

## Role of Siberia and the Far East in development of Russia's FEC in the long-term perspective

B.G.Saneev, A.V.Lagerev, V.N. Khanaeva (ESI SB RAS)

**Abstract.** The paper presents a forecast of demand and supply of energy resources in Russia during the first half of the 21<sup>st</sup> century. Role of the Eastern regions in production and consumption of energy resources in the country is shown. The dynamics and structure of energy supply from the Eastern region to European Russia and to other countries are presented.

**Key words:** Eastern regions (Siberia the Far East), forecast, FEC, energy resources, export.

The Eastern regions of Russia (Siberia and the Far East) possess unique energy resources of national and international significance.

Currently the regions produce above 70% of oil in the country, 93% of gas, above 90% of coal, and generate above 30% of all electricity of the country (Table 1).

TABLE 1. ROLE OF THE EASTERN REGIONS IN PRODUCTION OF ENERGY RESOURCES IN RUSSIA (2008)

Indices	Russia	Eastern regions		
		Siberia (including Tyumen region)	Far East	Total
Production of energy resources, total, million tce including:	1793	1386 (77)	59 (3)	1445 (80)
Oil and gas condensate, million tce	488	333 (68)	14 (3)	347 (71)
Natural gas, billion m <sup>3</sup>	664	609(92)	9 (1)	618 (93)
Coal, million t	326	270 (83)	32 (10)	302 (93)
Electricity production, TWh	1037	304 (29)	42 (4)	346 (33)
including: HPP	167	88 (51)	13 (8)	99 (59)
Heat production for district heating, million Gcal	1361	293 (22)	69(5)	362(27)
Oil refining, million t	236	41(17)	11 (5)	52(22)

( %) – share of production in Russia

In 2008 Siberia delivered outside the region 290 million t of oil (87% of its production in the region), 163 million t of coal (60% of coal produced in the region), 570 billion m<sup>3</sup> of natural gas (94% of its production in the region), including: 67 % - to European regions of the country (including Ural) and 33% - to other countries.

Russia is characterized by extremely uneven allocation of energy production and consumption throughout the territory.

Consumption of primary energy resources in European part of Russia accounts for 70% of

primary energy resources consumed in the country (including 74% of oil and 83% of natural gas), whereas production makes up only 20%.

Major production of energy resources (77%) is concentrated in Siberia which consumers about one fourth (24%) of energy resources consumed in the country.

The Far Eastern region, that occupies 36% of country's territory, consumes 4% of all energy resources consumed in the country while produces only 3%.

Role and place of the Eastern regions in fuel and energy complex (FEC) of the country in the considered time horizon will depend on many factors including:

- pace of economic development in Russia, including its the Eastern regions;
  - development of resource potential of FEC in both European and Eastern regions of the country;
  - dynamics of fuel and energy prices in the domestic markets of Russia;
  - pace of technological progress in FEC;
  - situation in the world energy markets,
- etc.

Dynamic estimation of how these factors affect development of the national FEC and FEC of the Eastern regions is a rather challenging task. This required special calculations on *dynamic optimization model of Russia's FEC*. The model describes the process of Russia's energy

development till 2050 in dynamics with a step of 10 years for 4 regions: European Russia, West and East Siberia, and the Far East. The model is part of the model-computer complex that was developed at ESI, SB of RAS. It is intended to study the strategies of national and regional FEC development in relation to the economy [1].

Estimation of domestic demand for primary energy resources was made for two scenarios of economic development of the country: *moderate and optimistic*. The levels of energy consumption and energy conservation that correspond to the scenarios are presented in Table 2. The left boundary of the range of change in the parameters corresponds to the moderate scenario and the right one – to the optimistic one.

TABLE 2. FORECAST OF ECONOMIC DEVELOPMENT AND ENERGY CONSUMPTION IN RUSSIA

Indices	2005	Forecast	
		2030	2050
GDP growth rates versus 2005, %	100	310-355	600-740
Average annual rates of GDP growth, %		4,6-5,2	3,5-3,8
Population , million people	142,7	135	135-140
GDP per capita, thousand \$/persons	9,3	30-35	58-70
Primary energy consumption, million tce	950	1360-1460	1665-1765
Energy-GDP ratio, tce/ 1000\$	0,72	0,33-0,31	0,21-0,18
Average annual rates of energy-GDP ratio decrease,%		3,1-3,3	2,4-2,8

Based on parity: 13.5 Rub/USD (in 2005 prices)

According to the scenarios considered the GDP per capita in Russia should near the current average level of European countries in 2030 and current level of developed countries by 2050. To accomplish these goals average rates of GDP increase during the period up to 2030 should be no lower than 4.5% and according to the optimistic scenario – no lower than 5%.

The GDP growth rates are forecasted to slow down in the years to come (to 3.5-4%).

According to the authors' estimations in the considered time horizon the economic development in the Eastern regions will outpace the average rates of economic development in

Russia (approximately by 0.5 percentage points a year).

The volumes of primary energy consumption in the country and its Eastern regions are presented in Table 3.

As follows from Table 3 consumption of primary energy resources in Russia can increase by 1.75-1.85 times and that in the Eastern regions – by 2.0-2.2 times over the considered period.

In doing so the share of the Eastern regions in the total energy consumption in the country will increase from 27% in 2005 to 29-31% in 2030 and to 31-32% by 2050 (Fig.1).

TABLE 3. FORECASTED DYNAMICS OF ENERGY CONSUMPTION IN RUSSIA AND EASTERN REGIONS IN 2005-2050

Indices	2005		Forecast			
			2030		2050	
	R	ER	R	ER	R	ER
Consumption, total, million tce /%	<u>950</u> 100*	<u>260</u> 100*	<u>1360-1460</u> 143-153	<u>403-448</u> 155-172	<u>1665-1765</u> 175-185	<u>524-570</u> 200-219
including:						
Oil and oil products	165	45	240-252	71-77	325-340	99-113
Natural gas	499	85	653-655	133-134	690-705	164-172
Coal and other solid fuels	179	95	270-317	149-163	345-380	179-190
Non-fuel energy resources**	107	35	196-233	50-74	305-340	82-95

\* 2005=100%

\*\* HPP, NPP, RES

Note: R- Russia, ER- Eastern regions (Siberia and the Far East)

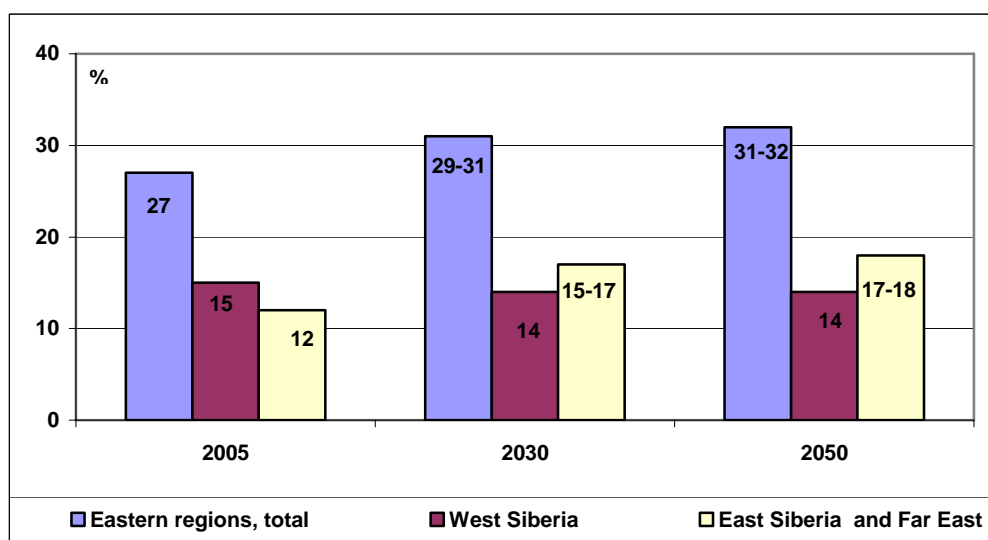


Fig. 1. Share of Russia's Eastern regions in energy consumption.

Currently Russia has the status of the largest world exporter of energy resources. In the considered time horizon the volumes and structure of export will be determined first of all by the factors of economic feasibility and will depend not only on fuel prices in the world energy markets but also on the production costs (prices) and volumes of the Russian producers. Relationship between these prices can vary in a large range depending on a large number of hardly predictable factors. However, despite the growing production and transportation costs Russian energy resources are forecasted to retain their competitiveness in the world energy markets.

The forecasted dynamics of world fuel prices that was used for calculations is shown in Table

4, the dynamics of domestic gas and coal prices – in Table 5.

TABLE 4. FORECAST OF FUEL PRICE DYNAMICS IN THE WORLD MARKETS\*

Indices	2005	Forecast	
		2030	2050
Oil, USD/t	395-420	680-870	800-990
USD/bar	52-55	90-115	105-130
Natural gas,			
USD/1000 m <sup>3</sup>			
Western Europe	205-230	350-420	440-490
NEA countries		260-335	345-420
(China)			
Coal, USD/tce	55-65	80-95	95-115

Sources [3-5] and authors' calculations - disregarding inflation (in 2005 USD).

TABLE 5. FORECAST OF FUEL PRICE DYNAMICS BY REGION OF RUSSIA, USD/TCE.\*

Regions, fuels	2005	Forecast	
		2030	2050
<i>European Russia</i>			
West-Siberian gas	40-45	90-105	130-150
Coal	45 -50	52-73	65 -80
<i>Siberia</i>			

Based on the estimates obtained when developing Energy Strategy till 2030 [2] and considering the world and domestic energy

Gas	35-40	65-80	100-120
Coal	20-25	40-50	50-60
<i>Far East</i>			
Sakhalin gas	35-40	80-90	100-110
Local coal	40-45	50-55	55-60

\* Sources [3-5] and authors' estimations – disregarding inflation (in 2005 USD)

prices taken in calculations, the forecasted export of energy resources in Russia till 2050 is presented in Table 6.

TABLE 6. FORECASTED EXPORT OF ENERGY RESOURCES FROM RUSSIA

Indices	2005	Forecast	
		2030	2050
Export, total, million tce	810	885-1000	650-700
Share of production in Russia, (%)	(47)	(41-42)	(29)
Including :			
Oil and oil products, million t	355	325-350	240-255
<i>Western direction</i>	339	225-245	130-135
<i>Eastern direction</i>	16	100-105	110-120
Natural gas, billion m <sup>3</sup>	208	290-350	190-230
<i>Western direction</i>	208	210-240	110-135
<i>Eastern direction</i>	-	80-110	80-95
Coal, million tce	66	70-75	65-70
Electric energy, TWh	12	60-90	85-115

In 2005 energy export made up 47% of its production in the country. Based on the authors' estimations the share of export with regard to energy production will decrease in the future and may make up 29-30% by 2050.

Western direction of energy export will continue to dominate in the considered period. By 2050 above 50% of oil and oil products and 58-60% of natural gas will be exported in this direction. At the same time economically efficient resources available in Asian regions of Russia and a growing demand for them in NEA will make the eastern direction of energy export from Russia increasingly topical. According to the authors' estimations by 2050 Russia's export to the NEA countries may account for 110-120 million t of oil and oil products, about

85-95 billion m<sup>3</sup> of natural gas, 60-65 billion kWh of electricity and 30 million t of coal.

Internal demand for energy resources and their delivery from the eastern regions can be provided by increasing their production in the considered time horizon by 28-37%, amounting to 1740-1865 million tce by 2050 (Table 7).

The calculations show that despite the growing production of energy resources in the Eastern regions their share in total production in the country will remain at 2005 level (77-78%) over the whole considered period. During the period 2005-2050 the share of West Siberia can decrease by 20-22%, and that of East Siberia and the Far East can correspondingly increase by 20-21% (Fig.2).

TABLE 7. FORECASTED PRODUCTION OF PRIMARY ENERGY RESOURCES IN RUSSIA AND THE EASTERN REGIONS

Indices	2005	Forecast	
		2030	2050
Production (Russia), total, million tce/%	<u>1735</u> 100*	<u>2180-2370</u> 126-136	<u>2245-2415</u> 130-140
<i>Eastern regions, total, million tce/%</i>	<u>1359</u> 100*	<u>1685-1855</u> 124-136	1740-1865 128-137
including:			
Oil and gas condensate (Russia), million t	470	500-535	470-500
<i>West Siberia</i>	334	280-305	260-275
<i>East Siberia and Far East</i>	4.2	75-100	105-110
Natural gas (Russia), billion m <sup>3</sup>	641	825-875	755-800
<i>West Siberia</i>	586	580-595	520-545
<i>East Siberia and Far East</i>	8	115-145	130-145
Coal (Russia), million t	300	455-535	590-655
<i>Siberia</i>	241	365-425	490-550
<i>Far East</i>	33(14)	70-90	80-85
Hydro power (Russia), TWh	174.5	265-315	365-375
<i>Siberia</i>	95	140-185	225-230
<i>Far East</i>	12	30-35	50-55
Nuclear power (Russia), TWh	149	365-425	670-810
<i>West Siberia and Far East</i>	1.5	15-30	40-60
Unconventional renewables (Russia), mln tce	2	25-30	50-55

\*2005=100%

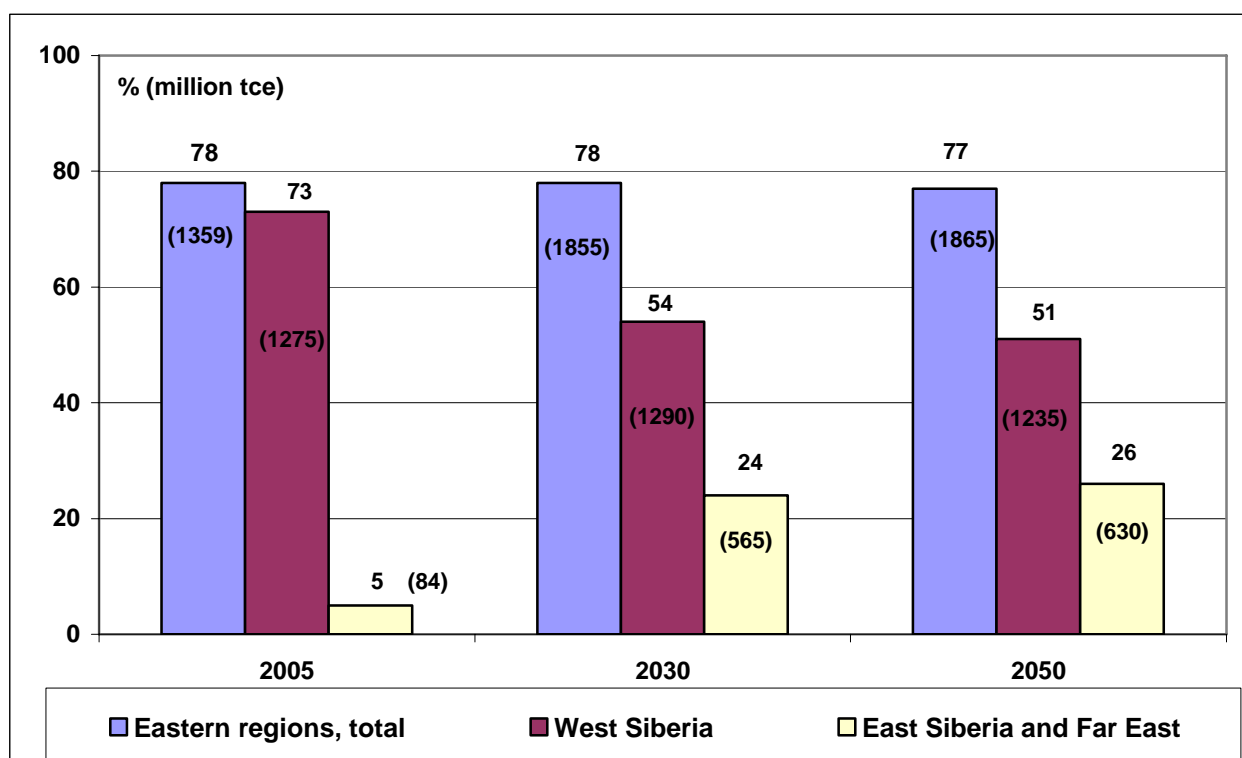


Fig. 2. Share of the Eastern regions in production of energy resources in Russia (Optimistic scenario)

TABLE 8. SHARE OF ENERGY RESOURCES PRODUCTION IN THE EASTERN REGIONS OF RUSSIA, %

	2005	Forecast	
		2030	2050
Oil and gas condensate	72	71-76	77
including: <i>West Siberia</i>	71,1	56-57	55
<i>East Siberia and Far East</i>	0,9	15-19	22
Natural gas	92	84-85	86
including: <i>West Siberia</i>	91	70-68	69-68
<i>East Siberia and Far East</i>	1	14-17	17-18
Coal	91	95-96	96-97
including: <i>West Siberia</i>	56	48-42	45-43
<i>East Siberia and Far East</i>	35	47-54	51-54
Hydro power	61	64-70	76
including: <i>Siberia</i>	54	53-59	62-61
<i>Far East</i>	7	11	14-15
Nuclear power	1	7	6-7
including: <i>Siberia</i>	0,9	4	2
<i>Far East</i>	0,1	3	4-5

Note: in % of Russia

By the end of the considered period oil production in the country is expected to fall to 55% as against 71% in 2005 and the share of East Siberia and the Far East will rise to 22% as against 0.9 % in 2005 (Table 8).

The share of the Eastern regions in natural gas production will decline to 86% by the year 2050 (as compared to 92 % in 2005). The share of West Siberia in its production, therewith, can decrease by 22-23%, and the share of East Siberia and the Far East can increase by 16-17%.

However, the share of the Eastern regions in coal production can rise to 96% by 2050 (in comparison with 91% in 2005). Here the share of West Siberia (the Kuznetsk basin) in coal production will decrease (from 56% in 2005 to 43-45% by 2050), and the share of East Siberia and the Far East will, on the contrary, increase (to 51-54% as against 35% in 2005).

In the considered time period the Eastern regions will remain, as before, the main suppliers of energy resources to both domestic markets and for export (Table 9).

TABLE 9. FORECASTED DELIVERIES OF ENERGY RESOURCES FROM THE EASTERN REGIONS (SIBERIA AND THE FAR EAST) OF RUSSIA

Indices	2005	Forecast	
		2030	2050
Delivery, total, million tce	1090	1295-1470	1205-1330
including:			
- to the European part of Russia, million tce	440	465-530	620-670
of which: Oil, million t	29	20-40	90-105
Natural gas, billion m <sup>3</sup>	317	305-310	305-310
Coal, million t	49	115-160	200-230
including: <i>Kuznetsky</i>	48	110-150	150-180
- Export ( <i>Western direction</i> ), million tce	620	550-610	295-340

of which: Oil, million t	242	225-245	130-135
Natural gas, billion m <sup>3</sup>	199	170-190	70-85
Coal, million t	65	40-50	35-60
- Export ( <i>Eastern direction</i> ), million tce	31	280-330	290-320
of which: Oil and oil products, million t	16	100-105	110-120
Natural gas, billion m <sup>3</sup>	-	80-110	80-95
Coal, million t	11.5	45-50	30
Electricity, TWh	0.5	40-60	60-65

In 2005 the European regions of Russia supplied some 1090 million tce of energy resources or 80% of their production to the European part and abroad. By 2050 the share of deliveries

beyond the regions in total production will decrease approximately to 69-70%.

For the period to 2030 delivery of energy resources from the Eastern regions will grow and then gradually decrease. Nonetheless, by the authors' estimates by the year 2050 delivery of energy resources from the Eastern regions will be 10-20% higher than in 2005.

The share in delivery of energy resources by direction will also change (Fig. 3). In so doing the share in delivery of energy resources to the European regions of Russia will continuously increase and by 2050 will make up more than half (52-54%) the energy resources delivered from the Eastern regions of the country (in comparison with 40% in 2005).

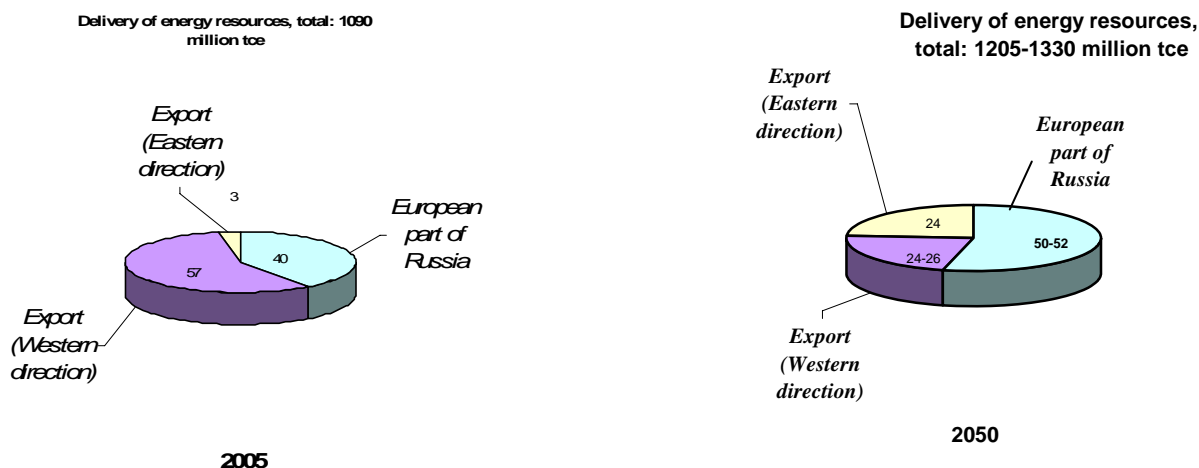


Fig. 3. Structure of delivery (by direction) of energy resources from the Eastern regions (Siberia and the Far East) of Russia, %

The studies performed have shown that by the year 2050 only a quarter (24-26%) of energy resources will be exported from the Eastern regions in the western direction.

By the end of the considered period export of Siberian oil in the western direction will decrease to 70-80 million t (as against 240 million t in 2005), that of natural gas will decrease by a factor of 1.5-1.6 and will amount to 70-85 billion m<sup>3</sup> (as against 200 billion m<sup>3</sup> in 2005).

The share in export of energy resources in the eastern direction is predicted to increase and by 2050 can rise to 24% as compared to 3% currently. Export of oil and oil products can increase to 110-120 million t, natural gas – to 80-95 billion m<sup>3</sup>, coal – to 30 million t, electricity – to 60-65 billion kWh.

## CONCLUSION

1. The Eastern regions of Russia (Siberia and the Far East) concentrate unique reserves of energy resources of both Russian and world significance.

2. For the considered scenarios of Russia's economic development domestic demand for energy resources and their delivery beyond the regions can be provided by the increase in their production by 28-37%, reaching 1740-1865 million tce by the year 2050.

3. The studies have shown that despite the growing production of energy resources in the Eastern regions their share in total production in the country will remain at 2005 level (77-78%) during the whole period. However, the share of West Siberia can decrease by 20-22% and the share of East

Siberia and the Far East can correspondingly increase by 20-21%.

4. In the considered time horizon the consumption growth rates of energy resources will surpass those for Russia as a whole. As a result the share of the Eastern regions in total consumption in the country will increase from 27% in 2005 to 29-31% by 2030 and to 31-32% by 2050.

5. The Eastern regions will be the main suppliers of energy resources both for domestic markets and export as before.

6. Delivery of energy resources to the European part of the country will continuously increase and by 2050 will reach more than half the energy resources delivered from the Eastern regions of the country (40% in 2005).

7. By 2050 only a quarter (57% in 2005) of energy resources delivered from the Eastern regions will be exported in the western direction. The share of energy resources exported in the eastern direction will increase possibly to 24-26% by 2050 in comparison with 3% at present.

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## BIOGRAPHIES

**Boris G.Saneev** is Deputy Director of Melentiev Energy Systems Institute, Professor. In 1967 he graduated from Novosibirsk State University and began to work at Siberian Energy Institute of SB RAS (at present Melentiev Energy Systems Institute). His main direction of research is scientific fundamentals of the regional energy policy, methodological approaches, systems of models and databases to forecast regional energy demand, principles, methods and models for studying and choosing rational options of FEC development in the country and regions, energy impact on the environment.

**Anatoly V.Lagerev** a Leading Researcher at Melentiev Energy Systems Institute of SB RAS, Candidate of Technical Sciences. In 1974 he graduated from Irkutsk Polytechnic Institute, the Energy Chair and began to work at Siberian Energy Institute of SB RAS. The sphere of research interests is methods and models for studying and assessment of the main directions in the national and regional FEC development, study of complex problems in FEC development and the impact of energy development on the environment.

**Valentina N. Khanaeva** is a Leading Researcher at Melentiev Energy Systems Institute of SB RAS, Candidate of Economic Sciences. In 1963 she graduated from Leningrad Polytechnic Institute as a specialist in economics and organization of energy production and began to work at Siberian Energy Institute of SB RAS. Her main research interests are development of methodological approaches and models to study and choose rational options of FEC development in the country and regions and also study complex problems in energy development.