

BRANCH-WISE AND REGIONAL ECONOMY

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Approaches to assessment of energy security in the region (by the example of the Chelyabinsk oblast)

The article presents the results of analysis of key aspects of economic activity in the Chelyabinsk oblast by the example of assessment of energy security in the region. The article shows its dependence on individual elements of the fuel and energy complex. The authors calculated indicators of energy security and identified possible solutions of problems related to the potential threat to energy security in the region.

Energy security, energy system, economic analysis, fuel and energy complex, innovative technology.



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Energy security in the region is the most important economic aspect of the market conditions, when different types of energy markets are appeared, the government regulates the tariffs and there are seasonal and other fluctuations in energy consumption.

The Chelyabinsk oblast was selected for the initial analysis of approaches to economic assessment of the regional energy security. This article is the first attempt of economic analysis of regional problems by the example of energy. Such researches will be continued. In future we

plan to refine approaches to assessment of energy security in the region and develop specific economic recommendations.

1. Characteristics of energy situation in the region

The Chelyabinsk oblast is one of the largest economic players in the Russian Federation. Here the economical level, as in the whole Southern Urals, determines the significant industrial potential, which contains the metallurgical, machine building, military-industrial and nuclear facilities. Stable operation of these enterprises is possible if there will be a powerful and dynamic fuel and energy complex (FEC). The fuel and energy complex is the most significant component of the energy supply system in regional economy, the sustainable functioning of which is the major factor of energy security. Ensuring of energy security in the region involves determining of the effective use of energy resources and industrial potential of FEC in different ways of development of regional economy, including the terms of possible restrictions on foreign supplies of resources.

The Chelyabinsk oblast is a scarce energy region, i.e. production volume of its own resources is insufficient to meet the needs. The main source of the vast majority of energy resources (FER) is the external supply from the other regions (fig. 1).

This situation is dangerous for energy economy of the Chelyabinsk oblast; it threatens energy security in the region.

The fuel and energy complex of the region is presented by facilities of power industry, coal mining, a system of long-haul gas and oil delivery ducts (fig. 2, 3).

Characteristics of the major energy capacities of the Chelyabinsk oblast

Troitskaya State District Power Station (SDPS) is the largest source of electric power generation in Chelyabinsk oblast. Installed capacity: electric – 2059 MW, heat – 315 Gcal/h.

- The station is included in the united system of the Urals; it is located in the area of power interchange Ekaterinburg – Chelyabinsk – Magnitogorsk and on the line of direct deliveries to Northern Kazakhstan.

Figure 1. Production and consumption of fuel and energy resources in the Chelyabinsk oblast in 2009 (according to the Federal State Statistics Service)

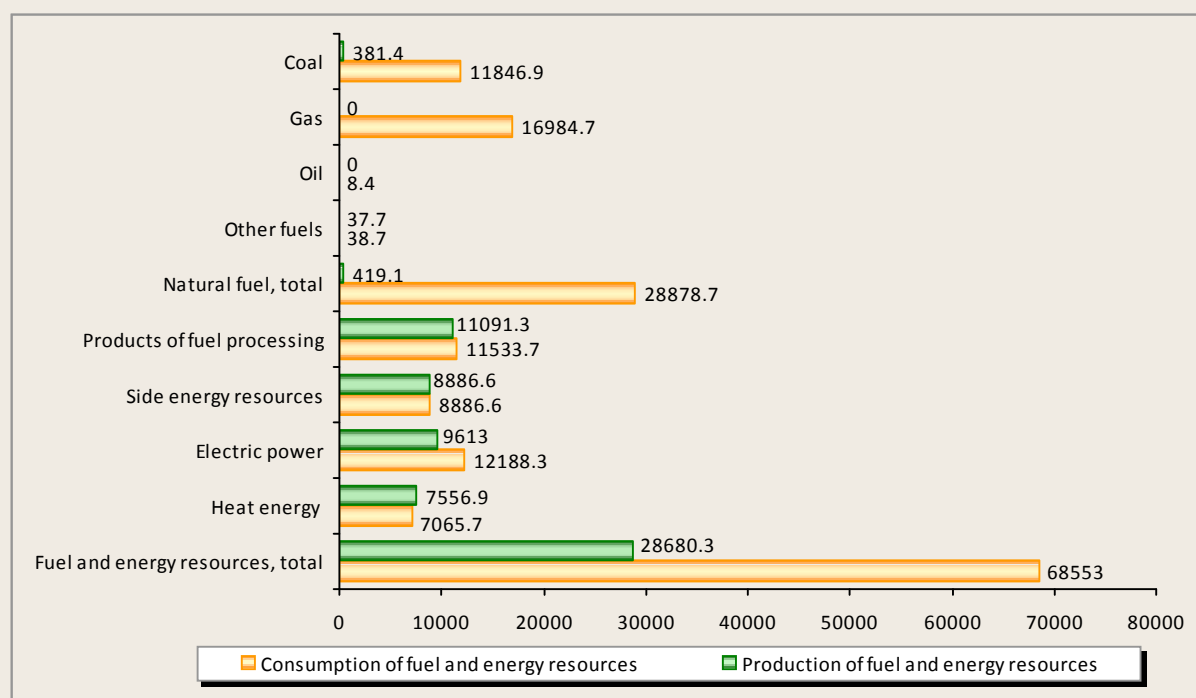


Figure 2. The main objects of the fuel and energy complex in the Chelyabinsk oblast

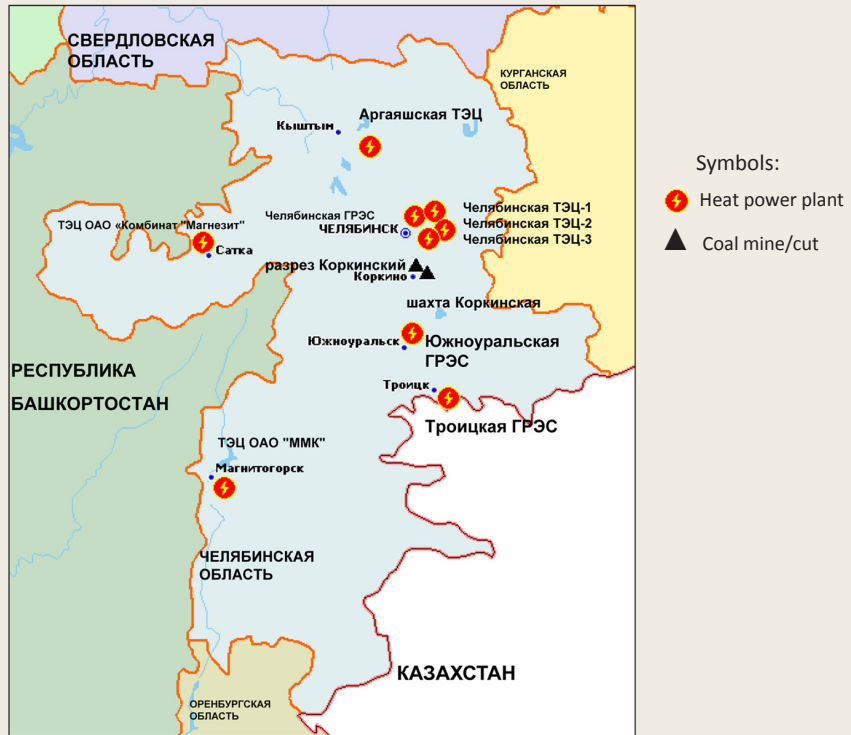
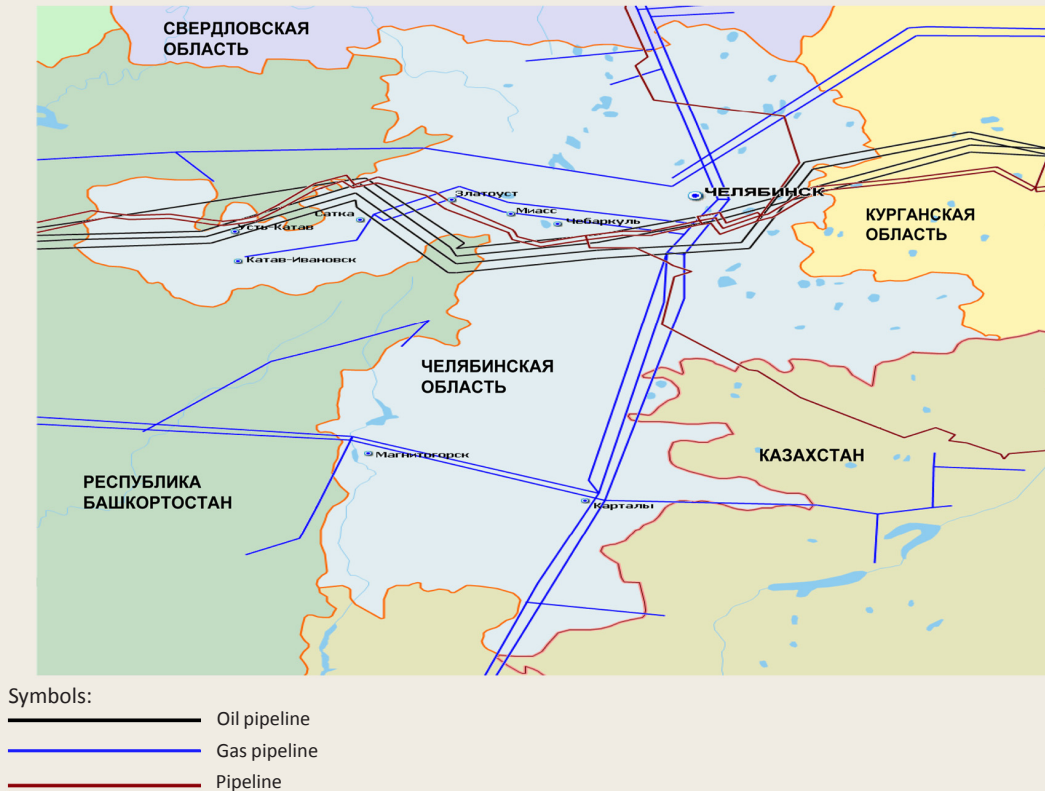


Figure 3. Trunk pipelines located in the Chelyabinsk oblast



- The main type of fuel – Ekibastuz coal.
- There are such consumers of electricity and heat power of SDPS as OJSC “Chelyabinsk Electrometallurgical Plant”, LLC “Magnitogorsk Energy Company”, OJSC “Chelyabenergosbyt”.

South Ural SDPS. Installed capacity: electric – 882 MW, heat – 395 Gcal/h.

- The main types of fuel – gas, Chelyabinsk coal (20%). Consumers of electricity and heat are industrial enterprises of Chelyabinsk oblast and Yuzhnouralsk, municipal and private housing funds of the town of Yuzhnouralsk.

• Part of electricity, generated in the South Ural SDPS, is delivered to wholesale electricity market.

Chelyabinsk CHPP-3. Installed capacity: electric – 360 MW, heat – 1092 Gcal/h.

- The main type of fuel – natural gas.
- Consumers of electricity and heat are industrial enterprises and housing sector of the northern and north-western districts of Chelyabinsk.

• The largest regional substations such as “Kozyrevo” (500 kV) and “Novometallurgicheskaya” (220 kV) as well as power lines linking them were put into operation to ensure the power output of the second power generating unit of Chelyabinsk CHPP-3.

Chelyabinsk CHPP-2. Installed capacity: electric – 320 MW, heat – 956 Gcal/h.

- The main types of fuel – natural gas, coal (about 2%).

• Consumers of electricity and heat: industrial enterprises and housing sector of Chelyabinsk.

• There are three heat lines which go from the station to the center, the north-east and in the village of Churilovo (Churilovo is the most promising area for additional heat supply from CHP-2).

Argayashskaya CHPP. Installed capacity: electric – 195 MW, heat – 576 Gcal/h.

- The main types of fuel – natural gas, coal (near 20%).

• It is the main source of electricity and heat for the village of Novogornyy, the town of Ozersk and the chemical plant “Mayak” 13.

Chelyabinsk CHPP-1. Installed capacity: electric – 149 MW, heat – 1341 Gcal/h.

- The main types of fuel – natural gas, coal (about 1.2%).

• Consumers of electricity and heat: industrial enterprises and housing sector of the south-east district in Chelyabinsk.

Chelyabinsk TPP. Installed capacity: electric – 82 MW, heat – 814 Gcal/h.

- The main type of fuel – natural gas.
- Consumers of electricity and heat are industrial plants and built-up areas which are located near the station.

In addition to the heat power plants more than 790 departmental and municipal boilers supply towns and regional centers in Chelyabinsk oblast with heat. The main problem in providing consumers with heat is wear and tear – it is over 80% for the majority of boilers.

Prospects for development of electricity in Chelyabinsk oblast are associated with the reconstruction of Chelyabinsk TPP, Chelyabinsk CHPP-1 and Argayashskaya CHPP because they have a high degree of wear of power equipment.

The total length of oil-pipelines in the region in one line version is more than 1330 km.

Oil pumping is carried out by the trunk lines:

- Tuymazy (the Republic of Bashkortostan) – Omsk – Novosibirsk;
- Nizhnevartovsk (Tyumen oblast) – Kurgan – Kuibyshev;
- Ust-Balik (Tyumen oblast) – Kurgan – Ufa (the Republic of Bashkortostan) – Almeteyevsk (the Republic of Tatarstan).

Oil delivery ducts:

- Ufa – Chelyabinsk – Petropavlovsk (North Kazakhstan);
- Chelyabinsk – Yekaterinburg (Sverdlovsk oblast).

The total length of gas pipelines is about 10 thousand km. The following gas mains pass through the territory:

- Western Siberia – Center.
- Central Asia – Center.
- Urengoy – Chelyabinsk.
- Vyngapur (Tyumen oblast) – Surgut – Chelyabinsk.
- Bukhara – Ural.
- gas pipeline branch Bukhara – Ural “Kartaly” (Chelyabinsk oblast) – Magnitogorsk (Chelyabinsk oblast).
- gas pipeline branch Bukhara – Ural “Kartaly” (Chelyabinsk oblast) – Kustanay (Kazakhstan); gas pipeline branches from Bukhara – Ural to Chebarkul, Zlatoust, Satka, Katav-Ivanovsk, Ust-Katav (Chelyabinsk oblast).

There are 646 km of gas pipeline branches and 85 gas-distribution stations in this region to provide consumers with natural gas.

2. Economic evaluation of energy situation in the region

Chelyabinsk oblast is one of the most power-consuming regions in the Russian Federation: consumption of electricity is more than 32 billion kW · h per year (according to the Federal State Statistics Service). The Chelyabinsk oblast was the third in the Ural federal district and the twelfth in Russia by power generation in 2009. Power plants can provide about 78% of the total demand for electricity in the region. Since the generating enterprises are part of a system of the single energy cycle of Ural and the Unified Energy System, the amount of missing energy is made up with its purchase in the wholesale electricity and power market.

There is a deficit of energy and capacity of transmission lines and substations in the region. There is a large load on the networks, but many of them are worn out. As a result, there isn't a reliable scheme of power supply in 40 settlements and there isn't backup power supply in 400 settlements.

Nowadays the main problem of development of the power industry is a progressive deterioration of the equipment of

power plants. Much of the equipment at the stations (including departmental affiliation) was set up till 1960. Worn-out equipment has low energy and economic efficiency. So the specific fuel consumption for electricity production averaged 379 g/kW·h in 2009 (at UVI – 342.7 g/kW·h; in Russia – 335.7 g/kW·h). The boilers with low energy efficiency, which is no more than 60%, are also dominated in the municipal sector. Negative processes in the operation of generating facilities could increase threats and the potential destabilization of the region's energy security.

The consequence of various emergency situations at facilities generating electricity is a failure or damage to energy resources and energy communications, serious problems with the energy supply system of population and material damage to different fields of economy.

Also the region is suffered from uneven loading of the stations with electric power, peak demand and lack of electric network resources to connect new customers.

The Chelyabinsk oblast is the largest consumer of boiler and stove fuels (BSF). The region has such own natural fuel resource as brown coal. The region was the fifteenth on coal mining in Russia and the second in the Ural federal district in 2009. The regional self-sufficiency by coal is only 5.5%. Also there is a reduction in production volumes here. So it was produced 863 thousand tons in 2009, it is 80.5% less than in 2000. Chelyabinsk coals are characterized by the regional boundaries of marketing and they are consumed mainly in the mining area. The main customers are power plants (90%), industrial boilers, municipal sector and the population of the Chelyabinsk oblast. The coal industry of the Chelyabinsk oblast has a lot of difficulties recently. Further development of coalfields makes the geological conditions of production worse. This fact is a reason of increasing of coal's price and reducing of its competitiveness. Demand for Chelyabinsk coal has dramatically fallen that's why coal is produced only in the mine “Korkinskaya” and open-pit mine “Korkinsky”.

Due to the high ash content, low heat dissipation and thus high selling prices Chelyabinsk coal cannot compete with Kuzbass coal or Ekibastuz (Kazakhstan) coal. CHP and power plants which carried out supplies were originally designed for local fuel, but it couldn't save the situation. Energy enterprises have been buying brown coal because they are under the pressure from regional authorities. The stability of the remaining enterprises of Chelyabinsk coal field and socio-economic situation in the mining towns depends on the purchase of the local brown coal that can ensure profitability of production. It is also useful to reduce the share of imported Ekibastuz coal to assure energy security in the region.

Limited own fuel resources put regional power engineering into the dependence on suppliers. Natural gas which comes from the other regions through the gas pipelines has a dominant position in the regional fuel balance – 44.7% (share of gas in power plants – 61.6%).

The volume of natural gas supply to domestic consumers in 2009 was 14.7 billion cubic meters (93.6% to 2008), 0.7 billion cubic meters (97.7%) of which – to the population. The Chelyabinsk oblast is one of the most gasified regions of Russia: the level of gasification is 68% (the average nationwide rate – 62%). The transport component of the HPC (the main gas, oil and oil products pipelines) solves the major task of stable ensuring of the Chelyabinsk oblast with energy resources. Disruptions of the functioning of the main pipelines and laterals may disrupt oil, gas and oil products supplies to companies of the region and other regions as well.

3. Economic analysis of energy security in the region

Ensuring of energy security in the region involves identifying of factors and risks, which directly or indirectly can pose a threat both to the energy sector companies and consumers of its products. For these purposes an analysis of current system status of indicators – indicators (ind. EnS), characterizing the level of EnS and threats depth of EnS in the region (*table*) was carried out.

While creating an information base for the calculation of indicators, factual data of annual statistical reports on production, consumption, import or export of energy resources and some other estimates as well were taken into account.

Comparative analysis of indicators of energy security of the Russian Federation is carried out to identify the possible emergence of “threatening states” of the main characteristics of the functioning of fuel and energy sector, while comparing the current value of the indicators and their threshold (limit) state. The indicative analysis of the energy security rate of the Chelyabinsk oblast showed that many indicators of EnS have reached thresholds of threatening state of energy security (ind. EnS № 4, 15-17, 20). This situation is conditioned, primarily, by the region volatility, i.e. the lack of own raw materials, the lack of generating capacity, significant depreciation of fixed assets, liquidation of coal mines, etc.

The main threats include energy lack in the region, receiving 100% of natural gas and almost 20% of electricity from external supplies from outside the region. Coal produced in the oblast satisfies only 5.5% of the demand of the region. In addition, there is a sharp decrease in coal production over the previous year. It should also point out the lack of generating capacity (shortage of generation in 2009 – 6.8 bln kW·h), the progressive aging of the equipment and infrastructure in the power industry (the average wear and tear indicator by the stations – up to 60%, boiler and electric grid equipment – over 80%), the use of obsolete equipment in coal mining, etc. Full or partial expression of these threats and their consequences, as well as the development of the existing negative trends in fuel and energy sector of the region may inevitably lead to a breach of the stability operations of the fuel and energy supply, if necessary measures are not promptly taken.

4. Economic approaches to the prevention of threats to energy security

Preventing and overcoming of existing and potential threats of internal and external character is essential for ensuring energy security in the region. To ensure energy

Dynamics of indicators of energy security of the Chelyabinsk oblast
(according to the Federal State Statistics Service)

No	Indicators	Year of 2005	Year of 2006	Year of 2007	Year of 2008	Year of 2009
1.	The weighted average security of the region with own energy resources, **%	23.9	25.5	24.5	24.9	22.7
2.	Self-sufficiency of the region with electricity,%	73.6	80.7	81.6	80.3	78.0
3.	Index of electricity production to the previous year,%	98.4	114.8	104.3	97.6	87.5
4.	Electricity production per capita, kW • h / pers	6944.0	8004.5	8357.2	8163.5	7147.2
5.	Electricity consumption per capita kW • h / person	9430.8	9920.4	10242.7	10164.1	9166.2
6.	Index of change in per capita consumption of electricity to the previous year,%	99.4	105.2	103.3	99.2	90.2
7.	Index of heat production to the base period,%	100.0	102.9	101.7	99.9	97.2
8.	Production of heat energy per capita, Gcal / person	14.0	14.4	14.3	14.0	13.7
9.	Heat energy consumption per capita, Gcal / person	13.3	13.6	13.3	13.1	13.7
10.	Index of change in per capita consumption of electricity to the base period,%	100.0	102.5	100.1	98.8	102.8
11.	Share of the most major energy source in the TES, %	42.1	42.1	40.3	40.3	40.3
12.	Relative magnitude of power grids reserve, %	5.2	5.8	3.4	4.8	5.5
13.	Annual growth rate of energy capacity, %	0.7	-0.1	4.4	0.1	0.1
14.	Annual growth rate of energy capacity, %	-1.2	4.8	3.1	-0.8	-9.8
15.	Ratio of capacity and consumption growth of electricity (the meanings of paragraph 13 - the meanings of paragraph 14), %	1.9	-4.9	1.3	0.9	9.9
16.	Self-sufficiency in the region with coal fuel, %	18.8	15.0	12.1	11.1	5.5
17.	Index of coal production to the previous year,%	94.0	89.0	78.5	87.0	42.4
18.	Share of the dominant type of fuel (gas) in the consumption structure of HPR*, %	26.8	26.0	25.1	24.8	24.6
19.	Share of the dominant type of fuel (gas) in the total consumption of BSF*, %	48.1	46.5	43.1	43.8	44.7
20.	Share of the dominant type of fuel (gas) in power plants,%	63.6	57.1	58.4	59.0	61.6
21.	Share of coal-fired plants in electricity production, %	20.1	31.9	30.8	31.5	31.0

* Red color shows threatening and pre- threatening state of indicators.

security is necessary to implement measures aimed at improving the reliability and power quality, efficient use of natural energy resources, that is:

- introduction of new generating capacity, upgrading and rehabilitation of existing equipment;
- construction of new and reconstruction of existing power lines and network equipment;
- balanced development of fuel and energy complex;
- reliable providing of customers with high-quality coal fuel in view of ensuring its competitiveness;
- energy efficiency use of energy resources;
- introduction of energy saving technologies;
- development of alternative and low energy, etc.

Note particularly that in the Chelyabinsk oblast there are some large enterprises of the

nuclear industry, some branches of Research Nuclear University MEPHI, which may later be connected to monitoring the state of development of the regional power.

Economic evaluation of necessary expenses to overcome these threats are beyond the scope of this work, they will be made in subsequent cycles of research work. It is important to note that all of them are related to the investment processes, and energy-saving technologies, development of alternative and low power - with innovative approaches and high-technology. Within a particular region it can be expressed in the formation of innovative investment programs, development of projects in other organizational and economic activities. It is important that the result of these measures was the increase of energy security in the region, which is a very strong incentive for attracting investment into the regional economy.

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