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Energy Efficiency at Regional Level in Arkhangelsk, Astrakhan and Kaliningrad Regions

Kaliningrad Fuel and Energy Balance

Draft Report

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LIST OF ABBREVIATIONS

bos	basic oxygen steel
bbl	barrel
bcm	billion cubic metres
b/d	barrels per day
Btu	British thermal unit
CCGT	combined-cycle gas turbine
CHP	combined heat and power (plant)
CNG	compressed natural gas
CO	carbon monoxide
CO2	carbon dioxide
COG	coke-oven gas
CV	calorific value
GCV	gross calorifc value
GHG	greenhouse gas
GJ	gigajoule, or one joule x 109 (see joule)
GJ/t	gigajoule per tonne
J	joule
kWh	killowatt/hour, or one watt x one hour x 103
LNG	liquefied natural gas
LPG	liquefied petroleum gas; refers to propane, butane and their isomers, which are gases at atmospheric pressure and normal temperature
MBtu	million British termal units
MJ/m3	megajoule/cubic metre
Mm3	million cubic metres
MPP	main (public) power producer
MSW	municipal solid waste
Mtce	million tonnes of coal equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt, or one watt x 106
NCV	net calorific value
Nm3	normal cubic metre
NOx	nitrogen oxides
PV	Photovoltaic
Ttce	Thousand tonnes of coal equivalent
tce	tonne of coal equivalent; 1 tce = 0.7 toe
TFC	total final consumption (“end-use” or “useful” consumption)
TJ	Tera joule, or one joule x 1012
toe	tonne of oil equivalent
TPES	total primary energy supply
VOCs	volatile organic compounds

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1. Development of an integrated energy balance

1.1 Introduction

One of the tasks under the current EuropeAid project on "Energy Efficiency at the regional level in Astrakhan, Arkhangelsk and Kaliningrad regions" is to attempt developing regional fuel energy balances in the three regions.

This report contains the first results of this task for the Kaliningrad region. The first chapter introduces the energy balance in international format and the available Russian information sources. Chapters 2, 3 and 4 deal with a detailed description of the elements of the fuel and energy balance and the final result, including an assessment of energy supply efficiency in Kaliningrad region..

Chapters 5, 6 and 7 discuss respectively the planned energy sector development in Kaliningrad region, the potential for renewable energy use and the implementation of the energy efficiency programme in the region. Chapter 8 concludes with remarks on several institutional issues that stand in the way of overall improvement of energy data.

Chapter 9 presents conclusions and recommendations.

1.2 Fuel and Energy Balance

Accurate and comprehensive energy sector data and statistics form the basis for sound energy and energy efficiency strategies and policies. Fuel and energy balances combine energy sector information in one overview and are used structurally in many countries. The need to develop a comprehensive national Integrated Fuel and Energy Balance has been discussed at length ever since the late 30'es. However, to date the concept has not been effectively used in Russia.[1], although during the period of the Soviet Union, a summary energy balance by regions and nation-wide was developed once every five years; but not anymore.

In this report a regional fuel and energy balance is developed based on a widespread and accepted international methodology, i.c. the format of the International Energy Agency (IEA). The energy situation in the region is described using the IEA model, but integrating the specific features of the Russian energy statistics. This is important to

- reflect the relations between energy supply- and end-use comprehensively;
- improve the reliability of analysis and projections of inter-fuel competition in many sectors;
- take into account the energy resource (natural gas in the first place) competition between sectors.

The Fuel and Energy Balance consists of three blocks:

1. Primary energy resources;
2. Energy resource transformation;
3. Energy end-use (final energy consumption, usually by sector).

The Resource Block includes primary energy production, export and import, and stock changes.

The second block describes transformation of energy resources. It includes fuel balances of the power and heat sectors showing the contribution of technical progress towards improved efficiency of heat- and power generation; fuel price competition parameters; and overall power- and heat generation and consumption.

[1]See Veiz V.I., Probst A.E., and Rusakovsky E.A. The National Unified Energy Balance in the 3rd five-years-period. Planned Economy. 1937, No. 9-10; Also see the contemporary discussion on Unified Energy Balance in "Tariff regulation and expertise", No. 2. 2005.

The third block describes energy end-use by sectors (final energy consumption). Thus, power-, heat-, and fuel demand are continuously evaluated based on changing economic development parameters and energy balance dynamics. This provides a systematic picture of the energy sector situation and a sound basis for demand and supply forecasts. The structure of the balance changes, as determined by changing proportions of sub-sector economic development; technical progress; price fluctuations; and other factors that are incorporated into the analysis of energy balances.

1.3 Major sources of information

1.3.1 STATISTICAL DATA

Russian regional statistic departments provide statistical reports containing energy sector data (statistical yearbooks, bulletins, analytical papers etc.). This allows developming of an initial database for the energy balance. The statistical forms used are the following:

⇒ Three statistical forms to develop power balance parameters:
  - o "E-1" (Power balance of the economy, production, trade, consumption);
  - o "E-2" (Power consumption by major industries);
  - o "E-3" (Power consumption by major industrial sectors);
  - o and "Power sectors and power plants of Russia, the CIS countries and the Baltic states" Inventory published by Incotech;

⇒ Five more statistical forms to develop power-, heat-, and fuel balances:
  - o "11 TER" (fuel, heat, and power use);
  - o "6 TP" (power and heat generation and fuel use in the power sector);
  - o "4-fuel" (data on fuel residues, supply and consumption, waste petroleum products collection and use);
  - o "22 ZhKH" (data on utilities' performance during the reform period, also containing partial information on heat-, natural gas-, and power consumption);
  - o Forms on heat generated by boiler houses and heat distribution systems.

Not all institutions are required to submit the whole set of completed forms. For example, Form "11 TER" is only for companies whose annual fuel and energy consumption is above 10 tce. Therefore, some sources allow for a basic, rather than a comprehensive, picture of energy use, and additional data, as well as data verification, are required. For example, "11 TER" only reflects transportation heat losses, and continuously tends to underestimate them.

In spite of its incompleteness, "11 TER" is the basic data source for Fuel and Energy Balance development. It is the basis for fuel consumption statistics, and for the understanding of the region's power sector development by the Oblast Government. This form integrates three data blocks:

⇒ Output by major industries and production stages;

⇒ Corresponding power-, heat-, and fuels consumption;

⇒ Specific power-, heat-, and fuel consumption to provide various types of work and services.

The latter group of indicators allows evaluating the efficiency of energy use. Comparison of specific indicators over a period of time and with other regions and countries provides an indication of the energy efficiency potential by industries and production stages.

"11 TER" provides data for 23 energy carriers, which are not really necessary for describing the general energy situation in the region. Further analysis considers only six major groups:

- power,

- heat,
- coal,
- crude oil and petroleum products,
- natural gas,
- other solid fuels.

This type of classification of energy carriers is the usual practice for the IEA and many countries, although more profound detalization is possible for some sectors.

"11 TER" does not allow automatic distribution of data by the above mentioned three blocks of the Fuel and Energy Balance. A special effort is required to do so, following the logics, rather than the letter, of the IEA energy balance development methods, because the source information does not fit this purpose completely.

Regional energy supply efficiency analysis uses a "bottom-up" approach. Evaluation starts from the 3rd block. Efficiency of energy use is assessed for each sector, industry, or product. Overall consumption of a particular energy carrier is the sum of this energy carrier consumption by sectors. The second block evaluates the efficiency of each sector with due consideration of energy loss coefficients, own needs consumption, and specific consumption of energy transformation. Data from the first block (with an account of the necessary fuel stock piling) are used to determine regional demand for local energy resource production, or import, of energy resources from other regions. And *vice versa*, having information on possible oil-, gas-, coal-, and power production, energy import-export balance can be developed. Coal, oil, gas, and power (hydro and renewable) outputs are evaluated through a critical estimation of available development projections for these sectors.

It should be noted, that data from different statistical forms may be contradictory (see Section 2). Therefore, any manipulation with these data requires a careful and weighted approach.

1.3.2 SECTORAL STATISTICS

Power- and utility sector reforms have caused a fragmentation of data for energy consumption and generation that are available for specific sectors. The available sectoral data only deal with their own (sub-) sector or market niche and therefore a comprehensive picture even in its own energy market segment where they operate, is lacking. However, these data are still useful and important for understanding the energy situation in the region.

Most useful are the data presented to the Tariff Service to justify power-, heat-, and gas tariffs for the next regulation period. They are very important to improve reliability of estimates in the Fuel and Energy Balance. However, access to these data is very limited. If the regional Government would establish and implement monitoring of the local energy situation, data provided to the Tariff Service could become the core for such monitoring.

Unfortunately, the data and other information accumulated by the Tariff Services is only used to justify the tariffs, whereas its application potential could in practice be much wider.

2 Analysis of the regional energy supply and demand

2.1 Power balance

2.1.1 POWER BALANCE STATISTICS

The regional power balance is based on the "E-1", "E-2", and "E-3" forms and is shown in Table 2.1. Working with these data involves certain problems. The three forms significantly differ in terms of industrial power consumption, and these differences can hardly be ignored. This is a specific problem of Kaliningrad Oblast; and in Arkhangelsk Oblast for example, there are no such discrepancies.

Table 2.1. Kalinigrad Oblast power balance based on "E-1", "E-2", and "E-3" (mln kWh)

	2000	2001	2002	2003	2004	2005
Power generation	**211.90**	**246.70**	**250.40**	**272.70**	**275.40**	**548.20**
Power import	**2,857.20**	**3,076.50**	**3,230.10**	**3,347.70**	**3,259.70**	**3,481.00**
Overall consumption	**2,980.30**	**3,211.90**	**3,255.50**	**3,428.70**	**3,535.10**	**4,029.20**
Distribution losses	583.90	707.10	653.80	658.60	699.00	697.60
Industry, total ("E-1")	**693.90**	**749.80**	**775.40**	**839.00**	**847.10**	
Industry, total ("E-2" and "E-3")	**588.74**	**622.05**	**659.01**	**628.96**	**687.94**	
Industry discrepancies	*105.17*	*127.75*	*116.39*	*210.04*	*159.16*	
Power consumption by the industries below	**577.12**	**614.29**	**654.03**	**627.52**	**685.81**	
Own needs ("E-1")	11.20	13.00	14.10	15.20	14.10	
Power sector ("E-2")	43.66	42.70	45.72	46.69	44.78	
Fuel sector	36.69	36.90	47.70	62.84	62.41	
Ferrous Metallurgy	0.69	0.58	0.98	0.91	0.83	
Chemical and Petrochemical	0.53	0.03	0.97	0.03	0.55	
Machine building and Metal working	106.46	114.10	118.37	76.87	114.94	
Timber, Wood, and Pulp&Paper	296.48	330.98	338.04	334.72	344.55	
Building Materials	11.69	14.65	17.28	18.18	23.08	
Light industry	5.78	4.81	4.69	4.30	5.72	
Food industry	63.96	56.55	66.20	67.77	74.85	
Construction, total	**29.30**	**31.50**	**34.90**	**42.60**	**40.40**	**58.80**
incl. oil- and gas-wells	3.70	2.70	2.40	2.40	1.30	
Utilities, total	**853.00**	**848.50**	**886.90**	**907.50**	**950.10**	
incl. lighting and household needs of urban population	652.70	651.50	689.40	707.60	696.90	
street lighting in cities and towns	28.40	25.50	25.80	26.50	26.50	
water supply and sewage	85.30	84.50	83.90	85.10	86.00	
other utilities	86.60	87.00	87.80	88.30	140.70	
Agriculture, total	**277.10**	**297.60**	**322.40**	**328.50**	**317.00**	**297.30**
incl. for industrial needs	115.00	114.40	107.10	106.60	99.80	106.4
lighting and household needs of rural population	121.30	142.70	173.90	178.80	175.30	190.9
post offices and telecommunication agencies; storages	40.80	40.50	41.40	43.10	41.90	38.60
Transport, total	**71.90**	**79.30**	**83.30**	**94.80**	**97.50**	**107.80**
railway, water, air, and	47.40	55.40	62.40	74.50	79.20	

	2000	2001	2002	2003	2004	2005
automobile						
Incl. railway	20.90	26.20	31.30	35.80	42.50	49.30
Incl. for electric traction		0.00	0.00	0.00	0.00	1.60
Metro, trams, trolleybuses	24.50	23.90	20.90	20.30	18.30	17.20
Post offices and telecommunication agencies; culture agencies; health care institutions; trade	**471.20**	**498.10**	**498.80**	**557.70**	**584.00**	
Export to other RF regions	88.80	111.30	225.00	191.70	0.00	0.00

Sources: Forms "E-1", "E-2", and "E-3".

There is also a problem dealing with a correct estimation of the own needs for power consumption of power plants, both for industrial and general use. According to "E-1", it equaled 14 mln. kWh in 2004 (5% of overall power generation), while according to "E-2", this value is 44.8 mln. kWh, or 16% of overall power generation. A complete picture of own needs consumption is provided by form "6-TP".

Table 2.1 is not structured in the most effective way. For example, residential power consumption in rural areas is represented in the Utilities and Agriculture. Agriculture also includes commercial consumption in the rural areas. The Other Utilities line seems to include power consumption by boiler-houses. Therefore, a considerable restructuring of Table 2.1 data is required to develop the power consumption concept for the Fuel and Energy Balance by (sub-) sector..

Changes in the statistical classification have become a serious problem.. The "All-Russian Classifier of Economic Activities" (OKVED) was adopted effectively since January 1, 2003, to replace the previous All-Russian Classifier of Sectors of Economy (OKONKh)[2]. OKVED classifies types of economic activities. Basic classification parameters include area of activity, technology, raw materials. Unlike in OKONKh, types of economic activities are classified regardless of companies' type of ownership or departmental subordination. Therefore, the 2005 data are not specified by sectors in detail, they are only broken down by fossil fuels extraction (83.1 mln. kWh in 2005), processing (642.2 mln. kWh in 2005), and power, gas, and water production and distribution (825.1 mln. kWh in 2005)[3]. Apart from these, there are data on agricultural, transport, and communication consumption (see the 2005 column in Table 2.1).

The new classification does not specify residential power consumption; it is included in power-, gas-, and water distribution. Such power consumption breakdown is extremely inadequate for analysis. All Russian analysts faced an inability prolonging power consumption rows by sectors for 2005.

2.1.2 "11-TER" DATA

"11-TER" allows a relatively easy prolongation of dynamic statistical series to analyze the energy situation in accordance with OKVED, because it has always presented data not only by sectors, but specifying "cross-cutting" types of economic activities for all sectors. For example, oil extraction shows cast iron and bread outputs, apart from basic activities. "11-TER" is basically structured according to the technology principle. Therefore the evolution of product and technology structure of production in demand analysis and forecasts can be taken into account, as well as developing a classification of the most energy intensive types of products and services. This is also convenient for analysis and forecasts purposes. "11-TER" does not

[2] For detail see "Re-estimation of Russia's GDP rows in compliance with transfer to new classifiers". Submitted by the Statistical Committee of the Russian Federation (Rosstat). UN. Economic and Social Council. European statistical commission. Conference of European Statistics. Group of experts in national accounts. Geneve, April 25-28, 2006.

[3] Fossil fuels extraction, processing industries, power-, natural gas- and water generation and distribution in Kaliningrad Oblast. FSGS. Kaliningrad, 2006; Analytical paper "On the problems of fuel and energy resource consumption in Kaliningrad Oblast". FSGS. Kaliningrad. 2006.

provide data on non-ferrous metals (there is none in Kaliningrad Oblast), while machine building is only represented by metal processing.

At the same time, a lot of industrial energy consumption is shared between a few universal energy carrier outputs (oxygen, compressed air, heat) and water output; operation of industrial railway transport, lifting and road construction equipment. In other words, "11-TER" has proved to be the most sustainable form to reflect the structure of power consumption, given the changes in economic statistics classifier for Russia (see Table 2.2).

Table 2.2. Kaliningrad Oblast power balance based on Form "11-TER" (mln kWh)

	2000	2001	2002	2003	2004	2005
Power generation by fuel oil-fired power plants	157.79	184.16	184.63	198.78	192.74	466.63
Power generation by diesel power plants	1.58	3.82	7.83	9.95	15.54	19.63
Heat supply by power plants	1.53	1.84				
Technology needs of RAO "EES Rossii" power systems	24.16	21.35	22.96	24.24	25.38	21.29
Transmission power losses	583.97	708.36	657.29	660.31	700.75	699.32
Heat generation by boiler-houses	63.56	68.77	68.28	66.36	70.36	56.84
Industrial	**296.27**	**336.41**	**346.18**	**351.65**	**349.49**	**337.92**
Oil extraction, including gas condensate	29.90	31.53	31.58	33.20	20.11	25.16
Operation drilling of oil- and gas wells	0.80	0.63	0.93	1.81	3.01	4.89
Oil treatment in the oil fields	0.20	0.21	0.30	0.30	0.36	0.53
Oxygen	0.10	0.03	0.13	0.17	0.18	0.19
Cast iron moulding (no thermal treatment)	0.52	0.53	0.30	0.53	0.50	0.49
Cellulose, total	113.98	125.47	127.64	124.12	122.50	104.46
Paper	54.07	63.90	72.20	69.47	76.16	69.29
Card board	11.70	11.43	16.61	18.34	22.74	20.23
Meat (incl. 1st category subproducts)	8.48	23.06	23.04	23.82	21.56	26.15
Bread and bakery products	6.51	5.23	3.44	2.79	2.54	2.85
Water raise and supply (excl. utility needs)	62.79	65.87	62.15	67.11	69.61	71.47
Effluent treatment	7.22	8.53	7.88	9.99	10.21	12.22
Transport	**48.59**	**103.29**	**47.14**	**48.78**	**51.63**	**48.38**
Electric traction of railway trains (Ministry of Transportation)	7.18	7.26	6.66	6.12	6.72	6.86
Operation of railways (Ministry of Transportation), excl. of electric traction	19.42	69.20	21.45	23.24	25.62	26.24
Electric traction of trams	14.40	7.26	12.59	12.83	13.24	10.38
Electric traction of trolleybuses	7.59	19.58	6.45	6.59	6.05	4.91
Other industrial	**443.69**	**478.58**	**452.84**	**517.84**	**555.94**	**568.55**
Total industrial	**878.31**	**953.56**	**938.49**	**1009.19**	**1052.80**	**1032.98**
Utility	**134.75**	**129.60**	**129.13**	**135.02**	**119.74**	**119.81**
Residential	815.97	844.63	902.91	959.60	939.08	999.19
Overall consumption	**2410.96**	**2691.00**	**2626.74**	**2763.79**	**2812.36**	**2851.30**
Of the overall consumption in Table 2.1	80.9%	90.3%	88.1%	92.7%	94.4%	95.7%

Source: Form "11 TER" for various years

Despite the fact that this form does not include all consumers, it has been reflecting 94-96% of overall power consumption in the region (see the last row in Table 2.2) over the recent years. There is one discrepancy concerning Table 2.1. The power consumption in Kaliningrad Oblast has grown by 14%, while the source of such growth is not clear; and according to Table 2.2, it has increased only by 1.4%, while Pulp & Paper consumption somewhat declined due to the output reduction, and Transport consumption decreased as well.

2.1.3 "22-ZhKH" DATA

"22 ZhKH" gives only three figures: overall power sales (2678 mln. kWh in 2005), including to the residential sector (995 mln. kWh) and social facilities (249 mln. kWh). The figure for residential consumption is practically the same as in "11-TER".

2.1.4 DATA FROM KALININGRAD OBLAST GOVERNMENT

One more document to search for the summary information on power generation and consumption in the region is the Report of Kaliningrad Oblast Government "Operation results of the Fuel & Energy Sector of Kaliningrad Oblast in 2005". Data from the Supplements to this Report are given in Table 2.3. These data must have in large been presented by "Jantarenergo". Thus, this is the third version of the regional Fuel and Energy Balance.

Table 2.3. Power balance based on the KAO Report 2005 (mln kWh)

	2000	2001	2002	2003	2004	2005	2006
Power generation	210.2	242.1	242.3	262.2	260.0	528.0	2465.0
incl. by block-stations	155.5	175.0	169.9	175.8	178.3	181.0	190.0
Power consumption	2979.0	3220.0	3256.0	3427.0	3569.0	3584.0	3990.0
Transmission losses	604.1	742.1	665.8	658.6	699.0	698.0	690.0
Power supply	2174.0	2265.0	2358.0	2505.0	2607.0	2678.0	3300.0
Own needs	*200.9*	*212.9*	*232.2*	*263.4*	*263.0*	*208.0*	*0.0*
Industrial and equated consumers						835.5	
Agriculture						113.5	
Electric urban transport						17.2	
Federal public sector consumption						350.0	
Other non-industrial consumption						367.0	
Oblast budget-financed						31.5	
Municipal budget-financed						177.3	
Commercial						158.2	
Population and towns						994.9	

Source: Kaliningrad Oblast Government Report "Performance of Kaliningrad Oblast Fuel and Energy Sector in 2005".

Importantly, according to these data, in 2005 power consumption in the region increased not by 14%, but only by 0.4%. A more dynamic growth was only expected in 2006. Also,, before 2004, estimating own needs consumption as the difference between overall consumption, distribution losses, and useful consumption results in a value practically equal to the total power generation in the region. Logically, this value should have increased in 2005-2006, after KTETs-2 was commissioned; but even if it had stayed at the 2004 level, useful power consumption should have grown in 2006 to reach 3037 bln. kWh, i.e. by 13.4%. In this respect, it seems important highlighting a strange "insistence" of the regional Government on 13-14% estimates of power consumption growth in 2005-2006.

Public consumption, financed from various-level budgets, accounted for 559 bln. kWh, or 21% of useful consumption in the region in 2004.

2.1.5 COMPARATIVE ANALYSIS OF POWER BALANCE DATA TAKEN FROM DIFFERENT SOURCES

Before we start assembling the "puzzle" of the regional power balance for its further integration in the Fuel and Energy Balance, it is important to compare data from Tables 2.1-2.3 and decide on the reliability and accuracy of information provided by different sources. Unfortunately, there are discrepancies between all the sources related to all critical indicators, especially for 2005 data (see Table 2.4). Therefore, the development of an integral power balance is based on all available sources.

Table.2.4. Comparison of major indicators of the regional power balance (mln kWh)

	2000	2001	2002	2003	2004	2005	2006*
Power generation							
Statistics – power balance	212	247	250	273	275	548	
Government	210	242	242	262	260	528	2,465
Statistics – 11 TER	185	211	215	233	234	508	
Power consumption							
Statistics – power balance	2,980	3,212	3,256	3,429	3,535	4,029	
Government	2,979	3,220	3,256	3,427	3,569	3,584	3,990
Statistics – 11 TER	2,411	2,691	2,627	2,764	2,812	2,851	
Useful power consumption							
Statistics – power balance	2,342	2,449	2,542	2,708	2,777	3,332	
Government	2,174	2,265	2,358	2,505	2,607	2,678	3,300
Statistics – 11 TER	2,410	2,690	2,626	2,763	2,812	2,851	
Transmission losses							
Statistics – power balance	583.9	707.1	653.8	658.6	699.0	697.6	
Statistics – 11 TER	584.0	708.4	657.3	660.3	700.7	699.3	
Government	604.1	742.1	665.8	658.6	699.0	698.0	690.0
Residential power consumption							
Statistics – power balance	774	794	863	886	872		
Statistics – 11 TER	816	845	903	960	939	999	
Statistics – 22 ZhKH					995		
Government					995		

* Estimated
Source: Data from Tables 2.1-2.3

2.1.6 INTEGRATED POWER BALANCE OF KALININGRAD OBLAST

The integrated power balance has been developed based on the information on the three power sector blocks: power resources, transformation and transmission/distribution losses and useful consumption. and has sufficient degree of detail for further analysis. It also accounts for the recent changes in the power consumption statistics.

2.1.7 THE BLOCK OF POWER RESOURCES

The block of power resources comprises power generation of

- "Jantarenergo" (GRES-2 and Gusevskaya co-generation plant);
- Kaliningradskaya co-generation plant-2 commissioned on October 28, 2005 and owned by RAO "EES Rossii";
- three pulp & paper plants (ZAO SP "Tsepruss" and co-generation plant of OAO "Sovetsky TsBZ, and "Nemansky Pulp & Paper Combinat");
- three hydro power plants (Ozerskaya, Pravdinskaya, and Zaozernaya);
- the Zelengradskaya wind power plant.

The problem of power generation discrepancies is partially a problem of which power generation sources are taken into account (for example, whether or not the analysis includes hydro- and wind sources). The power resources block was developed with maximum focus on the statistical data (see Table 2.5).

Table.2.5. Power generation in Kaliningrad Oblast (mln kWh)

	2000	2001	2002	2003	2004	2005	2006*
Power generation	211.9	246.7	250.4	272.7	275.4	548.2	2465.0
Jantarenergo power plants	54.7	67.1	72.7	86.4	81.5	78.0	80.0
KTETs-2						270.0	2175.0
Block stations	155.5	175.0	169.6	175.8	178.3	181.0	190.0
Hydro and wind plants	1.7	4.6	8.1	10.5	17.3	15.0	20.0
Import from other RF regions	2,857.2	3,076.5	3,230.1	3,347.7	3,259.7	3,035.8	1,525.0
Export to other RF regions	88.8	111.3	225.0	191.7	0.0	0.0	0.0
Net import	2,768.4	2,965.2	3,005.1	3,156.0	3,259.7	3,035.8	1,525.0
Total resource for consumption	2,979.0	3,220.0	3,256.0	3,427.0	3,569.0	3,584.0	3,990.0
Statistical discrepancy	1.3	-8.1	-0.5	1.7	-33.9	0.0	0.0

* Estimated
Source: Data from Tables 2.1-2.3

In November-December 2005, KTETs-2 was operated in the start-up and adjustment regime. Power generation over this period equaled 270 mln. kWh. Renewables (wind- and small hydro power plants) provided in total 15 mln kWh in 2005 (17.3 mln kWh in 2004). Small hydro plants generated 10 mln kWh in 2005 (11.8 mln kWh in 2004), and wind plants 5 mln kWh (5.5 mln kWh in 2004).

2.1.8 POWER CONSUMPTION DURING ENERY TRANSFORMATION, TRANSMISSION, AND DISTRIBUTION

Power consumption during energy transformation, transmission, and distribution includes consumption for own and technology needs, distribution losses and power transformation (for example, for heat generation, see Table 2.6).

Table.2.6. Power consumption during energy transformation, transmission, and distribution (mln kWh)

	2000	2001	2002	2003	2004	2005	2006*
Overall resources for consumption	2,979.0	3,220.0	3,256.0	3,427.0	3,569.0	3,584.0	3,990.0
Own and technology needs of power plants	52.5	58.7	57.9	64.0	67.1	86.2	214.2
Share in power generation	*24.8%*	*23.8%*	*23.1%*	*23.5%*	*24.4%*	*15.7%*	*8.7%*
Supply to the grid	2,926.5	3,161.3	3,198.1	3,363.0	3,501.9	3,497.8	3,775.8
Transmission losses	604.1	742.1	665.8	658.6	699.0	698.0	690.0
Share in power supply to the grid	*20.6%*	*23.5%*	*20.8%*	*19.6%*	*20.0%*	*19.8%*	*18.3%*
Useful power supply	2,322.4	2,419.2	2,532.3	2,704.4	2,802.9	2,823.9	3,085.8
Power consumption to generate heat in boiler-houses	63.6	68.8	68.3	66.4	70.4	56.8	66.0
End-use consumption	2,258.8	2,350.4	2,464.0	2,638.1	2,732.5	2,767.0	3,019.8
Share in resources for consumption	*75.8%*	*73.0%*	*75.7%*	*77.0%*	*76.6%*	*77.2%*	*75.7%*

* Estimated
Source: Consultant's estimates based on the data of Tables 2.1-2.4.

While there is certain concurrence in transmission losses data (see Table 2.4), information sources very much differ in terms of own needs power consumption. In Table 2.5, own needs consumption is the difference between power generation and supply by power plants ("11-TER"). However, these data do not take into account own needs determined by KTETs-2 commissioning in 2005-2006. They were estimated by the consultant. Information on power consumption for heat generation by boiler-houses was taken from "11-TER".

Useful supply of power in 2005 increased by 0.7%, and in 2006, based on preliminary estimates, by 9.3%. In general, end-users obtain only three quarters of overall power resources.

2.1.9 THE BLOCK OF POWER END-USE

The block of power end-use was developed with an account of the recent changes in the power consumption statistics (introduction of OKVED), and keeping in mind that "11-TER" was not affected by these changes. 14 consumer groups are specified (see Table 2.7). Residential and Commercial consumptions are responsible for almost 60% of power end-use, followed by Other Industrial Consumption (not broken down in other sectors). Pulp & Paper is responsible for 7% of power consumption. None of the remaining groups consumes more than 4.5%. A combination of Tables 2.5-2.7 provides the Kaliningrad Oblast power balance.

Table.2.7. The structure of useful power consumption in Kaliningrad Oblast (mln. kWh)

	2000	2001	2002	2003	2004	2005	Share in 2005
Final consumption, total	2,258.8	2,350.4	2,464.0	2,638.1	2,732.5	2,767.0	100.0%
Oil extraction	29.9	31.5	31.6	33.2	20.1	25.2	0.9%
Pulp	114.0	125.5	127.6	124.1	122.5	104.5	3.8%
Paper	54.1	63.9	72.2	69.5	76.2	69.3	2.5%
Cardboard	11.7	11.4	16.6	18.3	22.7	20.2	0.7%
Meat (including by-products)	8.5	23.1	23.0	23.8	21.6	26.1	0.9%
Bread and bakery products	6.5	5.2	3.4	2.8	2.5	2.9	0.1%
Water raise, supply, and treatment (including utility needs)	70.0	74.4	70.0	77.1	79.8	83.7	3.0%
Other industrial consumption	240.3	255.8	232.1	283.6	328.9	314.5	11.4%
Construction	29.3	31.5	34.9	42.6	40.4	58.8	2.1%
Transport	71.90	79.30	83.30	94.80	97.50	107.80	3.9%
Production needs of the agricultural sector	115.00	114.40	107.10	106.60	99.80	106.4	3.8%
Residential	816.0	844.6	902.9	959.6	939.1	999.2	36.1%
Utility sector	134.7	129.6	129.1	135.0	119.7	119.8	4.3%
Commercial	512.0	538.6	540.2	600.8	625.9	652.0	23.6%
Other	44.9	21.6	89.8	66.2	135.7	76.7	2.8%

Source: Consultant's estimates based on the data from Tables 2.1-2.5.

2.2 Heat balance

Conflicting and poor data on heat generation and consumption, taken from different information sources, considerably complicate development of a heat balance. Both the statistical yearbook "On the problems of fuel and energy consumption in Kaliningrad Oblast" for 2005, and the Report by Kaliningrad Oblast Government "Operation results of the Fuel and Energy Sector of Kaliningrad Oblast in 2005" only devote 1 page each to the situation in heat supply.

"11-TER" is the basic source for heat balance development; also some use was made of the inventory "Kaliningrad Oblast heating network operation" and data obtained based on "22 ZhKH".

2.2.1 THE BLOCK OF HEAT RESOURCES

It is important to point out that in terms of energy heat supplied to heating networks rather than heat generated, is statistically reported. Heat sources own needs consumption is not adequately reflected in the statistics. "11-TER" provides the most complete information on heat supplied, therefore it was taken as the basis (see Table 2.8). Recovered heat should also be included in the heat balance. With such comprehensive approach it turned out, that overall heat generation in 2005 declined by 0.6%.

Table.2.8. Heat generation in Kaliningrad Oblast (th Gcal)

	2000	2001	2002	2003	2004	2005	Share in 2005
"11-TER"							
Heat supply, including recovered heat	4,800	5,248	5,509	5,594	5,830	5,796	100.0 %
Heat supply	4,764	5,204	5,457	5,542	5,779	5,745	99.1%
Heat supplied by power plants	1,342	1,466	1,491	1,474	1,503	1,468	25.3%
Heat supplied by boiler-houses	3,421	3,739	3,966	4,068	4,276	4,226	72.9%
Including regional boiler-houses	660	703	784	844	805	705	12.2%
Heat recovery units	37	43	52	52	51	51	0.9%
Data from Inventory "On problems of fuel and energy consumption"	4,766	5,205	5,457	5,542	5,779	5,694	
Data from Kaliningrad Oblast Government Report							
"Jantarenergo"			965	993	969	909	15.7%
Co-generation plant-1*					677	643	11.1%
GRES-2					186	170	2.9%
Gusevskaya co-generation plant					106	96	1.7%
Total pulp & paper combined generation			2,138	2,142	2,246	1,972	34.0%
"Sovetsky Pulp&Paper Plant"**			915	919	931	920	15.9%
"Nemansky Pulp&Paper Combinat"*			576	593	661	479	8.3%
"Tsepruss"			647	630	654	573	9.9%
Inventory "Kaliningrad Oblast heating network operation"							
Boiler-houses						2,462	42.5%
With capacity up to 3 Gcal/hr						321	5.5%
With capacity between 3 and 20 Gcal/hr						470	8.1%
With capacity between 20 and 100 Gcal/hr						782	13.5%

* generates only heat
** part of heat (292 th. Gcal in 2005) generates on boiler-houses

At first sight, the data from the Government Report conflict with this form, because the share of "Jantarenergo" and the Pulp & Paper Plant equals 2,881, not 1,468 thou. Gcal. However, since co-generation plant-1 and "Nemansky Pulp&Paper Combinat" work as boiler-houses, and part of heat at "Sovetsky Pulp & Paper Plant" is also generated by boiler-houses, this conflict is eliminated. The inventory ""Kaliningrad Oblast heating network operation" provides information only on 43% of overall heat generation in the region.

2.2.2 HEAT CONSUMPTION DURING ENERGY TRANSFORMATION, TRANSMISSION, AND DISTRIBUTION

"11-TER" data on heat transmission losses can hardly be taken as reliable (see Table 2.9). The value for 2005 practically increased by an order of magnitude, but still hardly reflects the real situation.

Table.2.9. Evaluation of transportation heat losses (th. Gcal)

	2000	2001	2002	2003	2004	2005
Transportation heat losses	6.7	18.4	30.6	34.1	28.9	268.6
Share in heat supply	*0.1%*	*0.4%*	*0.6%*	*0.6%*	*0.5%*	*4.7%*
Distribution heat losses, according to Inventory "Kaliningrad Oblast heating network operation"						416.3
Share of losses in heat supply						*11.2%*
Total heat transportation losses	720.1	787.1	826.3	839.2	874.5	869.4
Share of losses in heat supply	*15.0%*	*15.0%*	*15.0%*	*15.0%*	*15.0%*	*15.0%*

Sources: "11 TER" and consultant's estimates

According to the Inventory "Kaliningrad Oblast heating network operation", transportation and distribution heat losses equal 416 thou. Gcal, or 11.2% of 3,300 thou. Gcal supplied through the common use heating network. Overall losses equal 684.9 thou. Gcal, or 11.8% of total heat resources. However, according to Kaliningrad Oblast Ministry of Fuel and Energy Sector (Yu.N. Zlobin[4]), transportation and distribution heat losses account to 20-25%, and up to 60% in regions. Ministry of Municipal Utility Services (S.A. Dyagilev[5]), estimates heat losses at 35%. L.L. Prishep, Director of Kaliningrad city Department for Municipal Utility Services, states in his report that the share of municipal distribution heat losses exceeds 15%[6]. In other municipalities of the region, the losses are higher than that. Based on the data from the Inventory "Kaliningrad Oblast heating network operation", the consultant has preliminarily assessed heat losses at 16%. In heat balance estimates it was assumed, that average transportation and distribution heat losses (including industrial consumers, many of whom generate heat at their own boiler-houses and have comparatively low losses) equal 15% (see Table 2.9).

2.2.3 THE BLOCK OF HEAT END-USE

The block of heat end-use should reflect unaccounted heat losses. An assumption was made, that all accounted heat losses are related to Industrial and Other industrial consumption, while all unaccounted losses to the Utility Sector, Commercial, and Residential in proportion to their respective heat consumption. For these sectors, unaccounted heat losses are specified in a separate line (see Table 2.10). It turned out, that residential heat consumption is 20% below the accounted value. This is a normal difference between estimated and actually metered levels of heat consumption both in Russia and Kaliningrad Oblast. Values verified for unaccounted losses much more accurately reflect the real situation in heat consumption.

[4] Estimated in personal communication
[5] Estimated in personal communication
[6] L.L. Prishep. The problems of the Municipal Utility Services Sector in Kaliningrad city and the goals of the Russian-German project. Workshop "Improving residential energy efficiency in Kaliningrad Oblast. Kaliningrad, October 2-3, 2006.

Table.2.10. Heat consumption in Kaliningrad Oblast (th. Gcal)

	2000	2001	2002	2003	2004	2005	Share in 2005
Industrial	1,694.7	1,957.0	1,852.4	1,977.2	2,236.7	2,013.7	42.1%
Pulp – total	808.1	899.6	900.7	872.6	893.1	746.8	15.6%
Paper	194.1	228.0	243.5	223.3	270.6	227.6	4.8%
Cardboard	35.8	38.5	52.6	60.5	75.3	61.7	1.3%
Meat (including 1st category by-products)	32.7	58.6	51.6	55.7	56.8	49.1	1.0%
Bread and bakery products	50.6	37.2	28.8	25.5	21.4	21.5	0.4%
Water raise and supply (excl. of utility needs)	5.9	5.2	5.1	6.0	5.8	4.6	0.1%
Effluent treatment	1.3	1.2	1.0	1.1	0.9	1.3	0.0%
Other industrial consumption	566.0	688.7	569.1	732.4	912.8	901.0	18.8%
Transport and communication	*101.0*	*117.4*	*133.9*	*126.4*	*124.3*	128.7	2.7%
Railways production needs	61.7	*71.8*	81.8	77.3	75.9	78.7	1.6%
Agriculture	*204.8*	*203.7*	*190.7*	*189.9*	*177.7*	189.5	4.0%
Construction	*0.6*	*0.7*	*0.8*	*0.9*	*0.9*	1.3	0.0%
Total industrial	1,961.6	2,179.3	2,213.1	2,272.3	2,397.1	2,234.2	46.7%
Utility sector	363.0	380.4	399.3	373.3	330.5	387.3	8.1%
Commercial	*135.2*	*141.6*	*148.7*	*139.0*	*123.1*	144.2	3.0%
Consumption	270.3	281.3	303.0	281.3	244.8	314.2	6.6%
Unaccounted losses	92.7	99.1	96.3	92.0	85.7	73.1	1.5%
Residential	2,429.7	2,569.9	2,901.2	2,892.7	2,931.1	2,756.3	57.6%
Consumption	1,809.0	1,900.3	2,201.7	2,179.6	2,171.2	2,236.1	46.7%
Unaccounted losses	620.7	669.6	699.5	713.1	759.9	520.1	10.9%
Overall useful consumption	4,754.3	5,129.6	5,513.6	5,538.3	5,658.7	5,377.8	112.4%
Same, excl. unaccounted losses	4,040.9	4,360.9	4,717.9	4,733.2	4,813.1	4,784.6	100.0%

* The values in italics are the consultant's estimates

Residential, commercial, and utility sectors are responsible for over 53% of useful heat consumption. According to "22-ZhKH", residential heat consumption equaled 2,369 thou. Gcal, including 1,367 th.. Gcal for space heating and hot water supply. Heat end-use efficiency in the region to a large extent depends on how effectively people use hot water in their homes.

Nearly 22% of heat consumption is the share of pulp & paper industry. Heat consumption decline in this industry (determined by 18% reduction of pulp output, as well as by cardboard and paper output drop) resulted in reduced overall useful heat consumption in 2005. On average, over 2000-2005, annual heat consumption growth equaled 3.4%

2.3 Natural gas balance

2.3.1 THE BLOCK OF NATURAL GAS RESOURCES

Natural gas resources consists of associated gas extraction and natural gas received from Russia through the territories of Belarus and Lithuania (see Table 2.11). In 2005, associated gas extraction was 17.3 mln. m3, including 10.3 mln m3 sold to consumers; the remaining quantity was consumed at oil extraction sites. Natural gas supply to the consumers of Kaliningrad Oblast amounts to 719.5 mln. m3 in 2005.

Table.2.11. Natural gas resources (mln. m3)

	2000	2001	2002	2003	2004	2005
Production	11.0	11.0	10.5	16.7	16.8	17.3
Supply to Kaliningrad Oblast	466.0	514.0	563.5	568.8	636.4	719.5
Total resources	477.0	525.0	574.0	585.5	653.2	736.8
Losses and own needs consumption	20.6	20.6	22.7	38.6	28.2	27.4

Sources: Fossil fuels extraction, processing industries, power-, natural gas- and water generation and distribution in Kaliningrad Oblast. FSGS. Kaliningrad, 2006; Analytical paper "On the problems of fuel and energy resource consumption in Kaliningrad Oblast". FSGS. Kaliningrad. 2006.

2.3.2 NATURAL GAS CONSUMPTION DURING ENERGY TRANSFORMATION, TRANSMISSION, AND DISTRIBUTION

The data on natural gas industrial consumption were taken from "11-TER", while on residential consumption and consumption by social facilities from "22-ZhKH" and "4-T". The sum of these data has only a small discrepancy with the data from "Kaliningrad Oblast in Figures. 2006" Statistical Yearbook (see the last row in Table 2.12).

Table 2.12. Natural gas consumption in Kaliningrad Oblast (mln. m3)

	2000	2001	2002	2003	2004	2005	Share in 2005
Transformation to power and heat	322.7	358.0	408.7	415.6	479.9	562.9	79.3%
Power supplied by power plants	7.8	7.8	14.7	6.4	16.7	84.6	11.9%
Heat supplied by power plants	65.2	73.7	67.8	78.5	125.0	116.6	16.4%
Heat supplied by boiler-houses	249.7	276.5	326.2	330.8	338.2	361.8	51.0%
incl. regional boiler-houses	82.6	86.4	95.4	96.9	91.8	83.2	11.7%
Industry	9.4	9.6	9.9	4.2	9.4	11.6	1.6%
Oil treatment	0.0	0.0	0.0	0.0	4.5	6.7	0.9%
Other industrial consumption	9.4	9.6	9.9	4.2	4.9	4.9	0.7%
Total industrial consumption	332.1	367.6	418.7	419.8	489.3	574.5	81.0%
Utility sector	0.5	1.0	1.0	6.0	0.9	0.1	0.0%
Social facilities	*7.0*	*6.9*	*6.7*	*6.1*	*6.8*	6.8	1.0%
Residential	*126.5*	129.0	125.0	115.0	128.0	128.0	18.0%
Total consumption	466.0	504.4	551.3	546.9	625.0	709.4	100.0 %
Data from the statistical inventory	466.0	499.0	546.0	540.0	625.0	707.0	99.7%

* The figures in italics are the consultants estimates.
Sources: "11-TER", "22-ZhKH", "4-T", and sources to Table 2.11.

In 2000-2006, natural gas consumption increased 2.7-fold, and for power generation nearly 11-fold. The major part of natural gas (almost 80%) is used to generate heat and power. In 2005, 83.9 mln. m3 of gas were used for start-up and adjustment of the first block of KTETs-2. In 2006, OAO "Gasprom" was planning to increase natural gas supply to the region to reach 1,270 mln. m3; of these 600 mln. m3 were to be consumed by KTETs-2, and the remaining 670 mln. m3 were for use by industrial, utility, and residential sectors. Therefore, the share of natural gas consumption for power and heat generation purposes will increase to 84-85%.

2.3.3 THE BLOCK OF NATURAL GAS END-USE

Natural gas consumption in 2005 was below the allocated limits, which can be explained by a relatively warm winter. Industrial sector (excluding industrial boiler-houses) is only responsible for 1.6% of natural gas consumption. Residential sector is the third largest gas consumer (after power- and heat generation); residents use gas for cooking, as well as for individual heat generation and hot water production. Despite the ongoing process of gasification, residential gas consumption is not growing. New consumers are using natural gas resources that were realized by previously connected consumers through improved gas efficiency. In 2005, 3,602 flats were connected to gas supply, including 3,269 to natural gas, 311 to liquefied gas, and 22

to associated gas. 2,772 flats were switched from liquefied gas to natural gas supply. 9,380 individual gas meters are installed.

2.4 Coal balance

There is no coal extraction in Kaliningrad Oblast; all the coal is imported (primarily from Kuznetsky and Minusinsky coalfields). Information on coal consumption was taken from "11-TER" and "4-T" (see Table 2.13). Coal consumption considerably declined in 2003 through reduced heat generation by coal-fired power plants. Then it somewhat stabilized. Coal is primarily consumed by 386 coal-fired boiler-houses. As more towns are connected to gas supply, coal consumption by boiler-houses is not growing, while residential consumption for individual space heating is going down.

Table.2.13. Coal consumption in Kaliningrad Oblast (Ttce)

	2000	2001	2002	2003	2004	2005	Share in 2005
Power supplied by power plants	12.5	17.3	0.4			2.4	1.3%
Heat supplied by power plants	63.1	81.4	4.5			10.0	5.6%
Heat supplied by boiler-houses	99.5	108.1	108.9	111.9	107.2	111.5	62.4%
incl. district boiler-houses	6.0	8.2	9.5	16.1	17.9	15.5	8.7%
Other industrial consumption	4.9	6.2	7.0	7.7	7.1	6.6	3.7%
Utility sector	21.1	24.0	24.5	25.5	24.0	8.9	5.0%
Commercial and other consumption	27.2	14.8	32.5	30.8	28.5	26.3	14.7%
Residential	25.1	46.0	23.6	31.4	26.9	12.9	7.2%
Total consumption	**253.6**	**297.8**	**177.8**	**176.0**	**166.8**	**178.6**	100.0%

Source: "11-TER" and "4-T"

2.5 Fuel oil balance

Information on fuel oil consumption is entirely taken from "11-TER". They are not much different from "4-T" form (see Table 2.14). Fuel oil is basically used at boiler-houses and power plants with a small share used for other applications. As natural gas consumption grows, fuel oil is being continuously replaced from the heat- and power balance of the region.

Table.2.14. Fuel oil consumption in Kaliningrad Oblast (ktons)

	2000	2001	2002	2003	2004	2005	Share in 2005
Power supplied by power plants	20.7	20.4	28.6	30.5	22.3	26.5	13.4%
Heat supplied by power plants	76.4	71.2	128.2	127.9	85.5	77.8	39.1%
Heat supplied by boiler-houses	143.1	155.5	132.8	117.1	129.1	89.3	44.9%
incl. district boiler-houses	4.2	3.7	5.9	11.2	10.5	6.4	3.2%
Other industrial consumption	3.4	2.3	2.2	1.7	1.2	3.4	1.7%
Utility sector	3.6	2.1	3.1	1.9	0.4	1.3	0.7%
Non-fuel use	1.6	0.4	0.3	0.0	0.2	0.4	0.2%
Total consumption according to "11-TER"	248.8	251.9	295.2	279.2	238.6	198.8	100.0 %
Total consumption according to "4-T"	255.4	258.4	283.2	277.6	240.9	198.8	

Source: "11-TER" and "4-T"

3 Integrated Fuel and Energy Balance

The integrated Fuel and Energy Balance of Kaliningrad Oblast for 2005 is the result of combining power-, heat-, natural gas-, coal-, fuel oil- and other liquid and solid fuels (wood, peat, etc.). The integrated Fuel and Energy Balance provides an opportunity to comprehensively present the energy situation in the region in one table (see Table 3.1).

Fuel and energy consumption estimated in the integrated Fuel and Energy Balance (2,089 thou. tce) considerably differs from the figures reported by the regional statistics (1,309 thou. tce), because the latter is not complete. 86% of primary energy consumed in the region is locally produced; this is basically crude oil, which is also exported. Imports of energy resources (coal, petroleum products, natural gas, and power) considerably exceeds oil export.

Regional energy end-use is only 78% of primary energy, with the rest being lost during energy transformation. The share of losses will somewhat grow, as KTETs-2 starts full-scale operation.

The industrial sector is responsible for nearly 26% of overall energy end-use. However, if fuel consumption by industrial co-generation plants and boiler-houses is added, the share of industrial sector in the overall primary energy consumption will significantly increase. The share of transport in the energy end-use equals 15.9%, agriculture – 3.2%, utility sector – 4.6%, commercial – 10.8%, and residential – 39.6%. Compared to 2000, the share of residential consumption has grown by 3.5%, basically due to the transport consumption decline.

The proportions of Kaliningrad Oblast integrated Fuel and Energy Balance for 2005 give grounds to some conclusions in terms of possible Fuel &Energy Balance development and the effectiveness of energy generation in the region. Crude oil is the major local primary energy resource. Natural gas and other solid fuels, including peat, have small shares. Hydro and renewables do not contribute significantly.

Natural gas dominates in the structure of primary energy consumption (40.8%), followed by petroleum products and imported electricity. The share of natural gas in the fuel balance of power plants is nearly 60%, and in the fuel balance of boiler-houses – 61%. In the boiler-houses, natural gas is basically replacing petroleum products.

Heat dominates in energy end-use (43%), followed by liquid fuel, power, and natural gas. The share of heat in the energy end-use is also large in industry (68%), agriculture (51%), and in the residential sector (50%). Therefore, it is worthwhile giving special attention to heat generation, distribution, and end-use efficiency.

The share of electricity tends to grow nearly in all end-use sectors.

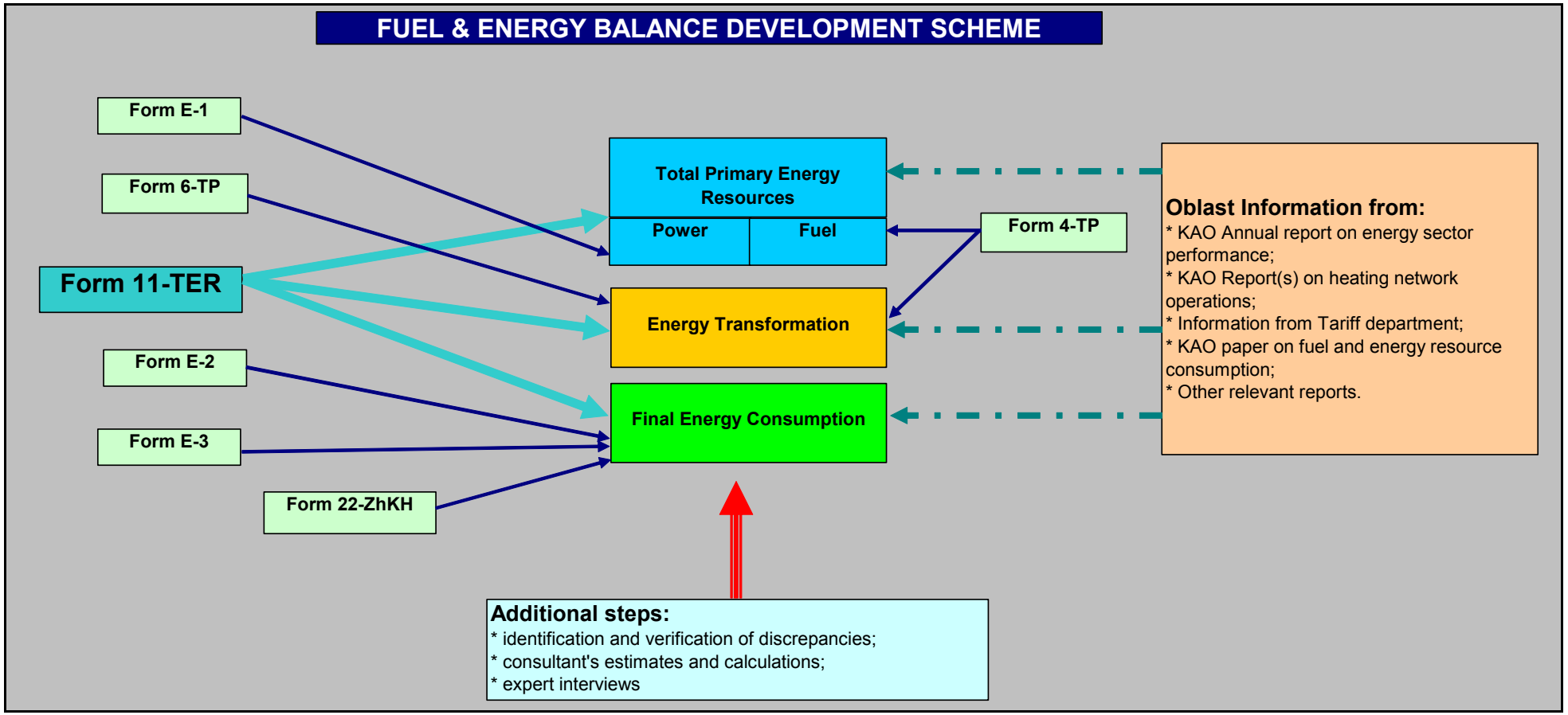
Figure 3.1 below shows a summary in schematic form how the fuel and energy balance was developed from different information sources as discussed in detail in the previous chapters.

Table.3.1. Integrated Fuel and Energy Balance of Kaliningrad Oblast for 2005 (Ttce)

	Coal	Crude oil	Petrol. Pro-ducts	Natu-ral gas	Hydro and renew-ables	Other solid fuels	Power	Heat	Total
Production		1741.7		20.0	1.8	28.1			1791.7
Import	178.6		653.4	832.5			373.4		2037.9
Export		-1741.7					0.0		-1741.7
Stock changes									0
Primary energy consumption	**178.6**	**0.0**	**653.4**	**852.5**	**1.8**	**28.1**	**373.4**		**2087.8**
Statistical discrepancies	0.0		0.0	0.0			-3.5	0.0	-3.5
Power plants	-12.4		-142.8	-232.7	-1.8		66.9	210.0	-112.9
Power generation	-2.4		-36.3	-97.8	-1.8		66.9		-71.5
Heat generation	-121.5		-257.4	-553.4		-8.8		821.6	-119.6
Co-generation plants	-10.03		-106.5	-134.9				210.0	-41.4
Boiler-houses	-111.5		-150.9	-418.6		-8.8		604.3	-85
Industrial	-96.0		-138.9	-322.3		-8.3		503.4	-62
General use	-15.5		-12.0	-96.3		-0.5		100.9	-23.4
Heat recovery units								7.3	7.3
Own needs				-31.7			-17.6		-49.3
Distribution losses							-85.9	-123.2	-209.1
Energy end-use	**54.6**		**359.7**	**169.5**		**19.3**	**340.4**	**698.3**	**1627.1**
Industrial	6.6		19.0	13.4		5.8	88.9	288.0	421.7
Oil extraction			8.5	7.8			3.1		19.3
Pulp							12.9	106.8	119.6
Paper							8.5	32.5	41.1
Cardboard							2.5	8.8	11.3
Meat products							3.2	7.0	10.2
Bakery products			0.0				0.4	3.1	3.4
Other	6.6		10.6	5.6		5.8	58.4	129.7	216.7
Construction			7.4				7.2	0.2	14.8
Transport	0.0	0.0	227.3	0.0	0.0	0.0	13.3	18.4	259.0
Aircraft			29.0						29.0
Automobile			168.6						168.6
Railway			29.2				6.1	11.2	46.5
Water			0.5						0.5
Urban electric							2.1		2.1
Other transport							5.1	7.2	12.2
Agriculture			12.5				13.1	27.1	52.7
Utility sector	8.9		21.4	0.2		0.6	14.7	28.2	74.1
Commercial	26.3		44.4	7.9			80.2	16.7	175.5
Residential	12.9		27.6	148.1		12.8	122.9	319.8	644.1

Source: Developed by the consultant

Figure 3.1 Fuel and Energy Balance development chart



4 Assessment of the energy supply efficiency in Kaliningrad Oblast

4.1 Assessment of the efficiency of energy supply

According to Table 4.1, the fuel-use factor at power plants equals 71%. Specific fuel consumption for power generation tends to decline, but because of KTETs-2 start-up and adjustment in 2005, it has increased considerably (see Table 4.1). Specific fuel consumption for heat generation at power plants is not metered but calculated from the fuel allocation process between heat and electricity based on boiler efficiency. To keep co-generation plants competitive, it needs to be reduced, just like specific fuel consumption of industrial boiler-houses. The efficiency of heat generation by boiler-houses is 87.6%, and by industrial boiler-houses – 89%. Keeping in mind that many boiler-houses are liquid fuel- or coal-fired, such efficiency estimate may seem too high. The efficiency of general use boiler-houses is 81%, which is probably closer to the real figure.

Table 4.1. Integrated Fuel and Energy Balance of Kaliningrad Oblast for 2005 (%)

	Coal	Crude oil	Petrol. Pro-ducts	Natural gas	Hydro and renew-ables	Other solid fuels	Power	Heat	Total
Production		97.2%		1.1%	0.1%	1.6%			100.0%
Import	8.8%		32.1%	40.8%	0.0%	0.0%	18.3%		100.0%
Export		100.0%							100.0%
Primary energy consumption	8.6%		31.3%	40.8%	0.1%	1.3%	17.9%	0.0%	100.0%
Power plants	3.2%		36.6%	59.7%	0.5%	0.0%	17.2%	53.9%	71.0%
Power generation	1.7%		26.2%	70.7%	1.3%		48.4%		
Heat generation	12.9%		27.3%	58.8%	0.0%	0.9%		87.3%	
Co-generation plants	4.0%		42.4%	53.7%	0.0%	0.0%		83.5%	
Boiler-houses	16.2%		21.9%	60.7%	0.0%	1.3%		87.6%	
Industrial	17.0%		24.6%	57.0%	0.0%	1.5%		89.0%	
General use	12.5%		9.7%	77.5%	0.0%	0.4%		81.2%	
Heat recovery units								100.0%	
Own needs				3.7%			4.0%		
Distribution losses							20.3%	15.0%	
Energy end-use	3.4%		22.1%	10.4%		1.2%	20.9%	42.9%	100.0%
Industrial	1.6%		4.5%	3.2%		1.4%	21.1%	68.3%	100.0%
Oil extraction			43.8%	40.2%			16.0%		100.0%
Pulp							10.7%	89.3%	100.0%
Paper							20.8%	79.2%	100.0%
Cardboard							22.0%	78.0%	100.0%
Meat products							31.4%	68.6%	100.0%
Bakery products							10.4%	89.6%	100.0%
Other	3.0%		4.9%	2.6%		2.7%	27.0%	59.8%	100.0%
Construction			49.9%				48.9%	1.3%	100.0%
Transport			87.8%				5.1%	7.1%	100.0%
Aviation			100.0%						100.0%
Automobile			100.0%						100.0%
Railway			62.8%				13.0%	24.2%	100.0%
Water	0.0%		100.0%						100.0%
Urban electric	0.0%		0.0%				100.0%		100.0%
Other	0.0%		0.0%				41.5%	58.5%	100.0%
Agriculture	0.0%		23.8%				24.8%	51.4%	100.0%
Utility sector	12.1%		28.9%	0.2%		0.9%	19.9%	38.0%	100.0%
Commercial	15.0%		25.3%	4.5%			45.7%	9.5%	100.0%
Residential	2.0%		4.3%	23.0%		2.0%	19.1%	49.6%	100.0%

Source: Estimates based on Table 2.14.

Heat transmission and distribution losses are estimated at 15% (see above). The share of dilapidated heat network is 24% of overall heat network length. There are higher assessments, but they only refer to distribution pipelines. Power distribution losses are 20%. Nearly 80% of power losses occur in low-voltage (0.4 kV) lines. Local experts' estimates of commercial losses equal 608%. Almost all power lines are owned or managed by "Jantarenergo". This organization is to launch an effort to reduce commercial losses. Technical losses equal 12-14%, or twice the value of many foreign countries.

Table 4.2. Specific fuel consumption for power- and heat generation and power distribution losses

	Units	2000	2001	2002	2003	2004	2005
Power supplied by fuel oil-fired power plants	gce/kWh	315.5	293.1	306.4	247.0	258.6	292.6
Heat supplied by power plants	kgce/Gcal	180.6	179.5	173.4	180.4	174.1	171.2
Heat supplied by industrial and district boiler-houses	kgce/Gcal	180.0	183.0	179.3	172.9	171.1	165.6
Incl. District boiler-houses	kgce/Gcal	165.6	165.1	167.0	174.4	178.7	177.0
According to "Kaliningrad Oblast heating network operation" Inventory	kgce/Gcal						175.4
Distribution power losses	%	20.6	23.5	20.8	19.6	20.0	20.0

Source: "11-TER".

4.2 Assessment of industrial energy end-use efficiency

In 2000-2005, the efficiency of energy end-use was growing, although the dynamics were uneven (see Table 4.3). To a certain extent, the dynamics are determined by changes in the production scale. Oil extraction growth resulted in the reduction of corresponding specific consumption, and a decline of water consumption resulted in an increase of specific consumption for water abstraction and treatment.

Table 4.3 Specific fuel and energy end-use consumption

	Units	2000	2001	2002	2003	2004	2005
Oil extraction	kgce/t	4.9	5.2	5.2	5.4	3.3	2.5
Operation drilling of oil- and gas wells	kgce/м	49.1	135.1	80.4	25.8	37.0	45.9
Oil treatment	kgce/t	16.1	15.1	15.4	6.4	6.4	6.4
Oxygen	kgce/th..m3	516.6	181.8	732.1	961.6	1,113.2	1,143.9
Cast iron moulding	kgce/t	274.5	263.0	309.1	312.1	303.0	307.7
Pulp	kgce/t	662.1	681.0	661.5	649.9	640.5	634.0
Paper	kgce/t	629.5	659.9	604.3	575.9	682.8	589.8
Cardboard	kgce/t	616.4	620.1	571.2	529.7	578.0	495.0
Meat	kgce/t	1,328.8	826.6	896.5	975.6	806.4	760.5
Bread and bakery products	kgce/t	166.8	138.6	117.4	117.3	110.8	122.4
Operation needs of Ministry of Transport' railways	10 th.. tkm gross	28.6	28.0	23.3	19.0	17.3	17.9
Electric traction of trains of Ministry of Transport' railways	kgce/10 th. tkm	32.3	32.8	33.0	31.8	31.2	32.0
Operation needs of Ministry of Transport' railways (excl. of electric traction)	kgce/10 th. tkm	7.7	6.8	5.3	4.9	5.0	5.1
Electric traction of trams	kgce/th. tkm	17.8	18.2	25.7	20.0	22.9	21.3
Electric traction of trolleybuses	kgce/th. tkm	25.0	23.4	29.0	29.0	27.9	27.6
Water abstraction and supply (excl. municipal utility sector)	kgce/th.m3	96.3	97.1	96.2	101.7	101.4	100.3
Effluent treatment	kgce/th.m3	16.1	21.0	18.8	23.3	23.4	26.1

Source: "11-TER".

5 Analysis of energy sector forecasts in the region

5.1 Economic and energy development projections

On December 2006, the Oblast Government discussed "Kaliningrad Oblast development strategy until 2030". A complete version of the document was not available for assessment. It was never publicly discussed in the Oblast. However, some materials that give an idea of the development, have been collected, including several personal communications.

The overall economic goal is to use the advantages of a free economic zone to reach the following targets:

- ⇒ Gross regional product (GRP) annual growth rates of 9-12% under the average scenario, and of 18% under the optimistic scenario. For comparison GRP growth in 2004 was 12.3%, and in 2005 – 1.7%, which results in a 7% annual average with rapid development of assembling industry;
- ⇒ Population growth to reach 1.4 mln. people. This would mean immigration of at least 500 thou. people in the coming few years. In 2001-2005, the number of the Oblast population declined by 15 thou. people, or by 1.6%.

These goals seem rather optimistic. In 2007-2012, Russia's GDP dynamics will be slowing down due to oil and gas prices and export reduction, and will equal 4-6% annual. The sources of considerably (two or three times) higher growth in Kaliningrad Oblast (even taking into account the free economic zone regime) are not obvious. Sustainable annual growth of labor productivity can hardly exceed 4-5%. In 2003-2005, given a GRP annual growth of 7%, the number of employees in the Oblast was growing by 5% per annum, and labor productivity increased only by 2% per annum. Annual employment growth of 8-13% will be required to ensure GRP growth of 12-18% per annum. There is no housing or other infrastructure in the Oblast for this increased number of employees (including family members). Average salary in the Oblast is not high enough to attract labor migrants from the rest of Russia and other countries. In other words, the target economic growth rates do not seem realistic.

Perspective large projects until 2030 include: steel works construction; launching deep processing of wood; setting up industrial zones for furniture and appliance production; meat processing development; launching building materials production (two cement works, production of wall and finishing materials, a brick-and-tile factory); metal ware processing; vegetable oil processing; and agriculture development. The planned steel works in particular will be difficult to establish. The economic rational seems low , mainly because the region has neither sufficient personnel nor raw materials and energy.

Such large-scale economic development plans, obviously, need a corresponding development of the fuel and energy sector in the Oblast (see Table 5.1). Power consumption is to grow 2.8-fold, natural gas consumption – 5.4-fold, and coal consumption – 3-fold. On the contrary, fuel oil consumption is to go down. According to the authors of the "Strategy", natural gas will be the major fuel to ensure the economic development before 2015; then it will be replaced by "clean technology" coal.

Table.5.1. Fuel and energy consumption projection of Kaliningrad Oblast in 2010-2030

	Units	2000	2005	2010	2015	2020	2025	2030	Growth in 2030 versus 2005	
									times	% annual
Power	mln. kWh	2,979	3,990	5,713	7,340	9,576	10,382	11,100	2.8	4.2%
Natural gas	mln. m3	466	740	3,124	3,560	3,818	3,894	3,972	5.4	7.0%
Coal	thou. t	320	270	310	230	780	800	820	3.0	4.5%
Fuel oil	thou. t	247	350	320	180	150	150	150	0.4	-3.3%

Source: Report "Kaliningrad Oblast fuel and energy sector development perspectives"

Projections up to 2020 are given in the "Kaliningrad Oblast social and economic development program for 2007-2016" (see tables 5.2 and 5.3). Average annual power consumption growth under the moderate scenario is 4.0%, and under the active scenario 10%. This is a significant acceleration of power consumption growth in key consumption sectors (see Fig. 1).

Table 5.2. Power balance of Kaliningrad Oblast energy utility until 2020 (active scenario), mln kWh

	2002	2003	2004	2005	2006	2010	2015	2020
	actual	actual	actual	actual	projected	proj.	proj.	proj.
RESOURCES	**3,256**	**3,427**	**3,568**	**3,584**	**3,990**	**5,570**	**7,260**	**9,590**
Generation	**242.2**	**262.2**	**260**	**539**	**3,021.5**	**4,840**	**7,260**	**9,590**
Co-generation plants	232.6	242.2	240	519	3004	4,808.5	7,140.5	9,461.5
Hydro	5.8	10	10	10	10	24	37	46
Other sources	3.8	10	10	10	7.5	7.5	82.5	82.5
Import	**3,013.8**	**3,164.8**	**3,308**	**3,045**	**968.5**	**730**	**0**	**0**
Distribution	**3,256**	**3,427**	**3,568**	**3,584**	**3,990**	**5,570**	**7,260**	**9,590**
Total consumption	**3,256**	**3,427**	**3,568**	**3,584**	**3,990**	**5,570**	**7,260**	**9,590**
Industry	780	845	901	915	1,040	1,720	2,550	3,780
agriculture	110	110	140	140	220	350	460	590
Transport	78	95	95	95	120	150	200	300
construction	28	30	40	45	70	150	200	300
residential&commercial	1,600	1,664	1,690	1,691	1,800	2,420	3,000	3,700
Losses and own needs consumption	660	683	702	698	740	780	850	920

Source: "Kaliningrad Oblast social and economic development program for 2007-2016". Kaliningrad. 2006.

Table 5.3. Power balance of Kaliningrad Oblast energy utility until 2020 (moderate scenario), mln kWh

	2002	2003	2004	2005	2006	2010	2015	2020
	actual	actual	actual	actual	projected	proj.	proj.	proj.
RESOURCES	**3,256**	**3,427**	**3,568**	**3,584**	**3,990**	**4,840**	**5,220**	**5,800**
Generation	**242.2**	**262.2**	**260**	**539**	**3,021.5**	**4,840**	**5,220**	**5,800**
Co-generation plants	232.6	242.2	240	519	3,004	4,808.5	5,100.5	5,671.5
Hydro	5.8	10	10	10	10	24	37	46
Other sources	3.8	10	10	10	7.5	7.5	82.5	82.5
Import	**3,013.8**	**3,164.8**	**3,308**	**3,045**	**968.5**	**0**	**0**	**0**
Distribution	**3,256**	**3,427**	**3,568**	**3,584**	**3,990**	**4,840**	**5,220**	**5,800**
Total consumption	**3,256**	**3,427**	**3,568**	**3,584**	**3,990**	**4,840**	**5,220**	**5,800**
Industry	780	845	901	915	1,040	1,490	1,670	1,840
agriculture	110	110	140	140	220	320	390	490
Transport	78	95	95	95	120	130	150	190
construction	28	30	40	45	70	120	140	200
residential&commercial	1,600	1,664	1,690	1,691	1,800	2,000	2,090	2,300
Losses and own needs consumption	660	683	702	698	740	780	780	780

Source: “Kaliningrad Oblast social and economic development program for 2007-2016”. Kaliningrad. 2006.

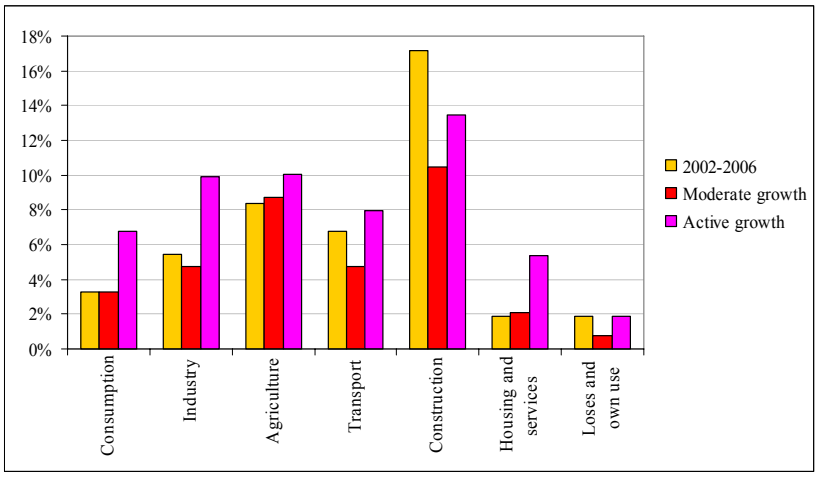


Fig.5.1. Average annual growth of power consumption in Kaliningrad Oblast in 2005-2020

6.8% average annual growth of power consumption under the “active” scenario, given a GRP annual growth of 18%, means that power intensity declines by almost 11% per annum. However, the Program does not specify, what exactly needs to be done to ensure such rapid power intensity decline. Therefore, despite the wide range of power demand projection for 2020 (between 5,800 and 9,590 bln kWh) this projection can hardly be viewed as realistic.

5.2 Potential energy supply development barriers

Even with today’s energy consumption level, the region may face significant energy difficulties aroung 2009:

⇒ In 2009, Ignalinskaya nuclear power plant (Lithuania), which currently supplies power to Kaliningrad Oblast, may be decommissioned. Belarus power plants may also become bottlenecks for lack of natural gas;

- ⇒ Russia's energy system is shifting from energy exports to energy imports; therefore, it will not be easy to replace Lithuanian power with Russian power. Besides, in 2009, Lithuanian power lines are to comply with the EU technical standards, and for this reason considerable investment will be required to obtain power through Lithuania. Currently, Kaliningrad Oblast receives through Lithuania 680 MW capacity by three 330 KW power lines;
- ⇒ To make up for power supply from Ignalinskaya nuclear power plant, it is important to commission the second block of KTETs-2 (another 450 MW capacity); additional 450-750 mln. m3 of natural gas will be required to operate this capacity. Such huge amount of natural gas cannot be delivered through the existing in place;
- ⇒ Current North-European Gas Pipeline project does not include a branche to Kaliningrad Oblast; but even if it did, the price of natural gas would be $US 170 or more per 1,000 m3;
- ⇒ Existing gas supply system operate with gas pressure problems. Gas pressure often drops to 5-10 bar, while power plant turbines need at least 21 bar. To ensure the required gas pressure and reliable gas supply to the region, it is necessary to build an underground gas storage with the capacity of 800 mln. m3. The construction was recently launched and may take up to 10 years. The construction is done in turns: the first turn is 80 mln. m3, the second 400 mln. m3, the third 320 mln. m3;
- ⇒ The coal alternative also has certain problems. Coal is supplied from Kuzbass. The second block of KTETs-2 would annually require 1,200-1,300 thou. tons of coal, or 2-3 trainloads of coal daily, which would need to pass through Lithuania. In this case, Lithuania requires repair of its railway. Coal may also be brought by sea transport, but the sea port infrastructure cannot handle such large quantities of coal;
- ⇒ Power outputs by existing power plants are expected to increase; however, this would require considerable investment in equipment upgrade. For example, Gusevskaya co-generation plant was commissioned back in 1955, Svetlogorskaya GRES in 1948 and has been operating at almost full efficiency over the last 13 years;
- ⇒ "Jantarenergo" has issued power supply obligations for 400 MW and no longer accepts any requests. Of course, power connection obligations are being met with a considerable lag; however, maximum power load is expected to grow up to 900 MW by 2015. In January 2006, peak load was 711 MW because gas pressure dropped at -14.3^{o}C outdoor air temperature. Power consumption for electric space heating at that point was around 80 MW. If there were no pressure drop, the peak would have been 650 MW. In other words, capacity demand growth in 2007-2015 will be 39%, or 3.7% annually.

If the economic growth is as rapid, as is planned, energy supply problems will become ever more acute. Lack of energy, accompanied by energy use inefficiency, may become a critical limitation factor for the planned economic development.

Kaliningrad Oblast is taking serious effort to address the reliability of energy supply. In 2005, implementation of eight projects in the fuel and energy sector, which are included in the Federal Program of Kaliningrad Oblast Development until 2010, continued. Under this Federal Program, construction of the first turn of KTETs-2 was accomplished. In 2005, the first stage of renovation work for the operating gas pipeline to Kaliningrad Oblast was accomplished. "Krasnoznamenskaya" compressor station was commissioned; in the territory of Lithuania a 63 km loop was built; an effort was made to increase the carrying capacity of gas metering station in the town of Shakyai. Due to the measures implemented, the gas pipeline capacity grew up to 1,050 mln. m3 /year. However, the regional demand in 2006 is 1,270 mln. m3, and in 2007 – 1,400 mln. m3. Construction of the underground gas storage was launched. Gasification work in Kaliningrad Oblast was continued in 12 municipalities: Gurievsky, Zelenogradsky, Bagrationovsky, Krasnozemsky, Nemansky, and Polessky districts, Kaliningrad, Sovetsk, Ladushkin, and Pionersky cities, and Svetlovsky and Svetlogorsky municipal districts. Under the boiler-houses fuel switch project, in 2005 a peat-fired boiler-house was built in the city of

Nesterov; renovation of the 1st stage of the boiler-house in Turukhanskaya St., Kaliningrad city, was accomplished.

In 2006, 12 projects of the Federal Program were being implemented: construction of the second energy block of Kaliningrad co-generation plant-2; renovation of existing gas pipeline; construction of underground gas storage; construction of a branche of the North European gas pipeline; gas supply to regions and cities of Kaliningrad Oblast; construction of gas pipeline branches to the cities of Chernyakhovsk and Svetly; further expansion of offshore Kravtsovskoye oil field in the Baltic Sea; construction of a heat main from co-generation plant-2; renovation of co-generation plant-1; renovation of a power distribution complex of OAO "Jantarenergo"; construction of a hydro power plant in the city of Krasnoznamensk; construction of a wind energy park.

There is another serious energy supply problem. Like before, continuous growth of municipal debt for fuel and heat supply roots in insufficient financing for municipal utility enterprises from municipal budgets (to cover the costs of municipal utility subsidies to the residential consumers); low affordability of residents, poor payment discipline and incompliance with the federal standard of 100% coverage of municipal utility costs. Because heat bills are not paid, heat utilities reduce heat supply parameters.

5.3 Potential improvement of energy projections

Kaliningrad Oblast energy projections have shortcomings that are typical for Russia. Simulation of "energy / economic" development is still under developed in Russia. Existing energy and power demand projection models are often based on outdated methodologies and not transparent, and they do not allow for checking estimations or reproducing them with a different set of assumptions. They practically do not take into account market factors, such as producer or consumer reactions to price fluctuations, or tax incentives, etc.

As a basis for improvement of the energy and energy efficiency strategy/policy of the oblast, energy supply and demand projection models need to be structured to perform certain tasks. These tasks include among others:

- ⇒ Better integration of power sector development projections with macroeconomic projections, as well as with projected changes in the fuel and energy balance;
- ⇒ To improve reliability of the power sector development projections, improvement of projections of power (capacity), heat, and fuel demand by consumer groups and by sectors of the economy, sufficient to account for the impacts of the following groups of factors:
    - o Economic structure development and other structural changes;
    - o Technology shifts;
    - o Consumer reactions to changing energy prices;
    - o Interfuel price and non-price competition;
- ⇒ Identifying key management parameters in the models ensuring a realistic development of different scenarios that are consistent and can be compared, and analysised. The scenarios include procedures for sensitivity analysis and elimination contradictory scenario elements;
- ⇒ Ensuring the possibility for simulating the efficiency of the energy policy, including price growth scenarios and meeting the energy demand both through construction of new energy sources and energy efficiency improvements;
- ⇒ A possibility to assess the effects of tariff growth on consumers' affordability, energy producers' competitiveness, and energy utilities' revenues;
- ⇒ Providing decision-makers with effective tools to evaluate integrated consequences of technical, pricing, tax, environmental, and investment policies;

- ⇒ Coordination of procedures for short-term, medium-term (5 years), and long-term (15 to 30 years) energy development projections and development of a technology for systemic verification of projected power and capacity balances as the basis for investment programs implementation;
- ⇒ Ensuring a transparent technology for source data collection and processing for model development and calibrating;
- ⇒ Ensuring effective formats for projections presentation.

In order to achieve a situation that enables making sound economic and energy projections, the regional administration needs establishing the proper organization, have staff trained in the use of forecasting models and integrate the results in its policies.

6. Potential of secondary and renewable energy use

In 2002, the first Russia wind energy farm of 5.1 MW overall capacity was commissioned in Kulikovo, Zelenograd region. OAO "Jantarenergo" provided financing for a feasibility study for development of offshore wind energy farms of 50 MW installed capacity.

A number of small hydro power plants were renovated and built. Perspective plans, taking into account local hydrological conditions, include expansion of their overall installed power capacity to reach 10 MW. In other words, renewable power generation may reach 120 mln kWh by 2010, or 2% of the 2010 projected consumption. Development of renewable power generation is one of the priorities in the "Oblast development strategy until 2030". However, it provides no reference points or targets for potential output growth until 2030. Strategy documents in general usually contain specific targets, for example, renewable power generation increases to 7% of overall power consumption in 2030, or 777 mln kWh.

Peat is one of the fuels extensively used over the recent years through commissioning of peat-fired heat sources. In 2005, 8.4 thousand tons of peat were extracted (4.9 thousand tons in 2004). Peat extracting companies have set peat stocks sufficient to meet the demand of boiler-houses. In 2005, OAO "Torfopredpriyatiye "Nesterovskoye"" extracted 3.6 thousand tons, and OOO "Torfo" – 4 thousand tons of peat. Possibilities to increase peat use look good.

During the recent years three new peat-fired boiler-houses were built. Two municipal wood waste-fired boiler-houses were built recently and are in operation. More than 10 wood waste-fired heat sources operate in local plants. The Oblast has significant unused resources of pulp & paper waste. However, this needs special assessment of wood waste conditions and appropriateness for energy use.

Heat recovery has increased compared to the 2000 level and stabilized at 51-52 thou. Gcal. Steam boilers of heat recovery boiler-house (OOO "Nemansky TsBK") have been renovated. This resource may also be considerably expanded. However, evaluation of its scale is only possible through a thorough energy audit.

Feasibility studies and financing mechanisms are necessary for a further increase of the use of secondary and renewable energy sources in the oblast.

A more detailed background information on the potential for secondary and renewable energy sources is presented in Annex II to this report.

7 Energy efficiency policy implementation

Implementation of a 5-year Energy efficiency program of Kaliningrad Oblast for 2001-2005 is accomplished. The Program was adopted in 2001 through a corresponding law of Kaliningrad Oblast. A total of 943.7 mln rubles have been spent on energy efficiency measures during this period. The funding came from the following sources: (see table below)

Table 7.1. Financing energy efficiency measures (mln. rubles)

Source of funding	2001	2002	2003	2004	2005	Total
Oblast budget	-	2.2	1.9	4.3	8.9	17.3 (2%)
Companies' funds	-	92.7	120	45.4	78	336.1 (36%)
Other financial sources (local funds, consumers)	138	44	66.3	152	190	590.3 (62%)
Total	**138**	**138.9**	**188.2**	**210.7**	**276.9**	**943.7 (100%)**
Total energy savings						113.000 tce
Costs per tce						8 531 Rubl/tce

The Program measures resulted in 113 thou. tce energy savings worth 273 mln rubles over 2002-2005. According to Kaliningrad Oblast industrial enterprises, the total economic effect of energy efficiency measures equaled 215.3 mln rubles. In 2005, 18 municipalities were involved in local energy efficiency programs versus 8 in 2003. The remaining local self-government authorities approved of corresponding action plans. The Oblast municipalities directed some 400 mln rubles for energy efficiency programs in 2002-2005.

In 2002-2005, more than 100 boiler-houses were renovated, including 62 coal-fired, 28 liquid fuel-fired, and 10 gas-fired boiler-houses.

Basic technical energy efficiency measures in 2004-2005 included: replacement of worn out power lines; installation of a heat supply and gas consumption metering system at co-generation plant-2; replacement of old and installation of more power meters (OAO "Jantarenergo"); replacement of heating pipelines with pre-insulated pipes; installation of gas meters; installation of variable speed drives; installation of an automated system for energy management control; etc.

Kaliningrad Oblast budget provided financing for the implementation of Subprogram "Energy Efficiency. Optimization of energy use in Oblast-level public agencies". Oblast-level public agencies have all the necessary energy meters. In 2005, installed heat meters and automated system for heat supply regulation allowed for 7.7 thou. Gcal savings worth 3.9 mln rubles by public agencies.

In 2001-2005, the Oblast municipalities installed 186 thousand energy meters and controls.. In early 2005, 52% of the municipal utility service companies and 40.6% of the residential sector have been equipped with energy meters.

It seems worth while developing and launching implementation of Kaliningrad Oblast energy efficiency Program for 2007-2015. Under this Program it is important to give a push to energy efficiency activities in the industrial, housing and utility, and fuel and energy sectors.

To give an outlook on the potential benefits of a continued energy efficiency programme, the consultant has estimated how much less fuel would be needed, if for example power and heat

distribution losses decreased to 10%, and boiler-house efficiency increased up to 95%. The results showed that consumption of liquid fuel by power plants and boiler-houses could be reduced by 96 ktons, and natural gas consumption would go down by 17 mln m3.

To ensure combined heat and power generation by KTETs-2 in 2004-2005, an agreement was reached to build a heating pipeline from KTETs-2 to the southern part of Kaliningrad city. KTETs-2 is located 15 km to the south-west of Kaliningrad. After the heating pipeline is built in 2007-2009, a number of gas-fired boiler-houses are likely to be closed down saving 70 mln m3 of natural gas per year. In other words, optimization and improved energy efficiency of energy supply alone would save at least 96 ktons of fuel oil and around 90 mln m3 of natural gas. Thus energy efficiency improvement can have a significant impact on the energy supply system reliability in Kaliningrad Oblast.

However, this requires an effective organization of energy efficiency policies and programmes, which is currently lacking.

The Oblast Government has made an attempt to divest heat- and water supply systems to the private sector. However, lack of long-term tariff agreements keeps the private sector from investing in energy cost reduction in the housing and utility sector. Without such agreements or guarantees the private sector is not willing to move to the housing and utility sector in Kaliningrad Oblast. Public funding for housing and utility sector renovation is allocated, but not for guaranteed efficiency improvements or improved operation reliability. Approximately 10-15 regulated energy utilities need approval of the investment component in the tariffs. Public utility commission controls loss reduction through the implementation of projects to incorporate the investment component. For example, in 2006, “Yantarenergo” was forced to somewhat reduce loss projection in their tariff substantiation materials.

8 Institutional issues for developing energy policies

8.1 Major institutional holders of energy information

Development of energy balances requires a considerable amount of data on separate energy resources production, supply and consumption, including descriptions of their transformation processes. Major sources of these data include:

- ⇒ Federal statistics authorities. Previously, power balances and fuel consumption data belonged to "closed" sources of information. In recent years, these data are publicly available;
- ⇒ Regional structures of sectoral energy holdings (RAO "EES Rossii", RAO "Gasprom", etc.). Power sector reform and anti-monopoly measures have made information that is available to these holdings more fragmentary. The number of power sales companies in one oblast may be large, so obtaining data from them is a time consuming and costly effort;
- ⇒ Departments of the Oblast Government (fuel and energy; municipal utility sector, Tariff Service, etc.). This information is often a compilation of data from various sources; it is not complete and poorly structured. However, in some Russian regions (for example, in KhMAO – Yugra) there is a monitoring of heat supply companies, and these data provide a more reliable picture;
- ⇒ Consulting companies, including energy efficiency centers and agencies. These sources have data on energy losses; energy efficiency potential based on implemented energy audits. They provide more reliable information on actual energy consumption by some organizations and on energy losses, than other sources.

The result of the evolution of the information base for energy balance development is a shift from using primarily sectoral statistics to a larger use of federal statistics. However, this certainly does not mean, that a single source of information may be ignored while collecting data.

8.2 Information support to energy policy implementation

The quality of federal energy statistics is not yet optimal. There is sometimes an internal inconsistency, as well as a lack of special knowledge by statistical personnel and this requires additional institutional and other data sources. In order to obtain a comprehensive picture of energy supply in Kaliningrad Oblast it is necessary to systematize data collection from all information holders. However, currently data collection from all sources, except statistical authorities, has been extremely complicated over the recent years. Access to information is often denied on the grounds of commercial classified data, lack of personnel, or other excuses. In some instances, letters of inquiry from the above authorities are needed to provide the required data. However, the effectiveness of such data collection method is limited, and only part of required information is provided for through such letters. There is no monitoring of the utility systems state-of-the-art, or understanding of the need for such monitoring.

Lack of coordination between Oblast-level agencies should also be noted. The Housing & Utility Sector Ministry takes usually no part in fuel tenders, or in the discussions of utility investment programs. Price and tariffs regulation service of Kaliningrad Oblast does not analyze the impacts of pricing policies on energy consumers, or assess demand elasticity parameters.

It is very important to provide informational support to the development and implementation of documents such as the "Strategy of Kaliningrad Oblast Development Until 2030". However, it is

necessary having broad and open discussion on economic and energy development plans in order to facilitate the improvement of the informational base for the decision-making process.

Communication with the local experts also revealed the lack of sufficient institutional resources and qualified personnel capable of energy use data collection and analysis. The data used by the Oblast government are often not complete or reliable (see also section 2). The Oblast government mainly focuses on the collection and procession of current information. This puts a barrier to both the development of effective energy policies and monitoring of their implementation.

Annex I to this report contains more detailed information on the institutional background of the Kaliningrad Oblast and its energy policies.

9 Conclusions and Recommendations

A. Conclusions

- It is possible to develop an integrated fuel and energy balance for the Kaliningrad region. However, all available sources of information need to be collected, verified for consistency and analysed, including some expert's assessments in order to achieve a comprehensive and consistent vision of the past and present energy situation. The energy data reliability could be greatly improved if relevant energy data were reported and collected in a structural way.

- The existing energy data are mostly in the format of sectoral reports and fragmented formats of regional statistics and are not integrated and compatible.

- Having a comprehensive and reliable fuel and energy balance allows making an analysis of major energy proportions and trends along with an assessment of the efficiency of energy supply and consumption limitations and problems. This forms a good basis for developing regional energy projections as well as for developing regional energy and energy efficiency policies to mitigate potential energy supply shortages in future.

- Energy forecasting methods, including scenario development needs to be made more consistent and realistic.

B. Recommendations

1. It is recommended to strengthen the oblast organization, perhaps formalized by governor's decree or resolution, by:
   - Establishing an energy planning group in the organization with the responsibility of developing and maintaining a comprehensive energy data base and other relevant data in order to produce annually updated energy balances as a basis for annual regional energy situation analysis and reporting.
   - Establishing new formats for processing energy statistics data to form a region wide integrated energy balance.
   - Establishing structural procedures for collection additional or missing information for energy balance development.

2. Develop a modern methodological basis for comprehensive projections of the regional energy future and energy sector development scenarios including:
   - Integrating macroeconomic projections with the development of integrated energy balances and all energy supply systems and demand sectors in order to identify the most effective and least cost solutions for safeguarding the reliable energy basis for future economic development.
   - Training staff in the use of computerized models for supply and demand forecasting.

3. Assign clear responsibilities within the organization for energy and energy efficiency policy.
   - Consider energy efficiency improvements as an important least cost resource in meeting expected additional energy demand;
   - Develop a comprehensive oblast energy efficiency improvement program, which may include subprograms for power sector; housing and communal sector; industrial sector; transportation, public buildings sector etc;

- Allocate sufficient administrative and financial resources for program implementation;

4. Establish a practice of demand-side management for electricity, heat and gas supply;

5. Establish minimal energy efficiency performance requirements for energy facilities (energy sources and networks) operating at regulated tariffs, which progress over time.

ANNEXES

Annex I Institutional aspects of energy sector development and energy saving in Kaliningrad oblast

Table of Content

1. Structure of energy sector in Kaliningrad oblast

Kaliningrad oblast experiences an energy shortage. It's dependant on supply of fuel and energy resources from the main territory of the Russian Federation (up to 95 % of electric energy, 100 % of natural gas, coal and mineral oil). Since 2001 the region has been demonstrating a stable trend for annual growth of consumption of the main fuel and energy resources, which is related to the economic development as a whole. Consumption of electric energy during 2001-2004 has 20% increased and by 2004 made up 3.6 bil. kWh, natural gas consumption has 36.6 % increased up to 636.4 mil. m³, heat energy - by 7 % up to 5100 th. Gcal.

Supply of energy to the consumers is carried out by Yantarenergo OJSC (a filial of RAO UES of Russia). The joint-stock company includes HPP-1 (Kaliningrad), GRES-2 (Svetly), HPP-5 (Gousev) with a total installed electric capacity of 132 MW.

In Kaliningrad oblast a large company LUKOIL-Kaliningradmorneft LLC annually produces about 700-750 th. t of oil, which is exported from the region in raw. There are several small hydro electric power plants with a total installed capacity of 1.7 MW. Since 2002 a Russia's first wind power station has been operating with 5.1 MW installed capacity.

Electric energy is supplied to Kaliningrad oblast mainly through a transit on Lithuania.

The gasification is on the way in the oblast. During recent years 150 km of gas distribution networks have been laid, 10.7 th. apartments have been connected to the gas supply system. The main projects of the FTP in the energy sector: construction of Kaliningrad HPP-2 with 900 MW installed electric capacity, 680 Gcal/h heat capacity (the second power unit is to be commissioned in 2010); reconstruction of the existing gas main and construction of the second gas pipeline in Kaliningrad oblast increasing natural gas supply up to 2.5 bil. m³ by 2010; construction of underground gas storage with 1 bil. m³ active storage (deadline - 2010). The oblast is also supplied with a liquefied gas, 21.5 th.t were delivered in 2004.

2. Management and coordination setup

Presently there are no public and administrative structures dealing with energy efficiency issues in the region. Before public authorities' reorganization, organization and coordination of energy efficiency and energy saving activities were under responsibility of the Territorial Department of Gosenergonadzor.

In 1999 an energy saving division was formed within Energonadzor. After adoption of the Law "On Energy Saving", a relevant regional law with a content similar to the federal one was passed. Almost at the same time energy saving divisions were established within the Administration of Kaliningrad oblast and REC. In 2005, after the restructuring, all these divisions

were abolished. As for the Government of KO, power and energy supply issues are under responsibility of the Ministry of Infrastructure Development being a part of FEC Department.

A public tariff regulation body is the Service of Public Regulation of Tariffs and Prices of Kaliningrad Oblast (former Regional Energy Commission). The Regional Energy Commission included an energy saving division, which was abolished at reorganization. The service is under continuous reforming in terms of functions and amount of staff. The staff has been 50% reduced, an energy saving responsibility has been eliminated together with the division.

In the frameworks of a joint international project with Denmark a Regional Energy Saving Center (RESC) has been set up as a nonprofit partnership. The founders are KO Administration and territorial department of Gosenergonadzor. The key activities of the center include:

- Concentration of organizational efforts and other resources for energy saving measures implementation
- Awareness on energy efficiency and energy saving, dissemination of the advanced experience
- Training of energomanagers
- Exhibitions, seminars etc.
- Energy audit of enterprises and organizations
- Consulting services on energy saving

RESC is fully financed via commercial service contracts concluded with enterprises and organizations, municipalities, as well as in the frameworks of international cooperation. RESC failed to transform into a regional administrative body on energy efficiency. The Energy Center elaborated and proposed a set-up of sustainable system of energy efficient development of KO, which can be illustrated with the following diagram.

In present, an association of heating companies is close to complete its legal registration (Kaliningrad Regional Network of Heating Utilities).

In the frameworks of one of the international cooperation projects, a regional network of energomanagers was created in KO. This networks envisioned availability of points of the network (energomanagers) in each municipality. Their tasks included coordination of energy efficiency activities in particular areas. However this network has factually faded away with completion of the project.

There are some other organizations acting in the region, destined to tackle with energy efficiency and energy saving issues. However their influence and activity are insignificant. They include:

- Kaliningrad Energy Saving Association – established under Yantarenergo and including several enterprises.
- Kaliningradregionenergo FSD (Kaliningrad filial of the Department of Energy Efficiency and Energy Saving in Moscow Region) – established under the RF Minpromenergo (the Ministry of Industry and Energy) and the Interregional Association on Energy Efficiency and Regulation. It is dealing with review of norms of specific fuel consumption, fuel stock, technological losses of heat and electric energy, regulated by the relevant orders of the RF Minpromenergo.

For the purpose of addressing the electric energy problems existing in the region, a Regional Energy Company Oblast State Unitary Enterprise has been set up. The main task of the Company is attraction of investments to finance construction of electric energy facilities facilitating a rapid growth of industrial and housing sectors.

There is an opinion in the KO Administration, that the Regional Energy Company should formally receive a part of public shares of Yantarenergo OJSC, which would be further operated

by Yantarenergo OJSC based on the lease agreements envisioning a respective rental payment.

3. Role of energy sector in the development of an Exclusive Economic Zone of Kaliningrad oblast

Kaliningrad oblast, which is detached from Russia, surrounded by foreign states, but having a beneficial geopolitical location may become an important junction of European land, marine and air transport corridors. A semi-enclave may be a promising exporter of relatively cheaper Russian electric energy.

All these benefits are to materialize through the Federal Law (new edition) "On an Exclusive Economic Zone in Kaliningrad oblast" which shall be valid for 20 years. What does the law give? It imbues a new meaning to the idea of Exclusive Economic Zone (EEZ), accounts for the changed conditions, creates economic prerequisites for the oblast development. It envisages a 10-year transition period in order enterprises and institutions, working in pursuance to the former Law on EEZ valid since 1996, could smoothly adapt to the new rules.

The second Law on Kaliningrad Exclusive Economic Zone promises serious preferences for the investors who decided to work in the region. For the business project to be considered as the investment one a number of parameters should be met. In particular, the scope of investments in the oblast should not be below 150 mil. RUR, the activity should be carried out in the territory of the oblast. In this case the investor shall not pay a profit tax during six years, and shall pay 50% of it during the following 6 years. Moreover, in the first 6 years the enterprise shall not pay a tax on assets used in the frameworks of the investment project. These initiatives promise a considerable improvement of the investment climate.

A sticking point in implementation of such big plans in the oblast is energy sector. In order to satisfy the energy demand of the oblast, taking into account the expected industrial growth, heat and electric energy supply should be higher many times. In November 2005 a first unit of

Kaliningrad HPP-2 was commissioned, providing 60% of electric energy demand in the oblast. After commissioning of the 2nd unit in 2010 – the regional demand will be covered 90%. Kaliningrad HPP-2 is a core infrastructure facility; according to Governor Boos is one "of absolutely necessary conditions for attraction of large investments in the frameworks of the Law on Exclusive Energy Zone of the Region". Application of modern technologies at HPP-2 will allow to develop large industrial facilities, to improve well-being of population and the services quality through solving the electricity supply problem in the outlook.

HPP-2 and future investments projects require sustainable supply of energy resources, therefore *gas supply in the oblast is a milestone of the energy safety in the region.*

Representatives of management of gas companies believe that cost of gas for Kaliningrad oblast should be at least a quarter higher, as it's not profitable to supply gas to this region. By the end of July 2006 this price was 1,304 RUR per 1 th. m³ for enterprises and 920 RUR for households. In 2005 the Russian gas holding agreed to increase gas supplies to Kaliningrad up to 1.5 bil. m³ per year since 2006. This became possible due to new compressor plants installed in 2005-2006, which allow to increase transport through the existing gas pipeline through Belarus and Lithuania. Moreover, in 2005 gas branches were constructed to oblast from Lithuanian territory. The mentioned activities resulted in increase of a prime cost of gas supply for the oblast. Nevertheless, gas demand in Kaliningrad oblast is at least one third higher than actual average annual consumption.

4. Foundations for energy safety in Kaliningrad oblast

All energy in the Russian enclave is supplied via transfer of electric energy from the Unified Energy System of Russia through Belarus and Baltic countries, as well as purchases in Lithuania. Enlargement of the EU and decommissioning of generation capacities of Ignaline NPP in Lithuania complicate a reliable energy supply to Kaliningrad oblast, which affects regional economic development.

The gas is delivered to Kaliningrad oblast through "Minsk - Vilnius - Kaunas - Kaliningrad" gas main. Such geography of the route creates difficulties for Russia: a haggle on a transit tariff and gas volumes, which could be supplied by Gazprom to these regions, is an instrument of pressure on Russia when dealing with diplomatic and political issues. In case Belarus blocks gas supply to Kaliningrad oblast, the energy safety of the region may be endangered. Such dependence urges for seeking the alternative energy sources (black oil, coal, supply of electricity or fuel from Poland or private suppliers in Lithuania, development of local oil-refining etc.) keeping an extreme importance of natural gas supply.

According to the Federal Target Program on Kaliningrad oblast development, gas-main "Minsk - Vilnius - Kaunas - Kaliningrad" was extended in 2006 from 640 to 1050 mil. m³ a year. Now oblast government requests Gazprom on increase of gas supply up to 1200 - 1400 mil. m³ a year (i.e. almost twice more than present level). The additional investments for increased supply up to 1.2 bil. m³ a year are to be about $30 mil, as estimated by Gazprom. One should keep in mind, that here we talk about the gas-main crossing the territory of foreign countries. This is only the one component of the problem.

According to Gazprom, annual losses of the company related to gas supply to Kaliningrad oblast in 2005 amounted to almost $4 mil. per year. The losses increased up to $8.4 mil. after the pipeline was extended to 1050 mil. m³. Gas prices for Kaliningrad oblast corresponds to the 10th belt of Russia – i.e. a level of Rostov oblast, whereas transit costs and gas transport system expansion aren't taken into account. Gazprom together with Governor of Kaliningrad oblast applied to the RF Government with a proposal to make Kaliningrad oblast as a separate price zone, which will allow to include Gazprom's costs. It's the opinion of the company's management, that a cheap Russian gas will be used in Kaliningrad oblast not only for households' supply, but for production of export-oriented goods, as the export of cellulose, electric energy and some other goods is expected to grow. In EEZ conditions the investors to be coming soon to the region will have substantial preferences in terms of taxes and possibility to raise competitive capacity of their goods at the expense of cheap gas.

However energy safety issues are beyond a concept of one source. Importance of hydrocarbon material provision is dependant on volume of heat produced by all boiler houses of the region, which is equal to 4 mil. 380 th. Gcal and is 50% covered by natural gas; 26,5% - be black oil; 20% - by coal; 2% - by diesel fuel, 1.5% - by other fuels including biofuel.

Shortage of energy resources in the region is a complex problem, which depends on capacity of transport facilities crossing the territories of transit countries and on possibility to supply fuel and energy resources using these facilities. Increase of gas supply to the oblast will not solve the problem. 50% of the present fuel balance of Kaliningrad oblast is occupied by natural gas (in 2004 this share was 41%), and in 2007 the share may increase to 65%. World experience shows that energy safety doesn't accept prevailing of one fuel. This is very grave issue for an exclave region, as gas is transported via an only transit gas-main "Minsk - Vilnius - Kaunas - Kaliningrad", which capacity has been increased. It is extremely dangerous for the region in case of accident or other difficulties in the region, as gas constitutes 50 % of fuel used.

The existing situation with gas provision, the outlook for construction of a Baltic pipeline, inevitable rise of gas prices necessitate seeking alternative options allowing to supply energy to small and medium-size settlements (consumers) guided by a variety of generating sources and "big-small" relation. First of all the focus should be put on nontraditional and renewable energy sources, including biofuel, more efficient coal use, wind, sun, geothermal energy, small hydroelectric plants (HP) and not in the least the energy saving.

Kaliningrad oblast and Kaliningrad City have 1010 boiler houses based on black coal. These boilers mainly provide heat and hot water to the population. The most of boilers (974) can be regarded as small and medium-size ones – with a capacity up to 10 Gcal/h. As a rule these boiler houses are equipped with water boilers with grate-fired furnaces with manual loading. The average efficiency is 18–30 %. It's necessary to modernize the existing boilers and to construct new coal boilers with the efficiency not less than 80 %.

In 2002 a Russia's first 5.1 MW wind farm was commission in Kaliningrad oblast (21 units in total). But it's important to mention how the windmills are concentrated – they are all placed in one location, which contradicts with a principle of dispersion, on which a prewar energy was based in the region. At that time there were more than 30 mini-HP at the territory of the present-day Kaliningrad oblast. Now the greatest share of them is out of operation and abandoned. A hydroelectric potential of the oblast is assessed as 25 MW. It needs to be used.

Some experts propose the following option of energy consumption zones creation based on the existing regional electric energy sources. The first zone – around Kaliningrad TPP-2; the second zone – around Svetly GRES-2; the third zone – Gousev TPP (thermal power plant), Sovetsky TPP-7, Pravdinsky hydrocascade; the fourth zone – construction of 5-6 more modular HPP 10 th. kW each (similar to those widely used in Europe) with loads in their centers; the fifth zone and the further zones – all mini and micro electric power plants with a capacity from 0.5 to 5000 kW. Svetly, Gousev and Sovetsky electric power plants require modernization, and Pravdinsky hydrocascade needs reconstruction. The existing electric power plants of the region shall be modernized and oriented on application of a lest-cost fuel. This option is to promote a sustainability of the regional energy system.

The projects devoted to development of wind energy, hydro energy and other alternatives in the region must have institutional and legal support, which matches with an optimal development option and. It is also environmentally beneficial and can ensure the energy safety of Kaliningrad oblast.

Strengthening of energy safety necessitates elaboration of a regional energy sector development strategy. The current situation in Kaliningrad oblast is endangered due to reliance on gas as dominating fuel. There are no worthy projects on construction of considerable generation sources based on alternative fuels. The energy safety in the region may be strengthened by construction of an underground gas storage, which cannot fully guarantee elimination of various accidents and emergencies, but will solve not the least important problem

— it'll diminish an irregularity of gas consumption. Gazprom has the project on construction of an underground gas storage in Kaliningrad oblast, but it is still waiting for implementation.

The project itself and location of future gas storage cannot be changed, as all preparatory work has been done, and all necessary approvals have been obtained, including environmental impact assessment. All these activities require much money and time. It's planned to place 14 reservoirs по 66 mil. conditional m³ each in rock salts. The total storage volume is 1.2 bil. m³. The first complex is to contain 80 mil. m³. After it's commissioning the capacity of the storage shall be gradually growing to the design parameters. The estimated project cost in prices of 2001 was 3.1 bil. RUR.

5. Importance of TPP-2 for reliable energy supply in Kaliningrad oblast

95% of electric energy is delivered to the oblast from Russia through Belarus and Baltic countries. Until recently the shortage of energy has been compensated by purchase of energy from Lithuania. The situation has aggravated due to decommissioning of Ignaline NPP in Lithuania. Reliability of energy supply in Kaliningrad region under present conditions is fully dependant on technical condition and operating modes of energy sources and electric grids of the neighboring countries, their observance of energy transit obligations. According to the oblast economy development forecasts, by 2010 electricity consumption will have increased to 3.4-3.9 bil. kW-h at max load of 610-670 MW, which will predetermine, based on energy safety considerations, a need for local powerful energy source.

Kaliningrad TPP-2 is an important strategic site, a main generating facility in the region ensuring the energy independence and safety of the established Exclusive Economic Zone. In 1994 it was decided to increase capacity of TPP-2 up to 900 MW using a gas-steam unit. According to the Federal Target Program of Kaliningrad Oblast Development until 2010, in 2002 the construction works recommenced, and on October 28, 2005 a first power unit was put into pilot industrial operation. Construction of TPP-2 is financed through the investment program, of RAO UES of Russia. In 2005 5.26 bil. RUR was assigned (including 3 bil. RUR of target investments of RAO UES of Russia and 2.26 bil. RUR of attracted credits). Besides, 150 mil. RUR was earmarked from the federal budget in 2005.

Kaliningrad TPP-2 was designed based on a modern steam-gas technology, it consists of two power units GSU-450.

- A total electric power - 900 MW, heat power – 680 Gcal/h.
- Main and reserve fuel - natural gas, annual consumption 1200 mil. m³
- Average annual fuel utilization factor - 76%
- Efficiency in condensation mode - 51%
- Internal consumption of electric energy - 2,22 %
- Average annual specific fuel utilization for the heat energy supplied – 155.0 kg/Gcal
- Payback period since beginning of operation - 4.5 .

A gas-steam cycle technology allows to save up to 20-25% of fuel and to reduce atmospheric emissions by one third. Presently such technology in Russia is applied at Severo-Zapadnaya TPP, Sochinskaya TPP, Tyumenskaya TPP. The first power unit of Kaliningrad TPP-2 is capable to provide 340 Gcal/h heat power, but in case heating mains from TPP-2 to Kaliningrad are constructed. It should be mentioned that at transition to heat-extraction mode, fuel utilization efficiency at Kaliningrad TPP will rise from 51% to 76%. This will be followed by increase of economic efficiency of the plant.

After commissioning of the first unit, the TPP-2 will be capable to cover own energy demand, however not in full so far. According to Anatoly Chubais, 900 MW is enough to cover Kaliningrad demand in electric energy. It must be said that in 2004 shortage of electric energy in Kaliningrad oblast amounted to 611.7 MW. Commissioning of a 450 MW unit the electric energy shortage has 70% reduced and has become about 1100 mil. kWh. RAO UES of Russia believes that electricity needs in the region can be fully satisfied only through construction of the second power unit increasing the design capacity of TPP-2 to 900 MW. After the second unit is put into operation, a total production of electric energy in the oblast would reach 4.1 bil. KWh a year,

thus triggering the development of large industries with many workplaces and creation of investment attractive environment in the region.

Losses of Yantarenergo OJSC are presently about 20 %, whereas total losses of electric energy in 1996 amounted to 9.7%. Given a forecasted consumption of electric energy in the region for 2010 as 5500 mil. kWh, and 10 bil kWh for 2015, it is necessary to reduce the losses considerably. Construction of TPP-2 will lead to their increase, keeping in mind internal needs and losses during transmission.

Commissioning of the first unit of TPP-2 and the expected commissioning of a 450 MW second unit in 2010 give rise to some questions. First of all, in some cases annual production of electric energy at TPP-2 may exceed demand in the region; a possibility to export the electric energy to Baltic states and Europe was considered during design phase. One shouldn't forget that electric energy of RAO UES of Russia competes with Russian gas in the foreign market – by this particular reason Gazprom lost Finnish market. In this regard, what is the expected relation of tariffs for electric energy produced at TPP-2 and the electric energy transited from North-West ring of the energy system of RAO UES of Russia. Is there reliable information on electric energy demand in surrounding counties in present and in foreseeable future (here we talk about "excess" 300–400 MW, which may be delivered to the mentioned regions)? What tariff policy will be applied in these countries, and will they be interested in purchase of electric energy from Kaliningrad oblast? All these questions can be answered only after compilation of a detailed fuel and energy balance of the region.

How the export of TPP-2 electric energy can be organized (technically and logistically) in context of a forthcoming separation of Baltic states from the energy system of RAO UES of Russia and transition to the European standards of generation and transport of electric energy (Lithuania is modernizing electric energy sector)? Are necessary capital investments envisioned to modernize Kaliningrad energy system to meet the EU standards?

There is one more problem which is worth mentioning – a sharp increase of cost of laying of service lines in old cities. This problem is to be related with a need to supply heat energy from TPP-2. It is necessary to finance construction of heat supply mains and modernization of heat facilities in the age-old city (a lengths of the heat main to transfer 680 Gcal/h is 30 km). How sustainable the heat supply of Kaliningrad will be with only one source with limited reliability infrastructure?

In present RAO UES is developing a scheme of project funding of construction of the second unit of Kaliningrad TPP-2. After the financing scheme is approved, a tender will be announced on subcontract for construction of the second unit. Besides the project on financing of construction of the heating mains from Kaliningrad TPP-2 to Kaliningrad city is under elaboration. RAO UES hasn't requested the necessary amount of funds from Veneshtorgbank (VTB) yet, but the bank's commitment to assign necessary sun has been preliminary agreed.

6. Prospects for gas supply to TPP-2

Construction of Kaliningrad plant and its successful functioning are strongly dependant on whether gas supply is secured. Besides gas demand in the region (800 mil. m³ gas a year), there is a demand for gas to ensure valid operation of Kaliningrad TPP-2. Gas consumption volume at full operation capacity will be equal to 600 mil. m³.

Gazprom fears that additional supplies to the region could curtail its export contracts. It is more beneficial for foreign partners to purchase electric energy produced in Russia on cheap fuel, than expensive feedstock from Gazprom. This situation can be considerably worsened by plans of Gazprom to increase gas prices to the European level during two years. Moreover Gazprom isn't eager to create new gas transit capacities in Lithuania and Belarus, whereas the existing capacities operate at the breaking point after increasing of supply volumes. According to Gazprom Board Chairman Alexey Miller, commissioning of Severo-Zapadnaya HPP, which exports all the energy it produces, caused interruption of gas supply to Finland. The company apprehends the similar situation with Baltic states. Loss of profit from gas supplies at Severo-Zapadnaya TPP on regulated prices is estimated by Gazprom as 1.8 bil. RUR annually.

Power specialists reply that Kaliningrad oblast is capable to consume all energy which HPP will; produce. Therefore Gazprom's fear has no grounds. Besides Russia doesn't have coincident contacts with Poland and Eastern Europe in general, and thus doesn't export electric energy to these countries. To make it more precise, there are some insular supplies to the border areas of Poland. They are limited in volume and not supposed to increase. RAO UES of Russia states that the second power unit is being constructed inter alias because of Lithuania declared on decommissioning of Ignaline NPP, energy of which is mostly consumed in Kaliningrad oblast. Once the Ignaline plant is closed, even the second power unit of Kaliningrad TPP, according to power specialists estimates, will not be capable energy shortage. Therefore, no export of electric energy is envisioned.

Kaliningrad oblast and Russia as a whole are technologically isolated from the EU energy system. A strategy of RAO UES is to implement the project on synchronization of the energy system of Russia together with Ukraine, Moldova, Baltic States and Kaliningrad oblast with European energy system. Synchronization is a unique political and business project. Some practical steps have been made up to date. There is an agreement with some NIS countries and the EU on preparation of the agreement on the project feasibility study. This work will be financed by parties fifty-fifty. The preliminary deadline of FS elaboration is 2007-2008.

Before 2005 gas supplies in Kaliningrad oblast were equal to 650 mil. m³ a year, which were transited through Belarus and Lithuania. At gas transit to Kaliningrad Gazprom incurs losses of $6 from each thousand cubic meters. According to Gazprom Head, this circumstance is lightly reflected on pricing of gas going to Kaliningrad. In general negotiations with Gazprom cannot be considered successful. Until recently RAO hasn't been able to agree gas price for TPP with Gazprom.

Nevertheless, Gazprom is ready to make advance for Kaliningrad oblast and to increase gas supply volume. Gazprom agreed to increase gas supply in 2006 up to 1.27 bil. m³. In fact in 2006 the oblast received 1.05 bil. m³, although the request of the oblast administration read 1.4 bil. m³, beginning from 2006. Given a rapid economic growth of Kaliningrad region, 1.05 bil. m³ gas a year is not enough for the oblast. The current total gas demand is 650 mil. m³ for the oblast plus TPP demand making up 1.25 bil.

Nowadays possibility to provide the plant with gas through construction of gas offtake main from the marine North European corridor is being discussed. But this issue requires further detailed study.

7. Investment policy

The region has wide experience of investments attraction. Improvement of the investment attractiveness is discussed at different levels from time to time. It concerns regional energy sector and energy efficiency initiatives in the frameworks of Working Group "Energy Efficiency in Kaliningrad Region and Financing Possibilities".

There are following most promising directions of creation of mechanisms for the investments attraction for KO in the area of energy efficiency:

1. arrangement of economic actors in the energy sector to be supervised by a federal constituent and guaranteeing payback through tariff mechanisms or economic activity of the company.
2. a tariff guarantee, i.e. inclusion of investment component into the tariffs at the level of regional regulation within the adopted thresholds.
3. utilization of mechanisms envisioned in the Law No.171-з "On State Support of Institutions Providing Capital Investments for KO" (tax remissions, budget guarantees).

Although one of the tariff regulation principles is declared as "…creation of economic incentives on introduction of energy saving technologies in production processes and conditions for investments attraction in fuel and energy complex", it can be very narrowly applied in practice.

It worth mentioning that opportunity to finance energy efficiency measures through tariffs (investment component) is not big in present. It is first of all related to the rather high existing level of tariffs as against other regions of Russia, as well as federal restrictions on tariff growth for particular region.

Activity of public tariffs regulating authorities as stipulated in FL No.10 on coordination of tariff surcharges setting and accumulation of other incomes (connection fees) for the development of housing infrastructure based on municipal development programs of the oblast is now just on the starting point.

It is necessary to point out a mechanism of state guarantees of oblast budget valid since 2001 and stipulated in Resolution No. 213 "On granting the state guarantees to KO". This mechanism in fact guarantees return of the investments without creation of nonbudgetary funds.

Oblast can provide guarantee for the resources attracted within the implemented projects if scope of funding doesn't exceed 0.01% of the oblast budget.

Investment (and any other) projects, financed, at least partially, from the budget, shall be implemented on a competitive basis. The projects should undergo appraisal in the administration. But there is no exact system of investment decisions making. The projects which don't utilize oblast resources and financed by e.g. municipalities or industries don't require any agreement at the oblast level.

The oblast has and experience of concession agreements in the communal housing sector. Recently a tender for preparation of a concession agreement on operating management of Kaliningradteploset MUE has been announced.

8. Tariff policy

Regulation authority

The state tariff regulation authority is the State Service on Regulation of Prices and Tariffs in Kaliningrad oblast (hereinafter referred to as "the Service" or "the SSRPT" SSRPT). The Service was established in pursuance to the Order of the Governor of Kaliningrad oblast of 3 November 2005 No. 82. Resolution of the Government of Kaliningrad oblast of 3 November 2005 No 35 approved the State Service on Regulation of Prices and Tariffs. The Resolution stipulates additional authorities in accordance with the Federal Law of 30.12.2004 No. 210 FL "On basic principles of regulation of tariffs of municipal utilities" in terms of determination of utilities regulation methods, coordination of their production programs, tariffs justification verification etc.

In pursuance of the Federal Law of 28.12.2005 No. 184-FL "On Amendments to the Federal Law "On basic principles of regulation of tariffs of municipal utilities" and some relevant regulations of the Russian Federation" and in compliance with the Order FTS of Russia, the Service shall also establish threshold indexes of tariff change for municipalities in relation to the previous year.

The SSRPT mainly regulates prices and tariffs in production and transmission of electric and heat energy, sale of natural and condensed gas to households, water supply and sewerage, as well as prices and extra charges for some goods and services in nonproduction sector. Moreover, the regulated enterprises are examined on appropriate application of the established prices, tariffs and extra charges.

The tariffs are regulated in compliance with the current legislation, based on the resolutions of the Government of the Russian Federation and the Federal Tariff Service (FTS of Russia), the resolutions of the Government of Kaliningrad oblast, resolutions and instructions of the Governor of Kaliningrad oblast.

In order to control and review the activity of fuel and energy utilities Registers of the regulated entities in Kaliningrad oblast are kept. As per 01.01.2006 249 utilities are enlisted, including:

- electric energy supply - 5;
- heat energy supply - 81;
- electric energy supply - 78;
- heat energy transmission - 3;
- water supply- 42;
- sewerage - 40.

Socially significant tariffs, such as electric energy for consumers in the oblast, including households, have been adopted by the Board with participation of the members of non-governmental Expert Council set up under the Service.

As the Service has been charged with additional functions and its staff has been reduced, there are plans on establishment of the Service's structural unit – a public entity on tariffs review. Kaliningrad Oblast Duma following the request has adopted the Resolution of 22.12.2005 No. 836 "On the establishment of oblast public entity "Center on review of tariffs and prices". A draft statute, set-up, staffing schedule and remuneration schedule have been prepared.

The Service has been charged with control and monitoring of regulated prices and tariffs. In 2005 a control and monitoring division was set up within the Service. This division together with other divisions of the Service permanently controlled proving and tariffs application practices of the utilities.

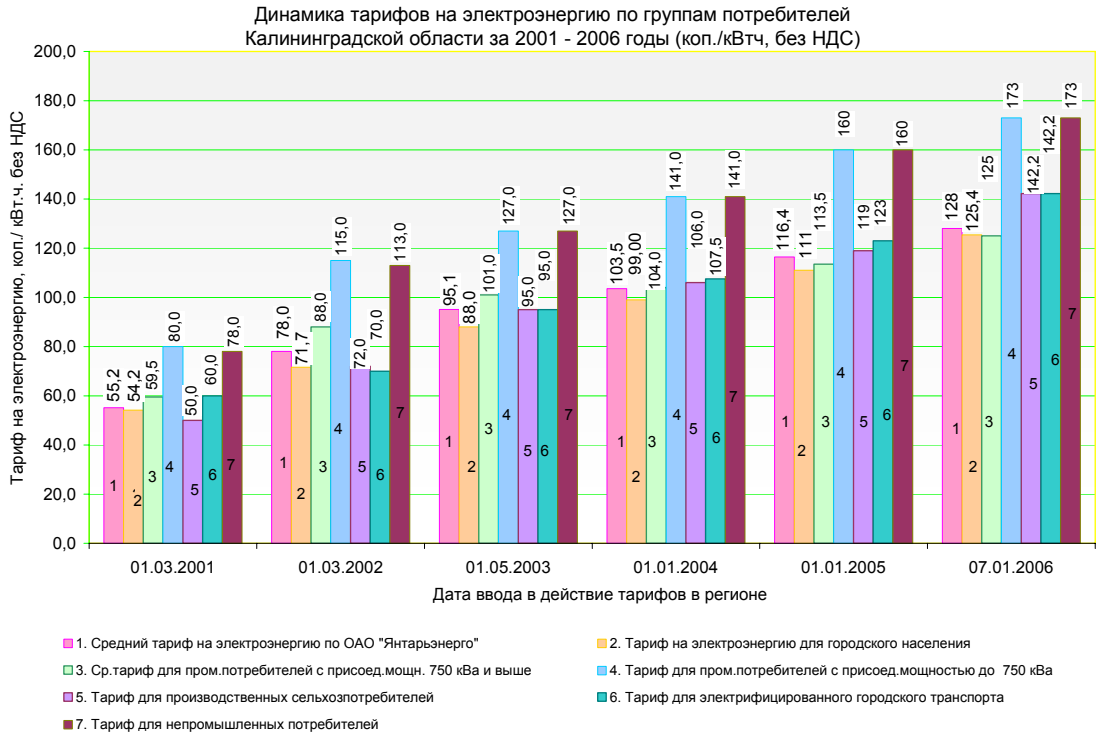
Electric energy tariffs

Electric and heat energy tariffs for consumers of Yantarenergo OJSC in 2006 were approved by the Decision of the Service of 22.12.2005, in 2007 – 28.12.2006. In 2006 the average electric energy tariff was 9.9 % higher than in the previous period and amounted 1.28 RUR/kWh (see Figure 1).

The tariffs has been revised in connection with regular increase of electric energy tariffs at the wholesale market of electric energy of Russia by 10.2 %, continuing structural transformations related to the reforming of RAO UES of Russia. These transformations were followed by growth of total expenditures for payment of services of "system organizations", which were formerly a part of RAO UES of Russia, by 34.2%. Besides almost double increase of prices for fuel oil, inflation has also contributed to growth of tariffs for electric and heat energy in 2006.

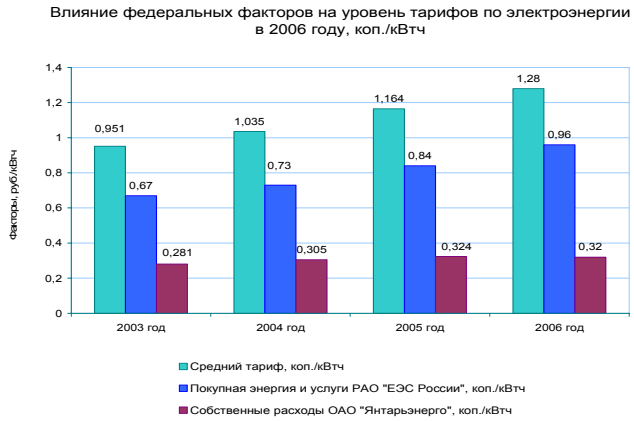
Tariff growth in 2007 as against 2006 was equal for all consumer groups from 5 to 6%.

Figure 1



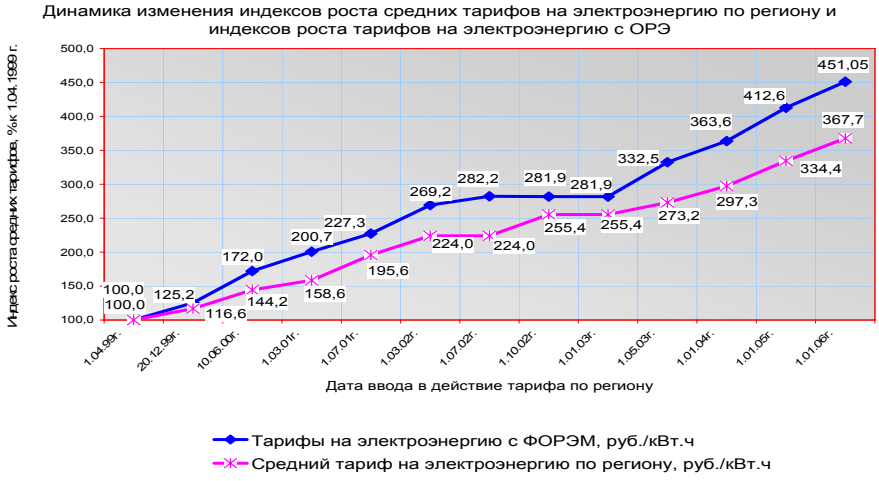
Analysis of impact of federal factors on level of costs of the energy supply utility (Yantarenergo OJSC) and amount of average consumer tariff between 2003-2006 indicates that a share of own operating expenses of Yantarenergo OJSC in total costs on production and transmission of electric energy is being decreased, and costs of energy system for purchase of energy from the Wholesale Electricity Market (WEM) and payment of services of "system companies" of RAO UES of Russia are steadily increasing (see Figures 2 and 3).

Figure 2 and 3



Change in indices of increase of average tariffs for electric energy in the region and indices of increase of tariffs for electric energy purchased at WEM reflects the outrunning growth of Tariffs at WEM (see Figure 4). In 2005 index of increase of the average sale tariff for energy in the region as against 1999 level amounted 334.4 %. The similar indicator of tariff growth at WEM made up 412.6 %.

Figure 4.



Regulation of the electric energy tariffs is within strict limits of threshold tariff levels, which are established in compliance with the applicable legislation, decisions of the Government of the Russian Federation or an authorized executive authority (FTS of Russia).

Now we observe increase of tariffs for electric energy purchased at WEM (10.2%), a sharp increase of service cost of "system companies", which were earlier within a structure of RAO UES of Russia, (34%). Moreover, the region demonstrates a considerable share of electric energy consumption by households – up to 40 %. In such conditions the Service decided to establish an average sale tariff for electric energy for Yantarenergo OJSC in 2006 at the threshold level of 1.28 RUR/kWh. The tariff for urban households is equal to 1.48 RUR/kWh (incl. VAT) with further increase as against previous year by 13.0% (1.56 RUR/kWh for 2007). Own expenditures of Yantarenergo OJSC for 2006 are almost at the level of the previous year.

The investment component of the profit in gross income of Yantarenergo OJSC was equal to 2.6% in 2004 and 2.0% in 2005, in 2006 it was not included.

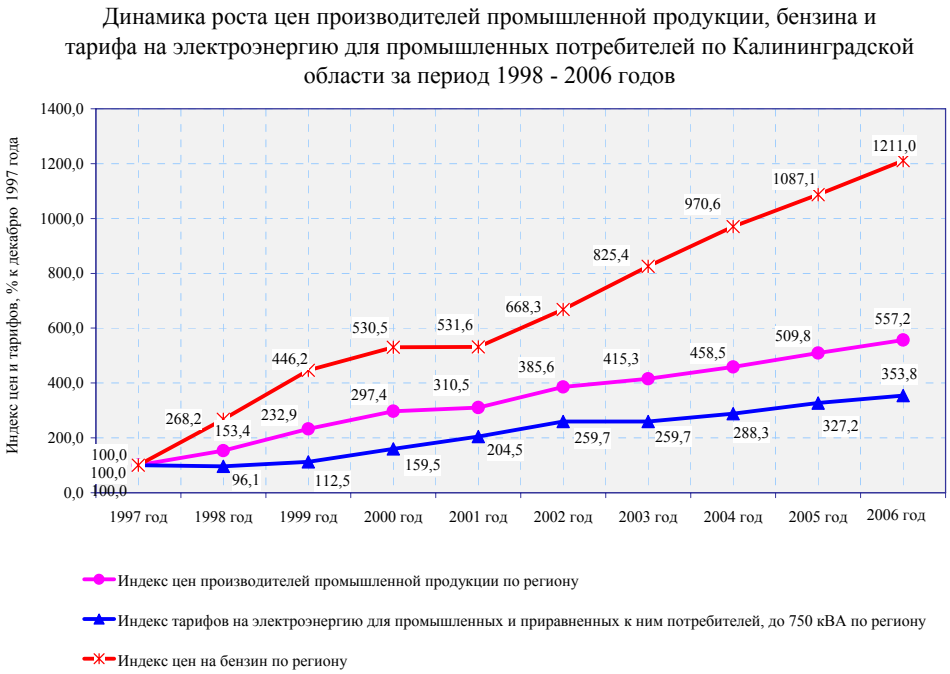
Change of consumer prices rise indices in Kaliningrad oblast and electric energy tariffs for households as against 2002 shows that increase of the electric energy tariffs for households (139.6) in 2006 was much lower the consumer prices rise index (155.8) (see Figure 5).

Figure 5.

Rise of prices of industrial produces manufacturers as against 1997 is 557.2, which is rapider than increase of electric energy tariffs for industrial consumers in the region (353,8 as against 1997). (see Figure 6).

In order to suppress the increase of electric energy tariffs for households in 2005-2006, a cross subsidizing of population was still applied. An economically justified tariff for electric energy for households in 2005 amounted to 1.46 RUR/kWh incl. VAT, the approved tariff – 1.31 RUR/kWh incl. VAT. In 2006: economically justified tariff – 1.62 RUR/kWh, approved tariff – 1.48 RUR/kWh. Cross subsidizing amount falling on industrial and trade sectors in Kaliningrad oblast in 2006 is equal to 246 mil. RUR.

Figure 6



Heat energy tariffs

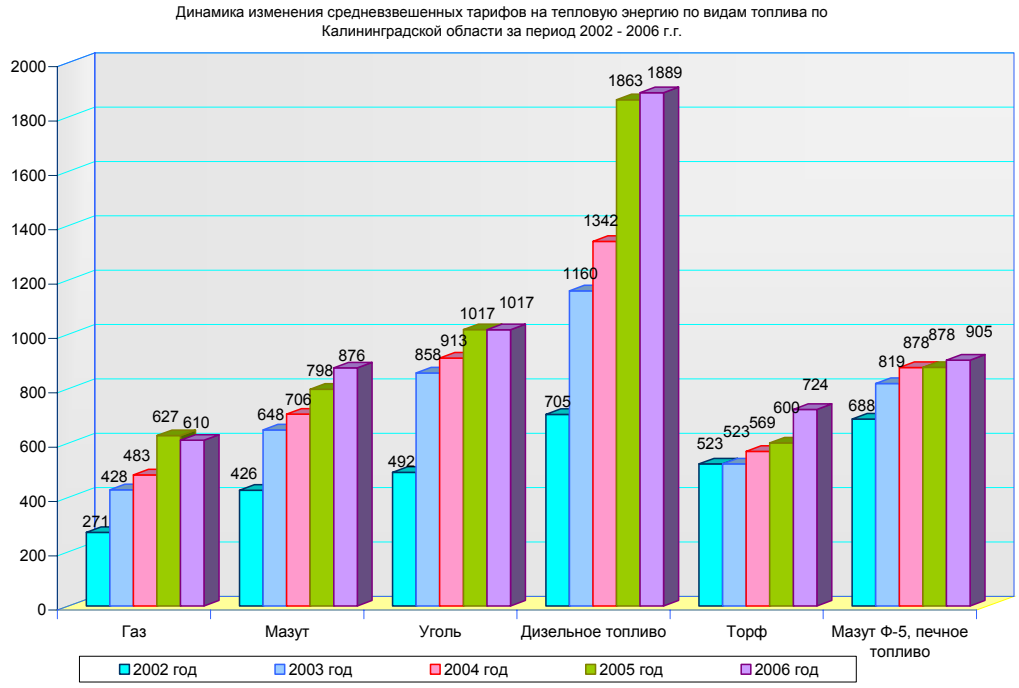
The Service sets economically justified consumer tariffs for heat energy of energy supply utilities in the frameworks of the established threshold levels of the heat energy tariffs in compliance with the instructions of the Federal Tariff Service.

With growth of expenses for fuel, electric energy, salary, other material and services, an average sale heat energy tariff of energy supply utilities of the oblast has 106.82% increased in 2006 as against 2005.

The level of heat energy tariff mainly depends on the type of fuel used, equipment load ratio. In case there are heating networks on the account of an entity, the tariffs level is also influenced by losses during transmission and distribution of heat energy.

Change of average weighted heat energy tariffs during 2002 - 2006 by type of fuel used is shown on Figure 7. The most considerable growth of tariffs is observed when diesel fuel is used for heat energy production. It was 268.7 % as against 2002 level. Growth of tariff for hat produce at gas-fired boilers had been 225 % by 2002, coal-fired – 206.5 %, black oil fired – 205.6%.

Figure 7.



Growth of average weighted heat energy tariffs by types of fuel used in 2006 as against 2005 level is illustrated below:

Type of fuel	Average weighted tariff 2005, RUR/Gcal	Average weighted tariff 2006, RUR/Gcal	Growth, %
Gas	626,96	609,83	97,3
Black oil	797,65	876,04	109,8
Coal	1017,07	1016,91	100,0
Diesel fuel	1863,31	1889,04	101,4
Combined fuel (gas, black oil, coal, diesel)	701,34	785,04	111,9
Other fuels (furnace, F-5, peat etc.)	635,76	745,34	117,2

Minor increase of the average weighted heat energy tariffs took place in relation with boiler houses working on a bunker oil, due to rise in prices. In Nesterov a company (OGUP "UPPT&I") was created, which produces heat energy using peat instead of coal. The prime cost of heat energy decreased.

The average weighted heat energy tariff related to heat sources based on coal hasn't increased. Some companies (Rimko Service+ LLC, Chernyakhovskaya heating station) has reconstructed the old coal-fired boiler houses with complete or partial replacement of the outdated equipment with new equipment with higher efficiency and more energy saving one. A part of the operating diesel-based boilers with high prime cost was mothballed, and their heat load was redistributed among modernized boilers. A set of the mentioned measures was a deterrent at establishment of heat energy tariffs related to the above heat sources. The average weighted tariff from gas heat sources has decreased (97.3 % as against the previous year) due to transfer of Nemansky PPF from fuel oil to natural gas for production of heat to cover heating demand in Neman.

Cross subsidizing in terms of establishment of differentiated (lowered) heat energy tariffs for households still exists for one energy supply utility– "Housing and Communal Services of Znamensk town" MUE of Gvardeysky Rayon Municipality, as the heat energy tariffs for this entity for 2006 haven't been revised since 2004.

Multimillion debts of heat energy and fuel consumers are one of the unsolved problems affecting sustainability of heat supply.

Suppliers of heat energy during the heating season were repeatedly warning the municipalities on heat supply limitation due to non-payment for heat supply services.

A constant growth of current backlog for fuel and heat energy of the municipalities is caused, as it was earlier, insufficient allocation of funds from the municipal budgets to the utilities to cover the difference between economically justified tariffs and the current tariffs for households, as well as low households affordability, lack of payment discipline of consumers and non-observance of the federal standard (100 %) of housing services payments.

Insufficient funding of the municipal utilities is the major reason of increase of the outstanding bills payable. Low incomes of municipal budgets don't allow to cover losses of the municipal utilities in full.

Prices regulation for natural and condensed gas

Public regulation of consumer prices for natural and condensed gas for households concerns two entities:

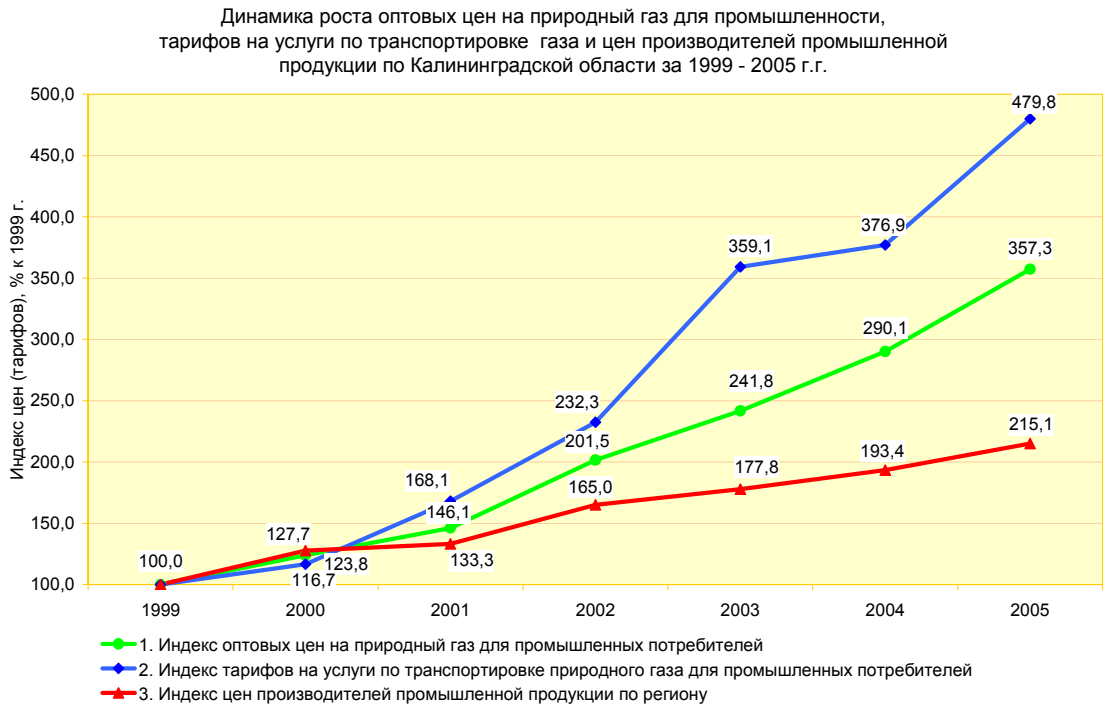
- Federal State Unitary Enterprise "Kaliningradgasificatsiya" dealing with sale of condensed gas to population (in cylinders and from group reservoir units), natural and oil (associated) gas;
- Limited Liability Company LUKOIL-Kaliningradmorneft dealing with sale of condensed gas in cylinders to population.

Increase of consumer prices for natural and liquefied hydrocarbon gas (LHG) in the region is much lower that the increase of wholesale prices being a trigger for consumer prices upsurge. A consumer price of condensed gas depends on whether it is sold in cylinders or from group reservoir units.

At the absence of metering devices, Kaliningradgasificatsiya calculations are based on the established norms of natural and condensed gas consumption by households. These norms are adopted by the relevant decisions of local self-government bodies. Tariffs for gas transportation through distribution pipelines of Kaliningradgasificatsiya are set by the FTS of Russia. No tariff for gas transportation on distribution pipelines in 2005 for the category 'households" was established.

Dynamics of growth of wholesale prices of natural gas for industries, prices of industrial products and tariffs for services of gas transportation to Kaliningrad oblast for 1999 – 2005 is shown on Figure 8.

Figure 8.



The cost of natural gas acquisition for industrial consumers in 2005 made up (with a consumption up to 10 mil. m³ gas per year inclusively) 1378.27 RUR/ th. m³ (excl. VAT) (increase by 24.3 %), incl. wholesale price for gas – 1154 RUR/ th. m³; tariff of gas transportation on the networks of Kaliningradgasificatsiya – 168.09 RUR/ th. m³; payment for supply and sale services of Gaz-Oil Region LLC – 56.18 RUR/ th. m³.

In 2006 the tariff for gas transportation services has 3.6 % increased on average, the payment for supply and sale services has decreased (due to considerable increase of gas supply volume) – by 35.4 %.

Much attention has been paid to setting of a wholesale price for gas for consumers in Kaliningrad oblast. The Federal Target Program of Kaliningrad Oblast Development until 2010 envisions increase of natural gas supply to the region. In order to implement the activities on expansion of gas transport system capacity and to account economically justified costs of Gazprom related to gas production and delivery to the region, Gazprom believes it is necessary in 2006 to rise – up to 60 % – wholesale price for natural gas for consumers in the region. In view of the aforesaid Gazprom applied to the Government of the Russian Federation with a request stipulating the need for detachment of Kaliningrad oblast as a separate price belt.

The issue related to the level of a state regulated wholesale price for gas supplied to Kaliningrad oblast in 2006 was considered by FTS Russia with participation of Gazprom, the Government of Kaliningrad oblast and RF ministries and agencies concerned. Given unfavorable social and economic consequences for consumers in the region, the Oblast Government insisted on the point that increase of wholesale prices (over the parameters approved at the meeting of the Government of the Russian Federation on June 16, 2005) is possible only in case the extra expenses of the oblast consumers are compensated from the federal budget.

As the outcome of the discussion of this problem at FTS Russia, taking into account an exclusive status of the region, it's been decided to separate Kaliningrad oblast as individual price belt 10-a with the following wholesale prices for 2006:

- Industrial consumers - 1304 RUR/ th. m³ (13 % increase, the average increase in other price belts – 10.5%);

- Households - 920 RUR/ th. m³ (11.9% increase at the level of the average increase in other price belts).

When setting consumer prices for natural and condensed gas for households the cross subsidizing was maintained valid in a form of inclusion of a part of the costs of condensed gas supply to population into natural gas price. The aim of such cross subsidizing is a social protection of LCG consumers, constituting over a half of the oblast inhabitants that use gas and have to use more expensive gas supply option. 10 of 22 municipalities in Kaliningrad oblast are more or less provided with natural gas, whereas 95% of natural gas consumers live in the oblast center, i.e. have higher income level.

9. Programs of energy sector development in Kaliningrad oblast

The regional energy sector development is reviewed in a number of analytical papers such as "The outputs of fuel and energy complex functioning in Kaliningrad oblast in 2005", "Problems concerning consumption of fuel and energy resources in Kaliningrad oblast in 2005 – 2006".

The key objectives of the regional energy sector is to ensure a reliable energy supply to the end-users and to facilitate effective social and economic development aimed at attraction of investments for the oblast economy. Development of the electric energy sector of the oblast is seen in conjunction with the development of such sectors in the neighbor countries. RAO UES of Russia was submitted for approval a ToR for "The Program of Energy Sector Development in Kaliningrad Oblast till 2010 with further outlook till 2020" and "The Master Plan of Development of Energy System in Kaliningrad Oblast till 2010 and further outlook till 2020", prepared by the Government of Kaliningrad oblast. These documents are based on "The fuel and energy balance of Kaliningrad oblast till 2020" elaborated in 2005 by Energosetproject Institute (Moscow). The forecasted demand of the oblast in energy resources has been determined based on macroeconomic indicators of the region development in compliance with the Concept of Kaliningrad Oblast Development Strategy.

Below a brief overview of the existing analytical materials and development programs is given.

9.1. The outputs of fuel and energy sector functioning in Kaliningrad oblast in 2005

In 2005 the fuel and energy sector (FES) provided sustainable energy supply and delivery of necessary fuel resources to the oblast; a number of important investment projects in electric energy sector, fuel industry and gasification sector were implemented in Kaliningrad oblast.

Commissioning of the first power unit of Kaliningrad TPP-2 in October 2005 has doubled electric energy production at internal generation sources. Oil production has 45 % increased as a result of development of Kravtsovskoye oil field. Heat energy production has increased by 8.7 %.

Table 1. FES production in natural exponents

Products	Units	2005	% as against 2004
Electric energy	mil. kWh	528	203
Heat energy	Th. Gcal	5650	108,7
Oil	th.t	1188	145
Associated petroleum gas	mil. m³	17,3	103,3

1. *Implementation of projects for fuel and energy complex within the Federal Target Program of Kaliningrad Oblast Development until 2010*

In 2005 implementation of the eight projects in fuel and energy complex, included into the Federal Target Program of Kaliningrad Oblast Development until 2010 (FTP) continued. Totally 6.97 bil. RUR (in 2005 prices) were assigned from:

- The federal budget;
- The oblast budget;
- Own funds of enterprises and other sources.

During 2005 two FTP project were completed. In October 2005 the first power unit of Kaliningrad HPP-2 was commissioned in pilot industrial mode. The Energy Saving Program of Kaliningrad Oblast 2001-2005 was finalized.

Six projects were continued. In December 2005 a first stage of reconstruction of the existing gas main in Kaliningrad oblast was finished and the capacity of the gas main was extended to 1050 mil. m³ gas a year. At the same time, to cover the region's demand in natural gas capacity of the gas main should be 1270 mil. m³ in 2006 and 1400 mil. m³ in 2007.

12 municipalities underwent gasification activities. In the frameworks of the project on transfer of boiler houses to local fuels, a peat-fueled boiler was constructed in 2005.

In 2006 12 FTP projects were continued. The most important are gas complex projects: finalization of reconstruction of the existing gas main in and construction of the underground storage. It is necessary to decide upon implementation of the project related to construction of the second gas main in Kaliningrad oblast.

2. *Electric power industry and heat power industry*

Total consumption of electric energy in Kaliningrad oblast in 2005 was 3584 mil. kWh. Production of electric energy at all generation sources of the oblast in 2005 reached 528 mil. kWh. Electric energy generated at Yantarenergo OJSC made up 78 mil. kWh and decreased against 2004 by 4.3 %. Renewable energy sources (windmills, small HPS) gave 15 mil. kWh of electric energy (in 2004 – 17.3 mil. kWh). Small HPS produced 10 mil. kWh (in 2004 – 11.8 mil. kWh), windmills - 5 mil. kWh of electric energy (in 2004 – 5.5 mil. kWh).

In 2005 the internal generation capacities provided only 14.7% of the total volume of regional consumption of electric energy. Productive supply of electric energy made up 2678 mil. kWh and increased against 2004 by 2.7 %. Share of industrial enterprises in total electricity consumption volume was equal to 31 % in 2005 (in 2004 – 33.7%). The major consumers of electric energy are still the households and non-industrial consumers - 64 % (in 2004 – 61.3 %).

Total consumption of heat energy in 2005 in the oblast was 5650 th. Gcal (108.6 % against 2004). Housing and social facilities received 3253 th. Gcal (57.6 %), industries - 2397 th. Gcal (42.4 %). As preliminary estimated, in 2006 a total volume of heat energy consumption shall increase by 4.4 %. The main consumer of heat energy is Kaliningrad City - 3349 th. Gcal (60.8 % of total consumption in the oblast). 69 %, of this volume was delivered to the district heating system, 2,7 % - for heating of individual houses, 28,3 % - to the industries.

In 2005 Yantarenergo OJSC produced 909 th. Gcal. of heat energy. Breakdown of heat energy production within the company is shown in Table 2.

Table 2. Generation of heat energy by structural units of Yantarenergo OJSC

Heat sources	Installed heat capacity, Gcal/h	Heat energy production in 2004	Heat energy production in 2005, th.
TPP-1 (including Yuzhnaya HP)	404	677	643
GRES-2	188	185,5	170
Gousevskaya HPP	81	106	96

3. Gas supply and gasification

Consumers in Kaliningrad oblast received 719.5 ,mil. m³ natural gas in 2005. 83.9 mil. m³ of natural gas (planned volume is 151.6) was used for start up and adjustment of the first power unit of Kaliningrad HPP-2. 635,6 mil. m³ (planned volume is 650) is supplied to the consumers of the oblast. In 2006 according to the estimates, Gazprom increased volume of natural gas supplies to Kaliningrad oblast to 1270 mil. m³, including 600 mil. m³ for HPP-2, 670 mil. m³ will be supplied to industrial, housing, social enterprises and households.

In 2005 total scope of investments in gas sector was equal to 1174.6 mil. RUR, of which:

- Federal budget funds – 25.4 mil.RUR;
- Oblast budget funds – 6.9 mil. RUR;
- Own funds of enterprises and other sources -1142,3 mil. RUR.

In 2005 consumption of the associated petroleum gas increased considerably: from 9.84 mil. m³ in 2004 to 17.3 mil. m³ in 2005, i.e. by 75.8 %. Condensed gas consumption made up 25 th.t (in 2004 - 22 th.t). The growth is primarily related to the wider use of condensed gas by vehicles.

4. Outputs of the energy saving program implementation

In 2005 a five year Program on Energy Saving in Kaliningrad oblast 2001-2005 adopted in pursuance to the relevant law of Kaliningrad oblast was completed. Within this period 943.7 mil. RUR were allocated for the energy saving activities. The funding sources were oblast budget (17.3 mil. RUR), own funds of enterprises (336.1 mil. RUR) and other (local budgets, consumers' funds – 590.3 mil. RUR).

Table 3. Energy saving measures financing, by years

Funding sources	**Years**				
	2001	**2002**	**2003**	**2004**	**2005**
Oblast budget	-	2,2	1,9	4,33	8,9
Funds of the enterprises	-	92,7	120	45,4	78
Other sources	138	44	66,3	152	190
TOTAL:	138	138,9	188,2	201,73	276,9

5. Key energy efficiency and energy saving interventions

The oblast is working on involvement of renewable and local sources into the fuel and energy balance. In 2002 a 5.1 MW wind farm was commissioned in Koulikovo town Zelenogradsky district for the first time ever in Russia. Presently upon the request of Yantarenergo OJSC a Feasibility Study for a 50 MW marine based wind farm.

A number of small HPS have been reconstructed and newly built. Taking into account local hydrogeological conditions their total installed capacity is planned to be expended to 10 MW.

During 2002-2005 more than 100 boiler houses were constructed, reconstructed and modernized, of which 62 are coal-fired, 28 are based on liquid fuel and 10 are gas-fired. The total amount of the investments is about 600 mil. RUR. Three boilers utilizing local peat fuel have been built.

The oblast budget financed implementation of a subprogram “Energy saving. Optimization of energy resources consumption in budget0financed institutions”, in the frameworks of which metering and regulation devices have been installed in the budget-financed institutions.

In 2005 the program implementation was finished. In this regard, it would be reasonable to continue the interventions and to elaborate an Energy Saving Program of Kaliningrad oblast for the forthcoming period based on the gained experience and changes in regional energy consumption.

The Energy Saving Program of Kaliningrad oblast enlists investment energy saving projects and contains their justification. The nearest investment projects are grouped by the following areas:

- Introduction of devices for metering and registration of the energy produced and consumed
- Reduction of losses, efficient energy consumption
- Application of new facilities and systems for energy production and distribution
- New (unconventional) energy sources in Kaliningrad oblast

These projects were funded from the local and oblast budgets, funds of the enterprises.

Besides, a number of investment projects for the long-term outlook has been prepared. The most important are :

- Expansion of capacity of the existing gas main
- Construction of an underground gas storage
- Reconstruction of Pravdinskaya HPP-4
- Construction of Zelenogradskaya wind power station of 5.1 MW
- Creation of heating sources equipped with heat pump units
- Environmentally safe treatment and utilization of municipal solid wastes and industrial wastes

The investment of the energy saving projects will rely on the following market mechanisms:

- commodity (energy) crediting
- financial leasing
- bank crediting
- tax credits
- creation of a mutual investment fund on energy saving
- target bonded loans

Due to termination of the Energy Saving Program of Kaliningrad oblast 2001-2005, the Ministry of Infrastructure Development issued Order No. 125 of 04.05 2006 “On Introduction of the action plan on energy efficiency and energy saving for municipal utilities and FES enterprises for 2006”.

The mentioned document includes a list of the immediate measures on energy efficiency in FES sector of the region. The Plan constitutes of the following sections

- Heating
- Electricity supply, lighting
- Gas supply
- Water supply
- Organizational arrangements

The most important activities of the plan include:

- Construction of a heat main from HPP-2 to the south of Kaliningrad

- Transfer of boiler houses to biofuel
- Construction of gas service lines to Svetly, Polessk, Gvardeysk
- Elaboration of the Energy Saving Program of Kaliningrad oblast 2006-2010

9.2. A program of energy sector development in Kaliningrad oblast until 2020 Developer – Energosetproject, 2005

This program includes a subprogram on development of generating sources and a subprogram on development of electricity supply facilities.

The objective is to investigate options for development of generating capacities and electrical grid facilities in Kaliningrad oblast in order to cover future electricity and heat demand in the region, to review further interaction with a United Energy System of Russia and energy systems of neighbor countries.

The program describes an existing situation in the oblast's economy and energy sector. A structure and modes of electricity consumption, a balance of electric and heat energy consumption, an exiting generating capacities and an exiting fuel supply have been analyzed. The outputs of the analysis of the existing situation served as a basis for determination of energy supply problems to be tackled.

Based on the analysis of economic development electricity and heat energy demand and electricity consumption modes have been forecasted. Planned balances of capacities and electric energy taking into account the renewable energy sources have been compiled. Organic fuel demand and supply options have been forecasted.

Due attention was paid to maintaining links of Yantarenergo OJSC with UES of Russia and possibilities of electric energy transit through energy systems of the neighbor countries and interaction with the energy systems of the EU. Capital costs of the electric power industry development and their financial viability are analyzed. Environmental impact of the electric power industry was also concerned.

1. *Economic development of the region and electric energy demand assessment*

Recently a draft law aimed at strengthening and expansion of a status of Kaliningrad oblast as an Exclusive Economic Zone has been passed. The following sectors and enterprises can be considered to be primary focused:

- High-tech companies
- Export-oriented companies
- Import-replacing productions
- Companies which already cooperate with other regions and foreign partners
- Fishing industry

Summarized data on forecasted electric energy demand in Kaliningrad oblast in a baseline option:

- Total electric energy consumption during 16 years may increase by 63% at GDP growth by 4.7
- An electric intensity of GDP may decrease from 61 to 21.1 kWh per th. RUR, or by 65%
- Electric energy consumption per capita may increase by 1.25 up to 5800 kWh, which is below the current level in Russia. This reflects the regional peculiarity (prevalence of little electric intensive sectors)

Electric energy demand, Yantarenergo OJSC, until 2020, baseline option:

2005 – 3.777 bil. kWh
2010 – 4.840 bil. kWh
2015 – 5.220 bil. kWh
2020 – 5.800 bil. kWh

According to a forecasted electricity consumption structure, perspective electric loads have been calculated and annual modes of electricity consumption have been defined. By 2020 the maximum load is expected to reach 1030 MW against 640 MW in 2004. At GDP growth by 4.7 during 2004-2020 the head demand would rise within 40-45%, which is conditioned by a high energy saving capacity.

2. Development of the generating sources

Construction of new and modernization of the existing power units of heating stations is planned to be based on gas-steam technologies. Generating capacity could be developed through utilization of local fuel resources. These issues are tackled primarily in view of ensuring the energy safety in the region.

Table 4. Required installed capacity in Kaliningrad system till 2020, MW

	2005	**2010**	**2015**	**2020**
Peak load of the energy system	678	849	922	1027
Capacity delivered (-) from the neighbor bulk electricity systems	630	0	0	0
Future normative power reserve	0	225	225	225
Power split	600.3	73.8	120.8	88.0
Total demand in the installed capacity	648.3	1147.8	1267.8	1340

Table 5. Required connections in Kaliningrad energy system till 2020, MW

	2005	**2010**	**2015**	**2020**
Demand in the installed capacity	648,3	1147.8	1267.8	1340
Not used capacity	130.7	66.7	66.7	66.7
Water and replacement needs	517.6	1081.1	1200.1	1272.3

Energy safety and development of the region oriented on self-sufficient and independent functioning require construction of a base energy source (Kaliningrad HPP-2 with 2 GSU-450), which is envisioned in the Federal Target Program of Kaliningrad Oblast Development until 2010.

Table 6. Electric energy balance

		2005	**2009**	**2010**	**2015**	**2020**
Demand	Mil. KWh					
Electricity consumption		3777.0	4602.0	4840.0	5220.0	5800.0
Total demand		3777.0	4602.0	4840.0	5220.0	5800.0
Coverage						
Electric energy supplied, total		3465.0	0.0	0.0	0.0	0.0
Electric energy imported, total		3465.0	0.0	0.0	0.0	0.0
Import from neighbor countries		3465.0	0.0	0.0	0.0	0.0
Electric energy generation		312.0	4602.0	4840.0	5220.0	5800.0
HPP		10.0	24	24	37	46
TPS		294.5	4570.5	4808.0	5100.5	5671.5
Unconventional		7.5	7.5	7.5	82.5	82.5
Coverage, total		3777.0	4602.0	4840.0	5220.0	5800.0
H of the capacity utilized	Hour	6544	4621	4775	4200	4716
Existing capacity TPS		45.0	989.0	1007.0	1214.5	1202.5

3. Fuel demand and balance

Table 7. Fuel needed to cover the established electricity consumption level, baseline option

	Unit	2005	2010	2020
Electric energy generation, TPS	Mil. kWh	294	4809	5672
Fuel required for EE generation	th. t equivalent fuel	61	1159	1291

With the gasification of the oblast, electric power plants will be being transferred to gas, and by 2020 black oil will used at TPS only as a reserve fuel.

Table 8. Fuel required for heat energy generation

	Unit	2005	2010	2020
Heat supply, total	th. Gcal	6000	7200	8000
Including				
TPS		2357	3090	3795
Boiler houses		3643	4110	4205
Heat demand for heat energy production, total	th. t equivalent fuel	1045	1224	1334
Including				
TPS		395	495	587
Boiler houses		650	729	747

4. Energy Supply in Kaliningrad oblast after decommissioning of Ignaline Nuclear Power Station

With commissioning of only one GSU-450 power unit at Kaliningrad HPP-2 a power shortage in Kaliningrad energy system will be about 490 MW in 2009 - 2010, and 350-470 MW in 2015-2020. The missing power and electric energy in Kaliningrad energy system is supposed to be provided from UES of ЕЭС Russia via transit through electric networks of Belarus and Baltic states.

Estimations of power network operating modes in the region in 2010 at different values of power shortage at bulk electricity system of Baltic states under decommissioning of Ignaline NPP indicate that if a self-balance of the energy system of Baltic states is at 2015 level, a load in interstate profiles Center – Belarus is 1200 MW, North-West – Estonia, Latvia – 300 MW. Therefore, electric power supply in Kaliningrad oblast with only one GSU-450 MW unit working at Kaliningrad HPP-2, Ignaline NPP decommissioning and a self-balance of Baltic states energy system will not necessitate additional strengthening of the interstate profiles. In case of power shortage in the energy system of Baltic states, Center – Belarus interstate profile will have to be expanded.

5. Analysis of funding schemes influence on Kaliningrad HPP-2 expansion

According to the estimates, both with design and with balance load of the equipment, the lowest tariff corresponds to the funding scheme envisioning 100% borrowed funds. The highest tariff – with 100% share capital. However, as fully borrowed funding is very risky for the creditors, the internationally recognized most optimal financing scheme of financially viable projects is a 50:50 mixture of own and borrowed funds. Share of external funding of credits of Russian energy companies is recommended to be not higher than 30%.

The following tariffs are estimated for the second power unit (60% - share capital, 40% - borrowed funds, repayment period – 10 years with tax exemptions (profit tax – 4%):

2010 – 4.37 cents/kWh
2015 – 4.41 cents/kWh
2020 – 3.56 cents/kWh

9.3. Fuel and Energy Balance of Kaliningrad oblast until 2020. Energosetproject, 2005

The balance includes:

- Brief overview of Kaliningrad oblast and economic situation
- Development forecast till 2020
- Description of fuel stock
- Description of the oblast energy sector
- A set of measures to ensure reliability of supplies to Kaliningrad oblast in view of future demand
- Activities aimed at better efficiency of fuel and energy resources utilization
- Main principles of fuel and energy balance calculation
- Conclusions

1. Key items of fuel and energy balance

The fuel and energy complex of the oblast includes enterprises dealing with electric power and heat supply, gas supply to the end users in the region, as well as fuel and oil production enterprises. Before 2006 the electric power was supplied mainly through its transportation from Russia on the networks of Belarus and Lithuania (85.8% of total electric power supplied in 2005).

Electric power industry is represented by Yantarenergo system. Its base generation source is Kaliningrad HPP-2. in October 2005m a 450 MW first power unit of was commissioned. A total installed electric capacity at Yantarenergo plants is 130 MW. In 2005 electric energy produced by all generating sources of the oblast was equal to 539 mil. kWh, i.e. 15% of total regional electric energy consumption. In 2005 Kaliningrad HPP-2, operating in adjustment mode, produced 281 mil. kWh.

Heat supply is carried out by a number of large heat sources of Yantarenergo OJSC: in Kaliningrad – HPP-1, Svetly – GRES-2, Gousev – HPP-5, as well as municipal and agency sources. The largest municipal heat sources are included into Kaliningradteploset MUE.

Gas supply in the oblast is based on natural and condensed gas. Natural gas has been delivered since 1985 after construction of a single gas main Vilnius – Kaliningrad and GRS-1 in Kaliningrad. In 2005 a first phase of the gas main construction was completed thus increased its capacity from 700 to 1050 mil. m³ gas a year. Nevertheless full coverage of the region's demand in natural gas requires expansion of capacity up to 1270 mil. m³, and further up to 1400. Gas supply sector of Kaliningrad oblast is represented by Gaz-Oil CJSC, Gaz-Oil Region LLC, Kaliningrad Department of Gas Mains and Kaliningradgasificatsyia FSUE.

Fuel industry includes oil production sector and peat extraction enterprises. The largest oil company extracting more than 95% of oil is LUKOIL-Kaliningradmorneft. Total extraction volume is growing due to development of the Baltic Sea shelf. In 2005 1218 th. t were extracted. The development prospect in connected with development of new field Kravtsovskoye. The extraction output will have decreased here by 2010. The oil is low-sulfur and good quality.

Peat extraction. Since 2002 oblast has commissioned two peat-based boiler houses, some new ones are planned for construction. The extraction is carried out by Torphopredpriyatiye Nesterovskoye, Torfo LLC, Slavsktorf.

2. A set of measures to ensure reliability of supplies to Kaliningrad oblast in view of future demand

Electric power supply. There are two levels of responsibility for electric energy supply. The first one is the federal level: the Government of the RF, the RF Ministry of Industry and Energy, the RF Ministry of Economic Development and Trade, RAO UES, the Federal Grid Company:

- Construction of the second 450 MW power unit of Kaliningrad HPP-2 by 2010, possible construction of the third power unit after 2015
- Reconstruction of the existing generating capacities of Yantarenergo
- Provision of possibility to transfer power and electric energy from UES of Russia в Kaliningrad oblast
- Construction and reconstruction of grids, including those used for transmission of power to the region from the main Russian territory
- Interaction with the energy systems of Baltic states concerning parallel operation with UES of Russia, transit of electric energy to Kaliningrad oblast.

The funding sources are federal budget and an investment program of RAO UES.

The second level deals with issues under responsibility of RAO UES and Yantarenergo OJSC:

- Construction of new substations and 110 kV high voltage lines in the oblast, modernization of the existing infrastructure
- Modernization and construction of electric grids below 110 kV.

The funding sources are RAO UES, an investment program of Yantarenergo, oblast budget, other funds.

Gas supply. The issues in this field are also tackled at two levels. The first level is under competence of the RF Government, the RF Ministry of Industry and Energy, the RF Ministry of Economic Development and Trade, Gazprom:

- Reconstruction of the existing gas main in Kaliningrad oblast with expansion of capacity up to 1.4 bil. m³ gas a year
- Construction of the second gas main in Kaliningrad oblast in order to increase reliability of gas supply, delivery of not less 2.5 bil. m³ of natural gas by 2010 with further increase to 3.5 bil. by 2015
- Construction of the underground gas storage in the oblast, with a 300-400 mil. m³ first turn commissioning in 2007.

The funding sources are federal budget and an investment program of Gazprom.

The second level is under competence of Gazprom, regional and municipal authorities.

- Construction of branch pipelines to the cities of the oblast
- Gasification of cities and rayons of the oblast

Funding sources: Gazprom, federal, oblast and municipal budgets, relevant tariffs for regional consumers, funds of the enterprises concerned.

3. Energy resources consumption profile

Consumption of fuel and energy resources is distributed as the following: electric energy - 29%, petrol – 26%, natural gas – 22%, black oil – 13%, other fuels – 10%.

Table 9. Electricity consumption by sectors of economy, bil. kWh

Sectors	2005	2006	2010		2015		2020	
			mod	wholesale	mod	wholesale	mod	wholesale
Industry	0.915	1.04	1.49	1.72	1.67	2.55	1.84	3.78
Construction	0.045	0.07	0.12	0.15	0.14	0.2	0.2	0.3
Transport	0.095	0.12	0.13	0.15	0.15	0.2	0.19	0.3
Social facilities	1.7	1.8	2.0	2.42	2.09	3.0	2.3	3.7
Agriculture	0.14	0.22	0.32	0.35	0.39	0.46	0.49	0.59
Internal use	0.698	0.74	0.78	0.78	0.78	0.85	0.78	0.92
Total	3.58	3.99	4.84	5.57	5.22	7.26	5.8	9.59

Annual growth of electricity consumption in the region for the period in question is forecasted at the level of 3-7%. Share of industries will increase from 27 to 40%, whereas social sector consumption will drop from 45 to 39%.

Consumption of heat energy in Kaliningrad oblast in 2005 amounted to 5400 th. Gcal, of which 3435 th. Gcal in Kaliningrad. This required 630 th. t of equivalent fuel, including 75% natural gas.

District heating in Kaliningrad shall be developed through stage-by-stage commissioning of Kaliningrad HPP-2 with total design annual supply of heat energy equal to 2385 th. Gcal. This will make it possible to close down low-efficient coal and black oil fired boilers thus resulting in decrease of fuel consumption for heat energy generation and considerable environmental improvements.

Table 10. Forecasted levels of heat energy consumption in Kaliningrad oblast, Mil. Gcal

Sectors	2006	2010		2015		2020	
		mod	wholesale	mod	wholesale	mod	wholesale
Total in the oblast	5.7	6.9	7.3	7.4	11.3	7.9	14.3
Including Kaliningrad	4.22	2.25	5.4	5.64	7.5	6.05	8.5

Average annual growth of heat energy consumption in the region within 2006 - 2020 will make up 2-10%.

The level of gasification in the region is not satisfactory.

Table 11. Total volume of natural gas consumption in Kaliningrad oblast till 2020 by consumer categories, mil. m³ a year

Sectors	2006	2010		2015		2020	
		mod	wholesale	mod	wholesale	mod	wholesale
Industrial enterprises	923*	1794**	1960	1980**	2360	2168**	2500
Incl. energy sector	903	1392	1392	1497	1982	1642	2167
Social services sector	350	530	830	610	850	680	900
Households	150	200	334	280	360	320	418
Total	1423	2524	3124	2870	3570	3168	3818

* including natural gas consumption at the first power unit of Kaliningrad HPP-2 in the amount of 600 mil. m³ a year

** including natural gas consumption at two power units of Kaliningrad HPP-2 in the amount of 1200 mil. m³ a year.

During 2006-2010 it is planned to build the first turn of a 350 mil. m³ underground gas storage and the second gas main in Kaliningrad oblast (branch of the North European gas main).

4. Activities aimed at better efficiency of fuel and energy resources utilization

Implementation of the energy saving program. A five-year energy saving program in Kaliningrad oblast for 2001-2005 has been finished. The funding of the energy saving measures is shown in the table below (mil. RUR)

Funding sources	2001	2002	2003	2004	2005
Oblast budget	-	2.2	1.9	4.33	8.9
Enterprises	-	92.7	120	45.4	78
Other sources	138	44	66.3	152	190
TOTAL	138	138.9	188.2	201.7	276.9

The main directions of energy efficiency and energy saving activities:

- A 5.1 MW wind farm in Koulikovo. The FS of a 50 MW marine based wind farm is under elaboration.
- In order to ensure Kaliningrad HPP-2 functioning, a project on construction of heating main from HPP-2 to serve consumers in the city is under implementation. This will allow to close a number of inefficient boiler houses.
- A number of small HPS are under construction and reconstruction. Their total installed capacity is planned to reach 10 MW taking into account local hydrogeological conditions.
- In 2002-2005 more than 100 boiler houses based on different fuels (coal – 62, liquid fluid – 28, gas – 10) were constructed, reconstructed and modernized. The total investment value was 600 mil. RUR.
- Three new peat-fueled boiler houses and two municipal boilers utilizing wood wastes have been constructed.

There are also some other developments in this area. Their total potential doesn't exceed 20%.

Some conclusions on development of energy sector and energy saving initiatives in Kaliningrad oblast

1. A new Law on Kaliningrad Exclusive Economic Zone is very promising for the investors, who took decision to work in the region. In case a business project is approved as the investment one, the investor shall not pay a profit tax during six years, and shall pay 50% of it during the following 6 years. Nevertheless attraction of investments in EEZ encounters significant problems. In particular, enterprises can't get permissions for connection to electric energy supply grids due to a serious lack of investments to finance grids expansion and an electric energy shortage. Successful operation of EEZ with new consumers appearing and population growing requires increased supply of electric energy.

2. According to RAO UES of Russia, the problem of electric power supply in the region could be solved only through construction of the second power unit extending the design capacity of HPP-2 to 900 MW. Kaliningrad HPP-2 is a core infrastructure facility and a key site for attraction of the investments to EEZ. However, construction the second power unit HPP-2 is hindered by argues between RAO UES and Gazprom concerning gas supply to the oblast.

   When designing HPP-2, a possibility to export the electric energy to Baltic states and Europe was considered. At the same time electric energy of RAO UES of Russia shall compete with Russian gas in the foreign market, which raises objections from the side of Gazprom. According to the management of Yantarenergo, electric energy to be generated at the second unit of HPP-2 will only cover the own needs, taking into account the forecasted increase of demand and need for reserve capacity. Export of electric energy from Kaliningrad oblast to Europe is possible, but still only in theory. Nowadays there is no reliable information on electric energy demand in surrounding countries in present and in foreseeable future. Is there any demand for "cheap" electric energy

produced in the region? How the export could be arranged in view of forthcoming separation of Baltic states from the energy system of RAO UES of Russia and transition to the European standards of electric energy generation and transmission?

3. A serious concern relates to the growing dependence of Kaliningrad oblast on one energy resource – a natural gas, which in the enclave conditions urges strengthening of energy safety in the region and transition to other energy resources, coal, for instance. But as long as gas is cheaper than coal, the transition would be very difficult, as gas has many advantages (from technological and environmental points of view). A wind power-engineering is the region is difficult to develop, as the electric energy generated by them is very expensive, and an issue of state subsidizing is not settled. There are also some technical problems related to inability to match «big» and «small» power engineering in a unified balance.

4. Taking into account an inevitable upsurge of gas prices, it becomes obviously necessary to investigate the alternative options of energy supply of small and medium-size locations (consumers), relying on a variety of generating sources and "big-small" relation. First of all, we can talk about unconventional and renewable energy sources, including biofuel, increase of coal utilization efficiency, wind, solar and geothermal energy sources, small HPS and, finally, the energy saving. Enhancement of energy supply reliability necessitates elaboration of a regional energy sector development strategy. The vulnerability of the existing situation is conditioned by the fact that the energy sector in Kaliningrad oblast relies only on gas. There are no worthy projects on construction of generating sources based on the alternative fuel. Underground gas storage could benefit to the energy safety of the region.

5. In the context of the foresaid energy sector development problems, an energy saving acquires the special importance. A five-year energy saving program in Kaliningrad oblast for 2001-2005 has been finished in the region. The Program enlists investment energy saving projects and contains their justification. These projects were funded from the local and oblast budgets, funds of the enterprises. Besides, a number of investment projects for the long-term outlook have been prepared. The investment of the energy saving projects is supposed to rely on the market mechanisms, such as commodity crediting, financial leasing, bank crediting, creation of a mutual investment fund on energy saving. The Program outputs served as a basis for elaboration of an action plan on energy efficiency of FES enterprises in the region. The most important activities of the plan include construction of a heat main from HPP-2, transfer of boiler houses to biofuel. Moreover, it’s planned to prepare an energy saving program in Kaliningrad oblast for 2006-2010 based on the lessons learned, experience gained and changes in energy consumption profile of the region. It’s necessary to have not only individual energy saving measures, but a comprehensive energy saving policy at the regional level.

6. Presently there are no public and administrative structures dealing with energy efficiency issues in the region. The relevant departments exiting within former Gosenergonadzor, REC and KO Administration, but have been abolished after reorganization. The Regional Energy Saving Center functions in fact as a consulting company. In spite of this, the oblast possesses good background and capacity for application of a systematic approach in energy efficiency and energy saving: duly qualified staff at public bodies and key “actors", the acting Regional Energy Saving Center, public awareness activities and interventions are definitely useful and progressive. There are no legal frameworks for the mechanisms of promotion of the investments in energy efficiency, they fall under the conditions generally applied for all investment projects of the Exclusive Economic Zone. The region has big experience in investments attraction, including foreign ones. Nevertheless, it seems there is no duly arranged clear system of investment decisions making in the region.

Annex II Background information on the potential for renewable energy use

Table of Contents

1. Introduction

Miscellaneous renewable energy sources are available in Kaliningrad Oblast:

- Biomass
- Peat
- Wood waste
- Straw and similar products
- Hydropower
- Wind
- Solar
- Geothermal
- Biogas
- Waste
- Brown coal / lignite

The amount of local Renewable Energy Sources used in the Oblast is continuously increasing Selected examples are:

- the use of biomass, wood waste and peat in boilers
- the construction of Russia's first major wind mill farm in 2002
- rehabilitation of one small-scale hydropower station
- etc

However, there are huge possibilities for increased use of Renewable Energy Sources / Secondary Sources. These are briefly indicated and discussed in each section below.

2. Renewable Energy Sources

2.1 Biomass

19 % of the Kaliningrad Oblast is covered by forests, which is less than neighbouring countries (see Appendix 1, Table 1). Forests comprise both coniferous and leaf-bearing trees, of which 40 % are planted and not natural forests.

Table 2, Appendix 2, summarizes biomass fuel resources in the east part Kaliningrad Oblast where most of the forests, and the largest, are located.

Table 3, Appendix 2, summarizes specific forestry data - type of tree - in different districts in Kaliningrad Oblast.

The Oblast nature administration has reserved a number of forests of value for landscape, flora, wildlife, etc. as natural resorts/parks which limits industrial cutting. These reservations have not been included in Table 2 above.

Currently a number of power plants in the Oblast use wood chips (or peat) as fuel (for a list of major power plants, see Appendix 2), e g the power plant in Pravdinsk and the power plant Stoikomplektles in Kaliningrad.

Increase of cutting rate will influence, and require improved, production management of the forests. Wood chip production will require establishment of new enterprises operating with cutting, chipping and transport to power plants.

Establishment of large scale cost-efficient wood chip production in Kaliningrad Oblast will need further studies and training.

Feasibility studies and pilot projects should focus on e g:

- Forest management and production economy

- Biomass production
- Production of pulp & and paper wood and timber
- Wood chip technologies - wood chip handling (transport, storage, etc)
- Regional biomass fuel assessments and forecasts
- Maintaining natural resort areas
- Pilot project(s) dealing with production and supply of forest wood chips, comprising supply of cutting and chipping equipment and forestry transport equipment, training of personnel in operation and maintenance misc. machinery, enterprise management, etc.

i.

The technology is of substantial interest for more investments in Kaliningrad Oblast in the future. Studies should be focused both on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible new projects.

2.2 Peat

Peat bogs exist all over the Kaliningrad Oblast – throughout the coasts of Kaliningrad and Curonian lagoons, on the watersheds of the Sheshupe and Instruch rivers, and in the valley of the Pregolya river.

Totally 282 peat deposits with a total area of 65 000 hectares and commercially available total volume of 1.7 billion m3 (corresponding to 310 million tons with 40 % humidity) exists.
The quality of the peat varies, and are classified either as low-moor, transitional-moor or high-moor peat. The low-moor peat contains 60 % carbon, has an average heat value of 20 MJ/kg and hence is suitable as fuel in boilers.

Peat is today extracted at 43 deposits with a total area of 12 300 hectares and peat reserves of 104 million tons. All peat is extracted as milled peat, about 0.6 – 0.7 million tonnes are produced every year. If considered as a fuel resource in the future, sod peat should be considered since it is easier to store, handle and transport.

Peat extraction today is rather low, and could be considerably increased. The major part of the peat extracted today is garden peat for export, while a minor part is used as fuel. Currently three power plants in the Oblast use peat as fuel (see Appendix 2).

Deposits with a total area of more than 20 ha, average thickness > 1.5 meter and ash content < 35 % are judged to be the most cost-efficient for industrial use.

33 deposits have been identified as suitable for exploitation as energy resources. The 33 deposits comprise a total area of over 11 000 hectares and contain app. 60 million tons of peat, with a layer thickness of between 3 and 12 meters.

12 peat deposits have over the years been extracted of the commercially reasonable content, and could/should now be re-cultivated, used for fish-farming etc.

Peat resources in Kaliningrad region are given in Appendix 3.

Since the technology is of interest for more investments in Kaliningrad Oblast in the future, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

2.3 Wood waste

Wood waste produced in Kaliningrad Oblast in the pulp and paper mills, saw mills, wood working enterprises, furniture producers, etc is estimated at 500 000 – 1 million tons per year. An increased amount is used internally in their own boilers and in smaller private boilers.

E g the Neman plant has been substantially rehabilitated, including conversion to burn bark and sawdust from wood processing in their own boilers.

All pulp and paper plants use both regional and imported (from other parts of Russia) wood and low-quality timber as raw material.

Since the technology is of interest for more investments in Kaliningrad Oblast in the future, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

2.4 Straw and similar products

Kaliningrad Oblast produces agricultural products sufficient for its own need, however the productivity per ha is lower then in west Europe. E g cereals like wheat, rye, barley and oats – all grown I the region – are estimated at a productivity of 3 tons/ha. With a heat value for straw of 15 MJ/kg, the agricultural field straw fuel output would be 45 000 MJ/km2.

The needed farm land to produce straw fuel exists in many locations in the Oblast, especially if the focus would be on supplying smaller boilers (< 1 MW) for minor settlements, institutions, etc.

If the technology is of interest for future possible investments in Kaliningrad Oblast, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

2.5 Hydropower

Kaliningrad Oblast has a dense network of rivers – totally 4610 rivers with a total length of 12 720 km. Before the Second World War more than 30 small-scale hydropower stations were constructed, a couple of them were in operation as late as the 1970ies (HPS No 3 and No 4 in Pravdinsk on the Lava river). Totally 57 power stations were in operation - 34 small-scale hydropower stations for productions of electricity and in addition some water mills and wind mills.

A survey of the hydropower potential in Kaliningrad Oblast has shown that the total potential is more than 40 MW Installed Capacity, with a yearly production of 300 GWh. ((Neman, Pregolya and Deima rivers have not been included because of the low flow velocity of the water, due to the flat land the rivers crosses . Constructing dams on these rivers would imply that substantial land areas being put under water, and furthermore the Neman river comprise the border with Lithuania).

Five rivers have the potential to produce 90% of the hydropower in Kaliningrad Oblast:

* Angrapa : Installed Capacity 14.5 MW, production 127 GWh
* Lava : Installed Capacity 10.4 MW, production 91 GWh
* Pissa : Installed Capacity 4.7 MW, production 41 GWh
* Sheshupe : Installed Capacity 3.8 MW, production 34 GWh
* Krasnaya : Installed Capacity 3.3 MW, production 29 GWh

Earlier estimates indicates that by using modern state-of-the-art equipment, assuming the average

water flow is 50 % of maximum flow, total installed capacity of the 34 old small-scale hydropower stations that were in operation is about 17 MW and estimated yearly production over 100 GWh (see Appendix 4).

Possible hydropower stations can be divided in 3 categories, depending on the level of the need for reconstruction and rehabilitation.

1. 70 % of existing constructions in good condition : 5 HPSs - HPS No 3 and No 4 in Pravdinsk, HPS on the Lava river in Znamensk, HPS on the Angrapa river in Ozersk, and HPS at the Pissa river in Gusev.

2. 40 – 70 % of existing constructions in good condition : 7 small-scale HPSs - on the Pissa river in Iljushino and Priozernoe villages, on the Angrapa river in Putyatino village, on the Geleznodorogniy river in the Geleznodorogniy village, on the Krasnaya river in the Lipovo village and Gusev-Leshoz village and on the Sheshupe river in Krasnoznamnensk village. The spillway dams of these constructions are judged to be in good condition.

3. 22 sites, each with installed capacity about 50 kW. These stations are micro hydropower stations and their constructions are damaged but could be reconstructed and used for local needs.

During the last years, rehabilitation of small-scale hydropower stations Pravdinsk No3 and Ozersk has been completed and are in commercial operation. Pravdinsk No4 has been redesigned. Three other sites have been selected for possible rehabilitation (information on estimated costs for consultancy services for feasibility study and design from consultant “Zapvodproekt”):

1. Gusev HPS : Feasibility study would take 3 months to complete, at a cost of less than 0.5 million RUR Design documentation (drawings, specification, procurement documents, etc) less than 0.75 million RUR, can be developed partly simultaneously with construction work, if requested.

2. Znamensk HPS : Feasibility study would take 3 months to complete, at a cost of less than 0.5 million RUR. Design documentation (drawings, specification, procurement documents, etc) about 1 million RUR, can be developed partly simultaneously with construction work, if requested.

3. Krasnoznamensk HPS : A Feasibility study focusing on technical and environmental investigations and assessments was conducted in 1994. Installed capacity is estimated at 1.2 MW, and electricity production is estimated at more than 7 GWh per year, which would be sufficient for the total electricity demand of Krasnoznamensk municipality. Commercial operation and production of electricity would be two years after start of construction. A new updated Feasibility Study would take 3 months to complete, at a cost of less than 0.5 million RUR. Design documentation (drawings, specification, procurement documents, etc) about 1 million RUR, can be developed partly simultaneously with construction work, if requested.

Since the technology is of interest for more investments in Kaliningrad Oblast in the future, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

2.6 Wind

The total theoretical possible installed capacity of wind power mills in Kaliningrad Oblast was some years ago estimated at 1100 MW.

Long-time meteorological measurements has been conducted, confirming that along the coastal zone from Baltyisk to Zelenogradsk and further north on the Kurskaya spit, average monthly wind speeds of 2 m/s (at ground level) during 6-10 months a year is prevalent. South of Baltyisk similar wind conditions exist. In addition, comparisons can be made with similar locations on e g the Swedish, Danish and German coastlines around the Baltic Sea, where a lot of wind data has been collected.

An assessment was made some years ago on the feasibility of installing 250 – 600 kW wind mills in various locations in Kaliningrad Oblast (see Appendix 5). Since the wind turbine technology continuously is developing towards larger and larger units, and cheaper and cheaper units (related to Installed kW/MW), these types of studies need to be continuously updated.

In 2000 three wind mills with a total installed capacity of 1 MW were in operation in Kaliningrad Oblast.

Russia's first major wind farm was constructed in the Kaliningrad Oblast in 2002 on the northern coast of the Semba peninsula close to Kulikovo village, one of the most favourable locations in the Oblast. 20 wind mills were erected and commissioned at the facility by Danish experts, while the Kaliningrad partner (Yantarenergo) was responsible for infrastructure (civil works, grid connection, etc).

As part of possible future project, Feasibility studies have been completed for 5 – 50 MW offshore wind farm(s).

Since the technology is of interest for more investments in Kaliningrad Oblast in the future, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

2.7 Solar

In Kaliningrad Oblast the insolation (solar radiation) at ground level over an entire year (including nights and periods of cloudy weather) is about 100 W/m². According to meteorological statistics, about 180 days a year are cloudy.

The solar radiation level of about 100 W/m2 represents the theoretically available solar power, and not the delivered power from a facility producing electricity (PV systems) or hot water.

At present, photovoltaic panels typically convert about 15% of incident sunlight into electricity; therefore, a solar panel in Kaliningrad Oblast on average would produce 15 W/m² of electricity.

Solar heating systems may be used to heat domestic hot water, swimming pool water, or for space heating. The heat can also be used for industrial applications or as an energy input for other uses such as cooling equipment.

A solar heating system can provide a very high percentage (50 to 75%) of domestic hot water energy. In many northern European countries, combined hot water and space heating systems are used to provide 15 to 25% of home heating energy, replacing e g fossil fuel in district heating or single stand-alone boilers.

If the technology is of interest for future possible investments in Kaliningrad Oblast, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

2.8 Geothermal

Geothermal energy sources are possible to exploit in various locations in Kaliningrad Oblast, for commercially use for different purposes – as an energy source for district heating, spas and health centres in the tourist sector, greenhouses for growing vegetables, etc.

Studies and investigations have been conducted, indicating e g that groundwater temperatures reach up to 95 degrees centigrade in the western part of the Oblast (Svetly), and 50 – 60 degrees centigrade in the east (Gusev and Chernyakhovsk).

An indicate assessment of a possible project has been conducted: Investment 25 million USD, heat production for district heating 400 GWh/year, with a water consumption of 250 m3, temperature 90 degrees centigrade, at a depth of 10 meters.

If the technology is of interest for future possible investments in Kaliningrad Oblast, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

2.9 Biogas

No biogas production facilities exist in Kaliningrad Oblast today.

Kaliningrad Oblast produces agricultural and animal products sufficient for its own need, hence the amount of produced “farming waste” – from grass or cereals as well as from pig, poultry and cattle – is on the average level for a 1 million self-supporting farming society in Europe.

Furthermore, import of some types of semi-processed animal and vegetable products – poultry, soy beans, etc – as well as the fishing industry produces substantial amounts of organic waste that could be used for biogas production.

From 1 kg of “agricultural waste” about 0.5 -0.8 m3 of biogas can be produced, with a heating value of about 20-25 MJ/m3.

Biogas is produced in an anaerobic digester (AD), an industrial system comprising a process which treats waste in producing biogas that can be used to power electricity generators, provide heat and produce soil improving material.

Anaerobic digesters have been in industrial operation for a long time and they are commonly used for sewage treatment or for managing animal waste. Increasing environmental pressures on waste disposal has increased the use of AD as a process for reducing waste volumes and generating useful byproducts. It is a fairly simple process that can greatly reduce the amount of organic matter which might otherwise end up in landfills or waste incinerators.

Almost any organic material can be processed in this manner. This includes biodegradable waste materials such as waste paper, grass clippings, leftover food, sewage and animal waste. Anaerobic digesters can also be fed with specially grown energy crops to boost biodegradable content and hence increase biogas production.

Methane capture through extraction of gas from landfills is a fairly simple technology adopted in many countries. The gas normally is used to heat premises at the landfill and/or for electricity production. Some district heating companies burn the gas as additional fuel in the district heating boilers.

If the technology is of interest for future possible investments in Kaliningrad Oblast, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

3.0 Waste

The quantities of household waste and industrial waste in Kaliningrad Oblast are lower than the European average per person. Studies on specific minor regions and areas indicate waste

amounts of less than 1 kg per person per day, maybe 0.75 kg/person/day, a number that will certainly increase in the future.

Kaliningrad is currently experiencing a substantial development in all sectors, well above the average in Russia. With improved living conditions in Kaliningrad Oblast the generation of waste will increase, and Kaliningrad will "close the waste production gap" compared to Western countries.

An indicative – and conservative - amount of waste available in Kaliningrad for e g waste incineration in a modern state-of-the art power plant complying with all EU regulations and directives on Incineration of Waste is 250 000 tons, corresponding to a total fuel heat content of 750 GWh per year.

Hence, one big power plant operation e g 6 000 hours per year could be designed at 150 MW capacity (using 20 % design margin), preferably with two boilers of 75 MW each, or three boilers of 50 MW each. Alternatively, in order to minimize/optimize waste transportation costs and distances, several medium-sized power plants in various places in the Oblast could be constructed – e g units with 25 MW boilers with flue gas and waste water treatment systems which comply with EU directives are in common use in Scandinavian countries.

If the technology is of interest for future possible investments in Kaliningrad Oblast, it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

3.1 Brown coal / lignite

Brown coal / lignite is not classified as a renewable energy source, however since it has been evaluated in some earlier studies for Kaliningrad, some information is included in this document.

There are two brown coal fields in Kaliningrad Oblast, located at Krasnotorovka settlement and Grachevka settlement. The total volume of the brown coal reserve is estimated at 50 million tones. According to the studies mentioned above, brown coal mining for energy use is not profitable. Other use, e g as raw material for wax production may be possible, though.

4. Secondary Energy Sources

Kaliningrad Oblast has some industries that could benefit from introducing various types of heat recovery equipment. No detailed total assessment or analysis has ever been made.

A few industries may have conducted some studies for their own enterprise and facility/-ies, however they normally claim it is classified information since the work has not been funded by donors or other official sources. One example is the Neman pulp plant, who conducted studies before a major rehabilitation program was implemented. This information is not available, at least not through official sources.

A substantial amount of energy use in the industry consists of the need of heat in the form of steam at different pressure levels and for firing furnaces. All industrial waste heat use together with exothermic heat from chemical reactions is eventually released to the ambient atmosphere through cooling water, cooling towers, flue gasses, and other heat losses.

A first, most logical, solution to this waste heat problem is to reuse the heat within the same process or at the same site. This kind of heat integration is already applied to a great extent within the industries in EU but offers no solution for the waste heat still remaining. The reuse of waste heat is hindered by one or several of the following reasons:

- The temperature level of the waste heat is too low to be reused again at the same site
- The waste heat is released at a different time than heat is needed.

- The distance between the source of the waste heat and need of heat are too far apart.
- Upgrading waste heat
    - If industrial waste heat can be upgraded to process heat of high quality, for example medium pressure steam of 230ºC, large energy savings are possible. Conventional heat pumps are not able to generate the temperature lift necessary (about 100ºC).
- Storage of (waste) heat
    - By storing waste heat in a way that the losses are very low, this waste heat can be reused again at another time.
- Transport of (waste) heat
    - If heat can be transported with low losses, heat supply and demand can be brought together resulting in overall energy savings.

Heat recovery from ventilation systems is a conventional technology, where maybe 50 % of the energy can be recovered which otherwise would have been lost.

Heat recovery from Waste Water Treatment and Sewage Plants, etc, could make a substantial contribution to heat production for e g space heating in industries and buildings.

Some technologies are definitely of interest for future possible investments in Kaliningrad Oblast, other technologies may be interesting. For all technologies it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

4. Conclusions

Substantial knowledge exists from earlier conducted studies and Energy Programmes and Strategies, for various types of Renewable energy sources (Biomass, Peat, Wood waste, Straw and similar products, Hydropower, Wind, Solar, Geothermal, Biogas, Waste and Brown coal/lignite).

There is a continuous increase of use of local Renewable Energy Sources in the Kaliningrad Oblast, e g:

- the use of biomass, wood waste and peat in boilers
- the construction of Russia's first major wind mill farm in 2002
- rehabilitation of one small-scale hydropower station
- etc

However, there are huge possibilities for further increases, which have briefly been indicated and discussed in each section.

Use of secondary energy sources, e g industrial waste heat, has not been dealt with to any extent.

Some technologies are definitely of interest for future possible investments in Kaliningrad Oblast, other technologies may be interesting. For all technologies it is recommended to conduct more detailed studies. These studies should then be focused on addressing relevant general technical, environmental, financial and socio-economical issues, as well as targeting possible promising projects.

Appendix 1

Biomass resources in Kaliningrad Oblast.

	Extent of forest by area			Total forest wood and yearly cutting by solid mass			
	1 Land area	2 Forest area	3 Forest area col2/col1	4 Total forest wood	5 Yearly growth	6 Yearly cutting	7 Yearly cutting col6/col5
	Ths. m³	Ths. m³	%	Mill. m³	Mill. m³	Mill. m³	%
Finland	338	222	66	1.900	81	62	77
Estonia	45	21	47	275	9	3	33
Latvia	65	29	45	432	9	5	56
Lithuania	65	20	31	346	11	5	45
Poland	313	88	28	1.323	35	24	69
Sweden	411	226	55	2.927	100	60	60
Denmark	43	5	10	55	3	2	59
Kaliningrad			18				
Kaliningrad East					0,535	0,096	18

Note 1 m³ solid mass = approximate 700 kg.

Table 1. Baltic region, forest areas and cutting rates.

Summarized for all major forests

	Softwood, decideous	Hardwood, decidous	Conifers	Total
Actual cut				
Intermediate fellings:				
Timber, m3s	25 997	1 112	1 938	29 047
Fire wood, m3s	14 404	909	1 668	16 981
Total, m3s	40 401	2 021	3 606	46 028
Final fellings:				
Timber, m3s	19 000	5 000	10 500	34 500
Fire wood, m3s	8 900	4 000	3 400	16 300
Total, m3s	27 900	9 000	13 900	50 800
Total actual cut, m3s	68 301	11 021	17 506	96 828
Planned cut				
Intermediate fellings:				
cut, m3s	37 100	12 100	31 000	80 200
Final fellings:				
cut, m3s	71 100	11 300	28 400	110 800
Total, m3s	108 200	23 400	59 400	191 000
Difference (planned minus actual cut), m3s				
Intermediate fellings:	-3 301	10 079	27 394	34 172
Final fellings:	43 200	2 300	14 500	60 000
Total, m3s	39 899	12 379	41 894	94 172
Growth, m3/ha/year	3,6	3,4	4,3	3,8
Total growth, m3/year	239 668	75 760	220 498	535 927
Age group distribution				
Age group 1:	3 169	1 395	12 740	17 304
Age group 2:	3 085	4 908	18 073	26 066
Age group 3:	0	0	0	0
Age group 4:	0	0	0	0
Age group 5:	41 921	11 953	14 029	67 903
Age group 6:	0	0	0	0
Age group 7:	0	0	0	0
Age group 8:	0	0	0	0
Age group 9:	7 954	2 659	4 377	14 990
Age group 10 and more:	9 849	1 127	2 279	13 255
Total area, ha	**65 978**	**22 042**	**51 498**	**139 518**

Table 2. Biomass wood resources in Kaliningrad oblast, eastern part

Type of tree in forests in diff. districts	Pine	Fur	Larch	Oak	Beech, pasturable	Ash	Maple, acacia	Birch	Asp	Alder	Linden	Popler
Bagrationovsky	16,8	18,1	0,2	18,9	1,8	1,1	0,1	27,7	0,5	11,3	3,2	0,3
Baltysky	63,2	-	-	4,3	1,6			20,3	1,0	9,1	0,3	0,2
Gvardeisky	7,0	15,8	0,1	24,2	1,8	7,1	0,1	25,8	2,7	10,3	5,0	0,1
Gusevsky	3,2	27,9	-	15,5	1,4	3,0	-	29,5	6,7	9,7	3,1	-
Zeleznodoroznyy	5,5	8,6	0,1	24,5	4,3	8,6	0,1	32,5	3,2	7,6	5,0	-
Kaliningrdadskyy	28,3	12,1	0,3	18,5	0,3	8,1	0,4	17,0	0,5	12,0	2,3	0,2
Krasnoznamensky	36,6	30,2	-	7,2	0,1	1,3	-	17,8	1,7	4,4	0,5	0,2
Nesterovsky	65,3	3,5	-	0,1	-	0,1	-	15,5	0,2	14,7	0,2	0,4
Polesky	41,1	21,9	-	7,8	0,6	0,3	-	24,7	0,5	2,8	0,3	_
Primorsky	7,5	23,7	0,1	14,5	0,7	13,2	-	21,0	0,8	17,2	1,3	-
Slavsky	10,1	23,3	0,4	20,3	0,8	2,5	0,4	26,4	0,2	14,5	0,9	0,2
Chernyahovsky	14,6	10,0	-	2,9	-	1,9	-	20,9	0,7	47,9	0,1	1,1
NP «Kurskaya Kosa»	9,3	25,0	0,1	22,7	1,4	4,4	-	24,8	2,4	6,5	3,3	0,1
Total	**18,8**	**19,4**	**0,1**	**14,3**	**1,1**	**4,6**	**0,1**	**23,5**	**1,6**	**14,4**	**2,0**	**0,2**

Table 3. Type of tree in different districts in Kaliningrad Oblast, %

Appendix 2

List of power plants using biomass as fuel

No	Location	Fuel	Fuel consumption per day	Note
1	Pravdinsk municipality	Chips, sawdust	40-50 m^3	In operation
2	Kaliningrad city	Chips, sawdust	30-40 m^3	Dismantled
3	Chernyahkovsk	Peat	35 m^3	In operation
4	Chernyahkovsk, Svoboda settlement	Peat	3-5 m^3	In operation
5	Gurievsk	Saw dust	No data	In operation
6	Gurievsk	Chips, saw dust	5-7 m^3	In operation
7	Svetlij	Chips, saw dust	20 m^3	In operation Door production industry
8	Svetlij	chips	No data	Closed down Wood processing industry
9	Nivenskoe settlement	Saw dust	No data	In operation Wood processing industry
10	Bagrationovsk	Saw dust, chips	No data	In operation Furniture production industry
11	Lyublino settlement	Saw dust, chips, logs	No data	In operation
12	Ijevskoe settlement	Chips, saw dust	No data	In operation - LUKOIL
13	Kaliningrad	Chips, saw dust	No data	In operation Wood processing industry
14	Neman	Chips, saw dust	No data	In operation (pulp and paper plant)
15	Nesterov	Peat	No data	In operation
16	Polessk	Chips, saw dust	No data	In operation
17	Kaliningrad	Saw dust	No data	In operation Furniture production industry
18	Kaliningrad	Saw dust	No data	In operation Wood processing industry - Lesobalt

Appendix 3

Peat deposit data in Kaliningrad Oblast.

Area,ha	Number of peat fields,	Industrial fields, Area, ha	Peat resources		
			ths. m^3	ths.t, 40% degree of humification	%
1 - 10	103	488	8462	1563	1,0
11 - 100	87	3163	56440	10520	3,0
101 - 500	50	11460	264173	48282	15,0
501 -1000	24	17060	466238	81036	26,0
> 1000	18	32807	1119701	169818	55,0
Total	282	64978	1915014	**311019**	100,0

Table 1. Peat deposits according to area size

Peat soil	Number of peat deposits,	Industrial bog, area, ha	Peat resources		
			ths. m^3	ths. t, 40% of humidity	%
Low-moor peat	214	40588	969082	184099	59,0
Transitional-moor peat	10	698	16336	2487	1,0
High-moor peat	58	23693	929596	124433	40,0
Total	282	64978	1915014	311019	100,0

Table 2. Peat deposits classified by type of peat soil

District	Number of peat deposits		Area of industrial bogs, ha		Peat resources				Ratio of deposits, %	
	Total	Including lower fields	Total	Including lower fields	Total	Including lower fields	Total	Including lower fields	Total	Underlying peat
					тыс. м^3		тыс. тонн			
1.1.1 Багратионовск	21	-	1683	-	35352	-	6467	•	1,5	-
Gvardeyskiy	15	2	1400	117	47627	1953	8968	T97	3	0,4
Guryevskiy	25	1	6160	21	182841	260	34766	26	10	0,1
Gusevskiy	18	-	191	-	2611	-	562	-	0,1	-
Zelenogradskiy	12	-	571	-	8785	-	19Й8	-	0,5	-
Krasnoznamenskiy	7	4	4166	4014	159086	95200	17074	10997	8	20
Nemanskiy	17	2	623	44	9777	899	1910	82	0,5	0,2
Neserovskiy	25	1	1090	479	31800	16888	4863	1688	2	3,2
Ozerskiy	35	2	330	15	7790	336	1504	34	0,4	0,1
Polesskiy	26	4	11016	2800	385106	55000	66284	5500	20	12
Pravdinskiy	16	4	2756	2454	103684	88606	12400	8861	5	19
Slavskiy	43	8	32093	6787	856208	162956	143505	15899	45	35
Chernyakhovskiy	16	8	2953	1977	84347	45478	10728	4155	4	10
Total	288	36	64978	18710	1915014	467578	311019	46919	100,0	100,0

Table 3. Location of peat deposits

Appendix 4

Small-scale Hydropower sites in Kaliningrad Oblast.

Technical data for small-scale Hydropower stations after rehabilitation

№	River	Head, m	Water flow, m^3/s	Installed Capacity, kW	Electricity production, MWh
1.	r. Pissa - Yagodnoe settlement	3.0	1.1	26	221
2.	r. Pissa – Kalinin settlement	1.5	1,2	15	128
3.	r. Pissa – Ilinskoe settlement	2.5	1.6	32.	278
4.	r. Pissa – Sosnovka settlement	2.5	2.6	53	455
5.	r. Pissa – Ilyushino settlement	3	2.1	50	431
6.	r. Pissa – Gusev municipality	3	8.6	205	1 775
7.	r. Pissa – Priozerskoe settlement	2.5	9.3	185	1 602
8.	r. Krasnaya – Lipovo settlement	4	3.6	116	1 000
9.	r. Krasnaya – Gusevo settlement	2	3.6	58	500
10.	r. Krasnaya – Tokarevka settlement	1.5	2.7	33	282
И.	r. Angrapa – Putyatino settlement	3.0	10.6	253	2 190
12.	r. Melnichnaya – Znamenka s.	4.0	0.2	6	56
13.	r.Vilejkla – Ladushkino-Sovkhoznoe s.	2.0	0.1	2	14
14.	r.Vilejkla – Ladushkini s.	5.0	0.2	7	59
15.	r.Kornevka –Kornevo settelment	8.0	0.8	48	415
16.	r.Kornevka – Kornevo – Yujnoe s.	1.5	0.6	8	66
17.	r. Kornevka – Medovoe s.	1.5	1.4	16	141
18.	r. Jeleznodorojnaya - Jeleznodorojnij s.	7	1.5	86	746
19.	r. Putilovka – Mozir s.	3	1.9	46	396
20.	r. Lava – Znamensk municipality	2.5	40.8	816	7 050
21.	r. Bajdukovka – Tumanovka s.	5	0.4	16	139
22.	r. Rezvaya- Nadejdino-Borovoe s.	5	0.4	18	154
23.	r. Majskaya-Avgustovka settlement	3	0.5	12	106
24.	r. Sadovaya-Krasnovka settlement	2	0.1	1	6.9
25.	r. Primorskaya- Russkoe settlement	3	0.3	6	54
26.	r. Muchnaya-Krilovka settlement	5	0.3	13	114
27.	r. Svetlogorka – Svetlogorsk mun.	2.5	0.2	4	36
28.	r. Zabava- Romanovo settlement	3	0.2	4	33
29.	r. Slavnaya – Melnikovo s.	2	0.3	4	37
30.	r. Zelenogradka- Ozerovo s.	2.5	0.3	6	55
31.	r. Sheshupe-Krasnoznamensk mun.	6.0	30.0	1 200	7 100
32..	r. Lava- HPS No 3 in Pravdinsk mun.	13.5	124.0	10 990	66 000
33.	r. Lava- HPS No 4 in Pravdinsk mun.	4.2	64.0	2 080	11 800
34.	p. Angrapa – HPS in Ozersk mun.	5.0	10.0	500	3 000
	TOTAL:			**16 915**	**106 440**

Appendix 5

Wind power sites in Kaliningrad Oblast.

Table 2. Technical data for suitable wind power sites, 250 and 600 kW Installed Capacity

No	2. Location	**Area required, ha**	**Number of wind turbines**		**Total Installed Capacity, MW**		**Electricity production, MWh/year**	
			250 kW	600 kW	250 kW	600 kW	250 kW	600 kW
1	Shchukino	80	60	29	15	17.4	25.1	30.8
2	Mzmonovo	95	71	34	17.75	20.4	29.9	34.3
3	Krasnoflotskoe	90	67	32	16.75	19.2	29.2	34.1
4	Veseloe	150	112	54	28	32.4	51.5	62.6
5	Ladushkin	80	60	29	15	17.4	22.2	27.0
6	Ladigino	85	64	31	16	18.6	24.1	29.2
7	Opitnaya	30	23	И	5.75	6.6	6.4	7.5
8	Primorskaya	75	56	27	14	16.2	23.1	28.7
9	Okunevo	100	75	36	18.5	21.6	36.8	42.1
10	Yantarniy 1	100	75	36	18.75	21.6	36.8	43.4
11	Yantarniy 2	95	71	34	17.75	20.4	29.8	36.3
12	Donskoe	50	38	18	9.5	10.8	16.4	19.6
13	Sinyavino	87	65	31	16.25	18.6	30.9	36.5
14	Kulikovo	85	64	31	16	18.6	25.7	31.1
15	Kievskoe	250	186	89	46.5	53.4	67.2	83.2
16	Mis Ostriy	100	75	36	18.75	21.6	26.1	33.2
17	Zalivnoe	105	79	38	19.75	22.8	25.1	32.2
18	Iyulskoe	70	53	25	13.25	15	15.3	18.0
19	Polessk	150	112	54	28	32.4	30.4	36.8
20	Galovkino	120	90	43	225	25.8	23.9	28.1
21	Sovetsk	60	45	22	11.25	13.2	8.9	11.8
22	Ribachie	40	30	15	7.5	9	16.4	20.4
23	Baltic Spit	120	90	43	22.5	25.8	41.0	51.8
24	Morskoe	60	45	22	11.25	13.2	15.0	18.6
25	Pribreghiy	135	101	48	25.25	28.8	43.4	51.4
26	Svetliy	30	23	11	5.75	6.6	10.9	13.0
27.	Romanovo	45	34	16	8.5	9.6	11.4	13.3
28	Yasnoe	30	23	И	5.75	6.6	7.1	8.4
29	Timiryazevo	33	25	12	6.25	7.2	8.5	10.3
30	Gukovka	42	32	15	8	9	10.9	12.9
31	Ctepnoe	60	45	22	11.25	13.2	18.1	22.7
32	Russkoe	55	41	20	10.25	12	14.9	18.2
33	Rogkovo	43	32	16	8	9.6	10.3	12.8
34	Priboy	32	24	12	6	7.2	9.7	12.0
35	Irkutskoe	60	45	22	11.25	13.2	15.0	18.6

	TOTAL:	**2842**	**2113**	**1007**	**528.25**	**604.2**	**826.7**	**1002.3**