Innovative priorities for power engineering

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Abstract. The article describes the features of the development of power engineering as one of the key industries that ensure stable economic growth in conditions of a high dependence of the Russian Federation on energy exports and world energy markets.

Engineering in modern conditions is a basic industry, which stimulates the development of a large number of related industries. A state that does not have its own competitive machine-building products is doomed to depend on market conditions, which entails the lack of the possibility of ensuring stable production of finished products. Under these conditions, it is even more difficult to switch to the production of fundamentally new products, the creation of which involves the use of new equipment and technologies.

Issues of technological modernization of the energy engineering sector due to changes in the global oil and gas market. Today, global energy markets are showing signs of a new cycle in the development of the energy sector, and this could be a serious challenge for Russia. With a drastic change in the conjuncture of foreign markets, Russia will have to significantly adjust its development strategy.

The prospects for the economic development of the Russian economy are closely related to the changes occurring in the global energy market: the development of gas production from shale rocks; the rapid expansion of the supply of liquefied natural gas (LNG); changing the conditions of competition in the world and, above all, the European energy market.

The main problems that cause Russia to lag behind world leaders in the application of new technologies in the extraction and transportation of traditional energy sources are poorly developed electricity production from alternative sources, low energy efficiency of the economy, less flexible than the American and European domestic energy market.

Today, it is of fundamental importance for the Russian Federation not to fall behind in technological terms in the field of the fuel and energy complex, to turn the mining sector into one of the high-tech segments of the economy, and to follow global trends in the transition to new alternative energy sources. It is obvious that the creation and implementation of new technologies implies the emergence of interest in them from consumers. The main task of the state in this case is to increase the requirements for the quality of energy carriers, as well as to create conditions for the effective development of the machine-building complex.

The total electricity consumption in the world by 2030 will be 61% higher, the level of 2011, increasing by 2.5% per year (according to the Energy Research Institute of the Russian Academy of Sciences). Electricity continues to increase its share in the final energy use, and will be in 2030 meet 33% of energy demand for non-transport consumers compared with 28% in 2011.
Electricity consumption is closely related to economic growth and industrialization. Growth in global electricity demand accelerated with the onset of large-scale industrialization in China. After 2020, this growth will slow due to the shift in the Chinese economy towards less energy-intensive growth.

To this “China effect” is added the pervasive increase in end-use efficiency, which will lead to an overall decrease in the use of electricity per unit of GDP.

Over the past 10 years, the number of research projects in the field of energy technologies around the world has increased significantly. The leaders are such countries as the USA, Canada, Japan, Korea and China, as well as the EU states. At the same time, the structure of research has changed significantly, the priority areas are: the creation of highly efficient fuel cells, the use of hydrogen as an energy resource, and the development of renewable energy technologies. The total annual volume of state support for R & D programs in the energy sector of the largest countries in the world is more than $ 17 billion.

The main directions of development of technologies in the field of traditional energy (according to the EDB, “Power Engineering in the CES Member States”) are:
- increase the parameters of the working fluid (temperature and pressure) through the use of new structural materials;
- use of combined systems to reduce flue gas emissions;
- new flue gas cleaning technologies, transportation and disposal of solid waste;
- an increase in the adjustment ranges of power and maneuverability of steam turbine and gas turbine installations;
- an increase in the adjustment ranges of hydraulic units with the provision of regulatory vibration characteristics;
- improving the safety and operational characteristics of the main and auxiliary equipment of the stations.

The development of the global market for power engineering directly depends on the development of the global energy industry as a whole. In accordance with the World Energy Outlook for the Year 2040 (RAS, 2014), the consumption of primary energy resources will increase from 12,911 million tons of oil equivalent. (oil equivalent) in 2010 to 18,815 million tons AD in 2040 Such growth will have a positive effect on the sales market for power engineering products in general. Given that the issues of environmental conservation and resource conservation are becoming increasingly important, manufacturers of energy-efficient equipment will benefit.

In the structure of consumption, no noticeable decrease in the total share of oil and gas in the world primary energy consumption is expected - 53.2% in 2010 and 49.8% by 2040, while the share of oil by 2040 will decrease from 32 to 26% and gas increase from 21 to 24%. The environmental factor will help reduce the proportion of coal from 28 to 26%.

Power engineering is characterized by a long cycle, high capital intensity and manufacturability. The main consumers of the industry's products are generating and distributing energy enterprises. Production and supply of equipment is carried out, as a rule, by international concerns, whose enterprises are located throughout the world. According to the International Energy Agency (France), the growth of demand for electrical machines and equipment is projected for the period until 2030, which is due to the growing electricity consumption in the world, with more than 80% of the growth in the period until 2030 being provided by developing economies. The total global investment in the development of the sector will amount to 13.7 trillion. dollars in the period up to 2030 (International Energy Agency).

The structure of the market by manufacturers may vary significantly depending on the timing of the execution of large orders. Nevertheless, the largest players in the market are General Electric, Siemens, Alstom, Mitsubishi Heavy Industries, which control more than half of the global market.

Recently, major players from East Asia and Latin America have appeared on the energy engineering market. Less technological, but significantly cheaper products of these companies have a high competitiveness in emerging markets, including in the EAEU countries.
Recently, the industry began to show a tendency to consolidate the assets of power engineering companies. The market share of the power engineering companies of the EAEU occupies about 2% of the world market, although until the beginning of the 1990s, the share of the world market occupied by power equipment supplied to the external market from the USSR was 13%.

Currently, globalization processes have a significant impact on the EAEU power engineering market. World industry leaders are actively implementing investment projects in the EEU and create joint ventures (JV), for example, Siemens created a JV with the Russian company Power Machines back in 1991.

| company       | country | activity in the Russian Federation                                      |
|---------------|---------|------------------------------------------------------------------------|
| ABB           | Sweden  | Electrical equipment of power stations and installations, automatic control systems, cable products, diesel power engineering. |
| Alstom        | France  | Gas turbines, steam and gas installations, power units for oil and gas fields, steam turbines, generators, electrical equipment, auxiliary equipment of power plants, automatic control systems, engineering works. |
| General Electric | USA    | Gas turbines, automatic control systems, diesel power engineering         |
| Siemens       | Germany | Gas and steam-gas equipment for power plants, automatic control systems. |
| Skoda JS      | Czech   | Gas processing equipment                                                |
| Solar         | USA     | Gas turbines for oil and gas fields                                      |

**Figure 1.** The structure of the global energy equipment market by manufacturers.

The processes of mergers and acquisitions are due, among other reasons, to the need for more efficient financing of R & D and the supply of the entire product line to the customer. These trends are creating new threats to the domestic power engineering industry. If, prior to mergers, Russian companies...
took part in international consortiums for the supply of equipment, performing part of the work, then at the moment foreign manufacturers do not need to be connected to these projects by Russian machine builders. This is largely due to the disunity of Russian companies, which is why they are limited to the supply to the market of individual units and functional units of power plants. In today's position, a separate Russian enterprise does not have all the necessary product line to supply the ready-made solution to the market - a modern turnkey power plant.

In addition, the sharply increased costs while maintaining a relatively low efficiency of the production process, including due to the small size of the production series, led to the fact that prices for Russian power equipment already exceeded the price level for similar Chinese-made equipment and came close to the price level leading European, American and Japanese companies.

According to a number of experts, the Russian energy engineering industry has three main scenarios for further development:

- voluntary consolidation in the industry in the face of increasing unequal competition with foreign manufacturers. This step can give the natural advantages of a large company: the effect of scale, the possibility of obtaining loans at a lower interest, etc.;

- creation of a single large customer, capable of becoming not only a large EPC contractor, but also a conductor between the market and state money allocated for R & D and industry support. Acting as an intermediary between the market, manufacturers and the state, such a player would be an effective tool for implementing the strategy for the development of power engineering;

- the creation of individual Russian manufacturers of alliances with foreign companies with the prospect of a gradual transfer of technologies. Currently, this is the most actively implemented scenario. The advantages of this development scenario are known - foreign companies can provide new technologies. The disadvantages are that foreign partners rarely share truly key and advanced technologies and solutions. There is a real danger to turn the domestic power equipment into a “screwdriver” production from imported components.

Successful implementation of one of these scenarios will allow Russian machine builders to maintain their positions in the domestic market, modernize the energy sector, and reduce negative environmental pressures. At the same time, it is obvious that the development of this industry and any non-commodity sectors of the economy in the context of high energy prices and the strengthening of real the effective exchange rate of the ruble without creating favorable conditions for the growth of national companies will be limited. Efficient consumers will focus on the acquisition of cheaper and more efficient imported counterparts. At the same time, with a deterioration in foreign market conditions and a weakening of the ruble exchange rate, the restoration of the positions of domestic machine builders in the domestic market without significant advancements will be painful and slow. Thus, today we need to solve a dual problem.

To create conditions for the growth of Russian companies in the non-primary sector, in fact, to support national producers, especially in the industries creating technological equipment for the mining complex. Due to this, it is possible to create a material base for technological renewal of the mining complex, a gradual restructuring of the economy in the direction of the development of the manufacturing sector. Realization of this task presupposes support not only of the energy and machine-building industry, but also a change in the view on the role of the state in the economy, recognition of the need to create conditions for the development of the manufacturing industry in a globalizing economy and increased international competition.

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