  
of the professions

- ▶ Combining the tasks of an energy engineer and an economist in one specialty for implementing investment projects for equipment modernization.

KEY  
competences

- ▶ Selection of power equipment in accordance with the technical task.
- ▶ Attracting investments under insured and stable financial schemes.
- ▶ Development of mutually beneficial investment - friendly financing schemes

- ▶ In Kazakhstan, power equipment is extremely worn out. Large amounts of money will be required to upgrade the equipment. The situation is complicated by low energy tariffs in Kazakhstan, which prevent the owners of energy companies from accumulating enough funds for renewal. Due to the high cost of projects, the list of investors is limited, and low tariffs make it less attractive financially. It will be necessary to develop financing schemes and attract investors to the industry.

TRENDS

- ▶ Improve energy efficiency.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Multilingualism and multiculturalism.
- ▶ Ability to manage processes and projects.
- ▶ Customer focus.
- ▶ Cross-industry communication skills.



## CAD DEVELOPMENT ENGINEER

HORIZON of appearance ▶ 2030

THE NOVELTY of the professions

- ▶ Solving new problems: modeling the physical behavior of objects in the virtual world. Modeling energy objects: setting their geometry, properties, and physical composition.

KEY competences

- ▶ Modeling object behavior in various environments, in statics, dynamics, etc.
- ▶ Development of recommendations for studying the object.

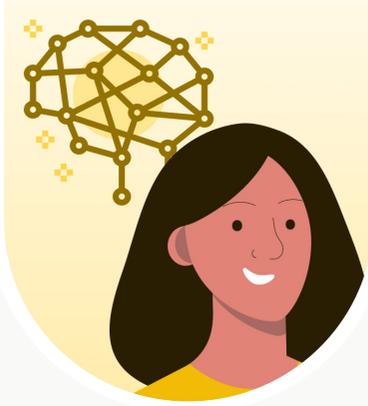
- ▶ Based on multiphysical modeling of energy facilities
- ▶ Creating models of a physical object will allow you to quickly and cost-effectively see how the object will change under the influence of different environments, in different situations. This is especially true for large and complex systems such as energy companies.

TRENDS

- ▶ Improvement of network management and monitoring structure, introduction of smart technologies.

SUPER PROFESSIONAL skills and abilities

- ▶ Programming. Robotics. Artificial intelligence.
- ▶ Ability to manage processes and projects.
- ▶ Cross-industry communication skills.



HORIZON  
of appearance

▶ 2025

THE NOVELTY  
of the professions

- ▶ Solving new challenges: reducing errors caused by the human factor in high-quality enterprises.

KEY  
competences

- ▶ Diagnostics of the psychological state of employees.
- ▶ Determination of the willingness of people to work in a team.
- ▶ Determine the readiness of specialists to manage complex systems at the plant at the NPP.
- ▶ Develop measures to reduce the risk of human error.

## PRODUCTION PSYCHOLOGIST

- ▶ Research shows that most errors in nuclear power plants are caused by human factors. If you diagnose the psychotypes of employees, determine their compatibility, prevent, and prevent conflicts at the enterprise, you can significantly reduce the number of errors and increase the reliability of nuclear power plants, where the cost of failure or accident can be very high.

### TRENDS

- ▶ Improving the availability and safety of nuclear power.

SUPER PROFESSIONAL  
skills and abilities

- ▶ Multilingualism and multiculturalism.
- ▶ Work with people.
- ▶ Cross-industry communication skills.



TRANSFORMING  
PROFESSIONS IN THE  
ENERGY INDUSTRY OF  
KAZAKHSTAN

6.2.



2025



01

## OPERATOR DISPATCHER

### OUTDATED SKILLS

- ▶ Automatic control skill

- ▶ A qualified specialist in the management of various types of equipment. It is engaged in start-up, maintenance, and maintenance. Controls the progress of the technological process.

### NEW SKILL

- ▶ The skill of control, early detection of system errors.

2027



02

## ENGINEER ENERGY EFFICIENCY RESEARCH ENGINEER

- ▶ Highly qualified specialist who analyzes the energy consumption and use of energy resources of the enterprise. Identifies the potential for improving energy efficiency and minimizing costs and develops appropriate recommendations.

### NEW SKILL

- ▶ The skill of control, early detection of system errors.

2025



03

## CAR MECHANIC ELECTRO MOBILES MECHANIC

### OUTDATED SKILLS

- ▶ Knowledge and skills of engine repair.

- ▶ Qualified workers who perform maintenance and repair of vehicles and individual units (engines, gearboxes, etc.), adjustment and adjustment of systems and components.

### NEW SKILL

- ▶ Knowledge and skills to repair vehicles, in-depth knowledge, and skills in the repair of electric motors.



🕒 2025

04

## ENGINEER FOR HYDRAULIC STRUCTURES

### HYDRAULIC ENGINEER 2.0



- ▶ Is a highly Qualified specialist who organizes the operation and repair of equipment for berths, locks, dams, watercraft, and other equipment. Develops measures for maintenance and repairs, safety measures and protection from the negative effects of water. Participates in the design and development of structures.

#### NEW SKILL

- ▶ New approaches related to climate change.

🕒 2023

05

## ECOBROKER

### ENERGOBROKER



#### OUTDATED SKILLS

- ▶ In connection with the transition to rational energy consumption, it will not be relevant to promote excessive consumption.

- ▶ Does not have a specific qualification, but has knowledge in the field of environmental protection, and is motivated to discuss environmental issues. Prepares printed and video materials and posts them in social networks. Participates in the discussion of environmental issues at public events, is involved as an expert by the authorities and the management of large enterprises.

#### NEW SKILL

- ▶ You will need to be able to instill energy consumption as a culture.

A

DISAPPEARING  
PROFESSIONS IN THE  
ENERGY INDUSTRY OF  
KAZAKHSTAN



6.3.





▶ 2025-  
2027



## CRAWLER

OF AUXILIARY EQUIPMENT, EXTERNAL DEVICES,  
COMMUNICATIONS

- ▶ Use of unmanned aerial vehicles, automatic control sensors for these purposes.



▶ 2025



## SAMPLER

- ▶ Introduction of automatic raw material control systems



▶ 2025

▶ 3

## POWER CONSUMPTION CONTROLLER



- ▶ The introduction of telemetry: automatic transmission of instrument readings.



▶ 2025-  
2027

▶ 4

## DISPATCHER



- ▶ Automation of dispatching processes, remote management of production processes.



▶ 2025

▶ 5



## CASHIER

- ▶ Switching to cashless payments, online payments.



▶ 2023

▶ 6



## DELIVERY OF RECEIPTS

- ▶ Automation. Sending receipts by email or through your personal account, artificial intelligence system, etc.



▶ 2021

▶ 7



## CHAIRMAN OF KSK

- ▶ Abolition of KSK, automation of the residential building management process.



▶ 2022

▶ 8



## CALL CENTER OPERATOR

- ▶ Due to the transition to an automated system of energy consumption and consumption, the relevant information will not be needed.



▶ 2025

▶ 9

### MANAGER (IN THE DIRECTION)\*



- ▶ Introduction of an automated control system.



▶ 2030

▶ 10

### DEPUTY DIRECTOR FOR ECONOMICS\*



- ▶ Implementation of an automated management system.

\*The number of personnel in these categories is expected to decrease

A

WHERE  
TO STUDY FOR  
NEW ENERGY  
PROFESSIONS?

Мен жастарыңызға сенемін.  
Сіздердің білімдеріңіз, қабілеттеріңіз бен  
еңбектеріңіз қуатты елімізден  
Қазақстанның қалыптасуына қолың  
жеткізіңіз.

Н.Ә. Назарбаев

7.

**ЕВРАЗИЙСКИЙ  
НАЦИОНАЛЬНЫЙ  
УНИВЕРСИТЕТ  
имени  
Л.Н.Гумилева**



Я верю в нашу молодежь.  
Уверен, ваши знания, ваша энергия и  
ваш труд будут работать на построение  
сильного и процветающего Казахстана.

Н. Назарбаев





## WHERE TO STUDY FOR NEW ENERGY PROFESSIONS?

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The next stage in the development and implementation of the Atlas of new professions in Kazakhstan is the localization of new professions (professions of the future) in the energy industry of Kazakhstan, which were developed and proposed by leading experts in this industry.

As part of localization, 28 Universities were considered (table 1). these Universities were taken from the list that was formed by NCE "Atameken" in 2019. the rating of selected Universities in the framework of national competitions is as follows:

Table 7.1.

**Rating of universities for localization of new professions in the energy industry of the Republic of Kazakhstan\*.**

	Higher educational	Rating	Number new professions
1	O.A. Baikonurov Zhezkazgan University	3.89	20
2	Atyrau Oil and Gas University	3.87	26
3	Almaty University of Energy and Communication	3.62	22
4	D. Serikbayev East Kazakhstan State Technical University	3.61	29
5	M. Kozybayev North Kazakhstan State University	3.60	27
6	Innovative University of Eurasia	3.59	26
7	K.Satpayev Ekibastuz Engineering and Technical Institute	3.53	17
8	Z. Aldamzhar Kostanay Social Technical University	3.434	21
9	West Kazakhstan Innovation and Technology University	3.426	25
10	Toraighyrov University	3.42	31
11	Zhangir khan West Kazakhstan Agrarian Technical University	3.38	24
12	Karaganda State Industrial University	3.37	22
13	A. Baitursynov Kostanay State University	3.36	27
14	Kazakh National Agrarian University	3.30	31

\*SOURCE: <https://atameken.kz/uploads/content/files/%D0%AD%D0%BB%D0%B5%D0%BA%D1%80%D0%BE%D1%8D%D0%BD%D0%B5%D1%80%D0%B3%D0%B5%D1%82%D0%B8%D0%BA%D0%B0.pdf>



	Higher educational	Rating	Number new professions
15	S.Seifullin Kazakh Agro Technical University	15 Kazakh	25
16	Karaganda State Technical University	3.263	28
17	Akmeshit humanitarian and technical Institute	3.257	13
18	Kazakh Academy of Transport and Communication	3.22	15
19	Sh. Yessenov Caspian State University of Technologies and Engineering	3.20	28
20	Kazakh Humanitarian Law Innovative University	3.08	17
21	Eurasian Technological University	3.075	23
22	M. Auezov South-Kazakhstan State University	3.069	30
23	Rudnyi Industrial Institute	3.05	26
24	M.Kh. Dulaty Taraz State University	2.91	31
25	Korkyt Ata Kyzylorda State University	2.90	27
26	Al-Farabi Kazakh National University	2.87	30
27	Satbayev University	2.80	10
28	Khoja Akhmet Yassawi International Kazakh-Turkish University	2.48	28

Table 2 shows 34 new professions in the energy industry, as well as educational specializations, on the basis of which it is possible to deploy localization of new professions. Localization of new professions is an activity aimed at developing educational and methodological materials and special training practices for teaching knowledge, skills, and competencies for new tasks in the industry.

Table 7.2.

**List of faculties required for localization of new professions in the energy industry of the Republic of Kazakhstan.**

Professions		List of faculties and departments required for localization of new professions in the industry
1	Biology and ecology in the energy sector	
1.1	Meteoenergy specialist	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> </ul>
1.2	Agronomist of energy crops	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> <li>▶ 5B080100 - Agronomy</li> </ul>
1.3	Microalgae microbiologist	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> <li>▶ 5B06070-Biology</li> </ul>
1.4	Bioenergy specialist	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> </ul>

Professions		List of faculties and departments required for localization of new professions in the industry
1.5	Recovery and recycling engineer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B070200 - Automation and control</li> </ul>
<b>2 Decentralization of power grids</b>		
2.1	Smart grid designer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B051100 - Marketing</li> </ul>
2.2	Complex design specialist for power supply systems	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B070200 - Automation and control</li> </ul>
2.3	Engineer for development and implementation of artificial intelligence	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B070300 - Information systems</li> </ul>
2.4	Smart manager	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B070300 - Information systems</li> </ul>
2.5	Operational dispatcher of RES	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> </ul>
2.6	Energy marketer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B051100 - Marketing</li> </ul>
2.7	Hydrogen energy engineer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> </ul>

Professions		List of faculties and departments required for localization of new professions in the industry
2.8	Developer-designer of autonomous power systems	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B070200 - automation and control</li> </ul>
2.9	Developer-designer of electric and thermal energy storage	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> </ul>
2.10	Specialist in numerical methods in power engineering	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B070300 - Information systems</li> </ul>
<b>3 Managing energy consumption in an urban environment</b>		
3.1	Manager of buildings, apartment buildings	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> <li>▶ 5B060500-Nuclear physics</li> </ul>
3.2	City moderator	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> <li>▶ 5B060500-Nuclear physics</li> </ul>
3.3	Specialist in nuclear power plants (NPP) construction and operation	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> <li>▶ 5B060500-Nuclear physics</li> </ul>
3.4	Engineer for the modernization of traditional energy equipment	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> </ul>

Professions		List of faculties and departments required for localization of new professions in the industry
3.5	Aero hydrodynamics of wind and hydroturbines	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> </ul>
3.6	Reactor equipment engineer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> </ul>
3.7	Nuclear fuel production cycle engineer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> <li>▶ 5B060500-Nuclear physics</li> </ul>
<b>4 New technologies in the energy sector</b>		
4.1	Recovery engineer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> </ul>
4.2	Designer of electric filling stations	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B060800 - Ecology and/or</li> <li>▶ 5B073100 - Life safety and environmental protection</li> </ul>
4.3	Generating device mechanic	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> </ul>
4.4	Engineer-technologist in high-temperature materials science	<ul style="list-style-type: none"> <li>▶ 5B072100-Chemical technology of organic substances and/or</li> <li>▶ 5B072000-Chemical technology of inorganic substances</li> </ul>
<b>5 Effective management of energy companies</b>		

Professions		List of faculties and departments required for localization of new professions in the industry
5.1	Cybersecurity specialist for complex networks in the energy industry	<ul style="list-style-type: none"> <li>▶ 5B070300 - Информационные системы</li> <li>▶ 5B030100 - Юриспруденция</li> </ul>
5.2	Energy manager	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B050700 - Management</li> </ul>
5.3	On-demand economics specialist	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B050600 - Economics</li> </ul>
5.4	Energy Manager	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B050700 - Management</li> </ul>
5.5	CAD development engineer	<ul style="list-style-type: none"> <li>▶ 5B071800 - Electricity and / or</li> <li>▶ 5B071700 - Heat power engineering</li> <li>▶ 5B070300 - Information systems</li> </ul>
5.6	Production psychologist	<ul style="list-style-type: none"> <li>▶ 5B050300 - Psychology</li> </ul>

# TABLE 7.3.

## LOCALIZATION OF PROFESSIONS OF THE FUTURE OF THE ENERGY INDUSTRY IN UNIVERSITIES OF THE REPUBLIC OF KAZAKHSTAN

Nº	Name of profession	Zhezkazgan University O.A. Baikonurova	Atyrau University of Oil and Gas S. Utebayev	Almaty University of Energy and Communication	East Kazakhstan State Technical University D. Serikbayev	North Kazakhstan State University M. Kozybaeva	Innovative Eurasian University	Ekibastuz Engineering and Technical Institute of Academician K. Satpayev	Kostanai Socio-Technical University, Academician Z. Aldamzhar	West Kazakhstan Innovative Technological University	Pavlodar State University S.Toraiгыrova	West Kazakhstan Agrarian and Technical University Zhangir Khan	Karaganda State Industrial
<b>Direction «Biology and Ecology in Power Engineering»</b>													
01	Meteorologist	●	●	●	●	●	●			●	●	●	●
02	Agronomist for energy crops					●					●	●	
03	Microalgae microbiologist	●				●	●				●	●	
04	Bioenergy	●	●	●	●	●	●			●	●	●	●
05	Recovery and recycling engineer	●	●	●	●			●	●		●		
<b>Direction «Decentralization of power grids»</b>													
01	Smart grid designer		●	●	●		●	●	●	●	●	●	●
02	Specialist in the complex design of energy supply systems	●	●	●	●		●	●			●		
03	Artificial Intelligence Development and Implementation Engineer		●	●	●	●	●	●	●	●	●	●	●
04	Smart Manager		●	●	●	●	●	●	●	●	●	●	●
05	Operative dispatcher of the substation of the subject of renewable energy source	●	●	●	●	●	●	●	●	●	●		
06	Energy Marketer				●						●		
07	Hydrogen Energy Engineer	●	●	●	●		●	●	●	●	●	●	●
08	Developer - designer of autonomous power systems	●	●	●	●		●	●			●		
09	Developer - designer of electric and thermal energy storage systems	●	●	●	●	●	●	●	●	●	●	●	●
10	Numerical methods in power engineering		●	●	●	●	●	●	●	●	●	●	●
<b>Direction «Management of energy consumption in the urban environment»</b>													
01	Manager of buildings, apartment building	●	●	●	●	●	●			●	●	●	●
02	City Moderator	●	●	●	●	●	●			●	●	●	●
03	Specialists in NPP construction and operation				●								
04	Engineer for the modernization of traditional energy equipment	●	●	●	●	●	●	●	●	●	●	●	●
05	Aerohydro dynamics of wind and hydro turbines	●	●	●	●	●	●			●	●	●	●
06	Reactor equipment engineer	●	●	●	●	●	●	●	●	●	●	●	●
07	Nuclear Fuel Cycle Production Engineer				●								
<b>Direction «New technologies in the energy sector»</b>													
01	Recuperation engineer	●	●	●	●						●		
02	Designer of electric filling stations	●	●	●	●	●	●			●	●	●	●



Nº	Name of profession	Zhezkazgan University O.A. Baikonurova	Atyrau University of Oil and Gas S. Utebayev	Almaty University of Energy and Communication	East Kazakhstan State Technical University D. Serikbayev	North Kazakhstan State University M. Kozybaeva	Innovative Eurasian University	Ekibastuz Engineering and Technical Institute of Academician K. Satpayev	Kostanai Socio-Technical University, Academician Z. Aldamzhar	West Kazakhstan Innovative Technological University	Pavlodar State University S.Toraigyrova	West Kazakhstan Agrarian and Technical University Zhangir Khan	Karaganda State Industrial
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**Direction «New technologies in the energy sector»**

03	Generating device mechanic	●	●	●	●	●	●	●	●	●	●	●	●
04	High-Temperature Materials Engineering		●			●	●			●	●		●

**Direction «Effective management of energy companies»**

01	Cyber security specialist for complex networks in the energy sector					●	●		●	●	●		
02	On-demand economics specialist	●			●	●	●	●	●	●	●	●	●
03	Energy Manager		●		●	●	●	●	●	●	●	●	●
04	Financial instruments engineer	●	●		●	●	●		●	●	●	●	●
05	CAD engineer based on multiphysics modeling of energy facilities		●	●	●	●	●	●	●	●	●	●	●
06	Production psychologist					●	●		●	●			
<b>Total:</b>		19	24	21	27	23	24	15	19	23	29	22	2

University	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Kostanai State University A. Baitursynov	●	●															
Kazakh National Agrarian University	●	●	●														
Kazakh Agrotechnical University S. Seifullin	●	●	●	●													
Karaganda State Technical University	●	●	●	●													
Akmeshit Humanitarian and Technical Institute	●																
Kazakh University of Railway Communication	●																
Caspian State University of Technology and Engineering Sh. Yessenova	●	●															
Kazakh Humanitarian-Legal Innovative University	●	●															
Eurasian University of Technology	●	●															
South Kazakhstan State University M. Auezov	●	●	●														
Rudny Industrial Institute	●	●															
Korkyt-Ata Kyzylorda State University	●	●	●	●													
Satbayev University	●	●	●	●													
Taraz State University M.H. Dulati	●	●	●	●													
Al-Farabi Kazakh National University	●	●															
International Kazakh-Turkish University H.A. Yasawi	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
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A

# HOW TO PREPARE FOR THE FUTURE

8.

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# 8.7.

## THE FOUR LITERACY OF THE FUTURE

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The path to the competencies of the future lies through the abyss of mastering new types of literacy, the modern adult will have to greatly expand the set of literacy skills that they possess.

### NOW ALMOST EVERY ADULT HAS THE FOLLOWING LITERACY SKILLS:

1. Ability to read and write.
2. Knowledge of accounts (arithmetic, simple statistics).
3. User digital literacy (ability to type, understanding of Windows, ability to work in the main editors).
4. Technical certificate of interaction with the world of modern things: smartphones, household electrical appliances.
5. Scientific picture of the world.

How will literacy help the future specialist in professional activities?

In order to master the skill of

playing a musical instrument, you will need to master musical literacy:

- ▶ treble clef and bass clef, location of notes on a stave,
- ▶ denoting dynamic shades and tempos,
- ▶ alterations and more

Without learning this letter, you will eventually be able to remember the sequence of keystrokes or pick up a melody by ear and play a simple piece. But you will not be able to perform complex works and classical music culture will not be available for you. Professional formation as a Muse-Kant without musical notation will be impossible.

## HISTORY THERE ARE EXAMPLES OF MASS ADOPTION OF LITERACY BY SOCIETY

*For example, the industrialization of the USSR required new specialists in the field of working with machinery and equipment. The country massively needed future professions of that time: engineers, technologists, mechanics-repairmen, mechanics-drivers, while the majority of the population of the country were illiterate and illiterate peasants.*

*To train such specialists of the future from the peasants, the country needed to conduct two programs to eliminate illiteracy: educational programs-mass training in reading and writing, and the development of engineering literacy.*

*Between 1919 and 1927, the literacy program covered about 10 million adults and 7.5 million children.<sup>5</sup> In 1933-1937, more than 20 million Negroes and about 20 million illiterates were already engaged in educational programs only in the registered schools. Only after the creation of basic literacy, the country was able to start training specialists for the complex professions of that time. For the emergence of a class of operators-machinists, as well as repairmen of new equipment, it was necessary to teach engineering literacy – reading drawings, the basics of technical mechanics, as well as knowledge about the details of machines and equipment. Without solving the problem of literacy, it is impossible to train specialists with high competencies.*

Our generation has experienced the development of user digital literacy – all of us we learned to type on the keyboard, we learned to work with Windows, with text and image editors. Having mastered these skills, clerks, journal designers, and accountants were able to master new competencies using the capabilities of computer technology in their professions.

Now these basic user literacy skills are already mandatory for modern professions.

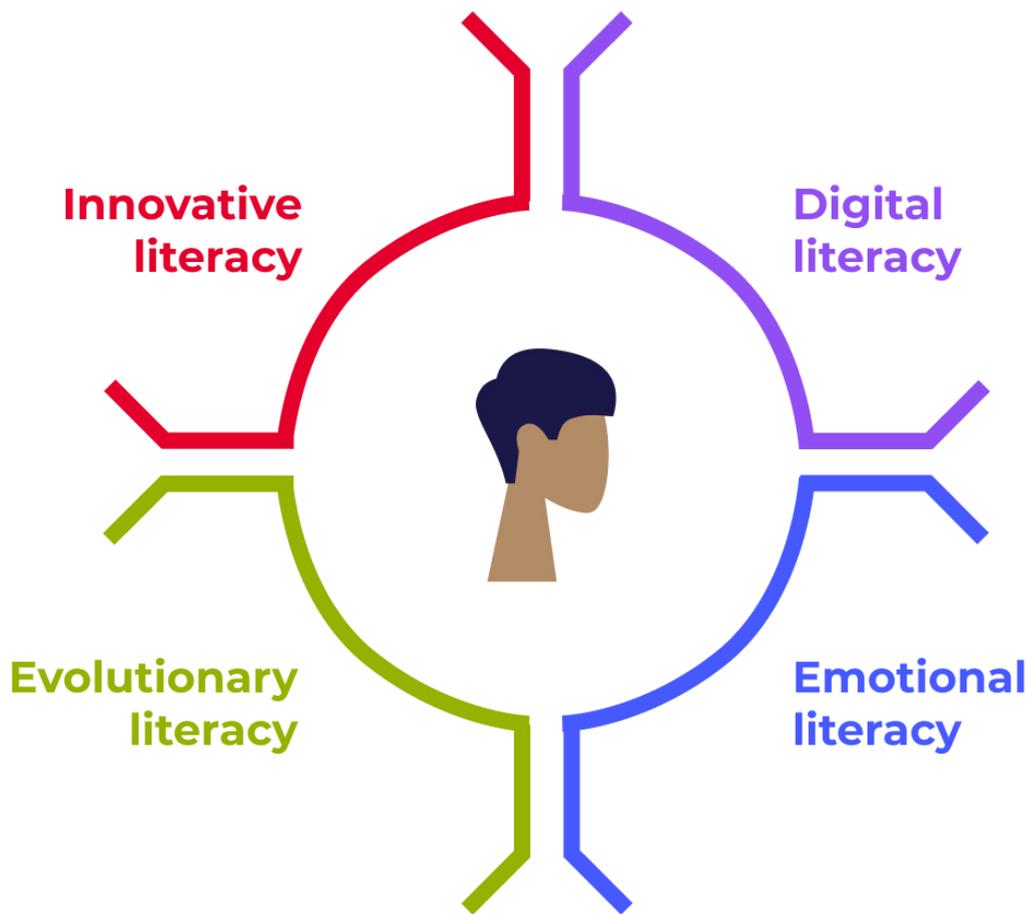
Having completed the historical examples of the importance of learning literacy for the transition to the future, let's clearly formulate what we will consider the literacy of our near future.

Literacy is the basic primary skills that allow you to create a platform for understanding and entering into solving new problems with new tools.

<sup>5</sup> Decree of the Council of people's Commissars of the RSFSR on the elimination of illiteracy. according to it, the entire population of Soviet Russia aged 8 to 50 years, who could not read and write, was obliged to learn to read and write in their native language or Russian at will.

IN THE NEXT 10 YEARS, WE FORECAST, WHAT WILL IT TAKE TO MASTER NEW TYPES OF LITERACY:

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## DIGITAL LITERACY

In the digital world, when information is considered the second oil, every modern specialist must have digital literacy.

Digital literacy will be in demand both in professional life and in everyday life. Accordingly, there is a basic and professional digital literacy.

Basic digital literacy includes the ability to use computers and smart backgrounds, use the most common programs, be able to search for information on the Internet, and know the basic rules for protecting financial transactions and personal data from intruders. A number of routine household operations are gradually moving to the digital world: conducting electronic correspondence, online purchases, paying bills and receiving public services online—as well as elements of basic digital literacy.

Professional digital literacy is the ability to use digital devices and software in professional activities. the list of devices

and programs is wide, because the specifics of the activity are different everywhere. The most widespread skills are working in 1: C, ERP and CRM systems, and automated process management systems.

**A** bility to translate data information into digital form, use of digital products for coordination and planning of work, preservation of ideas, preparation of joint projects, etc., these are elements of digital literacy.

## **E** MOTIONAL LITERACY

**E** motional literacy is the ability to understand and productively Express emotions, to have a sense of empathy. Emotional literacy at the exceeds personal and professional effectiveness and efficiency in the interaction within the teams.

To maintain stable performance without slumps, you need to be able to recognize and understand the emotions that are born during the day, neutralize them and manage the rest. It is important not only to control, but also to show emotions productively. Negative emotions can be expressed by swearing, breaking the distance, or you can correctly Express your

dissatisfaction without harming others and improving relations with colleagues at work.

Organizations of the future are more likely to agree on points of view, cooperate and cooperate than to be administratively subordinate. The effectiveness of collaboration largely depends on the emotional compatibility of team members. This requires being able to understand the feelings and emotions of others, empathize with others, and be able to eliminate the emotional damage that regularly occurs when working together, accumulates, and reduces effectiveness.

## E VOLUTIONARY LITERACY

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Organizations of the future will significantly increase employee autonomy. It will be necessary to understand and determine what to do. Therefore, the specialist will need evolutionary literacy.

Evolutionary literacy is the ability to understand and fulfill personal, group, and corporate goals (guidelines, intentions). Understanding the basics of life and career planning in the

global world and the conditions of constant change. An equal desire for vertical and horizontal career growth in organizations of the future. Willingness to combine the professional sphere and personal life and find a healthy compromise between them. A wide area of personal responsibility in the work.

This literacy base - Sya leadership, goal setting, group management, etc.

## E XISTENTIAL LITERACY

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In the future, obsolescence of ideas, knowledge, products, goods, and services will occur over the course of months or weeks. Companies and products can lose customers, become unnecessary, and go bankrupt in a short period of time.

Department, company, and product, future specialists will be able to build effective ecosystems.

To continue operating when the meaning of a company's existence seemed lost, you need to have existential literacy: the ability to find the uniqueness, purpose of a person, group, social groups, companies in a complex and changing world, as well as to build an eco - system around it to strengthen and develop it.

The ability to consciously connect and correctly use different forms and styles of thinking to unlock the potential and realize the purpose of a person, organization, or system.

A specialist of the future will be required to design and offer a new product or business model- it is based on the existing achievements of enterprises

By defining the uniqueness and purpose of a specialist,



## 8.2.

### SKILLS OF THE FUTURE SPECIALIST

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So, we have a list of professions that are likely to appear in 5-10 years. let's find out what skills you need to master a new profession and build a successful career in the oil and gas industry.

**T**he first thing you need to know is that in order to become a sought-after specialist in the future, you will need to have not only professional skills. With sufficient conservatism in the oil and gas industry, the demand for over-professional skills increases. The reason for this is a new generation of oil recovery

technologies, accelerated digitalization of processes, and the growing need for processing big data and developing solutions based on it.

Employers want to hire specialists who are able to adapt quickly, control themselves, and use modern planning and

organization tools.

**S** econd, the model of education will change: the main feature of the future will be complexity.

Everyone will have to adapt to new forms of education. The model of education that we are used to is called industrial, and was developed by the German school in the XIX century. This model is characterized by the con-Weyer "school-College-University - high school".

#### **DISTINGUISHING FEATURES OF THE OLD MODEL:**

1. Getting an education in youth.
2. One education for life.
3. Long-term training in the received specialty from three to five years, depending on the level of education.
4. Fundamental theoretical training.
5. After receiving education professional development occurs at the request, it is not necessary. Exceptions are established by law.
6. The training System is localized in the educational institution.

The new model of education has

not yet been formed, and different authors describe it in different ways.

#### **THE DISTINCTIVE FEATURES OF THE NEW MODEL WILL BE:**

1. Continuous education of mixed age groups:
  - **a.** It will Become the norm to get a new profession at a young age.<sup>6</sup>
  - **b.** New teaching methods will be created that take into account the age characteristics of students: memory loss, a higher level of responsibility and perseverance.
2. The emergence of different length of educational programs, from super-short (10-15 hours), to very long.
3. Globalization of the educational space:
  - **a.** On the one hand, the inhabitants of the regions will have more opportunities of access to quality education. Moving to the capital or to highly developed countries will not be the only way to get a specific education, for example, in biology, astrophysics, etc. There will be more equal opportunities.
4. The emergence of educational ecosystems and unified thematic

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<sup>6</sup> For example, this will affect drivers of self-propelled vehicles, operators of non-automated mechanisms (onion, tipper, etc.), because their professions will disappear. Specialists maintenance and repair in connection with what will be a new, radically different equipment and there will be new tasks for the modernization of old equipment.

educational platforms in the country (unified medical, engineering, and

other platforms that unite classical Universities).

**WITHIN THE FRAMEWORK OF THE PROJECT "ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN", SKILLS WERE GROUPED INTO 4 LARGE BLOCKS:**

1. Popular thinking styles.
2. Social skills.
3. Technical skills.
4. Corporateskills.

## 1 THINKING SKILLS

Experts agree that more and more of the processes and functions will be fulfilled-use robots and artificial intelligence. By 2030-2040 in performing typical tasks, the person will lose to the machine. How do we win the competition? Thinking is one of the few areas where machines have not yet penetrated. Critical, creative, systematic, and other styles of thinking are available

only to humans and will remain their monopoly for the foreseeable future. Even today, specialists of the future should purposefully develop in itself, thinking styles and techniques. Only in this case will we be able to gain a foothold in the future with machines and make them assistants that collect data for us and perform simple functions for us and those that are easy to algorithmize.

## 2 SOCIAL SKILLS

The specialist of the future does not need to be able to work with machines, he needs to be able to manage and interact with other people. With the development of technology, the demand for building a trusting network of communication to meet emotional needs will increase more and more. Social

networks, new production networks, and temporary project teams will require specialists to negotiate and cooperate, present, moderate, and facilitate the work of groups. These skills will become a separate vector of training and self-improvement of the future specialist.

### 3 TECHNOLOGICAL SKILLS

In the middle of the last century, computer specialists believed that by the beginning of the twenty-first century, computer literacy will be as necessary for a person as the ability to read and write. We see that their forecasts have come true.

Digitalization gives a person a volume of information thousands of times larger than it was at the beginning of the century. A large volume of weakly structured data is called big data. This data

contains information on the basis of which the Manager will be able to make more informed and more objective decisions.

The volume of information increases every year, but without processing this information is useless. Therefore, there will be a demand for specialists who can identify data collection points and tools, structure and analyze them, and provide structured information to the Manager for decision-making.

### 4 CORPORATE SKILLS

The core of twentieth - century industrial companies was Fabry and the Corporation. These are large organizations that can bring together a large number

of specialists and organize mass production. According to experts, the core of business in the XXI century will be digital platforms.

On the horizon of 10-15 years, we will see a synthesis of organizational models of the XX and XXI centuries. Sauveur-large corporations are clumsy and overly hierarchical. If an employee wants to make a proposal, it will take a long time to go through the stages of approval, changes to existing regulations, inertia, and overcome resistance to changes. The lower the employee is in the corporate hierarchy, the more difficult it is to pass these procedures.

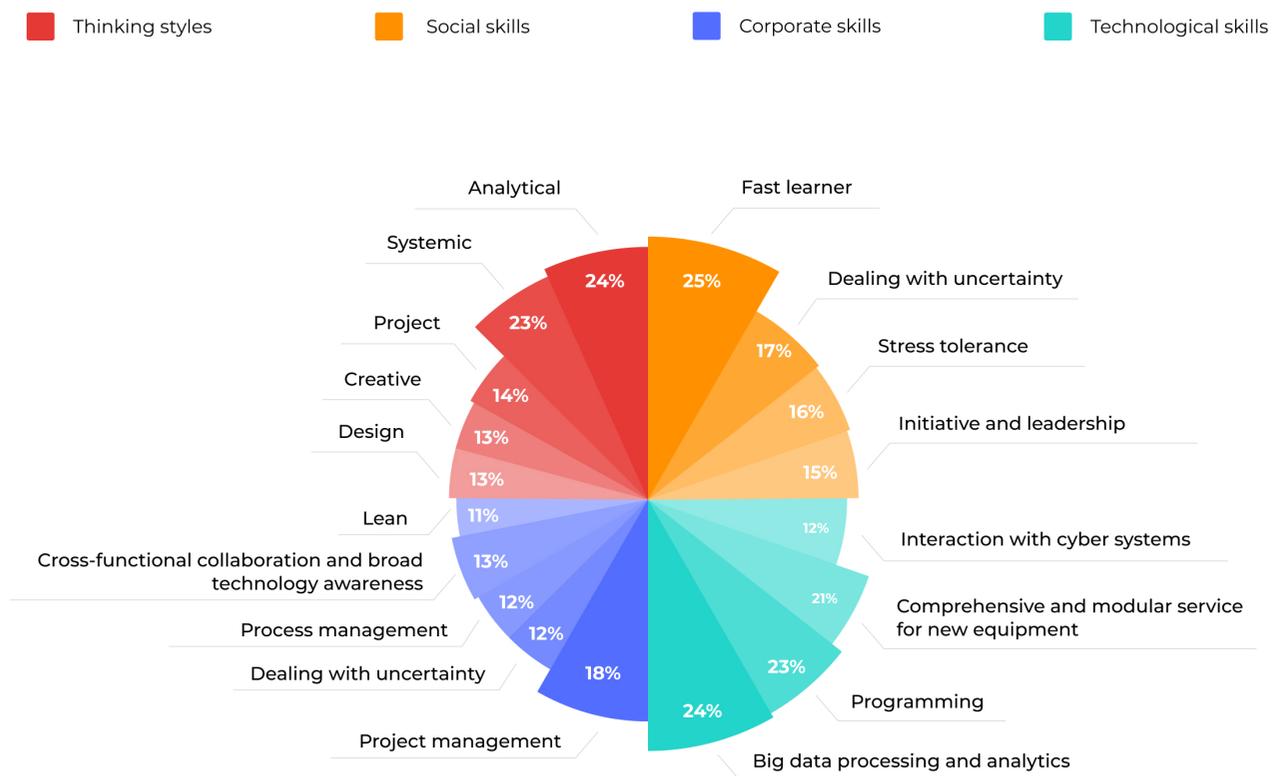
The key to success in competition is rapid decision-making and implementation. In the future, the demand for this speed will only increase. To overcome this disadvantage, modern corporations are changing their management style. Organizations of the future provide all dedicated employees who have an innovative idea of improvement with the opportunity to Express themselves, regardless of their position in the hierarchy. To take advantage of this opportunity, an employee

needs to master a number of skills: management, Agile planning. Employees who have ideas for improvements and can self -

organize to implement them will be the driving force behind the development of the companies of the future.

## B LEADING EXPERTS IN THE ENERGY INDUSTRY EXPRESSED THEIR OPINION ON WHAT SKILLS WILL BE THE BASIS OF CAREER GROWTH

Figure 8.1. *Skills of a specialist in the future of the energy industry of the Republic of Kazakhstan.*



## **T**HINKING SKILL. WHAT KIND OF SKILLS WILL BE REQUIRED TO WIN THE COMPETITION FROM CARS?

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The most important thinking styles for building a career in energy companies in the future will be analytical thinking, systems thinking, creative thinking, and project thinking.

**ANALYTICAL (24%) AND SYSTEMS THINKING (23%)** lead with a significant leap. Experts note that this is due to increasing uncertainty and expanding the list of complex tasks. Specialists of the future should be able to in difficult conditions, identify valuable data (Analytics), and then group them into complete models or pictures of the situation (systematization). In the future, their number will only grow. Analytical and systems thinking helps to organize a large amount of incoming data and make decisions in conditions of their lack. Those who use these skills see the cause-and-effect relationships of developments both in production and in the industry, and identify the priority of tasks. Analytical and system-based thinking skills will be required, because professions that focus only on working with large volumes of data collected in production are beginning to develop. for example, an analyst of production data, a specialist in collecting information, etc.

**PROJECT THINKING (14%)** is the representation of work tasks in the form of projects, i.e., the

ability to determine the stages of achievement goals, find solutions, and identify the necessary resources and performers. Project thinking is required in various areas of activity: from management to IT product development, from the implementation of an automated management system at the enterprise to the implementation of a corporate strategy. Enterprises are gradually moving away from the routine management method and moving to the project type of management.

### **CREATIVE THINKING (13)**

– thinking that allows you to look at the situation in a new way and find a non-standard solution. Creative thinking is primarily a large variation in the use of thinking tools. Modern the world is changing rapidly and we are faced with situations where it is impossible to find a ready-made solution using standard algorithms and rules. Using creativity, you can create a fundamentally new product, solve the problem in a fundamentally different way. At the same time, we use our imagination, look for new connections, establish new laws between events and phenomena, look for new ways to use familiar things, and respond to old situations and phenomena in a new way.

A creative person can completely

abandon previous experience and knowledge and thus find a non-standard solution. At the same time, the effectiveness of this approach can significantly exceed the decision made on the basis of familiar algorithms.

#### **DESIGN THINKING (13%)**

An ability to develop technical solutions to improve the properties of equipment, increase labor productivity. Such specialists will be required in the field of MRO.

Experts predict that there is a need for rapid learning, initiative and leadership, stress tolerance, and the ability to work in conditions of uncertainty..

#### **FAST LEARNING/ UNLEARNING (25 %).**

Knowledge is rapidly becoming obsolete. In order to master new knowledge, it is necessary to develop the ability to learn quickly. A specialist needs not only to learn quickly, but also to learn quickly, giving up irrelevant knowledge, skills, and beliefs. If ten years ago it was necessary for managers and employees of the IT sector to quickly learn, now it is becoming mandatory for employees of other industries, and the oil and gas industry is no exception.

#### **WORKING UNDER UNCERTAINTY (17%)**

is a relatively young skill. If in the middle of the last century the amount of data needed for decision-making was relatively small, and conditions remained stable, now the amount of data is growing rapidly, conditions can change in real time. This also

requires a different approach to decision-making. If earlier it was believed that in order to make a decision, it is necessary to collect as much initial information as possible, now it is impossible to do so. Now it is more important to determine the minimum sufficient amount of necessary information, be able to allocate and reallocate resources, and respond to changes in time. Skills will be in demand among developers of computer models of field operations, project managers, etc.

#### **STRESS TOLERANCE (16%).**

Unfortunately, rapid changes in the technological order and the growing level of uncertainty increases the level of stress both at work and at work. and in everyday life. In order to be successful, you need to be able to cope with stress: to identify stress factors, to determine which of them are controllable and manageable, and which are not, to know and apply methods of dealing with stress.

#### **INITIATIVE AND LEADERSHIP (15%)**

experts consider the most important skills for a specialist of the future. Gradually, the structure of organizations becomes less hierarchical and more horizontal. There are fewer formal leaders and an increasing role for informal leaders who do not have nominal power. Proactive employees aim higher, because the companies of the future need to respond faster to changing conditions, without waiting for a command from above. Initiative and leadership are in demand in all areas, from teams working around mining sites to the top level of

management.

Among the corporate skills, it will be important for the future employee to establish and maintain cross-functional interaction, as well as to have at least basic project and process management skills, use a flexible approach to task execution planning (Agile planning), and interact at the inter - functional level, for example, drillers and financiers.

### **PROJECT MANAGEMENT.**

As already mentioned, project management is gaining popularity because changes occur too quickly, and the traditional functional structure of enterprises does not have time to respond to them. The project Manager must solve problems of a high degree of novelty and complexity, in terms of budget constraints, deadlines, while ensuring the quality of work. In contrast to traditional, highly hierarchical structures, temporary project teams are formed, which are formed after the project is completed. Enterprises in the oil and gas industry of Kazakhstan need technological improvement, since technologies do not stand still.

First of all, this applies to methods for improving oil recovery and implementing methods for processing big data and improving technological and business processes.

### **CROSS-FUNCTIONAL INTERACTION SKILLS**

will be required for those who work at the intersection of different fields of activity, for

example, laboratory assistants and specialists-these skills will be in demand among continuing education specialists, facility managers, R&D project managers, etc.

### **PROCESS MANAGEMENT.**

A business process in any company is a sequence of actions for performing a typical task. In order to effectively manage processes, you need to be able to distinguish the process from the routine of employees ' actions and describe it graphically and schematically, preferably using one of the formal methods of description.

It is important to see how the stages of the process are related to each other, what the sequence of actions is, and who is responsible for execution. As a result, we get a visual representation of the process. When we have a visual description, we can start optimizing. The main indicator is to find how to do the same thing, but faster, easier, with less involvement of employees. At first glance, it seems that the process is optimally designed: every action is necessary, every performer is in his place.

Practice shows that each process can be optimized, sometimes even at times.

### **WORKING UNDER UNCERTAINTY (17%)**

is a relatively young skill. In the middle of the last century the amount of data needed for decision-making was relatively small, and conditions remained stable, now the amount of data is

growing rapidly, conditions can change in real time.

This also requires a different approach to decision-making. If earlier it was believed that to make a decision, you need to collect as much initial information as possible, now it is impossible to do so. Now it is more important to determine the minimum sufficient amount of necessary information, be able to allocate and reallocate resources, and respond to changes in time. Skills will be in demand among developers of computer models of field operations, project managers, etc.

#### LEAN MANUFACTURING.

It should be noted that such a rule as lean production in the world management culture began to develop around the 50s of the 20th century. Currently, these technologies are increasingly in demand and are penetrating many sectors of the economy, including energy. In the group of skills of safe production, managers of enterprises include the ability to conduct continuous improvement of production. This requires skills such as mapping the flow of production, the ability to build a system of order in the workplace (5C), to ensure the development of systems of structured quality in the process, the ability to create breakthrough teams, as well as to improve the performance of enterprises based on the principle of "SIZ - up".

**T**echnological skills of the future – the ability to work with cyber systems, digital devices, programming skills, working with big data, and the ability to perform modular

maintenance of modern equipment.

#### BIG DATA SKILLS

they will be in demand primarily from big data analysts, developers of digital models of enterprises and place - births.

Big data is the new oil, and companies that know how to collect it and manage businesses based on it have made great progress in improving efficiency. In the future, every professional should be able to collect, organize and use data in their workplace.

#### PROGRAMMING

previously used by software developers. In the future, these skills will be required for process equipment operators and repair service personnel to set up equipment, adapt to the process, and eliminate defects. Software-controlled hardware that also requires programming is distributed.

Programming will be required for such professions of the future as: service engineer-oilman, IT dispatcher, engineer-analyst in NGOs, etc.

#### COMPREHENSIVE AND MODULAR EQUIPMENT MAINTENANCE

it replaces maintenance with the replacement of individual parts due to the fact that modern equipment becomes more complex. A separate task of the MRO service is to modernize old equipment and combine equipment of different generations in one technological line.



## 8.3.

### PROFESSIONAL COMPETENCES OF THE FUTURE

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With the change in the technological structure, the emergence and transformation of professions, the requirements for the competencies of new employees will inevitably change. What are competencies?

Competencies are a set of skills, knowledge, and personality traits that help a specialist perform their job well. So, for a good teacher, empathy, patience, and attentiveness are important. For an officer – leadership qualities. For an accountant – perseverance, accuracy,

scrupulousness.

Please note that competencies do not make a person a specialist, but they make it much easier for a specialist to perform their duties and increase their value.

Competencies of the future – a

selection of competencies, the possession of which will make it possible to become more popular in the labor market in 5-10 years. Recently, there has even been a trend: to master not a profession,

but competencies. All professions are based on a number of competencies that will form the basis of professional skills in the near future.

## BASIC COMPETENCIES IN THE PRESENTED ATLAS, THE FOLLOWING ITEMS ARE SELECTED:

1. Lean manufacturing.
2. Multiculturalism and multilanguage.
3. Working with people.
4. Programming, artificial intelligence, robotics.
5. System thinking.
6. Eco-friendly thinking.
7. Skills of artistic creativity.
8. Intersectoral communication.
9. The focus on customers.

### 1 LEAN MANUFACTURING

Lean manufacturing is an enterprise management concept based on constant search, reduction, or elimination of losses. Losses are those actions, processes, or operations that consume resources (human, temporary, material, etc.), but do not add value to the final or intermediate consumer.

Lean manufacturing changes the approach to managing the efficiency of an enterprise from extensive (working more and faster) to intensive (working more efficiently, i.e., doing only what is necessary and not doing what you

can do without).

Specialists with thrift competencies will be able to improve the efficiency of divisions or businesses as a whole without attracting large investments.

The relevance of lean management methods is increasing, because traditional management methods have already reached their peak, and further business development will increasingly focus on intensive development and lean improvement methods.

## 2 MULTICULTURALISM AND MULTILINGUALISM

**M**ulticulturalism is the preservation and development in a particular community (state or enterprise) of the cultural characteristics of the people living there. Multiculturalism and multilingualism in the enterprise involves not only taking into account national or religious cultures, but also the culture of thinking, psychotypes, communications and individual characteristics.

The modern world is becoming global at a rapid pace. Even now, a company that employs specialists who were born or live-in different parts of the world is no exception. The policy of multiculturalism and

multilingualism sets the vector of interaction between dissimilar people: not to conflict, but to recognize each other.

The changes that are taking place today pose new challenges that have not been seen before. It is generally recognized that the most effective solutions are born at the intersection of different areas of knowledge, approaches, and cultures. The most effective teams include people with different features of thinking, psychology, and distribution of roles in the team. Multicultural teams will be able to find effective unusual solutions and even solve problems that are still unsolved.

## 3 WORKING WITH PEOPLE

**W**orking with people is the ability to maximize the potential of the team and each of its members to achieve the goals of the organization.

Despite mass robots and automation, the decisive role in the economy of the future is assigned to the person and his creative abilities.

This is especially evident in IT companies. Companies have approximately the same computers and know the same programming languages, although to varying degrees,

but some companies become successful, and others close after six months. As a rule, the key to success lies in the effective work of teams.

The relevance increases with the increase in the share of Millennials in work collectives. These people are more likely to value the individual approach.

**EFFECTIVELY UNLOCKING THE POTENTIAL OF EACH EMPLOYEE CAN CREATE A DECISIVE COMPETITIVE ADVANTAGE FOR THE ENTERPRISES OF THE FUTURE.**

## 4 PROGRAMMING, ROBOTICS, ARTIFICIAL INTELLIGENCE

This area includes various skills related to the development and configuration of artificial intelligence systems, setting up and configuring robots, developing programs for managing production processes and individual machines.

Automation and robotics are rapidly penetrating all areas, including manufacturing.

It is expected that in 15-20 years, machines will replace humans in most routine operations that do not require creative skills. Therefore, the need for specialists with these skills will grow in all industries. It is these specialists

who will have to ensure the mass arrival of machines in all sectors of the economy.

**AUTOMATION OF PRODUCTION WILL ELIMINATE THE HUMAN FACTOR AND INCREASE PRODUCTIVITY WHERE THERE ARE ROUTINE OPERATIONS THAT DO NOT REQUIRE SPECIAL TRAINING AND CREATIVE SKILLS.**

Specialists will be required not in the main production, but in the service sector and settings for machines, robots, and systems that make algorithmic decisions.

## 5 SYSTEM THINKING

The ability of a specialist to combine (generalize) particular facts into a General picture, build hierarchical levels for understanding various situations (economic, political, business) and making long - term decisions. An important quality is understanding how changes to one element will affect other elements in the future.

The importance of system thinking increases due to the acceleration of changes in life, the need to learn new professions, as well as the increasing interpenetration of various

spheres into each other (social networks, Economics, politics, production, etc.).

Specialists with the skills of systems thinking will be able to solve such tasks as making strong long-term decisions in the context of rapid changes in the economy, diagnose large technical and social systems, make decisions about eliminating the root causes that hinder development, and this skill will also ensure the integration of various project teams into a single working body.



## 6 ENVIRONMENTAL THINKING

**E**nvironmental thinking is focused on achieving harmony between business and the environment Wednesdays. The business cycle is already developing from creation to product disposal, not just sales and consumption. Environmental thinking places the highest priority on health and sustainable development. The importance of ecological thinking increases due to the fact that the development of industry has reached its limit

and the most comprehensive models of sustainable growth of society, economy and business should be built on the basis of mutual interests with nature, the ecosystem, its maintenance, and development. Specialists with environmental thinking skills will be able to solve such tasks as: careful attitude to resources, achieving zero emission of harmful substances into the environment, waste processing and use of secondary resources.

## 7 SKILLS OF ARTISTIC CREATIVITY

**S**kills of artistic creation, the ability to Express feelings and emotions in figurative forms forms, the ability to create their own artistic images, the presence of a developed aesthetic taste. In the future, robots and machines will replace humans in many areas. The only area that is not yet available to machines is the sphere of creativity. Specialists with creative skills will gain an advantage in almost all areas

of business. The emerging trend of personification and individualization of goods and services will continue to develop, and the day is not far off when all goods and services will become as personalized as possible.

Accordingly, the demand for new creative forms of advertising and marketing that take into account the individual characteristics of the consumer will increase.



## 8 INTERSECTORAL COMMUNICATION

Cross-industry communication consists in understanding technologies, processes, and the market situation in various related and non - adjacent industries. Cross - functional and cross-disciplinary interaction.

More and more advanced products are created at the intersection of different industries, and specialists need to be able to understand

several areas of knowledge at the same time. This competence allows you to learn faster, take the best from different areas, and through such mutual enrichment, ensure development within your field.

Specialists with this competence can create unexpected, unique, and breakthrough solutions.

## 9 CUSTOMER ORIENTATION.

Customer orientation is understood as the ability to work with customer requests, the ability of the company and its employees to determine the needs of customers in a timely manner in order to satisfy them with their products or services to the maximum benefit. This competence has become critical for the success of companies, competition for consumers is constantly growing, and all employers want to see customer-oriented employees. In the second

half of the XX century, the concept of an internal client appeared, i.e., an intermediate consumer located further along the production chain within one company.

Possession of this competence allows you to accurately understand the client's request and offer the most suitable solution for it, as well as to build the production and service process more rationally, excluding stages that are not important for the client.

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CONCLUSION

9.





## CONCLUSION

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Worldwide, coal- and oil- intensive energy production is declining, and renewable energy production is increasing.

Renewable energy is obtained from natural resources and is called "green", because it is more environmentally friendly and does not pollute nature. The desire to save the environment will change the culture of energy consumption. Buyers will spend energy wisely and choose whose energy – coal, solar, or wind-to buy and at what price. The development of modern technologies and consumption patterns is changing the future of the energy industry in Kazakhstan, posing complex challenges to production and putting forward new requirements to Kazakh specialists. The Atlas of new professions and competencies in the energy industry of Kazakhstan has prepared the basis for the successful formation of new specialists in the domestic energy sector in the next ten years.

According to experts who took part in the survey of industry problems and their discussion at foresight sessions, Kazakhstan is currently using the cheap energy model, but by 2030 it will switch to a moderately expensive one. According to the foresight vision of Kazakhstan's future energy

sector by 2035, the structure of energy production will change. There will be not only large thermal power plants using new, low - carbon technologies, but also generating centers in traditional industries. Energy will be produced and stored in metallurgy, construction, and agriculture. Based on biofuels and the cultivation of special biocultures, eco-energy villages will be created, which will become centers for generating electricity and heat, supplying alternative fuels/ energy carriers, and will switch to full self-sufficiency in energy supply and waste management.

Smart grids will allow you to optimally connect and distribute energy sources and consumers. It is possible to switch to distributed networks – when each district independently generates heat and energy and reduces costs. Experts expect to create an open electrical network with dispatching based on artificial intelligence. An open network allows you to take in excess energy from alternative micro-sources.

The city's power grid will be

strengthened and a system of electric filling stations for electric cars of private and urban transport will be created on their basis. Kazakhstan's transmission network has a high transit potential for the Eurasian energy space and allows selling surplus cheap energy abroad. Cardinal changes in the energy monitoring system will help save energy and reduce transmission losses. The technological revolution of energy consumption monitoring will be realized through the introduction of "smart" sensors based on telemetry and telemechanics and will allow a new look at the culture of consumption. It will be possible to determine the target energy consumption, plan consumption in the medium term, and introduce differentiated prices. Enterprises will reduce losses and become energy-efficient.

The Atlas of new professions and competencies allowed us to identify the main areas of changes in energy production, which will require special knowledge and application of new professional competencies:

- ▶ transition from large-scale CHP plants to microgeneration and new types of fuel;
- ▶ application of open networks and use of artificial intelligence for dispatching;
- ▶ the emergence of a culture of conscious consumption due to the mass introduction of telemetry and the creation of "smart" systems.

All this creates new requirements for specialists who need to gain knowledge not only in traditional energy, but also in new areas. Power engineers should know advanced wind generator designs,

study the chemistry and physics of solar energy processes, and master biochemistry for working with power plants and microalgae. We need solutions for the active use of digital technologies to create digital counterparts – energy enterprises, transport networks, modeling the imbalance of energy capacity, the use of artificial intelligence systems.

Modern power engineers will need the ability to study and model weather events to predict the amount of energy generated by wind and solar power plants.

The Atlas of new professions and competencies in the energy industry offers a description of 34 new professions, which are grouped into 5 groups. The year of their appearance is predicted, as well as the competencies that will be necessary for professions. The year of the expected appearance of the profession in the labor market will allow future employees, enterprises, and educational institutions to determine themselves. Recommendations are also given in which existing educational institution – University or College-can be deployed training of new specialists.

The list of professions presented in the Atlas of new professions and competencies it allows us to expand the work on creating a successful future labor market in the energy industry of Kazakhstan. Those who want to connect their future with energy can choose a profession and determine the skills necessary for work.

Educational institutions get a base for preparing new programs and planning the development of their own organization. Enterprises in the energy sector are able to make changes based on the use of the industry's foresight image and new tasks being solved by new specialists.

A

THE PROJECT  
TEAM

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## PROJECT RESEARCH TEAM

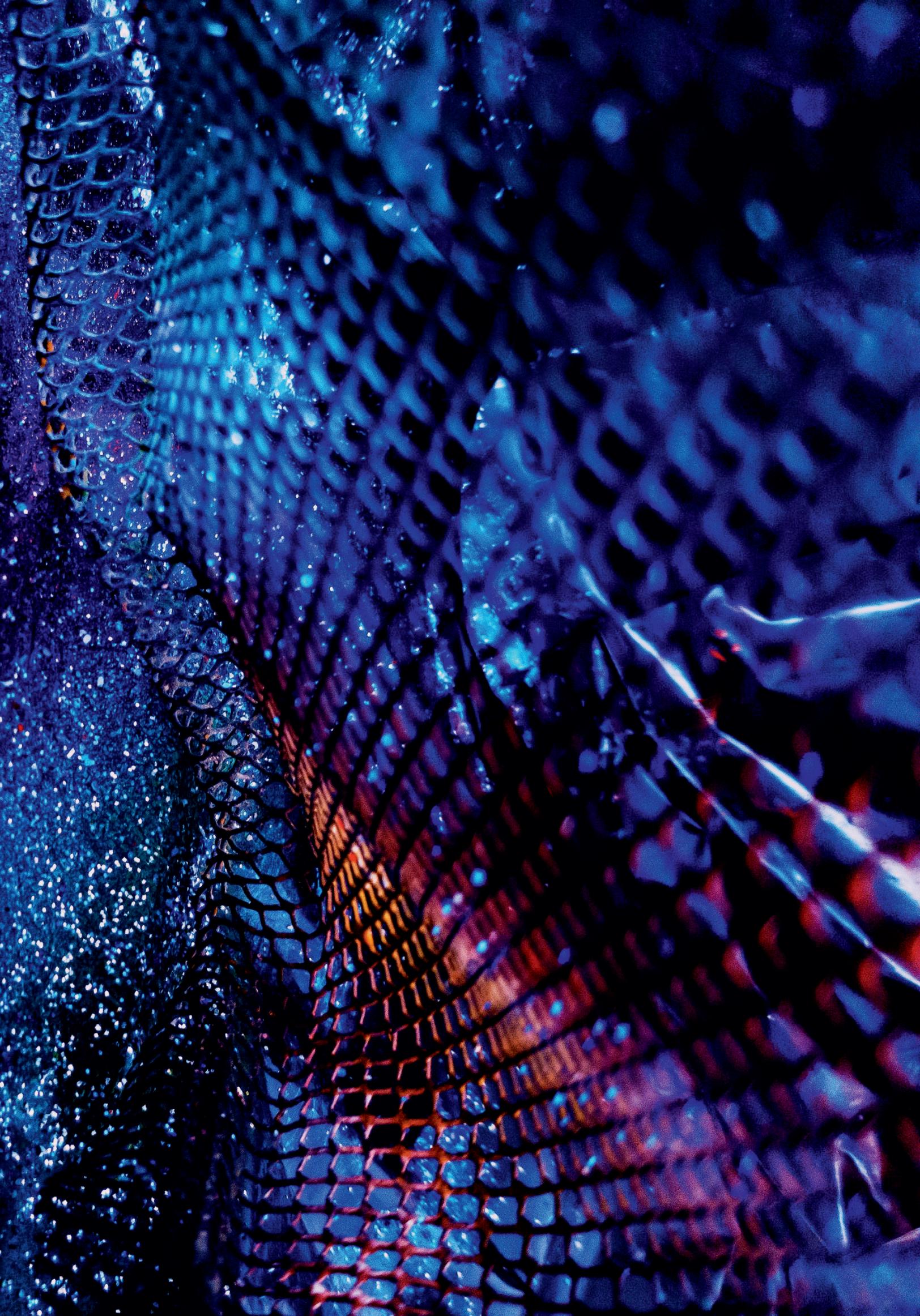
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LIST  
OF INDUSTRY  
EXPERTS ATTENDED  
THE FORESIGHT  
SESSION  
OF THE ENERGY  
INDUSTRY





## LIST OF INDUSTRY EXPERTS ATTENDED THE FORESIGHT SESSION OF THE ENERGY INDUSTRY

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\* List of industry experts who took an active part in the development of the Atlas of new professions and competencies of the energy industry of the Republic of Kazakhstan.

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- ▶ Central Asian Electric Power Corporation JSC
- ▶ Group of companies "Kazakhstan Utility Systems"
- ▶ Innovative University of Eurasia
- ▶ International Center for Green Technologies and Investment
- ▶ K.Zhubanov Aktobe Regional University
- ▶ Karaganda State Industrial University
- ▶ Karaganda State Technical University
- ▶ Kazakh Academy of Transport and Communications
- ▶ Kazakh National Agrarian Research University
- ▶ Kazakh-British Technical University
- ▶ Kazakh-German University
- ▶ Kazakhstan Electricity Association
- ▶ Kazakhstan Electricity Grid Operating Company (KEGOC) JSC
- ▶ Kazakhstan Innovation Academy
- ▶ Kazakhstan nuclear power stations
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- ▶ KAZENERGY Association
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