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

Arkhangelsk Fuel and Energy Balance

Draft Report

March 2007

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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
IFEB	Integrated Fuel and Energy Balance
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 Arkhangelsk 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. The RF Government realizes the importance of an integrated fuel and energy balance development for each Russian region for the purpose of energy situation analysis and projections. The RF Ministry of Industry and Energy has drafted an Executive Order and "Methodological recommendations on the development of projections of regional integrated fuel and energy balances, monitoring, and cooperation between federal and regional agencies of the Russian Federation". In this respect, the experience gained by the current project in Arkhangelsk, Astrakhan and Kaliningrad may provide recommendations to federal authorities for further development of methodological guidelines for Russian regions.

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;

[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.

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.

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 developing of an initial database for the energy balance. The statistical forms used are the following:

⇒ Three statistical forms to develop power balance parameters:

- "E-1" (Power balance of the economy, production, trade, consumption);
- "E-2" (Power consumption by major industries);
- "E-3" (Power consumption by major industrial sectors);

Since 2005, these have been replaced with two new forms:

- "23-N" (data on electricity generation and consumption);
- "24-energetika" (power plants electricity balance and performance reporting)

⇒ Several other statistical forms to develop power-, heat-, and fuel balances:

- "11 TER" (fuel, heat, and power use);
- "6 TP" (power and heat generation and fuel use in the power sector);
- "6-TP (hydro)" (data on hydropower plant operation);
- "6-TP (KES)" (data on electricity network operation);
- "PE" (data on the operation of thermal power plants owned by non-industrial organizations);
- "4-fuel" (data on fuel residues, supply and consumption, waste petroleum products collection and use);
- "22 ZhKH" (data on utilities' performance during the reform period, also containing partial information on heat-, natural gas-, and power consumption);
- Forms on heat generated by boiler houses and heat distribution systems.
- "1-TEK (oil)" and "2-TEK (gas)"

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. As a rule, they do not possess a comprehensive sector-wide picture even in the energy market sector they operate. 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.

1.3.3 DATA FROM ANALYTICAL STUDIES AND GOVERNMENT PROGRAMMES

Useful information on the state-of-the-art of the energy and housing & utility sectors may be found in reports and analytical papers of Arkhangelsk Oblast Government, such as “On the preparation of Arkhangelsk Oblast housing & utility sector for the operation in autumn-winter 2006/2007”; “On the results of 2005/2006 heat supply season”; “The results of operation of Arkhangelsk Oblast fuel & energy complex, housing & utility sector, and the Department of Fuel and Energy Complex and Housing and Utility Sector of Arkhangelsk Oblast Government in 2005”.

2 Analysis of the regional energy supply and demand

2.1 Power balance

2.1.1 POWER GENERATION

In 2005, in Arkhangelsk Oblast electricity was generated by 907 power plants with the total capacity of 2,023.3 thou. kW (Inventory "The energy capacity electricity consumption by Arkhangelsk Oblast enterprises in 2005"). According to the "6-TP" form, in 2005, the total capacity of all power plants in the Oblast with individual capacities above 500 MW equaled 1,879 MW (93% of the overall capacity). The share of 3 power plants of RAO "UES Rossii" is slightly over a half of overall installed capacity. The share of 5 largest power plants (with installed electric capacity between 189 and 450 MW) is 77% of installed capacity, and the share of 73 power plants of more than 500 MW each is 93%. The remaining 834 power plants include small diesel power plants with average installed capacity of 173 kW. These are responsible for practically all capacity increase in 2002-2005.

In the latest years, the RAO "UES Rossii" power plants have been responsible for 45 to 49% of overall electricity generation. The RAO "UES Rossii" power plants and industrial co-generation plants are responsible for 98% of the overall electricity generation in the Oblast (see Table 2.1).

Table 2.1 Basic operation parameters of Arkhangelsk oblast power plants (MW)

	2002	2003	2004	2005
Installed capacity (thou. kW)	1,778.8*	1,973.4	1,994.2	2,023.3
Electricity generation	6,203.2	6,585.6	6,832.4	7,112.3
RAO "EES Rossii" power plants	2,847.6	3,211.0	3,370.9	3,345.5
Industrial co-generation plants	3,203.9	3,211.5	3,328.3	3,627.9
Municipal power plants	93.7	97.2	83.5	87.7
Power plants of housing & utility companies	23.3	30.4	13.9	14.4
Transport power plants	1.2	2.7	1.7	0.5
Rural	17.4	17.6	15.6	14.9
Construction power plants	2.0	0.3	0.1	0.1
Other	14.1	19.4	18.4	21.3

* Excl. of small diesel power plants.
Source: "Energy capacity and electricity consumption by Arkhangelsk Oblast enterprises" for various years. Arkhangelskstat, Arkhangelsk.

The housing & utility sector is in the focus of the Arkhangelsk Oblast project; therefore, a special attention is given to the description of its state-of-the-art. Apart from boiler-houses, the Arkhangelsk Oblast housing & utility sector includes diesel power plants. In 2005, there were 8 municipal power plants and 80 diesel power plants owned by utilities. In the recent years, many of these have been operated by "Arkhangelsk Oblast Energy Company". However, power plants of RAO "UES Rossii" and industrial co-generation plants are responsible for the major share of electricity and heat generation for housing and utility needs.

"6-TP" is the major data source for the description of the electricity sector state-of-the-art; the tables of this form provide data on power and heat generation by power plants with the capacity above 500 kW; fuel consumption by these power plants and their efficiency; etc. This form served the basis for the development of the IFEB power sector tables (see Table 2.1). Many small diesel power plants are not included into this statistics. Processing the data of this form for Arkhangelsk Oblast turned out a very difficult task, because the power plants in the statistics are numerous (over 70 in 2005). The results of data processing are shown in Table 2.2.

Analysis of data from this table allows for the following findings:

- The share of RAO "UES Rossii" power plants in the electric capacity balance is slowly declining due to the growing share of industrial co-generation plants;
- The share of RAO "UES Rossii" power plants in electricity generation is also gradually declining;
- Electricity generation by large general use diesel power plants and by diesel power plants of industrial enterprises tends to grow on condition that more of these diesel power plants are associated gas-fired;
- In 2000-2005, electricity supply was dynamically growing: by 4.8% annually;
- Heat supply was growing more slowly: by 1.1% annually. As a result of this, the share of power generation in combined heat and power production somewhat declined, which led to the increase of average specific fuel consumption for power generation by RAO "UES Rossii" plants and its partial reduction at industrial co-generation plants;
- In 2000-2005, the share of natural gas in the electricity sector fuel balance increased by 2%, and the share of wood – by 3.8%, which allowed for partial replacement of fuel oil (1.5% reduction) and coal (2.6% reduction). Nevertheless, fossil fuels consumption by the electricity sector kept growing.

Table 2.2 Major characteristics of Arkhangelsk Oblast power plants

	Units	2000	2001	2002	2003	2004	2005	Share in 2005, %
Installed capacity	thou. kW	1,810	1,808	1,779	1,973	1,994	2,023	100.0%
RAO "UES Rossii" power plants	thou. kW	1,058	1,055	1,055	1,055	1,055	1,049	51.8%
Industrial co-generation plants	thou. kW	646	646	640	636	664	674	33.3%
Other general use power plants	thou. kW	38	37	36	42	59	75	3.7%
Other diesel power plants (>500 KW)	thou. kW	69	70	48	54	72	81	4.0%
Other diesel power plants (<500 KW)	thou. kW				186	145	145	7.1%
Installed capacity load (excl. small diesel power plants)	hours	3,102	3,561	3,447	3,636	3,655	3,745	
Electricity generation	mln. kWh	5,761	6,354	6,203	6,586	6,832	7,112	100.0%
RAO "EES Rossii" power plants	mln. kWh	2,585	3,,108	2,848	3,211	3,371	3,332	46.8%
Industrial co-generation plants	mln. kWh	2,956	2,993	3,115	3,090	3,121	3,284	46.2%
Other general use power plants	mln. kWh	81	88	94	93	116	218	3.1%
Other diesel power plants (>500 KW)	mln. kWh	54	80	76	105	153	203	2.9%
Other diesel power plants (<500 KW)	mln. kWh	86	86	86	86	71	76	1.1%
Electricity supply	mln. kWh	4,838	5,383	5,279	5,621	5,856	6,121	100.0%
RAO "EES Rossii" power plants	mln. kWh	2,164	2,648	2,416	2,752	2,902	2,856	46.7%
Industrial co-generation plants	mln. kWh	2,469	2,498	2,621	2,602	2,630	2,789	45.6%
Other general use power plants	mln. kWh	79	86	92	91	113	212	3.5%
Other diesel power plants (>500 KW)	mln. kWh	51	77	74	102	149	198	3.2%
Other diesel power plants (<500 KW)	mln. kWh	75	75	75	75	62	66	1.1%
Overall heat supply	th. Gcal	15,856	16,762	16,808	16,317	16,625	16,762	100.0%
RAO "UES Rossii" power plants	th. Gcal	4,949	5,867	5,867	5,612	5,776	5,729	34.2%
Industrial co-generation plants	th. Gcal	10,902	10,890	10,937	10,700	10,780	10,953	65.3%
Other general use power plants	th. Gcal	4	4	4	4	4	4	0.0%
incl. district boiler-houses	th. Gcal	4	4	4	4	4	4	0.0%
Other diesel power plants	th. Gcal	0	0	0	0	64	57	0.3%

(>500 KW)								
Own needs:	mln. kWh	911	972	925	964	976	991	
for electricity generation	mln. kWh	327	353	329	364	380	395	
for heat supply	mln. kWh	584	619	595	600	596	596	
Specific own needs consumption	%	15.8	15.3	14.9	14.6	14.3	13.9	
for electricity generation	%	5.8%	5.6%	5.4%	5.6%	5.6%	5.6%	
for heat supply	kWh/Gcal	36.8	36.2	35.6	36.1	35.3	34.9	
Total conventional fuel	thou. tce	4,233	4,486	4,490	4,552	4,697	4,764	100.0%
for electricity supply	thou. tce	1,436	1,662	1,607	1,739	1,838	1,923	40.4%
for heat supply	thou. tce	2,748	2,875	2,882	2,813	2,860	2,841	59.6%
natural gas	thou. tce	982	1,050	1,101	1,079	1,076	1,201	25.2%
petroleum products	thou. tce	1,296	1,454	1,363	1,385	1,467	1,396	29.3%
fuel oil	thou. tce	1,254	1,419	1,335	1,357	1,418	1,342	28.2%
diesel fuel	thou. tce	42	35	28	28	49	54	1.1%
coal	thou. tce	1,143	1,180	1,114	1,106	1,162	1,161	24.4%
wood	thou. tce	0	0	183	172	178	181	3.8%
other fuels	thou. tce	811	852	729	810	814	825	17.3%
Specific fuel consumption								
For electricity supply	kg/kWh	301.6	313.0	308.8	313.5	317.2	317.5	
For heat supply	kg/Gcal	173.3	171.5	171.5	172.4	172.0	169.5	

Source: Estimated based on "6-TP" for corresponding years.

2.1.2 POWER DISTRIBUTION

In 2005, in the course of the electricity sector reform, the following companies were established:

- OAO "Arkhangelskaya generation company" (heat and power generation and power sales)
- OAO "Arkhangelskaya sales company" (power sales);
- OAO "Arkhangelskaya electricity mains company" (electricity transportation). This includes five branches: "Arkhangelskiye electricity network", "Velskiye electricity network", "Kotlasskiye electricity network", "Mezenskiye electricity network", and "Plesetskiye electricity network".

Overall length of overhead and cable network of OAO "Arkhenergo" equalled 26,906 km in 2005, including:

overhead 220 kV lines	1,465 km;
overhead 110 kV lines	3,044 km;
overhead 35 kV lines	2,142 km;
overhead 6-10 kV lines	10,596 km;
overhead 0.4 kV lines	845 km;
cable 6-10 kV lines	1,051 km;
cable 0.4 kV lines	763 km.

In 2006, the length of electric lines (single-circuit) equalled 26,184 km, including 0.4 kV lines – 8,364 km; 6-10 kV – 11,138 km; 35-220 kV – 6,682 km. Because electric network construction and renovation is lagging behind, 5,377 km of overhead 0.4-10 kV electric lines are in unsatisfactory shape. The shape of overhead 35-220 kV lines is much better, than that of the distribution network.

The "bottlenecks" include:

- Single-circuit overhead lines of the main 220 kV network: if there is no fuel for co-generation plants and overhead lines fail, the energy system may have to work in isolation;
- Electricity supply to Onega city, Onezhsky, Pinezhsky, and a large part of Kholmogorsky regions through single-circuit and lengthy overhead 110 kV lines.
- According to the electricity balance, distribution losses in 2005 equaled 774 mln. kWh, or less than 10% of consumption. However, a large part of produced electricity (from

industrial co-generation plants) is not supplied to the grid. With this in mind, distribution losses in 2005 equalled 14.2%.

2.1.3 POWER BALANCE STATISTICS

Regional electricity balance for 2000-2005 built based on corresponding statistical forms is shown in Table 2.3. Table 2.3 however is not structured in the most effective way. For example, residential power consumption is represented both in the Utilities and Agriculture. Agriculture also includes commercial sector consumption for facilities located in the rural areas. Other Utilities line seems to include power consumption by boiler-houses. In the recent years (since 2005), previous electricity balance reporting forms were replaced with two new forms: "23-N" (data on electricity generation and consumption) and "24-energetika" (electricity balances and operation reports of power plants), with a new information submission structure as determined by transition from OKONKh to OKVED classification. Considerable restructuring of the Table 2.3 data is required to develop end-use sectors electricity consumption concept for the IFEB.

Electricity consumption increased in 2005 by 3.4% and in 2006 by 3.2%. However, useful supply dynamics is different: 3.6% growth in 2005 and 5.7% decline in 2006. In reality, there was no decline: merely since 2006, apart from the own needs of RAO "UES Rossii" power plants, the "Own needs" line includes the own needs of industrial co-generation plants (533.6 mln. kWh in 2005), and besides, more companies are required to report distribution losses. Distribution losses now include on-site losses of industrial enterprises (130 mln. kWh in 2005). While according to "11-TER", distribution losses have dropped.

Table 2.3 Arkhangelsk Oblast electricity balance based on statistical forms (mln. kWh)

	2000	2001	2002	2003	2004	2005
Electricity generation	5,710.0	6,305.9	6,203.2	6,585.6	6,832.4	7,112.3
Electricity import	1,574.0	1,353.8	1,546.1	1,316.2	1,364.9	1,336.8
Electricity export	178.1	243.5	216.4	261.4	299.1	294.6
Self-sufficiency (%)	80.4%	85.0%	82.3%	86.2%	86.5%	87.2%
Electricity consumption	7,105.9	7,416.2	7,532.9	7,640.4	7,898.2	8,154.5
Increase rate (%)		4.4%	1.6%	1.4%	3.4%	3.2%
Overall distribution losses	655.4	699.2	701.3	678.9	686.6	774.1
Share in overall consumption (%)	9.2%	9.4%	9.3%	8.9%	8.7%	9.5%
Power sector own needs	422.8	462.5	433.2	461.6	475.3	1,031.0
Electricity consumption	6,027.7	6,254.5	6,398.4	6,499.9	6,736.3	6,349.4
Increase rate (%)		3.8%	2.3%	1.6%	3.6%	-5.7%
Industrial consumption, excl. own needs	3,483.0	3,675.2	3,640.2	3,675.1	3,880.5	4,006.0
Fuel sector	24.1	154.4	176.1	225.4	307.0	
Ferrous Metallurgy	0.7	0.5	0.6	0.7	0.8	
Non-Ferrous Metallurgy	7.6	7.2	7.2	9.0	10.6	
Chemical and Petrochemical	2.6	2.6	2.6	2.7	4.4	
Machine building and Metal working	279.9	298.9	287.5	295.2	317.6	
Timber, Wood, and Pulp&Paper	2,938.3	2,975.8	2,925.7	2,911.3	2,968.6	
Building Materials	68.6	75.3	84.2	106.5	113.0	
Glass and porcelain industry	0.0	0.0	0.0	0.0	0.0	
Light industry	12.1	12.2	11.2	4.8	4.2	
Food industry	45.8	45.7	50.9	50.2	48.4	
Other	103.5	102.7	94.1	69.3	105.9	
Construction, total	75.7	83.6	88.3	78.0	83.9	214.7
incl. drilling of oil- and gas-wells	10.9	20.7	22.1	19.4	20.0	
Utilities, total	970.2	940.2	932.4	940.4	1016.7	
incl. lighting and household needs of urban population	588.9	546.3	542.4	522.2	581.4	551.0
lighting in cities and towns	19.4	17.0	19.5	16.7	19.0	29.9
water supply and sewage	129.6	107.9	101.7	111.9	109.4	104.9
other utilities	232.3	269.0	268.8	289.6	306.9	

	2000	2001	2002	2003	2004	2005
Agriculture, total	453.6	445.8	438.6	440.3	426.0	351.9
incl. for technology needs	155.2	128.9	124.5	112.1	98.2	123.7
lighting and household needs of rural population	147.4	149.8	157.2	160.2	154.5	228.2
post-offices and telecommunication agencies; storages	151.0	167.1	156.9	168.0	173.3	
Transport, total	439.3	469.9	524.0	580.8	689.2	673.3
railway, water, air, and automobile	399.5	433.9	488.1	545.1	634.8	616.7
railway	284.5	315.8	377.3	422.0	543.5	563.0
incl. for electric traction	208.3	240.4	302.8	343.7	437.1	426.9
metro, trams, trolleybuses	18.3	18.2	13.8	11.9	9.7	6.9
oil pipelines	1.5	2.2	4.9	5.8	25.6	0.1
natural gas pipelines	20.0	15.6	17.2	18.0	19.1	19.8
Communication						29.8
Post offices and telecommunication agencies; culture agencies; health care and trade institutions	605.9	639.8	677.8	661.5	640.0	405.6

Sources: forms “E-1”, “E-2”, and “E-3”. “Energy capacity and electricity consumption by Arkhangelsk Oblast enterprises for various years”. Arkhangelskstat. Arkhangelsk.

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 mining (471.8 mln. kWh in 2005), manufacturing (3533.0 mln. kWh in 2005), and utilities (electricity, gas, and water production and distribution – 1716.8 mln. kWh in 2005). Apart from these, there are data on agricultural, transport, and communication consumption (see the 2005 column in Table 2.3).

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 data series by sectors for 2005. Other statistical forms are to be used to develop a comprehensive intense power balance.

2.1.4 “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. “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.

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 2.4).

[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.

Table 2.4 Arkhangelsk Oblast power balance based on Form "11-TER" (mln kWh)

	2000	2001	2002	2003	2004	2005
Electricity supply	4,768.4	5,314.0	5,225.1	5,548.0	5,745.2	5,882.7
Power plants	4,715.3	5,250.8	5,147.9	5,476.2	5,692.7	5,832.6
Diesel power plants	53.1	63.1	77.2	71.8	52.5	50.1
Electricity and heat sectors' own needs	39.3	54.4	73.4	96.4	112.1	104.6
For electricity generation at power plants				0.4	0.3	
For heat generation by industrial and district boiler-houses	36.8	44.5	66.3	95.3	110.2	103.6
For heat supply by agricultural boiler-houses	2.2	9.7	7.1	0.8	0.7	
For heat supply by agricultural electric boiler-houses	0.3	0.1	0.1	0.01	0.9	0.9
Electricity transmission / distribution losses	642.0	692.2	687.6	663.8	695.3	642.4
Industry	2,057.1	2,134.7	2,203.5	2,236.6	2,661.4	2,872.0
Oil extraction, including gas condensate					132.0	194.7
On-site oil treatment	24.1	41.8	48.4	58.8	69.1	75.7
Oxygen	1.7	4.0	4.9	5.3	5.0	4.4
Compressed air	29.9	27.2	28.2	28.8	29.8	33.7
Electric steel	2.7	3.1	2.9	2.4	3.4	3.6
Harvesting and primary processing of wood	40.4	38.0	42.7	30.3	25.2	20.1
Wood drying	26.2	30.1	34.3	33.3	42.6	41.3
Pulp – total	1,032.7	1,066.5	1,078.6	1,087.4	1,127.3	1,166.5
Paper	365.1	373.6	386.2	401.8	404.9	411.2
Cardboard	403.2	428.3	445.6	454.0	463.0	493.5
Cement – total	0.0	0.0			94.9	47.5
Clinker	0.1	0.0				51.0
Meat (including 1st category subproducts)	0.4	2.9	10.3	15.5	9.3	9.1
Bread and bakery products	23.7	27.2	27.8	26.7	25.7	22.5
Water raise and supply (excl. municipal utility needs)	53.2	51.8	53.1	55.7	63.0	66.7
Effluent treatment	53.8	40.1	40.6	36.5	34.3	35.6
Transport	258.9	543.1	483.6	521.3	659.7	679.6
Natural gas transmission	23.7	190.8	24.4	27.8	31.2	32.4
Electric traction of railway trains (Ministry of Transport)	179.6	265.7	371.6	406.8	525.3	549.7
Operation of railways (Ministry of Transport), excl. electric traction	37.6	69.0	74.2	75.1	93.9	91.4
Electric traction of trams	11.8	12.0	8.8	6.2	3.8	
Electric traction of trolleybuses	6.2	5.6	4.7	5.5	5.6	6.1
Agriculture	6.1	6.1	12.5	5.9	4.9	3.5
Space heating in greenhouses	3.7	0.1	5.4			
Water pumping for melioration and water supply	2.2	0.2	7.1	5.1	0.3	0.2
Space heating in greenhouses (winter)	0.3	5.8	0.1	0.8	4.6	3.3
Construction	0.0	0.0	0.0	0.0	6.2	0.0
Operation drilling of oil- and gas wells					6.2	
Utilities	320.6	298.6	371.7	219.5	216.6	225.2
Other industrial consumption	992.0	1,033.8	812.6	931.0	665.2	520.9
Residential	1,130.6	864.8	714.8	910.6	756.5	740.4
Overall consumption	4,804.6	4,935.7	4,672.2	4,921.2	5,082.6	5,146.0
Of total consumption in Table 2.2 (%)	67.6%	66.6%	62.0%	64.4%	64.4%	63.1%
Of useful consumption in Table 2.2 (%)	79.7%	78.9%	73.0%	75.7%	75.5%	81.0%

Source: Form "11 TER" for various years

Not all data dynamics and values for Arkhangelsk Oblast can be viewed as reliable. For example, residential electricity consumption instability may only be explained by the fact that in separate years this indicator may have included "consumption in settlements", which, apart from residential consumption, includes commercial and other sectors. Data on electricity consumption in oil extraction and cement production are only available for the period since 2004. A significant part of electricity consumption in agriculture and construction is not included in the breakdown. Generally, this form reflects around 80% of final electricity use. Small consumers do not report the data required in this form. This form indicates residential consumption in 2005 39 mln kWh lower, than the electricity balance statistics.

2.1.5 "22-ZHKH" DATA

"22 ZhKH" gives only three figures: overall electricity sales (3,653 mln. kWh in 2005), including to the residential sector (709 mln. kWh) and social facilities (1,038.5 mln. kWh). This form shows the lowest value for residential electricity consumption: 70 mln. kWh lower than in the energy balance. According to this form, residential electricity consumption in 2002-2005 was growing by 1.8% annually. The share of residential electricity consumption in Nenetsky autonomous county equals 25.4 mln. kWh.

2.1.6 COMPARATIVE ANALYSIS OF POWER BALANCE DATA TAKEN FROM DIFFERENT SOURCES

Before developing the regional power balance for its further integration in the Fuel and Energy Balance, it is important to compare data from Tables 2.1-2.4 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 2.5). They root in different approaches to the coverage and classification of consumers. Therefore it is necessary developing an integral electricity balance based on *the integration* of all available data.

Table.2.5 Comparison of major indicators of the regional power balance (mln kWh)

	2000	2001	2002	2003	2004	2005
Electricity generation						
Statistics – "6-TP"	5,761.2	6,354.4	6,203.2	6,585.6	6,832.4	7,112.3
Statistics – electricity balance	5,710.0	6,305.9	6,203.2	6,585.6	6,832.4	7,112.3
Distribution losses						
Statistics – electricity balance	655.4	699.2	701.3	678.9	686.6	774.1
Statistics – "11-TER"	642.0	692.2	687.6	663.8	695.3	642.4
Own needs						
Statistics – "6-TP"	911.1	971.6	924.6	964.3	976.2	991.0
Statistics – electricity balance	422.8	462.5	433.2	461.6	475.3	1,031.0
Useful electricity consumption						
Statistics – electricity balance	6,027.7	6,254.5	6,398.4	6,499.9	6,736.3	6,349.4
Statistics – "11-TER"	4,804.6	4,935.7	4,672.2	4,921.2	5,082.6	5,146.0
Residential electricity consumption						
Statistics – electricity balance	736.3	696.1	699.6	682.4	735.9	779.2
Statistics – "11-TER"	1,130.6	864.8	714.8	910.6	756.5	740.4
Statistics – "22 ZhKH"			671.4	649.9	687.5	709.0

Source: Data from Tables 2.1-2.4

Based on the data from Table 2.5, in certain instances, and very carefully, we can judge on the accuracy of metering for the Oblast electricity balance. Before 2005, distribution losses metering error equalled 1-2%, but in 2005 it increased up to 20%. This growth is determined by the fact, that statistics started to account for distribution losses within industrial plants (130.2 mln kWh in 2005) and for losses at power plants of utility suppliers. At the same time, RAO "UES Rossii" distribution losses in the energy balance are the same as in "11-TER" form.

For residential electricity consumption in 2004-2005, statistical error is 10%. It may be even higher. For an unknown reason, residential consumption data for Arkhangelsk Oblast have an inverse correlation with the number of degree-days of the heat supply season (see Fig. 2.1). There is no rational explanation of this fact, and therefore, it is just another proof of the low quality of statistics. Using residential electricity consumption data we find that monthly per capita consumption only equals 45-50 kWh. It is almost 27-40% lower than the average value for Russia, and this against the background of a quite cold and long winter in Arkhangelsk Oblast. Seems that residential electricity consumption is considerably underestimated in the statistics.

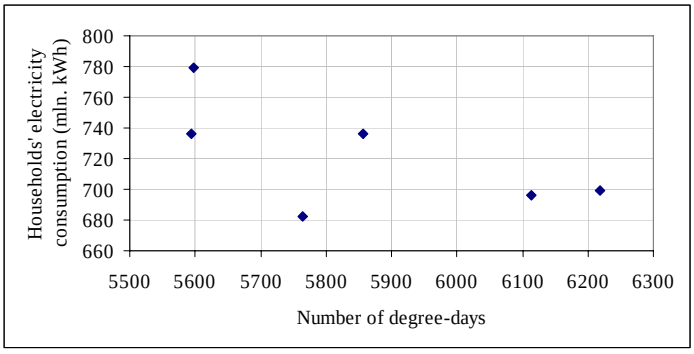


Fig. 2.1 Correlation between residential electricity consumption in 2000-2005 and the number of degree-days of the heat supply season

For some indicators the data from the electricity balance and "11-TER" form considerably and inexplicably differ, for others "11-TER" form does not provide any data. For example, electricity consumption by gas mains is shown differently by these two sources, while information on electricity consumption in oil extraction and cement production in 2000-2004 is missing. Electricity consumption statistics in Arkhangelsk Oblast must be considerably improved.

2.1.7 INTEGRATED POWER BALANCE OF ARKHANGELSK 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. It has sufficient degree of detail for further analysis. It also accounts for the recent changes in the power consumption statistics.

2.1.8 THE BLOCK OF POWER RESOURCES

The block of electricity resources includes electricity generation by RAO "EES Rossii" power plants, industrial power plants, and diesel power plants, as well as through electricity trade balance. Electricity self-sufficiency of Arkhangelsk Oblast has been growing recently and reached 87% in 2005.

With maximum use of the "6-TP" data a section of the block of electricity resources was developed (see Table 2.6).

Table 2.6 Electricity resources for Arkhangelsk Oblast (mln. kWh)

	2000	2001	2002	2003	2004	2005
Electricity generation	5,761.2	6,354.4	6,203.2	6,585.6	6,832.4	7,112.3
RAO "EES Rossii" power plants	2,584.8	3,107.8	2,847.6	3,211.0	3,370.9	3,331.7
Industrial co-generation plants	2,955.7	2,992.5	3,114.9	3,090.5	3,120.7	3,283.5
Other general use power plants	80.9	87.9	93.7	92.7	116.4	218.0
Other diesel power plants (>500 kW)	53.7	80.1	75.8	105.3	153.2	202.7
Other diesel power plants (<500 kW)	86.1	86.1	86.1	86.1	71.3	76.4
Electricity import	1,574.0	1,353.8	1,546.1	1,316.2	1,364.9	1,336.8

	2000	2001	2002	2003	2004	2005
Electricity export	178.1	243.5	216.4	261.4	299.1	294.6
Electricity trade balance	1,395.9	1,110.3	1,329.7	1,054.8	1,065.8	1,042.2
Self-sufficiency (%)	80.5%	85.1%	82.3%	86.2%	86.5%	87.2%
Total consumption	7,157.1	7,464.7	7,532.9	7,640.4	7,898.2	8,154.5
Increase rate (%)		4.3%	0.9%	1.4%	3.4%	3.2%

Source: Data from Tables 2.1-2.3

2.1.9 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 2.7).

Table 2.7 Power consumption during energy transformation, transmission, and distribution (mln kWh)

	2000	2001	2002	2003	2004	2005
Overall resources for consumption	7,157.1	7,464.7	7,532.9	7,640.4	7,898.2	8,154.5
Own needs of power plants	911.1	971.6	924.6	964.3	976.2	991.0
electricity generation	327.3	352.8	329.1	364.1	379.7	395.3
heat supply	583.8	618.7	595.5	600.2	596.5	595.7
Share in electricity generation (%)	15.8%	15.3%	14.9%	14.6%	14.3%	13.9%
Supply to the grid	6,246.0	6,493.2	6,608.3	6,676.1	6,922.0	7,163.5
Transmission / distribution losses	655.4	699.2	701.3	678.9	686.6	774.1
Share in electricity supply to the grid (%)	10.5%	10.8%	10.6%	10.2%	9.9%	10.8%
Useful electricity supply	5,590.6	5,794.0	5,907.0	5,997.2	6,235.4	6,389.4
Increase rate (%)		3.6%	2.0%	1.5%	4.0%	2.5%
Electricity consumption for heat generation in boiler-houses	39.3	54.4	73.4	96.1	111.8	104.6
End-use electricity consumption	5,551.2	5,739.6	5,833.6	5,901.2	6,123.6	6,284.8
Increase rate (%)		3.4%	1.6%	1.2%	3.8%	2.6%

Source: Consultant's estimates based on the data of Tables 2.1-2.6.

Transmission losses data were taken from the electricity balance statistics, own needs consumption data originated from the form "6-TP", and consumption by boiler-houses comes from form "11-TER". The contrast between overall and useful electricity consumption dynamics is not to be disregarded (see Tables 2.6 and 2.7). 77% of overall electricity resources are consumed by end-users.

2.1.10 THE BLOCK OF POWER END-USE

The block of electricity end-use was developed with an account of the recent changes in the electricity consumption statistics (introduction of OKVED), and keeping in mind that "11-TER" was not affected by these changes. So the data were compiled from various sources (see Table 2.8).

Table 2.8 Useful electricity supply breakdown for Arkhangelsk Oblast (mln kWh)

	2000	2001	2002	2003	2004	2005	Share in 2005
End-use electricity consumption	5,551.2	5,739.6	5,833.6	5,901.2	6,123.6	6,284.8	100.0%
Industry	3,196.9	3,381.8	3,402.8	3,464.2	3,552.9	3,405.8	54.2%
Oil extraction, including gas condensate	0.0	0.0	0.0	0.0	132.0	194.7	3.1%
On-site oil treatment	24.1	41.8	48.4	58.8	69.1	75.7	1.2%

	2000	2001	2002	2003	2004	2005	Share in 2005
Oxygen	1.7	4.0	4.9	5.3	5.0	4.4	0.1%
Compressed air	29.9	27.2	28.2	28.8	29.8	33.7	0.5%
Electric steel	2.7	3.1	2.9	2.4	3.4	3.6	0.1%
Harvesting of wood, wood processing and drying	66.6	68.1	77.0	63.6	67.7	61.4	1.0%
Pulp	1,032.7	1,066.5	1,078.6	1,087.4	1,127.3	1,166.5	18.6%
Paper	365.1	373.6	386.2	401.8	404.9	411.2	6.5%
Cardboard	403.2	428.3	445.6	454.0	463.0	493.5	7.9%
Cement and clinker	0.1	0.0	0.0	0.0	94.9	98.5	1.6%
Meat (incl. 1st category subproducts)	0.4	2.9	10.3	15.5	9.3	9.1	0.1%
Bread and bakery products	23.7	27.2	27.8	26.7	25.7	22.5	0.4%
Water raise, supply, and treatment (excl. for utility needs)	107.0	91.9	93.7	92.3	97.2	102.4	1.6%
Other	1,139.8	1,247.0	1,199.3	1,227.7	1,023.6	728.5	11.6%
Construction	75.7	83.6	88.3	78.0	83.9	214.7	3.4%
incl. for oil and gas wells drilling	10.9	20.7	22.1	19.4	20.0		0.0%
Fishery						12.8	0.2%
Agriculture	155.2	128.9	124.5	112.1	98.2	123.7	2.0%
Transport	439.3	469.9	524.0	580.8	689.2	673.3	10.7%
Railway, water, air, and automobile	399.5	433.9	488.1	545.1	634.8	0.0	0.0%
incl. railway	284.5	315.8	377.3	422.0	543.5	563.0	9.0%
incl. for electric traction	208.3	240.4	302.8	343.7	437.1	426.9	6.8%
metro, trams, trolleybuses	18.3	18.2	13.8	11.9	9.7	6.9	0.1%
oil pipelines	1.5	2.2	4.9	5.8	25.6	0.1	0.0%
gas pipelines	20.0	15.6	17.2	18.0	19.1	19.8	0.3%
Utility sector	342.0	339.5	316.6	322.1	323.5	435.3	6.9%
Lighting in cities and towns	19.4	17.0	19.5	16.7	19.0	29.9	0.5%
Municipal water supply and sewage	129.6	107.9	101.7	111.9	109.4	104.9	1.7%
Other utilities (excl. boiler-houses)	193.0	214.6	195.4	193.5	195.1	300.5	4.8%
Commercial	605.9	639.8	677.8	661.5	640.0	640.0	10.2%
Residential	736.3	696.1	699.6	682.4	735.9	779.2	12.4%

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

Industry (54.2%), and primarily pulp&paper, is the main electricity consumer. Residential and commercial sectors are responsible for only 22.6% of electricity end-use. Transport is responsible for 11% of electricity consumption, followed by the utility sector. Abrupt electricity consumption increase in construction and "other utilities" results from the change in the statistics system and re-allocation of electricity consumption by "other industrial consumers". Residential electricity consumption growth is determined by relatively cold weather. Local experts estimate electricity consumption for space heating in winter at 15% of overall residential consumption.

A combination of Tables 2.6-2.8 provides a comprehensive Arkhangelsk Oblast electricity balance. In 2006, electricity consumption increase equaled 2.5%.

2.2 Heat balance

"11-TER", "22-ZhKH", and statistical yearbook "Arkhangelsk Oblast housing stock and municipal utilities in 2005", as well as analytical papers of the Oblast government and "Arkhenergo" are the basic sources for heat balance development. Conflicting and poor data on heat generation and consumption, taken from different information sources, considerably complicate development of a heat balance.

2.2.1 THE BLOCK OF HEAT RESOURCES

The most complete information on heat generation by power plants and peak boiler-houses is provided in the from "6-TP"; by all heat sources in the form "11-TER"; and by boiler-houses in the statistical yearbook "Arkhangelsk Oblast housing stock and municipal utilities in 2005". These statistical forms were taken as the basis for heat resources evaluation (see Table 2.9).
As of early 2006, there were 985 heat sources with 2,888 boilers in Arkhangelsk Oblast. Most of them (84%) are small boilers with the capacity below 3 Gcal/hour. The number of such boiler-houses has been steadily declining in the recent years. In 2001-2005, 133 such boiler-houses were closed down. In 2005, only 67 boiler-houses were gas-fired, 52 liquid fuel-fired, and the remaining 865 (mostly small ones) coal- and wood-fired, often with manual fuel supply to outdated, extremely inefficient (50-60% efficiency) boilers, long prohibited by Rostechnadzor for operation.
In 2001-2005, heat generation in Arkhangelsk Oblast kept at approximately the same level. Power plants are the major heat source in the Oblast (72.4%), followed by boiler-houses (24,9%) and heat recovery units (2.8%), which use recovered heat in the pulp&paper industry and in gas pipelines. Due to the decentralization of heat supply, boiler-houses are continuously replacing power plants as heat sources.

Table 2.9 Heat generation in Arkhangelsk Oblast (thou. Gcal)

	2000	2001	2002	2003	2004	2005	Share in 2005
Heat supply by power plants	15,851	16,757	16,804	16,313	16,621	16,738	72.5%
RAO "EES Rossii" power plants	4,949	5,867	5,867	5,612	5,776	5,729	24.8%
Industrial co-generation plants	10,902	10,890	10,937	10,700	10,780	10,953	47.5%
Other diesel power plants (>500 kW)	0	0	0	0	64	57	0.2%
Heat supply by boiler-houses	4,102	4,617	5,452	4,633	5,531	5,730	24.9%
Heat generation by boiler-houses	3,959	4,466	5,342	4,602	5,507	5,707	24.8%
Industrial and district	642	692	688	664	695	11	0.0%
incl. district	585	735	760	688	711	642	2.8%
Agricultural boiler-houses	142	151	108	30	22	22	0.1%
Electric boiler-houses	2	0	2	1	1	1	0.0%
Heat supply by heat recovery units	524	647	589	548	602	602	2.6%
Pulp&paper plants			453	448	501	510	2.2%
Gas pipelines			131	95	98	88	0.4%
Other units	0	1	1	1	1	3	0.0%
Total	20,478	22,022	22,846	21,495	22,756	23,073	100.0%
Increase rate (%)		7.5%	3.7%	-5.9%	5.9%	1.4%	

Source: "6-TP" and "11-TER" forms.

2.2.2 HEAT CONSUMPTION DURING ENERGY TRANSFORMATION, TRANSMISSION, AND DISTRIBUTION

Importantly, heat consumption for heat sources' own needs is not reflected in the statistics. Therefore, transmission and distribution heat losses are the major indicator of this heat balance section. Statistical data show, that the length of the heat network in Arkhangelsk Oblast declined in 2001-2005 from 2,193 km (two-pipe network) to 2,076 km. Heat distribution network with the diameter below 200 mm (with low heat loads) dominates: 1,573 km, or 76%. In 2006, 51 km of heat network, or only 3%, were replaced. Insufficient replacement rates of dilapidated heat network resulted in 2001-2005 in 202 km increase of pipes, which need replacement, to reach 728 km, or by 35% of their overall length.

"11-TER" only provides data on heat transmission losses, which have considerably grown lately, but their share is not large (see Table 2.10). The real share of losses is much higher. First, because apart from transmission heat losses, distribution heat losses must be taken into

account. Second, because a lot of heat generated by industrial co-generation plants is not even supplied to the transmission network, but consumed on-site. And third, because the shape of the heat network is much poorer, than required by the norms.

"Arkhangelsk Oblast housing stock and municipal utilities" statistical yearbook indicates the share of heat transmission and distribution losses at 8.9%. This estimate seems reliable, if we assume, that distribution losses equal on average 15% of heat supply to the residential and utilities sectors (see Table 2.10).

Table 2.10 Evaluation of heat transmission and distribution losses (thou. Gcal)

	2000	2001	2002	2003	2004	2005
Heat supply by power plants and boiler-houses	19,954	21,374	22,256	20,946	22,152	22,468
Transmission losses	585	735	760	688	711	880
Share of losses (excl. heat recovery units)	2.9%	3.4%	3.4%	3.3%	3.2%	3.9%
Heat supplied to distribution networks (for residential or municipal utilities needs)	9,100	7,263	7,194	6,656	7,333	7,237
Share of heat supply by power plants and boiler-houses	45.6%	34.0%	32.3%	31.8%	33.1%	32.2%
Share of distribution losses	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Distribution losses	1,365	1,089	1,079	998	1,100	1,086
Total transmission and distribution losses	1,950	1,824	1,839	1,686	1,811	1,965
Share of losses, total	9.8%	8.5%	8.3%	8.1%	8.2%	8.7%

Sources: "11-TER" and Statistical yearbook "Arkhangelsk Oblast housing and municipal utilities" for various years.

In Arkhangelsk city, nearly 70% of heat pipes are placed in reinforced concrete channels with mineral wool insulation and in steel above- and underground pipework with glass wool insulation covered with ruberoid or tin. In some city districts, pipework is still placed in wooden chests. Underground pipes with glass wool insulation covered with ruberoid are swimming in water in spring and autumn, because subsoil waters are high and aggressive, and drainage is missing or not operating. Average lifecycle of such pipes is only 5-8 years. Insulation is often damaged leading to heat losses increase. Heat losses resulting from water leaks are also high. In general, local experts estimate heat distribution losses (for residential houses and other municipal facilities) for Arkhangelsk city at 30-35%. For the industrial sector they are obviously lower. It looks like unaccounted heat losses may be estimated at 15% of heat consumption by residential and utility sectors.

2.2.3 THE BLOCK OF HEAT END-USE

The block of heat end-use should reflect unaccounted heat distribution losses. An assumption was made, that all statistically accounted heat losses relate to industrial and other "production sector" consumption, while all unaccounted losses are attributed to the utility and services sector, as well as to the residential one in proportion to their respective heat consumptions. For these sectors, unaccounted heat losses are specified in a separate line (see Table 2.11). It turned out, that residential heat consumption is 16% below the statically accounted value. This is a normal difference between estimated and actual (metered) levels of heat consumption in Russian residential buildings. Values verified for unaccounted losses much more accurately reflect the real situation in heat consumption.

Table 2.11 Heat consumption in Arkhangelsk Oblast (thou. Gcal)

	2000	2001	2002	2003	2004	2005	Share in 2005
Industry	10,229	13,316	14,333	13,715	14,178	14,420	65.0%
Oil extraction, including gas condensate	0	0	47	58	645	904	4.1%
Harvesting of wood, primary processing and drying	351	496	496	427	435	404	1.8%
Pulp	6,479	6,600	6,670	6,544	6,812	6,954	31.3%
Paper	809	813	852	873	872	882	4.0%
Cardboard	1,286	1,311	1,293	1,339	1,394	1,458	6.6%
Cement and clinker	1	0	0	11	0	14	0.1%
Meat	3	7	13	34	12	19	0.1%
Bread and bakery products	40	52	41	32	37	34	0.2%
Water raise, supply and treatment (excl. municipal utility needs)	10	11	8	9	12	9	0.0%
Other industrial consumption	1,249	4,025	4,912	4,389	3,959	3,741	16.9%
Transport and communication	173.9	328.7	177.7	143.3	250.6	243.3	1.1%
Railway operation needs	74.6	172.3	94.3	90.8	196.0	193.2	0.9%
Gas transportation through gas mains	99.3	156.5	83.4	52.5	54.6	50.1	0.2%
Agriculture	320.0*	310.0*	310.9	236.6	245.0	240.2	1.1%
Greenhouse heating	115.5	171.5	145.2	124.9	122.2	111.1	0.5%
Construction	70.0*	70.0*	70.6	56.2	37.6	52.8	0.2%
Oil and gas wells drilling					28.5		0.0%
Utility and services sector ("22-ZhKH)	3,000	1,708	1,725	1,428	1,901	1,782	8.0%
Municipal utility sector	750	427	431	357	475	446	2.0%
Commercial	2,250	1,281	1,293	1,071	1,426	1,337	6.0%
Unaccounted losses	2,550	1,452	1,466	1,213	1,616	1,515	6.8%
Consumption	450	256	259	214	285	267	1.2%
Residential – "22 ZhKH"	6,100	5,555	5,470	5,228	5,432	5,455	24.6%
Space heating						4,066	18.3%
Hot water supply						1,346	6.1%
Unaccounted losses	5,185	4,722	4,649	4,444	4,617	4,637	20.9%
Consumption	915	833	820	784	815	818	3.7%
Total useful consumption	19,893	21,287	22,086	20,807	22,045	22,193	100.0%
Same, excl. unaccounted losses	18,528	20,198	21,007	19,808	20,945	21,108	95.1%
Increase rate (%)		9.0%	4.0%	-5.7%	5.7%	0.8%	

* Lack of information did not allow it to comprehensively reflect heat consumption in agriculture and construction. Partially heat consumption by these sectors is shown in "other industrial consumption". Figures marked with * show the consultant's estimates.
Sources: Forms "11-TER" and "22-ZhKH".

The industrial sector (basically, pulp&paper) is responsible for 65% of heat consumption. The residential and municipal utility sectors are responsible for one third of total useful heat consumption. According to "22-ZhKH", residential heat consumption in 2005 equaled 5,455 thou. Gcal, and according to "11-TER" – 4,712 thou. Gcal. Analysis of correlation between heat consumption and the number of degree-days of the heat supply season showed, that residential heat consumption in 2000 is overestimated, while in 2003, on the contrary, underestimated. According to the statistics, useful heat consumption in Arkhangelsk Oblast is slowly growing. On average, in 2000-2005, annual heat consumption growth equaled 2.5%. However, while the data on heat consumption scale may be viewed as relatively reliable, the data on heat consumption dynamics are absolutely unreliable.

2.3 Natural gas balance

2.3.1 THE BLOCK OF NATURAL GAS RESOURCES

Small amounts of associated gas are only extracted in Nenetsky autonomous county. In 2004, 551 mln. m3 were extracted (see Table 2.12). All this gas is consumed locally. Export gas pipeline "Severnoye Siyaniye" in the south of Arkhangelsk Oblast is he second largest source of natural gas. Before 2006, gasification in the Oblast was very slow: construction of the first part of gas pipeline Nyuksenitsa – Arkhangelsk (to Velsk, 147 km) took 12 years. Construction was pushed after the government decision to supply gas to Plesetsk cosmodrome. The second part of the gas pipeline (from Velsk to Plesetsk, 220 km) was built in 2006 and only took less than a year. Arkhangelsk Oblast government is hoping that these rates will persist, and in 2 or 3 years Arkhangelsk and Severodvinsk industrial sectors will have access to natural gas supply.

Table 2.12 Natural gas resources (mln. m3)

	2000	2001	2002	2003	2004	2005
Production	206.0	338.0	436.0	453.0	551.0	640.2
Gas import	1,660.1	1,992.7	1,666.6	1,675.8	1,845.4	1,929.8
Resources available for consumption	1,866.1	2,330.7	2,102.6	2,128.8	2,396.4	2,570.0

*Consultant's estimates
Sources: Arkhangelsk Oblast Statistical Yearbook-2006. "11-TER" and "4-TP" forms.

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

Co-generation plant of Kotlassky Pulp & Paper Combine is the largest natural gas consumer in Arkhangelsk Oblast. Besides, natural gas is used by small co-generation plants and gas-fired power plants of Nenetsky autonomous county and by "Polyarnoye Siyaniye" gas pipeline. Data on natural gas consumption in energy transformation, transmission, and distribution processes were taken from forms "6-TP" and "11-TER" (see Table 2.13). These data are somewhat inconsistent in terms of gas consumption by power plants. Nevertheless, power and heat generation are obviously responsible for half of all natural gas consumption in the Oblast.

Table 2.13 Natural gas consumption in Arkhangelsk Oblast (mln. m3)

	2000	2001	2002	2003	2004	2005	Share in 2005
Resources available for consumption	1,866.1	2,330.7	2,102.6	2,128.8	2,396.4	2,570.0	100.0%
Power plants – "6-TP"	852.6	912.2	957.2	938.7	935.7	1044.2	41.9%
Industrial co-generation plants	819.2	862.9	899.7	867.0	857.1	924.1	37.0%
Other general use power plants	33.4	37.3	39.7	40.0	42.7	85.1	3.4%
Other diesel power plants (>500 kW)	0.0	12.1	17.8	31.7	35.9	35.0	1.4%
Power plants – "11-TER"	862.4	874.2	953.1	889.6	917.8	969.0	38.8%
Power generation by power plants	321.6	310.6	366.8	331.4	367.6	414.0	16.6%
Heat generation by power plants	540.8	563.6	586.3	558.2	550.2	555.0	22.2%
Industrial and district boiler-houses	142.0	191.4	172.0	161.5	253.5	254.6	10.2%
Agricultural boiler-houses	3.2	4.5	5.0	4.4	3.1	3.1	0.1%
Total for transformation into power and heat	994.6	1,103.7	1,129.2	1,100.2	1,189.2	1,298.8	50.6%
Industry	43.7	45.0	42.1	73.9	226.3	193.1	7.5%
On-site oil treatment	1.6	0.0	0.0	0.0	41.5	62.5	2.4%
Other industrial consumption	42.1	45.0	42.1	73.9	184.8	130.6	5.1%
Transport	733.8	1081.7	810.4	843.1	868.4	959.0	37.4%

	2000	2001	2002	2003	2004	2005	Share in 2005
Municipal utility sector	3.7	0.1	0.0	0.0	6.4	5.4	0.2%
Commercial	41.5	45.5	48.4	42.7	41.0	44.0	1.7%
Residential	45.8	50.3	67.4	64.6	62.0	66.5	2.6%

* Italicized are the consultant' estimates.

Sources: Arkhangelsk Oblast Statistical Yearbook-2006; "11-TER", "22-ZhKH", and "4-T" forms.

2.3.3 THE BLOCK OF NATURAL GAS END-USE

Data on natural gas consumption were taken from forms "6-TP" and "11-TER", and on residential and public consumption from "22-ZhKH" and "4-T" (see Table 2.13).
Gas transportation sector (gas consumption for pipeline transportation) is the second largest natural gas consumer after the electricity sector (37.4%). Gas consumption by this sector may grow in the future, if "Gasprom" builds a 1.5-5 bln. m3 underground gas storage in Arkhangelsk Oblast at the joint of Primorsky, Plesetsky, and Onezhsky districts.
Industrial (primarily oil and gas), municipal utility, commercial, and residential sectors are only responsible for small shares of natural gas consumption.

2.4 Coal balance

There is no coal mining in Arkhangelsk Oblast; all the coal is delivered from other locations (primarily from Kuznetsky, Intinsky, and Vorkutinsky coalfields). Information on coal consumption was taken from "6-TP", "11-TER", and "4-T" (see Table 2.14). Data on coal consumption by power plants look most reliable of all.

Power and heat generation by power plants is responsible for 71% of overall coal consumption. Coal is the basic fuel for Severodvinskaya CHP-1, CHP-1 of Arkhangelsk Pulp & Paper Combine, co-generation plant of Onezhsky hydrolytic plant, and is also used by the co-generation plant of Solombalsky Pulp & Paper Combine and CHP-1 of Kotlassky Pulp & Paper Combine. Coal consumption for electricity generation is continuously growing.

Boiler-houses are the second largest coal consumers with relatively stable coal consumption (17.5%). Cement production is the third largest consumer (9.6%). The share of residential sector is only 0.6% of overall coal consumption.

Table 2.14 Coal consumption in Arkhangelsk Oblast (thou. tce)

	2000	2001	2002	2003	2004	2005	Share in 2005
Power and heat generation	1,382.4	1,456.5	1,385.4	1,365.9	1,435.7	1,447.4	88.7%
Power plants	1,143.4	1,179.9	1,113.6	1,105.9	1,165.3	1,160.9	71.1%
Electricity supply by power plants	485.9	501.0	466.6	476.5	513.5	529.1	32.4%
Heat supply by power plants	657.5	678.9	647.0	629.4	651.8	631.8	38.7%
Heat supply by boiler-houses	227.2	262.5	263.3	260.0	270.5	286.4	17.5%
Heat supply by boiler-houses of agricultural companies	11.8	14.1	8.5				0.0%
Industry	82.1	137.5	137.3	179.9	156.1	167.5	10.3%
Cement and clinker	35.8	69.1	84.8	121.6	135.7	156.5	9.6%
Other industrial consumption	46.3	68.4	52.5	58.3	20.4	11.0	0.7%
Municipal utility sector	21.8	29.3	22.5	15.1	15.9	7.5	0.5%
Residential	10.1	13.0	9.8	12.9	13.3	10.1	0.6%
Overall consumption	1,496.4	1,636.3	1,554.9	1,573.8	1,621.0	1,632.4	100.0%
Stock changes	-2.2	-65.9	76.7	-144.7	57.3	-44.6	

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

2.5 Petroleum products balance

Data on petroleum products consumption were estimated based on the data from "6-TP", "11-TER", and "4-T". Power and heat generation is the major petroleum products consumer (54%), followed by transport (28.5%). Another 3.2% are used in agriculture and fishery. The share of the other consumers is not large.

Petroleum products consumption in 2000-2005 was relatively stable: slight consumption growth in the transport sector was accompanied by decline in the agriculture. Consumption by the transport sector includes private vehicles.

Table 2.15 Petroleum products consumption in Arkhangelsk Oblast (thou. tce)

	2000	2001	2002	2003	2004	2005	Share in 2005
Heat and electricity generation	1,295.9	1,454.4	1,363.1	1,385.1	1,466.7	1,395.7	53.9%
Electricity generation by power plants (excl. diesel power plants)	524.3	635.2	580.5	722.6	730.0	693.9	26.8%
Heat generation by power plants	753.8	796.0	760.0	686.0	697.4	666.8	25.8%
Diesel power plants	41.8	35.5	28.1	27.6	49.1	53.8	2.1%
Boiler-houses (excl. agricultural)	157.9	161.8	242.2	196.3	224.4	248.6	9.6%
Agricultural boiler-houses	0.0	4.6	4.0	0.0	0.0	0.0	0.0%
Industry	119.3	91.9	122.9	128.2	94.2	56.0	2.2%
Oil extraction	0.4	3.8	3.8	3.8	4.0	3.7	0.1%
Thermal treatment of metals	3.5	5.4	5.4	5.7	5.0	5.7	0.2%
Cement production	12.8	0.0	0.0	0.0	0.0	3.6	0.1%
Diesel locomotives of industrial railway transport	2.1	3.3	3.5	3.1	2.0	2.2	0.1%
Lifting and construction machinery	5.1	4.5	4.6	4.8	4.4	4.8	0.2%
Tractors	1.1	0.9	0.6	0.2	0.1	0.1	0.0%
Other	94.2	74.0	105.0	110.5	78.7	36.0	1.4%
Transport	611.8	600.5	631.6	622.6	657.1	737.5	28.5%
Aviation	45.3	32.0	46.1	85.0	106.5	159.0	6.1%
Automobile	231.7	236.1	240.1	231.4	237.2	246.1	9.5%
Water transport	142.8	138.8	162.1	123.0	134.5	132.3	5.1%
Railway operation needs	192.0	193.5	183.3	183.3	178.9	200.1	7.7%
Agriculture and fishery	188.0	153.1	131.6	80.7	80.8	83.6	3.2%
Fishery	112.9	93.8	86.0	60.9	65.2	69.8	2.7%
Tractors	66.5	51.5	37.6	11.5	8.3	5.8	0.2%
Diesel locomotives of railway transport	0.4	0.6	0.6	0.6	0.4	0.4	0.0%
Lifting and construction machinery	8.2	7.3	7.3	7.6	7.0	7.6	0.3%
Construction	4.2	3.5	3.0	2.0	1.7	1.7	0.1%
Tractors	2.6	2.0	1.5	0.5	0.3	0.2	0.0%
Diesel locomotives of construction railway transport	0.2	0.3	0.3	0.2	0.2	0.2	0.0%
Lifting and construction machinery	1.4	1.2	1.2	1.3	1.2	1.3	0.0%
Utility sector	5.9	9.4	5.4	2.0	1.6	1.6	0.1%
Commercial	4.9	3.9	3.1	1.6	1.4	1.3	0.1%
Residential	94.5	54.4	51.3	48.0	44.2	42.7	1.7%
Total consumption	2,506.3	2,549.9	2,563.7	2,517.6	2,581.9	2,587.5	100.0%

* Italicized figures are the consultant's estimates.
Source: "11-TER" and "4-T".

2.6 Other solid fuels balance

Arkhangelsk Oblast differs from many Russia's regions in considerable (comparable with coal consumption) consumption of other solid fuels (see Table 2.16). These basically include pulp and paper waste and to a less degree food waste and wood. Other solid fuels are basically used for power and heat generation by co-generation plants of three pulp & paper combines located in the Oblast, and by boiler-houses. Against the background of growing fossil fuel prices pulp and paper waste utilization grows. Only 1% of other solid fuels is used in industry, and 2.9% for space heating in the residential sector.

Table 2.16 Other solid fuels consumption in Arkhangelsk Oblast (thou. tce)

	2000	2001	2002	2003	2004	2005	Share in 2005
Heat and electricity generation	1,005.7	1,134.0	1,246.0	1,248.6	1,256.0	1,231.6	95.7%
Electricity generation by power plants	86.9	99.5	115.0	128.5	119.3	123.8	9.6%
Heat generation by power plants	713.1	750.1	800.9	852.5	862.0	872.6	67.8%
Boiler-houses	193.3	279.0	327.6	267.4	274.7	235.2	18.3%
Agricultural boiler-houses	12.4	5.4	2.5	0.3	0.0	0.0	0.0%
Industry	21.1	24.8	14.9	21.5	21.5	12.6	1.0%
Harvesting and primary processing of wood	1.7	0.8	1.6	2.6	1.8	1.6	0.1%
Bread and bakery products	1.0	1.8	2.1	3.0	3.9	1.9	0.1%
Other industrial consumption	18.4	22.2	11.1	15.9	15.8	9.1	0.7%
Municipal utility sector consumption	18.2	24.8	8.2	7.6	10.5	5.1	0.4%
Residential	47.5	69.2	46.6	58.9	49.1	37.9	2.9%
Total consumption	1,092.4	1,252.9	1,315.7	1,336.6	1,337.0	1,287.1	100.0%

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

3 Integrated Fuel and Energy Balance

IFEB of Arkhangelsk Oblast for 2005 is the result of integrating electricity, heat, natural gas, coal, petroleum products and other solid fuels (wood, peat, etc.) balances. The IFEB provides an opportunity to comprehensively present the energy situation in the region in one table (see Table 3.1).

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

	Coal	Crude oil	Petro-leum pro-ducts	Natural gas	Hydro and renew ables	Other solid fuels	Elect-ricity	Heat	Total
Production		17321.6		736.2		1287.1			19344.9
Import	1587.9		2587.5	2219.2			164.4		6559.0
Export		-17321.6					-36.2		-17358
Stock changes	-44.6								-45
Primary energy consumption	1632.4	0.0	2587.5	2955.5	0.0	1287.1	128.2		8590.7
Statistical discrepancies				-10.7					-10.7
Power plants	-1160.9		-1414.5	-1200.8		-996.4	874.8	2393.6	-1504.3
Electricity generation	-529.1		-747.7	-562.6		-123.8	874.8		-1088.4
Heat generation	-918.3		-915.4	-934.7		-1107.7		3299.4	-576.6
Co-generation plants	-631.83		-666.8	-638.3		-872.6		2393.6	-415.9
Boiler-houses	-286.4		-248.6	-296.4		-235.2	-12.9	819.4	-260
Industrial	-286.4		-248.6	-292.8		-235.2	-12.7	816.2	-260
Agricultural				-3.6				3.1	-0.5
Heat recovery units								86.0	86.0
Own needs							-121.9		-121.9
Distribution losses							-95.2	-281.0	-376.2
Final energy consumption	185.0		924.4	1468.9		55.5	773.0	3018.4	6389.7
Industry	167.5		56.0	222.1		12.6	418.9	2062.0	2939.1
Oil and gas extraction			3.7	71.9			33.3	129.2	238.0
Harvesting and drying of wood						1.6	7.6	57.7	66.9
Pulp							143.5	994.5	1138.0
Paper							50.6	126.1	176.7
Cardboard							60.7	208.5	269.2
Cement	156		3.6				12.1	2.0	174.2
Water raise and supply							12.6	1.3	13.9
Bread and bakery products						1.9	2.8	4.8	9.5
Other	11.0		48.8	150.2		9.1	95.9	537.7	852.7
Construction			1.7				26.4	7.6	35.7

	Coal	Crude oil	Petro-leum pro-ducts	Natural gas	Hydro and renew ables	Other solid fuels	Elect-ricity	Heat	Total
Transport			737.5	1112.4			82.8	34.8	1967.5
Aviation			159.0						159.0
Automobile			246.1						246.1
Railway			200.1				69.2	27.6	297.0
Water			132.3						132.3
Urban electric							0.8		0.8
Other transport				1112.4			12.7	7.2	1132.3
Agriculture			83.6				16.8	34.3	134.8
Municipal utility sector	7.5		1.6	6.3		5.1	53.5	54.2	128.1
Commercial			1.3	77.1			78.7	162.5	319.6
Residential	10.1		42.7	51.0		37.9	95.8	663.1	900.6

Source: compiled by the consultant.

Total primary energy consumption equals 8,591 thou. tce. A considerable part of energy (2,287 thou. tce) is used in energy transformation, transmission, and distribution processes. This is partly made up for by heat recovery (86 thou. tce).

Industrial sector is responsible for 46% of total energy end-use, including the share of pulp & paper (25%). The share of transport in final energy end-use is 30.8% (including 17.7% for pipeline transportation), agriculture – 2.1%, utility sector – 2.0%, commercial – 5.0%, and residential – 14.1%. The share of residential end-use consumption is slowly declining.

All extracted crude oil is exported. Other solid fuels are the major local primary energy resource. Contributions of hydro and renewable energy are practically negligible. Arkhangelsk Oblast completely depends on petroleum products and coal imports, and to a large extent on natural gas imports.

Table 3.2 Major proportions of Integrated Fuel and Energy Balance of Arkhangelsk Oblast for 2005 (%)

	Coal	Crude oil	Petro-leum pro-ducts	Natural gas	Hyd-ro and renew-ables	Other solid fuels	Elect-ricity	Heat	Total
Production	0.0%	89.5%	0.0%	3.8%		6.7%			100.0%
Import	24.2%		39.4%	33.8%			2.5%		100.0%
Export		99.8%					0.2%		100.0%
Primary energy consumption	19.0%	0.0%	30.1%	34.4%		15.0%	1.5%	0.0%	100.0%
Power plants	24.3%		29.6%	25.2%		20.9%	18.3%	50.2%	68.5%
Electricity generation	27.0%		38.1%	28.7%		6.3%	44.6%		44.6%
Heat generation	23.7%		23.6%	24.1%		28.6%		85.1%	85.1%
Co-generation plants	22.5%		23.7%	22.7%		31.1%		85.2%	85.2%
Boiler-houses	26.9%		23.3%	27.8%		22.0%	-1.2%	76.8%	75.6%
Industrial	26.9%		23.4%	27.5%		22.1%	-1.2%	76.8%	75.6%
Agricultural				100.0%				85.8%	85.8%
Heat recovery units								100.0%	
Own needs							-95.1%		
Distribution losses							-10.8%	-8.5%	
Final energy consumption	2.9%		14.5%	23.0%		0.9%	12.1%	47.2%	100.0%
Industry	5.7%		1.9%	7.6%		0.4%	14.3%	70.2%	100.0%
Oil and gas extraction			1.5%	30.2%			14.0%	54.3%	100.0%

	Coal	Crude oil	Petro-leum pro-ducts	Natural gas	Hyd-ro and renew-ables	Other solid fuels	Elect-ricity	Heat	Total
Harvesting and drying of wood						2.4%	11.3%	86.3%	100.0%
Pulp							12.6%	87.4%	100.0%
Paper							28.6%	71.4%	100.0%
Cardboard							22.5%	77.5%	100.0%
Cement	89.8%		2.1%				7.0%	1.1%	100.0%
Water raise and supply							90.5%	9.5%	100.0%
Bread and bakery products						19.9%	29.1%	51.0%	100.0%
Other	1.3%		5.7%	17.6%		1.1%	11.2%	63.1%	100.0%
Construction	0.0%		4.7%	0.0%			74.1%	21.2%	100.0%
Transport			37.5%	56.5%			4.2%	1.8%	100.0%
Aviation			100.0%				0.0%		100.0%
Automobile			100.0%				0.0%		100.0%
Railway			67.4%				23.3%	9.3%	100.0%
Water			100.0%				0.0%		100.0%
Urban electric							100.0%		100.0%
Other				98.2%			1.1%	0.6%	100.0%
Agriculture			62.1%				12.5%	25.5%	100.0%
Municipal utility sector	5.8%		1.2%	4.9%		4.0%	41.8%	42.3%	100.0%
Commercial			0.4%	24.1%			24.6%	50.8%	100.0%
Residential	1.1%		4.7%	5.7%		4.2%	10.6%	73.6%	100.0%

Source: Consultant's estimates based on Table 2.14 data.

Natural gas dominates in the structure of primary energy consumption (34.4%), followed by petroleum products (30.1%), coal (19.0%), other solid fuels (15%) and imported power (1.5%). The share of petroleum products in the fuel balance of power plants is 29.6%, of natural gas – 25.2%, of coal – 24.3%, and of other solid fuels – 20.9%.
Heat dominates in energy end-use (47.2%), followed by natural gas, petroleum products, electricity, coal, and other solid fuels. The share of heat in the energy end-use is large in the industrial (70.2%) and residential (73.6%) sectors.

The share of electricity in energy end-use was stable in 2000-2005, and in the residential sector it was growing and reached 10.6% in 2005.

4 Assessment of the energy supply efficiency in Arkhangelsk Oblast

4.1 Assessment of the efficiency of energy supply

According to Table 3.2, the gross fuel efficiency factor at power plants equals 50.2%. Specific fuel consumption for power generation is slowly growing (see Table 4.1). Specific fuel consumption for heat generation at power plants is only estimated. To keep co-generation plants competitive, it needs to be reduced, at least to the level of specific fuel consumption of industrial boiler-houses.

Average efficiency of boiler-houses is only 77%. Statistics report tangible growth of rural boiler-houses' efficiency in 2003-2005; it left behind overall efficiency of all boiler-houses (see Table 4.1). Analysis of data by separate rural coal- and wood-fired boiler-houses shows, that their efficiency is only 50-60%, which corresponds to specific fuel consumption of 238-286 kgce/Gcal. Information on rural boiler-houses is viewed as not very reliable. Heat distribution losses are estimated at approximately 9%, and electricity distribution losses at around 10%.

Table 4.1 Specific fuel consumption for electricity and heat generation and electricity distribution losses

	Units	2000	2001	2002	2003	2004	2005
Share of plants own needs electricity consumption	%	5.8%	5.6%	5.4%	5.6%	5.6%	5.6%
Electricity consumption for heat generation by CHPs	kWh/Gcal	36.8	36.2	35.6	36.1	35.3	34.9
Electricity generation	gce/kWh	311.3	303.4	307.7	312.0	313.7	312.6
Heat supplied by power plants	kgce/Gcal	173.4	171.5	171.5	172.6	171.9	168.7
Heat supplied by industrial and municipal boiler-houses	kgce/Gcal	188.7	206.8	194.5	200.4	196.2	188.6
Heat supplied by agricultural boiler-houses	kgce/Gcal	199.0	202.3	199.6	178.8	160.7	170.7
Electricity distribution losses	%	10.5 %	10.8 %	10.6 %	10.2 %	9.9%	10.8 %
Heat losses (excl. recovered heat)	%	9.8%	8.5%	8.3%	8.1%	8.2%	8.7%

Source: forms "4-TP", "11-TER" and data from Tables 2.7 and 2.10.

4.2 Assessment of industrial and agricultural energy end-use efficiency

Data on end-use energy efficiency are shown only for products where they are comparable in time (see Table 4.2). The efficiency of energy end-use was growing in some sectors and declining in others. To a certain extent, such dynamics is determined by the changes in the production scale. Specific fuel consumption by major products and services (pulp, paper, and cardboard production, harvesting of wood and primary wood processing, and electric traction of railroad transport) was dynamically declining.

Table 4.2 Specific end-use fuel consumption in Arkhangelsk Oblast

	Units	2000	2001	2002	2003	2004	2005
Oxygen	kgce/thou.m3	202.1	415.6	493.5	363.3	283.7	251.1
Compressed air (t=20oC and P=1.4 atmospheres)	kgce/thou.m3	13.2	12.2	12.8	12.1	13.8	14.9
Electric steel	kgce/t	93.5	93.5	85.5	87.7	93.3	106.5
Rolled ferrous metals (including forged products)	kgce/t	927.6	758.2	1047.2	928.0	950.4	893.5
Ferrous castings (excl. thermal processing)	kgce/t	291.7	237.1	465.4	546.3	324.8	627.7
Steel castings (excl. thermal processing)	kgce/t	234.9	145.2	198.1	194.8	120.9	167.3
Thermal processing of metals	kgce/t	756.0	646.7	748.6	911.8	819.5	982.3
Harvesting and primary processing of wood	kgce/thou.m3	2610.6	2668.1	2785.8	1839.5	1504.2	1592.8
Wood drying	kgce/t	35.8	42.0	42.7	41.3	39.3	36.8
Pulp – total	kgce/t	614.7	613.6	590.2	565.9	565.1	554.3
Paper	kgce/t	536.7	539.4	525.6	520.4	515.8	516.5
Cardboard	kgce/t	374.3	382.9	352.7	343.8	351.2	342.5
Bread and bakery products	kgce/t	171.6	225.0	213.3	197.5	231.2	182.6
Electric traction of railroad transport	kgce/10 thou. tkm	14.0	12.9	12.5	11.9	11.6	11.7
Water raise and supply (excl. municipal utility needs)	kgce/thou.m3	54.8	50.2	51.1	56.1	60.5	56.7
Effluent treatment	kgce/thou.m3	48.0	35.8	37.4	34.2	33.3	34.6

Source: form “11-TER”

5 Analysis of energy sector forecasts in the region

5.1 Economic and energy development projections

Arkhangelsk Oblast economic and energy development projections are relatively poor. The Economic Development Department prepared a "Program of Arkhangelsk Oblast social and economic development for 2005-2008", which was adopted. This Program aims at the development of forestry and agricultural sectors, transport, communication, fishery, machine building, social sphere, environmental protection, and development of international cooperation and tourism.

Expected results include: 25% growth of GRP in 2005-2008, or 7.7% annually; 45% growth of investments in fixed capital; creation of 6.5 thousand jobs. However, the Program does not include any energy development projection. It only states, that in 2005-2008, gasification of Arkhangelsk Oblast will be continued, including primarily the construction of pipeline branches and distribution pipework of Nyuksenitsa-Arkhangelsk gas pipeline. It also states, that construction, renovation, and upgrade of Arkhangelsk Oblast boiler-houses will allow for 4-10% fuel consumption drop, heat generation costs reduction, and heat tariffs stabilization.
Meanwhile, there is a discussion, although not backed up by serious estimates, of the energy security and energy strategy in the Oblast. There are two basic ideas:

- finalize construction of Nyuksenitsa-Arkhangelsk gas pipeline and switch Arkhangelsk and Severodvinsk CHPs to natural gas;
- build a nuclear CHP.

Advocates of the second idea are actively promoting intellectual outsourcing. To be more exact, external stakeholders are persuading local experts. In 2005, the Center for Strategic Research "Severo-Zapad", while analyzing the energy situation in the Oblast, ended up with the following findings:

It is important to keep the centralized heat- and electricity supply system; only nuclear energy can make the North-West energy utility sustainable; the costs of connecting the Arkhangelsk energy utility to Karelia or Kolsky energy utility are comparable to the construction costs of a new nuclear power plant; and Arkhangelsk needs a nuclear CHP3.

However, the quality of this research is best illustrated by the following statement of the authors: "We never managed to answer the question: why in 1980 it took 123 kgce to produce 1,000 kWh, and now it takes 303 kgce". In other words, the authors are so poorly familiar with the energy sector, that can see no difference between the physical equivalent of electricity and specific fuel consumption for electricity generation. For this reason alone their findings are not trustworthy.

A number of local experts believe, that it is possible to implement both ides, and that mobilization of financing will be the key factor. The benefits of the nuclear CHP include reduction of heat and electricity tariffs (no exact estimates are available) and avoiding the risk of natural gas domestic price growth in the future. The opponents highlight the plans of building the North-European gas pipeline and of developing the Stockmann field. At the same time, the construction of a pipeline from the Stockmann field to Arkhangelsk is not even being discussed4.

[3] http://stra.teg.ru/lenta/innovation/861o/print
[4] http://www.consulsmi.ru/publications/pub577.shtml

The following aspects should be noted:

- lack of regional economic strategies beyond 2008;
- lack of substantiation of energy demand projections and energy supply systems development scenarios;
- lack of correlation between energy efficiency efforts and energy demand dynamics evaluations.

5.2 Potential energy supply development barriers

Expensive energy is the most important energy problem of the region. Average tariff for industrial consumers who receive electricity from OAO "Arkhangelskaya Generation Company" for 2007 is 2.06 rubles/kWh (7.8 U.S. cents, or 6 eurocents), which is twice higher than the average Russian tariff. The cost of electricity from Mezenskaya diesel power plant of OAO "Arkhenergo" is 7 rubles/kWh (or 20 eurocents), from "Solovetskaya diesel power plant" – 12.69 rubles/kWh (or 37 eurocents), and from the diesel power plant of OOO "Vzmorie" – 21.81 rubles/kWh (64 eurocents). While the heat tariff in Novodvinsk is 744 rubles/Gcal, in Solovki it is 3,956 rubles/Gcal (or 116 euros/Gcal).

In far-away towns the cost of energy supply is the highest, while the consumers' solvency is the lowest. This results in poor financial shape of energy utilities and providers of municipal utility services (determined both by low energy payments collection rate and by extreme instability of fuel oil- and coal prices) and in considerable financial burden on municipal budgets of financing the life-sustaining systems.

As of 01.10.2007, accounts payable amounted to 4.5 bln. Rubles, including: for heat and electricity – 1.6 bln. rubles, for fuel – 0.6 bln. rubles. Accounts receivable amounted to 2.6 bln. rubles, including: residential housing&utility debt – 1,042 mln. rubles; the debt of public organizations – 261 mln. rubles; the municipal budget subsidies debt – 560 mln. rubles. Huge debts result in the lack of equipment renovation investments and a considerable burden on all-levels budgets to finance energy supply to far-away districts, fuel delivery, and preparation for winter. A large share of depreciated fuel oil- and coal-fired CHPs and boiler-houses results in the growing costs of energy services provided by inefficient heat supply systems to relatively low-income population. Current management of energy supply in the Oblast is quite a challenge, and the Oblast government cannot allocate resources for the development of energy perspective.

Arkhangelsk Oblast may face other significant energy difficulties:

- Ensuring technical availability and affordability of energy supply requires renovation and replacement of a large part of depreciated equipment at numerous power plants, boiler-houses, electric and heat networks, capital repair of the housing stock and public buildings, and implementation of active energy efficiency policies;
- Unclear energy sector development strategies hamper search for investors in energy projects; and lack of investment will not let have a guaranteed energy security strategy in the Oblast;
- As gasification proceeds, distributed heat supply may expand, in which case district heating demand may relatively decline. This will set a barrier to high heat loads of the CHPs in place;
- Ignoring the energy efficiency potential, which is the most important resource to meet energy demand, leads to overestimating energy development investment demand and impedes search for investment.

5.3 Potential improvement of energy projections

There are no serious energy projection practices in Arkhangelsk Oblast. They are to be developed. The architecture of energy demand projection models in the Oblast depends on the tasks they need to address. These tasks should include:

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 analysed. The scenarios include procedures for sensitivity analysis and elimination of contradictory scenario elements;
- ⇒ Ensuring elimination of limitations to natural gas exports and power delivery to the grid;
- ⇒ 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.

All these tasks are yet to be accomplished in the Oblast.

6. Potential of secondary and renewable energy use

There is no comprehensive description of the renewable energy use potential in the Oblast. It is only known that there is an idea (but no project) of building Mezenskaya tidal power plant. However, the basic renewable resource for Arkhangelsk Oblast is solid combustible waste of wood processing and pulp & paper industry. Its share is nearly 15% of overall primary energy consumption in the Oblast. Apart from this, there is obviously a considerable potential for wind energy.

The following projects will be implemented under the social and economic target program "Renovation of Arkhangelsk Oblast municipal utility infrastructure for 2007-2010 to enhance efficient use of local fuels":

- Renovation of boiler-house in Nenoksa and switch to bio-fuel;
- Renovation of Ladushki boiler-house in Verkhniya Toima and switch to wood waste;
- Construction of a 550 kW wind energy plant in Kamenka;
- Construction of a 90 kW wind energy plant in Dolgoshchelie;
- Construction of a biofuel-fired CHP in Leshukonskoye.

7 Energy efficiency policy implementation

There is a certain experience in the implementation of energy efficiency programs in the Oblast. In September 2006, a social and economic target program “Renovation of Arkhangelsk Oblast municipal utility infrastructure for 2007-2010” was adopted, which, apart from the above mentioned subprogram on efficient use of local fuels (635 mln. rubles), includes the following subprograms:

1. Renovation of heat sources and heat supply systems (1,185 mln. rubles);
2. Efficient use of natural gas (314 mln. rubles);
3. Renovation of water supply and sewage systems (1,755 mln. rubles).

The program includes a list of projects and costs, but no estimates of the effects. For example, the program of heat supply systems renovation includes: construction of boiler-houses, replacement of boilers; renovation of heat networks and residential heat supply systems; installation of variable-speed drives; replacement of burners; installation of pipes with foam polyurethane insulation; installation of meters; renovation of water treatment systems.

The major goal of the program is to reduce the wear and tear of main assets of the municipal utility sector by 10%. In 2006, depreciation was 70% in heat network, 75% in water network, 57% in electric network, and 55% in sewage network. Heat losses through hot water leaks determined by poor pipe insulation amount to 50%, cold water losses – to 20%, and electricity losses – to 17%. Department of fuel and energy complex and municipal utility sector is assigned the responsibility for the program implementation.

Analysis of the program showed, that it, in fact, does not include any end-use efficiency measures, including in residential and public buildings. At the same time, the experience of Arkhangelsk energy efficiency center shows, that the project implemented in Arkhangelsk pioneer center resulted in 56% electricity savings; in Novodvinsk School No. 4 – in 33% heat and 33% electricity savings; and in Novodvinsk School No. 1 – in 46% electricity savings.

It seems desirable to develop Arkhangelsk Oblast energy efficiency program for 2007-2015. Department of fuel and energy complex and municipal utility sector has launched the program development, but the Department personnel needs assistance in this effort.

8 Institutional issues for developing energy policies

8.1 Major institutional holders of energy information

Arkhangelsk Oblast government basically monitors the current shape of the energy and municipal utilities sectors. For example, in autumn, monitoring of the preparedness of the housing stock, boiler-houses, heat and water networks, and other facilities for the winter is done on a semi-monthly basis. Importantly, there is no integrated picture of the Oblast energy sector state-of-the-art.

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 Arkhangelsk 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.

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 Astrakhan Oblast and its energy policies.

9 Conclusions and Recommendations

A. Conclusions

- It is possible to develop an integrated fuel and energy balance for the Arkhangelsk region. However, all available sources of information need to be collected, verified for consistency and analyzed, 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 Arkhangelsk oblast

INSTITUTIOANL ISSUES

ARHKANGELSK OBLAST

1. Overall Situation

1. Overall Situation

Arkhangelsk region (oblast) is located in the north of the European territory of Russia. The square of the oblast (including Nenetsky Autonomous Okrug (AO) and archipelago Novaya Zemlya) is 587 thousand km^2. The oblast territory spreads from the north to the south for more than 1650 km and covers three climatic zones. It borders with the Republic of Karelia from the west, Republic of Komi – from the east, Vologodsk and Kirov oblasts – from the south. Barents sea and White sea washes the oblast from the north and north-west.

Three large water flows cross the oblast territory. They are, primarily, Northern Dvina river with its many good inflows, then comes Onega river and Mezen river. Main towns are located along the water flows and the railways Moscow-Arkhangelsk. There are 13 towns in the oblast, including the two with the population of more than 100 thousand people (Arkhangelsk – 370 thousand people, Severodvinsk – 232 thousand people) and 21 administrative divisions (including Nenetsk AO). More than 1.5 million people live in the oblast. Assumed temperature of the coldest period is minus 32-Celsius degrees, the duration of the heating season in Arkhangelsk is 251 days.

The oblast does not have the international borders. Therefore there are no high-voltage lines connecting the oblast with the foreign countries. The access to the foreign energy market is difficult. The territory which, is served by the JSC “Arkhenergo” (distribution and network company), was not changed and is equal to 412 thousand km^2. 97 % of the total oblast population lives in this territory.

2. Institutional Structure of the Power Sub-sector

Currently the centralised power supplies cover 70% of the territory in the Arkhangelsk oblast, where 95% of the oblast population lives. Three TPP and one diesel power station of the JSC “Arkhenergo” with the total installed capacity of 1055.25 MW as well as the block-stations of cellulose and paper making and hydrolysis industries with the installed capacity of 646 MW provide the centralised energy supplies.

The load of the Astrakhan power center is mainly covered by the three power plants. Arkhangelskaya TPP (450 MW) and Severodvinskaya TPP-2 (410 MW) are operated with fuel oil (masut); Severodvinskaya TPP-1 (188.5 MW) – with the coal. The capacities of these TPPs for the power consumers are transported through the networks, including the transportation to the united energy system of Russia. The block-stations provide mainly own consumers with the output of the free capacity to the power networks. The structure of the productive power supply to the consumers of the Arkhangelsk oblast is the following:

Population	13,2%
Industry	60,7%
Transportation	8,7%
Agriculture	1,6%
Communal services	5,1%

There are about 140 local diesel power plants with the total installed capacity of up to 50 MW (including Íand the emergency supply) are operated in the area of the decentralised power supplies. Mezenskaya diesel power plant (9.3 MW) is the largest one. Inaccessibility of areas, where the diesel power plants are located, leads to the high cost of the diesel fuel supplies for the generators.

Power deficit in the system is covered by the purchase of capacity and power at the Federal Power Wholesale market (FOREM) from the power plants of the RAO "UES of Russia". The three current TPP – Arkhangelskaya TPP, Severodvinskaya TPP-1 and 2 – would be of the sufficient capacity to satisfy the future consumers at the assumed level of power consumption and generation. It is expected that these TPPs will become the main option to generate the energy ad the short-term and medium-term perspective. However the power plants and the electric and mechanical equipment are in the process of deterioration. Lifetime of the plants will be at least 10 years and then the plants operation will depend on the investment decision to be taken: capital repairs work, closure or transfer to the alternative fuel sources (complete or partial).

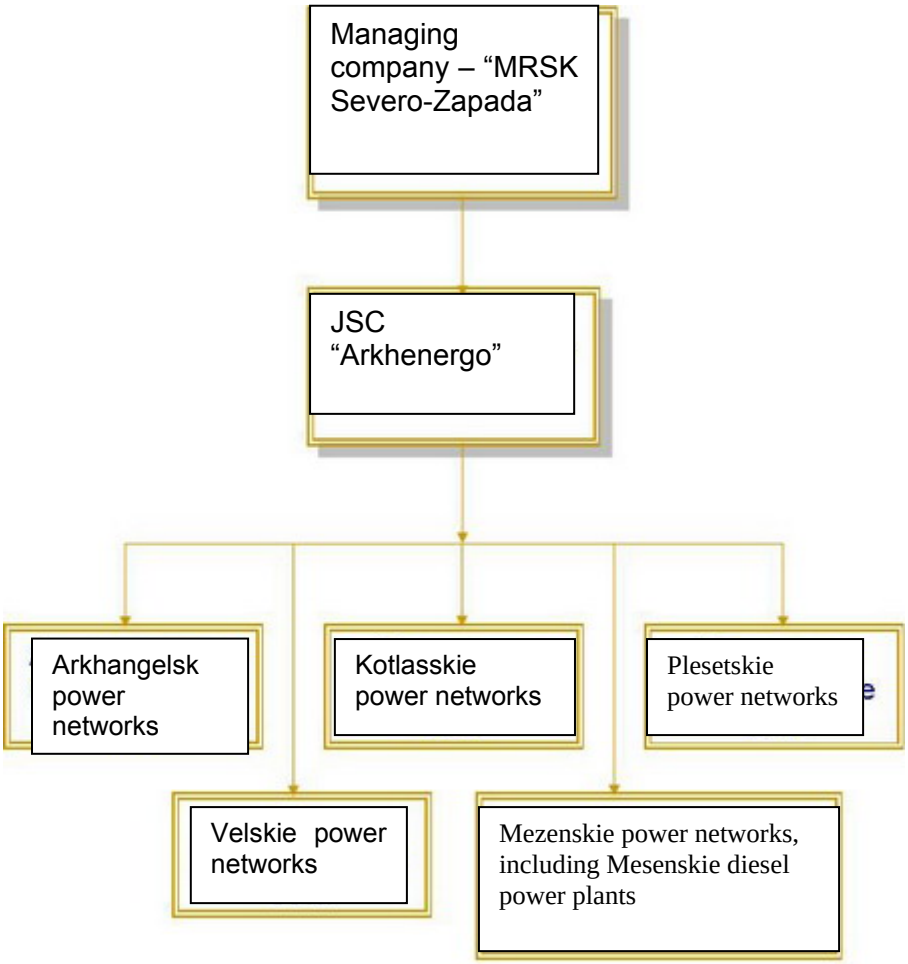
The JSC "Arkhenergo" was finally reorganised in 2005. The result of such a re-organisation was the forming of new legal entities, which are the following:

- JSC "Arkhangelsk Generating Company" (the main activities: generation of the thermal and power energy and sale of the thermal energy)
- JSC "Arkhangelsk Sales Company" (the main activity – sale of the power energy)
- JSC "Arkhangelsk Trunk Networks Company" (power transportation through the power networks which are not related to the United National Energy Networks.

It was decided to transfer the authorities of the JSC "Arkhenergo" entire executive body to the managing company – JSC "MRSK Severo-Zapada". It is registered as the legal body in St-Petersburg and is 100% affiliate of the JSC RAO "UES of Russia". The main task of the JSC "MRSK Severo-Zapada" is the provision of the reliable and secure power supply of the high quality to the consumers of the north-west, including Arkhangelsk oblast. Currently the JSC "MRSK Severo-Zapada" unites seven distributing network companies: JSC "Pskovenergo", JSC "Novgorodenergo", JSC "Karelenergo", JSC "Arkhenergo", JSC "Kolenergo", JSC "Lenenergo" and JSC "Yantarenergo".

As of 01.01.2005 the JSC "Arkhenergo" combined 12 branches: "Arkhangelskaya TPP", "Severodvinskata TPP-1", "Severodvinskata TPP-2", "Arkhangelsk Power Networks", "Velskie Power Networks", "Kotlasskie Power Networks", "Mezenskie Power Networks", "Plesetskie Power Networks", "Severodvinskie Urban Heat Networks", "Energosbyt", "Arkhangelsk Urban Heat Networks", and "Arkhangelsk Trunk Power Networks". The property (assets) from the balance of the JSC "Arkhenergo" branches were transferred to the starting capital of the societies set up on the basis of the JSC "Arkhenergo". As the result as of 31/12/2006 there are 5 branches of the JSC "Arkhenergo": "Arkhangelsk Power Networks", "Velskie Power Networks", "Kotlasskie Power Networks", "Mezenskie Power Networks", "Plesetskie Power Networks". These branches are managed both technologically and financially by the united center of the JSC "Arkhenergo".

2.1.1 DRAWING 1



The total spread of the overhead and cable networks of the JSC "Arkhenergo" is - 26.906 km. Total area - 245,7 thousand km^2.

The general chart for relations within the power sub-sector of the Oblast is also given as the drawing 2, Attachment (source: Arkhangelsk Oblast Energy Efficiency Centre).

3. Social and Economic Development of Arkhangelsk Obalst (without Nenetsk AO) in 2006

Industrial production index in the oblast in 2006 was 100.4% to the level of 2005.

Industrial production structure:

- "mineral deposits production" - 0,7%;
- "processing industries" - 80,9%;
- "production and distribution of power, gas and water" - 18,4%.

Mineral deposits production**.** Currently in the territory of the oblast there is a production of diamonds, bauxites, limestone, loam for concrete production, limestone for cellulose and paper-making industry, granite, sand and sand and gravel mixtures for construction and road building industries. The production of aggregates increased in 2006 by 21.0% and is equal to 2 716,2 thousand m^3.

Energy-consuming processing industries (product production by type of economic activity).

- Wood working and production of wooden goods. Production index was 93,6%, whereas the production of lumber reduced by 8,5%, fibreboards - by 1,3%, plywood – increased by 6,5%.

- Cellulose and paper-making industry. Publishing and polygraphic industry. The volume of the supplied goods was 43,7% in the total volume of the supplied goods by the processing industries. The production index - 99,7%.

- Production of construction materials. The volume of the supplied goods was 3,0% in the total volume of the supplied goods by the processing industries. The production index - 114,3%. The production of constructions and pats of the assembly reinforced concrete increased by 4,9%, concrete production by 16,2%, whereas the production of wall materials reduced by 5,3%.

- Production of means of transport and equipment. The volume of the supplied goods was 21,6% in the total volume of the supplied goods by the processing industries. The main enterprises for this particular type of activity are the ones of military and defense sector.

- Power and heat generation and distribution. In 2006 the power generation increased in the Arkhangelsk oblast by 0,6%, and heat by - 0,9%.

- Transportation. Cargo turnover of large and medium transport organisations in the oblast was 55,1 billion tons-km or 99,6% to the level of 2005. The cargo turnover of the air transport organizations increased (by 20,0%), sea transport increased (by 8,8%), railways transport reduced (by 2,2%), automobile transport reduced (by 10,3%), local water transport reduced (by 8,4%).

- Investments. The volume of investment to the fixed capital through all financial resources was 41.2 billion RUB in 2006 or 130,2% to the level of 2005. The pipeline transportation is the main investment facility.

4. Work of Fuel and Energy Sector, Housing and Utilities Infrastructure of the Arkhangelsk Oblast as well as the Work of Department for Fuel and Energy Sector and Housing and Utilities Infrastructure at the Oblast Administration in 2005

4.1 Fuel and Energy Sector

4.2 . Power sub-sector

In 2005 the Oblast power plants generated 6,6 bln kWh of the power (101,4% to 2004), and got 919,1 mln kWh (99,9%) from the FOREM Wholesale market. The generation volume is divided as following: JSC “Arkhangelskaya generating company” generated 3 345 mln kWh, power plants of the industrial enterprises (block-stations) – 3 211 mln kWh. In 2005 7,5 bln kWh of power was supplied to the consumers. In 2005 power plants of the JSC “Arkhangelskaya Generating Company” supplied 5 096 thousand Gcal of the heat (99,7% to the previous year).

In the area of the decentralized power supply the municipal and department diesel power plants generated 59,5 mln kWh of power in 2005 (93,5% to the previous year level), out of which 35,4 mln kWh (91,6%) – generated at the power plants of the State Unitary Enterprise "OblDES", 13,8 mln kWh (96,9%) – at Mezenskaya diesel power plant of the JSC “Arkhenergo” and 10,3 mln kWh (95,7%) – at municipal power plants.

The total demand for the backup power was defined for the housing and utilities infrastructure municipal entities, organizations and agencies under authorization of the regional structures. In 2005 some municipal entities got 10 power backups with the total installed capacity of 1146 kW, JSC “Arkhenergo” – 2 power plants with the capacity of 60 kW (to its branch “Kotlasskie Power Networks”) and 100 kW (to its branch “Arkhnagelsk Power Networks”). The state unitary enterprise “OblDES” developed the investment programme and the programme to upgrade the fixed assets, the Department approved the feasibility study for the construction of the min HPP operated with the biomass with the capacity of 5 MW in Leshukonskoe village. The regional programme of the capital investments for 2006 estimates 5 mln RUB to upgrade the generating equipment of the state unitary enterprise “OblDES”. The funds are allocated to reconstruct the current and build the new transmission lines for the first time in many years.

During the year there was the work with the municipal entities of the region directed to the reduction of the debt for the consumed power and heat to the energy supplying organizations. The debt of the municipal entities of the region for the consumed power to the JSC “Arkhangelsk Sales Company” did not change in 2005. It was 99,6 mln RUB for the beginning of 2006. The housing and utilities infrastructure of Arkhangelsk and Severodvinsk increased their dept for the consumed heat to the JSC “Arkhangelsk Generating Company” during the year, respectively by 21,5% and 19,7%. In 2005 the debt of the housing and utilities infrastructure of the municipal entities increased in 2,3 times to the state unitary enterprise “OblDES”.

In 2005 the process of reforms within the regional energy system JSC “Arkhenergo” was finalized. The results of these reforms was the forming of three independent companies starting from the 1st of April 2005. These companies are: JSC “Arkhangelsk Generating Company”, JSC “Arkhenergo” and “Arkhangelsk Sales Company”.

4.3 Thermal power sub-sector

The combined generation of the power and hear at the TPP of the former JSC “Arkhenergo” and block-stations of the Kotlass pulp-and-paper plant, Onezhsk and Arkhangelsk hydrolytic plants prevails in the Arkhangelsk region. It is 76%. The boiling-houses with the installed capacity of more than 3 Gcal/h generate 15,8%. The rest volume of heat is generated by the small boiling-houses. Heat sources, which belong to the shareholders’ societies, generate about 60% of the heat for the social and household sector in the region. The boiling-houses of the municipal entities generate the rest heat.

The housing stock prevails in the structure of the heat consumption for the social and household sector in the Arkhangelsk region. The centralized heat is supplied to the housing stock with the total square of about 1,3 mln m² in the Arkhangelsk region. That is 55% of the total housing stock square. 50% of the housing stock is also connected to the centralized hot water supplying system. Every village has its own heat and hot water supplying systems. There is no connection or the mutually served systems between the villages. In total there are 1086 boiling-houses in the region, out of which 66 are operated with the natural gas, 485 – coal, 51 – liquid fuel, 274 – wood and 181 – mixed fuel type. The total heat capacity of all boiling-houses is about 10500 Gcal/h.

4.4 Thermal power supply

Arkhangelsk region imports 92% of the primary energy resources from other regions, and only 8% is available locally: wood, wastes from the papermaking and wood-chemical industries, peat. The high prices for the imported fuel leads to the situation when the tariffs for power and heat are found to be the highest in the Russian Federation.

The most specific weight in the consumption of the primary energy resources is the natural gas (30,8 %), which comes to the region from the Western Siberia through the gas pipeline "Northern Lights" and the fields of the Nenetsk autonomous okrug. The natural gas from the Nenetsk autonomous okrug is used for the consumption within the okrug in total volume. The enterprises and municipal entities of Kotlasa, Koryazhmy and Kotalss district are the main users of the natural gas. During the last seven years there has been the construction of the gas pipeline "Niuksenitsa – Arkhangelsk" in the Arkhangelsk region. As of today there is the pipeline built from zero point forward to 147 km (Velsk). It is planned to build more about 600 km of the gas pipeline to Arkhangelsk and Severodvinsk. The construction is organsied on the basis of parity conditions by "Gazprom" (32% of financing) and Arkhangelsk region (67%).

The second place is given to the residual oil (23,35 %), the main volume of which is used at the TPP, block-stations and boiling-houses to generate heat and power. Coal (21,8 %) is also mainly used to generate heat and power at the TPP and boiling-houses. Coal is used as following: 52% - Intinsk, 41% - Vorkuta, 7% - Kuznetsk.

The share of the primary energy resources used to generate the power is 22,6 % from the total consumption rate at the region:

Residual oil	37%
Coal	14%
Natural gas	46%
Light oils	2%
Wood	1%

In 2003 to produce heat 48,4% was used, including:

Residual oil	31%
Coal	28%
Natural gas	33%
Wood	4%
Other	4%

In 2005 all contracts for purchase and supplies of the coal and diesel fuel to the far north and other areas of the similar climate condition with the limited period for load deliveries, were closed in due time. Such contracts are signed as the result of the organised tenders. During the "northern deliveries" the regional budget financed the delivery of 63,9 thousand of coal and 6,7 thousand of diesel fuel. It corresponds to the real limits of the budget financing for 2005. In 2005 in total 74,5 thousand tons of coal (102,3% from the plan of supplies at the expense of all financial funds) and 13,9 thousand tons of the diesels fuel (104,9% from the plan of supplies at the expense of all financial funds) was supplied to such areas. The housing stock with the most difficult access of the far north and other areas of the similar climate condition with the limited period of load deliveries were provided with the coal and diesel fuel during the heating period in required volume.

The main problem related to the fuel supplies is the dept of the housing and utilities infrastructure of the municipal entities to the main fuel suppliers. In 2005 there was the mutual work with the Federal bodies of the executive power regarding the issues of the fuel supplies to the municipal entities in the Arkhangelsk region. The proposals were submitted to the Ministry of the Regional Development of the Russian Federation and the Ministry of the Economic Development and Trade of the Russian Federation regarding the issues of purchase and supplies of coal and oil products to the areas of the far north and other areas of the similar climate condition with the limited period for load deliveries. Outline maps of coal and diesel fuel supplies to such areas in the Arkhangelsk region, explanatory note to the scheme of transportation and proposals for its optimisation were developed for the Ministry of the Regional Development. There is a control and weekly (when needed- daily) updated information about the reserves and supplies of the fuel at the municipal boiling-houses and diesel plants of the region.

4.5 . Gas Supplies Perspectives for Arkhangelsk Oblast

In 2006 two pipelines of the trunk gas pipeline "Niuksenitsa-Arkhangelsk" from Plesetsk to the direction of Severodvinsk and Novodvinsk were completed. The gas was supplied to the space center "Plesetsk" and Plesetsk area. The government of the Russian Federation took a decision to facilitate the construction of the gas pipeline and finalise its construction in 2007. The initial options of the gas pipeline design were developed in 1988-1992 upon the request of "Gazprom". One of the objectives of this gas pipeline is the supplies of hydrocarbons from Schtockmann gas field at the Barents Sea to the center of Russia, as well as the supplies to the plant-producing methanol, which is designed for Arkhangelsk and gas supplies to Arkhangelsk, Murmansk, Vologodsk and Republic of Karelea. The length of the main pipeline is 635 km, capacity – 5 bcm of natural gas per year. The construction of the gas pipeline "Niuksenitsa-Arkhangelsk" was started at the end of 1992. The first part of the gas pipeline is ready to be put into operation as of today. It is 147 km to Velsk town in the Arkhangelsk region. Here there is the gasification of the agricultural Velsk area with the population of 68 thousand people.

The experts think that the construction of the gas pipeline is not only of the economic meaning but the strategic one as well. Its construction will ensure the improvement of the energy supplies reliability for the defense shipbuilding sector at Severodvinsk and "Plesetsk" space centre. The transfer of the Arkhangelsk region energy sector to the gas will promote the improvement of the ecological situation, reduce emissions and wastes to dump and water reservoirs.

4.6 4.5. Housing and Utilities Infrastructure

The functioning of the housing and utilities infrastructure in 2005 was sustainable. The main objective of the department of the Fuel and Energy sector and Housing and Utilities Infrastructure during the reporting period was the coordination of the administrations of the municipal entities in the region to ensure accident-free heating season 2004-2005, preparation sites of the housing and utilities infrastructure and energy sector to the heating season 2005 – 2006, form the fuel reserves.

The heating season 2004-2005 passed satisfactory for the majority of the municipal entities. However due to the outdated condition and high rate of tear and wear of the equipment some accidents took place at the sites of the housing and utilities infrastructure. The accidents used to be settled in due time without any serious consequences. The main concern is the current condition of the housing stock. The square of the apartments in outdated and emergency fund was 2179,2 thousand square meters or 7,5% from the total square of the housing stock. The main reason for the emergency condition of the housing stock is the late capital repairs of the apartments.

One of the binding factors for the housing and utilities infrastructure is the difficult financial situation. Arrears of wages at the municipal entities of the housing and utilities infrastructure as of 01.01.2006 were 87,970 mln RUB.

During the reporting period the Department provided the following activities:

- Coordination of activities of the municipal administrations to ensure the accident-free heating seasons 2004-2005 and 2005-2006, preparation to the heating season 2005 – 2006 of the sites of the housing and utilities infrastructure and energy sector, forming the fuel reserves.

- Calculation of the regional budget to cover the losses to the energy supplying organisations in the region. Such losses are the result of the public tariffs regulation for heat, supplied to the population, and the control over its implementation.

- Development and signing of the agreements about inter-actions of the regional administration and municipal entities to ensure the preparation of the sites of the housing and utilities infrastructure and energy sector to the autumn-winter season 2005-2006 at the expense of the regional budget subsidies.

- Development of the draft programme of the public capital investments for 2006 within the framework of “Municipal Construction”, which was approved by the regional assembly of deputies.

- Once every three months there is the analysis if the tariffs to pay for the housing and utilities services and ratio of use of communal services by municipal entities of the Arkhangelsk oblast.

- Once every three months there is the analysis of the receivables and payables as well as the arrears of wages of the regional housing and utilities infrastructure.

- Calculation of the regional standards for the marginal cost of the housing and utilities services.

4.7 . Energy Efficiency

Use of fuel and energy at the housing and utilities infrastructure cannot be named efficient in the Arkhangelsk region. The main reasons for this are the following:

- Deterioration of the equipment and the outdated technologies at the energy sources;

- Low efficiency rate for the producing and use of the fuel and energy resources;

- Decrease of the production and lack of investments to upgrade and reconstruct the energy generating and energy consuming equipment;

- Insufficient load of the energy equipment;

- High level of dependency of the fuel supplies in the region from the supplies from the other regions of Russia;

- Insufficient development of gasification of the regional users;
- Imperfection of the legal and regulatory basis.

As the result the specific weight of the fuel consumption to generate the power at the outdated equipment and technologies is (Tons/kW-h):

- At Arkhangelsk TPP JSC “Arkhenergo” - 282,5;
- At Severodvinsk TPP-2 - 299,0;
- At Severodvinsk TPP-1 (coal) - 383,4;
- At block-stations from 270 to 350,

whereas the similar indicators at the TPP of the industrially developed countries at the West do not exceed 260-270 t/kW-h. Power intensity of the industrial products in the region remains to be very high and exceeds the European index in almost three times. 70% of the heat networks have to be reconstructed. Idle heat consumption rate due to the lack of the regulating and metering tools is not less than 20%.

Local fuel types (wood wastes, wood, peat) are used at the boiling-houses of the housing and utilities infrastructure and shareholders society dealing with the woodworking, block-stations of the pulp-and-paper and hydrolytic plants. The majority of the large boiling-houses heating the production process are adjusted to fire the wood fuel, which is not the case for the small boiling-houses. At the majority of such boiling-houses there is no appropriate fuel preparation. The wood comes with the high level of humidity, furnaces are not adjusted to fire the fuel of the high humidity level and thus this leads to the reduction of coefficient of efficiency at the boiling-houses and increase he fuel consumption rate.

The weighted consumption rate for the standard fuel can be 320 kg/Gcal at the norm of – up to 215 kg standard t/Gcal at the municipal boiling-houses, especially the small one. It means that excess fuel consumption is up to 105 kg of standard t per 1 Gcal.

- As of today some conclusions can be made from the implementation of the international Russian and Scandinavian Energy Efficiency Programme at the social sector of the Barents region. The programme commenced in 2005 and was worked out for 3 years. To implement this programme the Ecologic Financial Corporation of the Northern countries (NEFCO) approved the credit line for the projects of the social sector of the municipal entities. The loan is given at the favourable conditions in RUB with 3% of annual interest for the duration of 5 years with the grace period of 1 year. The Arkhangelsk regional energy efficiency center (AREEC) was defined by the financing organisation as the organisation responsible for the development and management over the project implementation as well as the coming monitoring over the completion. The Energy efficiency fund of the Arkhangelsk regional is also one of the projects developers together with the Centre. Energy saving projects are under implementation at the following municipal entities of the Arkhangelsk region:

- Kotlas – Energy efficiency measures at the social sector of Kotlas. The project includes the energy efficiency measures at 42 social sites.
- Velsky area - Energy efficiency measures at the social sector of Velsk. The projects aims to conduct the energy saving measures at the building of the central regional hospital and the kindergarten.
- Verkhnetoemsky district – Reconstruction of the heating system of Soiginsk main school at village Soiga.

- Onezhsky district – Reconstruction of the boiling-house of the central district hospital at Onega town. The project also included the reconstruction of the boiling-house.

- Koryazhma, Kotlassky district – Introduction of the energy saving measures at the social sites of Koryazhma town.

Within the framework of this programme about 34.4 mln RUB investments were attracted by the Arkhangelsk region, out of which Kotlas - 9,5 mln RUB. The total budget of five projects is 52,8 mln RUB with the consideration of the municipal and regional co-financing. AREEC and the Energy Saving Fund of the Arkhangelsk region developed four more projects, which are planned to be included to this programme in2007. Currently these projects are at the approval of the financing side.

- Koyda, Mezensky district – "Energy Saving Measures at the Social Sites of the village Koyda"

- Mezensky district – "Upgrade of the Energy Supplies System at village Dolgoschelije"" the construction of the wind-driven installation with the capacity of 90,

- Novodvinsk – "Energy Saving Measures at 9 sites of the municipal property of Novodvinsk" (kindergartens),

- Onega – "Reconstruction of the Boiling-house of the Central District Hospital of Onega town" (second stage of the project).

4.8 . Problems of the Fuel and Energy Sub-sector

- Together with the products of the forestry, wood-chemical and agricultural sectors the big meaning is with the largest in Russia enterprises of the defense sector, space center at Mirny town" You cannot limit such consumers of the special group, 1st category with the energy resources.

- The capacity of high-voltage line-220 kW covers the current demand for the power supplies. However the bottleneck of it is single-chain performance, which decreases the reliability of the operations.

- The calculated resources volume at the Arkhangelsk TPP and Severodvinsk TPP-1 and some block-stations is used by 60-90%.

Besides the analysis of the current condition of the energy sector in the region showed that as of today due to the objective reasons the problems were accumulated which demand the absolute decision. They are, namely:

- Wear and tear of the equipment and the outdated technologies of the energy sources;

- Need to reduce the sue of the masut at the power plants through its substitute by the other fuel types;

- Put into operation the energy capacities that are operated with the nuclear fuel;

- Reduction of the use of masut and coal through use of the local fuel types;

- Increasing dependency of the economic situation of fuel and energy users from the prices and tariffs;

- Low efficiency level of the fuel and energy resources' use;

- Load caused by the energy generating sources for the environment protection sector;

- Low efficiency for the use of fuel at the many boiling-houses with the low profit, especially the ones, which are operated with the fuels available locally;
- High rate of losses of power and heat during transportation;
- Unsatisfactory condition of the transmission lines with the voltage of 10 kV (27% of total number are in unsatisfactory and unacceptable condition);
- Lack of use of the small HPP, which are used to be operated in the region before;

4.9 . Perspectives for Development

The situation in the power sub-sector defines the energy efficiency level in the Arkhangelsk region. This demands further development of own energy sources.

Therefore the programme of development of the energy sector in the region envisages the following:

1. The construction of the gas pipeline Niuksenitsa-Arkhangelsk.
2. Reconstruction of the TPP through the replacement of the outdated equipment and increase the efficiency ratio.
3. Construction of the nuclear thermal power plant as the second source for the heat supplies in Arkhangelsk.
4. Construction of the mini TPP to be operated with the local fuels or the wastes of the own production.
5. Overall introduction of the energy saving measures and technologies within the housing and utilities infrastructure of the municipal entities and production units.
6. Upgrade of the heat generating equipment at the boiling-houses of small capacity with the extensive use of the fuel available locally.
7. Construction of the transmission lines, especially in Leshukonsky and Mezensky districts with the purpose to shut down the diesel power plants over there and reduce the volume of the seasonal fuel import as well as the improve the reliability level for the power supplies to the consumers in the region.

4.10 Possibility to use the alternative type of fuel

Use of Biomass

The use of the alternative energy sources, including the types of fuel available locally, is of growing interest due to the growing demand of the society for the energy and decrease of the mineral fuel resources. The energy efficiency project “Reconstruction of the Boiling-house at the Central Regional Hospital” finalised in Onega town is the case story for the Arkhangelsk region.

In 2006 two new boiling-houses appeared in Onega, which are operated with the biomass. These boiling-houses are operated with the bark and wood wastes. The powerful heating boiling-house is in the commissioning operations at the industrial zone of the town, which will supply heat and hot water to the housing stock. The start-up of the boiling-house will considerably improve the ecological situation in the town and stabilise the heat supplies. The special Finish equipment, which is highly automated, is installed at the boiling-house. Bark and other lumbering wastes are used as the fuel at the boiling-house. The owner of the Onezhsk wood sawing and wood working factory – concern “Orimi” from Saint Petersburg agreed to attract the investments for such a far-reaching project. This project is social not commercial. The

total cost of the project is more than 200 mln RUB. It is expected to cover some of the costs through the foreign investments within the framework of Kyoto protocol.

The second new boiling-house heats the Onezhsk Central hospital of the region. Four boilers from Byelorussia are installed over here, which are also operated with the bark wastes, and with the capacity of 2 MW each. The implementation of this project will allow use of one boiling-house operated with the lumbering wastes instead of the two operated with the coal. Thus the production cost for the heat will be decreases and the ecological situation in the town will be improved. The international organization “Nordic Environment Finance Corporation” (NEFCO) participates in the reconstruction of this boiling-house. This organization finance environment protection projects. Denmark, Finland, Iceland, Sweden and Norway participate in this non-profitable organisation. The energy efficiency fund of the Arkhangelsk region represents the interests of this corporation in Arkhangelsk. It was the one, which developed the project business-plan in many details.

The total amount of borrowings was 9,5 mln RUB, the payback is planned for the period till 2010. The district and regional budgets covered the rest of the needed funds. The new boilers were already installed, and the two of them were put into operation upon the beginning of the heating season.

The implementation of the energy saving project in Onega allowed the reduction of the municipal budget costs for the purchase of fuel and payment the bills for the consumed power as well as the reduction of the energy consumption and improvement the quality of the heat supplies. Besides there was the ecologic effect due to the transfer of the boiling-house from the coal to the wood wastes, which allows the reduction of emissions.

Currently there is the request for the implementation of the second stage of the project in Onega “Reconstruction of the Heat Networks in Onega”. It is planned to shut down three coal boiling-houses and connect these three sites to the new boiling house of the central regional hospital, including the construction of new heat networks within the framework of this project. The NEFCO preliminary approved this project.

Potential for he Wind Power

There are a lot of residential areas with the population of from 5-10 to several dozens or hundreds people in the territory of the Arkhangelsk region, the rural population of which (413 thousand people or 23% from the total population) lives in villages. As a rule such small areas are located in the remote territories with the difficult access. Thus they obliged to have own energy supplies sources: diesel generators or generators operated with the petrol. The combined schemes of the energy supplies have to be developed for these very areas. The combined energy supplies schemes include wind-driven aggregates, accumulators, photovoltaic array and diesel-power plants. Economic efficiency indicator for such schemes is the saving of costs for the power supplies which is grounded by the reduction of the purchased fuel volume, the price for which is high in the Arkhangelsk region and varies a lot including the cost of its delivery.

The changes of the average annual wind speed for the coastal districts in the Arkhangelsk region are not high. The variation ratio is within the range of 5-8%. 11 residential areas were selected to arrange the pilot power supply system, where it is possible to install wind-driven installations of BWC-10 type.

The table below contains the data on the power and heat consumption in some residential areas of the Arkhangelsk region and possible fuel saving volumes due to the use of the wind-driven installation. The data show that the use of the wind-driven installations-10 at the meteorological stations allow annual saving of 85 - 100% of the liquid fuel and 20-25% solid fuel. The use of the two wind-driven installations-10 at small northern villages will reduce the demand for the liquid fuel by 85-100%. Arkhangelsk region budget financed the installation and start-up of the two wind-driven installation ÂÝÓ-10 type in Krasnoe village.

Table 1. Generation and Possible Saving of Power and Heat due to the Installation of the Wind-driven Aggregates in some Residential Areas of the Arkhangelsk Region.

Name of site	Consumed power capacity, kW	Consumed power volume, kWh/year	Consumed heat volume, kWh/year	Output of wind-driven generator, kWh/year	Type of the wind-driven generator and their quantity, kW	Possible saving of fuel	
						liquid	solid
Morzhovets	8	122000	70100	266000	1õ10	100	20,8
Indiga	8	12200	70100	26600	1õ10	100	22,5
Sosnovets	8	12200	70100	26600	1õ10	100	20,8
Mys Konstatinovsky	8	12200	70100	29800	1õ10	100	25
Krasnoe	20	25300		35000	2õ10	100	
Megra	58	41100		35000	2õ10	85,3	

The wind-driven installations with the accumulating battery cover the minimum volume of the energy consumption up to of 50-60%. To satisfy the demand for the energy supplies up to 95-100% it is required to arrange the automated parallel operation of the diesel aggregate and the wind-driven installations. The start-up of the wind-driven installations was resonant in the region. Their successful operation will favourably promote the forming of the market for the wind-driven installations in Russia.

5. Legal Basis, Structure of Management and Coordination

Currently there are no public or administrative bodies or structures, which directly deal with the energy efficiency issues.

The territorial Department of the State Energy Supervision used to organise and coordinate activities in the sphere of the energy efficiency and energy saving before the reorganisation of the system of public power took place.

The Department of the Fuel and Energy Sector and Housing and Utilities Infrastructure at the Arkhangelsk region Administration deals with the issues of the energy sector and fuel and energy supplies. The Department does not directly deals with the energy efficiency issues. Such issues may occur in day-to-day operations and at the process of the planning for perspective, e.g. development of target programmes.

The division responsible for "the technologic auditing, programmes' development for the efficient use of the energy resources, energy saving and economic incentives for the enterprises as well as the development of the enterprises within the energy sector" at the Department for Tariffs and Prices at the Arkhangelsk region Administration partially deals with such aspects.

In 1997 in the Arkhangelsk region there was approved the regional law № N 52-12-ОЗ "About Energy Efficiency and Reduction of Energy Costs in the Territory of the Arkhangelsk Region". The law was developed on the basis of the Federal law "About Energy Efficiency", therefore it is similar to it very much. Some of the interested parties in the region consider that this law played the positive role however due to the changes, which took place at the structure of the public regulation, budget and tax administering, price setting system and tax regulation, this law became outdated. It is expected that upon the adoption of the new Federal law "About Energy Efficiency" the Region will adopt the respective similar one at the regional level.

Arkhangelsk Regional Energy Efficiency Centre

The independent non-profit making organisation "Arkhangelsk Regional Energy Efficiency Centre" (AREEC) was established to coordinate activities in the sphere of the energy saving and efficiency in the Arkhangelsk region.

The founders of the center are:

- Arkhangelsk region Administration
- Non-governmental Environment Fund named after Vernadsky
- Norwegian Energy Efficiency Group
- Association "Russian Pilot Zones of the High Energy Efficiency Level" (RUSDEM)
- Engineering center Energyservice

The objective of the AREEC is the establishment in the Arkhangelsk region the united permanent center to organise and coordinate activities in the sphere of energy and resources saving as well as the selection and dissemination within the Northern region the most efficient energy and resources saving technologies, search and attraction of the foreign partners and investments to this particular sphere.

Objectives of the Centre:

- Development of the integrated programmes and projects in the sphere if the energy and resources saving and environment protection activities;
- Coordination energy and resources saving activities;

- Energy auditing of the current industrial and civil sites, as well as the proposed projects for introduction. Environment assessment of different sites and territories;
- Development of the investment programmes, search and attraction of investors to the energy and resources saving and environment protection projects;
- Definition of the most efficient domestic and foreign energy and resources saving technologies and their adjustment to the local conditions;
- Organisation of the international meetings and symposiums;
- Training of the experts in the sphere of the energy and resources saving technologies;
- Services for the organisations and enterprises in the sphere of the energy and resources saving and environment protection;
- Development of the database on the energy efficiency and energy saving; development of the database for the sources of emissions, spew and wastes;
- Development and implementation of the Kyoto protocol provisions in the territory of the Arkhangelsk region.

The center is actively involved into the international cooperation. The status of the Energy pou sto within the Barents region was assigned to the Centre within the framework of the central working group for energy sector. Currently the Centre is involved into development of the long-term perspectives as well as the work over the specific projects.

Arkhangelsk Region Energy Efficiency Fund

The main objective – implementation of the efficient regional energy policy.

The founders of the Fund are:

- Arkhangelsk region Administration
- Arkhangelsk City Executive Board
- Severodvinsk City Executive Board
- JSC “Arkhenergo”
- Arkhangelsk State Technical University
- Primorsk State University

The main objectives of the Fund – accumulating and allocation of the financial proceeds on the payback and non-performing basis to the projects and measures of the users and suppliers of the energy resources, directed to the improvement of efficiency of the resources use.

The Fund is involved into the following:

- Accumulating of the financial proceeds from the different sources;
- Analysis of the energy efficiency projects, projects selection and setting up the

priorities for their further financing;

- Arrangement of the energy efficiency projects financing;
- Improvement of the legal basis in the sphere of the energy and resources saving;
- Development and introduction of the efficient incentives to apply the energy saving regimes to generate and consume the energy;
- Development and application of the alternative options to attract domestic and foreign investments to finance the projects on the development of the energy supplying systems to the resident arreas in the region.

6. Tariff Regulation

The Tariffs and Prices Department is the body of the executive power in the Arkhangelsk region, which pursues and implements the public tariffs (prices) policy within the territory of its responsibility.

The Tariffs and Prices Department at the Arkhangelsk region administration was formed in accordance with the regional law as of 30.06.2004 № 243-31-ОЗ “About the Structure of the Bodies of the Executive Power in the Arkhangelsk Region” and Resolution of the Regional Administration Head as of 09.07.2004 № 95 “About the Structure of the Bodies of the Executive Power in the Arkhangelsk Region”. The provisions for the tariffs and prices department are approved by the Resolution of the Regional administration Head as of 24.09.2004 № 151.

Public tariffs regulation in the territory of the Arkhangelsk region is provided in accordance with the Federal law as of 14 April 1995 № 41-ФЗ “About Public Tariffs Regulation for Power and Heat in the Russian Federation”, Federal law as of 26 March 2003 № 35-ФЗ “About Power Sub-sector”, Federal law as of 30.12.2004 № 210-ФЗ “About the Basis for the Tariffs Regulation for the Organisations within the Communal Infrastructure”, Resolution of the Government of Russia as of 07.03.1995 № 239 “About Measures to Improve the Public Prices (Tariffs) Regulation”, “Rules for Public Prices (Tariffs) Regulation by the Arkhangelsk Region Administration”, which is approved by the Administration Head as of 25.03.2004 N 57, and the other regulatory bills valid in the sphere of the public regulation.

Othe main objectives of the Department is to pursue and implement the public policy for the tariffs (prices) regulation in the territory of the region, public tariffs (prices) regulation in the sphere of the energy sector and some other spheres (defined by the respective Resolutions of the Government). Besides the department provides the public control over the price setting procedure and application of the regulated tariffs (prices) in accordance with the current legislation, protects interests of the users and producers within the spheres regulated by State.

The Department combines the Regional Energy Commission, established in 1996, and the price setting division, the history of which starts fro the 60-ies of the twentieth century. Currently the Department set up thousands of different tariffs per year, from the tariffs for the power and heat to the fare at the municipal transport and baby food prices. About 30 people work in the Department.

In accordance with the Provisions for the Tariffs and Prices Department:

- Department conducts its activities in the sphere of the public tariffs (prices) regulation for the goods (services) and controls tariffs (prices) in the spheres, which are defined by the Federal and Regional legislation on the united legal and regulatory basis, approved by the authorized bodies. It is independent with its decisions within the limits of its responsibilities ensures by the legislation.

- Department is the successor of the Regional Energy Commission of the Arkhangelsk region.

- Department interacts with the Federal bodies of the executive power, which regulate the natural monopolies, local governments, public organisations and the other Federal, territorial and regional bodies, organizations, institutions.

- Department is the legal body, has its bank account, letterheads, seals and stamps.

Department sets up the tariffs for the following goods and services:

- Power transmission through the distribution networks within the range of marginal (minimum and (or) maximum) tariff levels for the power transmission through the distribution networks approved by the Federal body of the executive power on the natural monopolies regulation.

- Heat transmission services.

- Sales mark-ups for the guaranteeing power suppliers.

- Heat except the one, which is generated by the power plants in the combined regime for power and heat generation.

- Heat generated by the power plants in the combined regime for the power and heat generation within the range of marginal (minimum and (or) maximum) tariff levels for heat approved by the Federal body of the executive power on the natural monopolies regulation.

- Power supplied by the energy supplying organisations to the consumers within the range of marginal (minimum and (or) maximum) tariff levels approved by the Federal body of the executive power on the natural monopolies regulation except the power sold by the non-regulated prices.

- Natural gas sold to the population and housing building societies

- Liquefied gas, sold to the population for the household needs (except the gas to fill the vehicles).

- Services by water supplying and sewage systems.

- Social services provided to the population of the Russian Federation by the municipal entities of the social assignment.

- Solid fuel, furnace household fuel and kerosene sold to the population, if otherwise is set up by the current legislation.

- Payment by the population for the housing and communal services, if the otherwise is set up by the current legislation.

- Other goods and services, which are under public regulation in the territory of the Arkhangelsk region.

The main objectives of the Department, apart of those, which are related to the pursuant and implementation of the public tariffs (prices) policy in the territory of the region, are also the following:

- Ensuring an access for the users in the spheres regulated by the State to the power and heat as well as the other goods (services).

- Development of the conditions for the attraction of the domestic and foreign investments to the spheres regulated by the State in the territory of the Arkhangelsk region.

- Development of the economic incentives which ensure the use of the energy saving and innovation technologies in the production process as well as the introduction of the organic technologies for energy production and use.

The Department possesses quite a range of the authorities provided on the legal basis, namely:

- Participation in the development of the consolidated budgeted balance of the power (capacity) generation and supplies within the framework of the United Energy System of Russia by the actors of the Russian Federation.

- Participation in the development of the regional energy saving programmes and control over their implementation.

- Development of the proposals for the target programmes to develop the energy sector, which are approved by the Federal Body of State Authority and are of interest of the Arkhangelsk region,, including the attraction of the independent experts on the basis of contracts and within the limits of the approved estimates, approved by the Regional Administration Head.

- Approval of the energy sector sites location in the territory of the Arkhangelsk region.

- Approval for the assigning to the energy sector actors the status of the guaranteeing suppliers.

- Submission to the Federal body of the executive power on the natural monopolies the proposals on the setting up the marginal (minimum and (or) maximum) tariff (price) levels for the power transmission through the distribution networks of the organizations located in the territory of the Arkhangelsk region.

- Expertise of the Federal and regional draft laws, submission of proposals to improve the current legal and regulatory basis for the public tariffs (prices) regulation to the bodies of state authority of the Arkhangelsk region, Federal body of the executive power on the natural monopolies regulation, as well as the official explanation of the decisions taken by the Department.

- Analysis and forecast for the price economic situation in the territory of the Arkhangelsk region in the course of the public tariffs (prices) regulation.

The Department combines the business divisions, which ensures the following:

- Finance and economy analysis and pursuant of the unified price policy in the territory of the region;

- Expertise and calculation of tariffs (prices) and markups for the goods and services by the regulated types of activity;

- Technologic auditing, development of the efficient energy resources use programmes, energy efficiency and economic incentives, development of the energy sector enterprises;

- Legal support to the Department;

- Documentary support.

The business divisions of the Department act on the basis of the provisions for such divisions, approved by the director of the Department.

The regional budget finances the activities of the Department. The settled property belongs to the Department only on the basis of the operating management and is the state property of the Arkhangelsk region.

In 2005 the Department adopted 364 resolutions, set up 1958 tariffs, prices and ratio for the marginal tariff increase, including 886 tariffs for power and heat by 273 organisations.

Public tariffs regulation for power and hear in the territory of the Arkhangelsk region is provided within the range of the marginal tariff levels approved by the Federal Tariffs Agency of the Russian Federation, including the marginal tariffs for population, marginal maximum tariff levels for the power transmission in the territory of the Arkhangelsk region, including JSC "Arkhenergo".

The order of the Federal Tariffs Agency as of 01.08.2006 № 166-э/1 "About Marginal Tariff Levels for Power and Heat for 2007" sets up and introduces the following for 2007:

1. Marginal minimum and maximum tariff levels for the power supplied to the consumers in average in the Arkhangelsk region, without differentiation by consumers' groups, voltage levels, annual number of hours for the use of the declared capacity, daily zones (hours) and calendar scheduling for 2007:

    - Marginal minimum tariff level - 176,56 kopecks/kWh without VAT;

    - Marginal maximum tariff level - 179,33 kopecks/kWh without VAT.

2. Marginal minimum and maximum tariff levels for the heat generated by the power plants operated in the combined regime to generate power and heat, in average for the Astrakhan region, without differentiation by the consumers' groups, type of heat source, steam parameters, system for the centralised heat supplies and calendar scheduling for 2007:

    - Marginal minimum tariff level - 434,5 RUB/Gcal;

    - Marginal maximum tariff level - 446,3 RUB/Gcal.

3. Marginal minimum and maximum tariff levels for power supplied to the population in the zone of the centralised and decentralised energy supplies in the Astrakhan region for 2007:

    - Marginal minimum tariff level - 159,50 kopecks/kWh with VAT;

    - Marginal maximum tariff level - 164,00 kopecks/kWh with VAT.

The mentioned tariff levels are set up in average for the Arkhangelsk region. Therefore the tariff levels (rate of increase) for specific energy supplying (energy selling) organizations can be lower or higher. The same is related to the tariffs by the groups and categories of the consumers.

In 2005 the setting up of the tariffs was provided in the condition of ongoing reforms in the power sub-sector. This is the specialty of the tariff campaign2005, which triggered the integrated review of tariffs for all energy companies, established in the process of reforms at the JSC "Arkhenergo". The following tariffs were approved: power and heat generation for JSC "Arkhangelsk Generating Company:, power transmission through the distribution networks of the JSC "Arkhenergo" and power tariffs sold by the JSC "Arkhangelsk Sales Company" (i.e. tariffs for the end-users).

In accordance with the resolution of the Government of the Russian Federation as of 26.02.2004 № 109 “About Price Setting for the Power and Heat in the Russian Federation” the method of the economically feasible expenditures (costs) is applied in the process of the tariffs regulation. The Department analysis the power and heat (capacity) balances, losses and energy consumption for own needs, structure of the fuel balance, weighted fuel consumption and the other regulatory parameters and costs items in the course of the review the submitted materials by the energy supplying organisations for the setting up the tariffs.

The costs included to the tariffs are defined on the basis of the analysis of the work during the previous two years and the current year with the consideration of the regulatory parameters as well as the price indexes for the regulated period, approved by the Ministry of the Economic Development and Trade of the Russian Federation. All costs without grounded economic support are excluded from the tariffs.

At the same time the required profit may include the additional funds. Thus, the JSC “Arkhenergo” planned 115 mln RUB to restore the abandoned power networks to accept to the balance in future.

To define the results of the tariff regulation there is the regular analysis of the finance condition of the organisations conducting the regulated activities, which mainly testifies the loss of the housing and utilities infrastructure in regard to the communal services.

Tariff for power for the urban population household needs for 2007 increased in comparison with the tariff for 2006 by 17,9 % and is 171 kopecks/kWh with VAT.

The reducing ratio of 0.7 is applied for the rural population and urban population from the housing stock with the installed electric stoves and electric heating systems in accordance with the resolution of the Government of the Russian Federation as of 07.12.1998 № 1444 “About Basis for the Price Setting for the Power Consumed by the Population”.

Tariffs for power for the population are set up without differentiation in dependence from the social consumption rates.

The tariff for 2007 for the other categories of the consumers was (to compare, one-rate at low volateg level):

- Budget consumers - 255,6 kopecks/kWh without VAT
- Rural consumers – 194,7 kopecks/kWh without VAT
- Organisations managing the tenement houses, summer resorts and garage cooperative societies – 145,0 kopecks/kWh without VAT
- Other consumers - 255,6 kopecks/kWh without VAT

Thus there is the cross subsidies within the power sub-sector in the region.

The specific problem in the Arkhangelsk region is the tariff regulation of the sites and consumers of the decentralized power supplies. In 2005 for the first time was set up the unified tariff for the state unitary enterprise “Arkhangelsk Regional Energy Company” (“ОblDES”), including all its 7 branches. Before every branch got its own power tariff. It allowed tariff reduction for the budget organisations at 5 of its branches. In general the power tariff increased by 25 % and was equal for the budget organizations (without the fuel component) – 2,92 RUB/kWh, for consumers category “the other” - 7,41 RUB/kWh. The population used to pay for the power as all residents of the region: urban – 1,45 RU/kWh, rural – 1,02 RUB/kWh. Such measures caused the including of subsidies to the regional budget for the state unitary enterprise “Arkhangelsk Regional Energy Company” at the amount of 287,5 mln RUB, budget

2007 – already 400 mln RUB, and budget of the municipal entities (for 12 official organizations with the diesel power plants), respectively 30,2 and 33,1 mln RUB.

The main objective of subsidies is the total recovery of the power supplying organisations' costs occurred in the process of the generation of power for the needs of the population. The ground for subsidies is the excess of the economically justified tariff for power over the tariff to population, set up by the tariffs and prices department at the regional administration.

Tariff for heat supplied to the heating needs and water supplies, in average for the region, increased by 10 per cent. The average tariff for heat supplied by the JSC "Arkhenergo" increased by 7%, for local boiling-houses - by 13,1%.

The relations chart in the course of the heat supplies to the population and other consumers is given in drawings 3 and 4 attached to the main text (Arkhangelsk is given as example, source: AREEC).

The regional budget also envisages the subsidies to the budgets of the municipal entities to cover the losses in the result of the public tariffs regulation for the heat supplied to the heating needs of population – 330 mln RUB and 350 mln RUB for 2006 and 2007 respectively. The main objective of the subsidies is the total costs recovery for the heat supplying organisations, when they generate heat for the needs of population. The ground for subsidies to the budget of the municipal entity is the excess of the economically grounded tariff (rate) for the heating services to population over the index, calculated for the heating season (26,0677 RUB per m^2 per month without VAT in 2006).

As a rule the Department follows the practice to include the investment component to the tariff to implement the projects proposed by the energy-supplying organisation only in relation to the large energy companies. The main restriction is the high level of tariffs in the Arkhangelsk region and the need to limit its further growth.

In the region there is the lack of production and investment programmes of the housing and utilities infrastructure developed in accordance with the Federal law N 210 to set up the respective mark-up to the tariff to implement such programmes.

Another problem of the tariff regulation in the region is the considerable share of the residual oil I the fuel balance, the cost of which is not stable. All these make the Department to monitor the information about the outlined profit of the energy supplying organization and request the respective institutions (Government of Russia, authorized representative of the President of the Russian Federation at the Northern-Western Federal okrug of Russia) to provide the financial support.

7. Social and Economic Target Programme "Modernisation of Facilities of the Public-Service Infrastructure in the Arkhangelsk Oblast for 2007 – 2010"

State Client of the Programme: Department of the Fuel and Energy Sector and Housing and Utilities Infrastructure of the Arkhangelsk Region Administration

Main developers of the Programme: Department of the Fuel and Energy Sector and Housing and Utilities Infrastructure;

Department of Economic Development

Objectives: Improvement the efficiency and functioning of the housing and utilities infrastructure

Decrease of the financial load for budgets at all levels

Ensuring self-sufficiency of the housing and utilities infrastructure

Ensuring reliability of the housing and utilities systems for life support

Improvement of quality of housing and utilities services

Total amount of financing: 3 888 760 thousand RUB.

Source for financing: Federal budget – 756 840 thousand RUB (19,5%);

Regional budget – 1 140 018 thousand RUB (29,3%);

Local budgets – 477 082 thousand RUB (12,3%);

Off-budget sources – 1 514 820 thousand RUB (38,9%).

Directions for the Programmed Implementation:

- Modernisation of the Communal Infrastructure. Activities directed to the improvement of water supplies, water discharge, energy supplies to the public-service sites in the region;
- Efficient use of the natural gas. Due to the construction of the gas pipeline and possibility to use the natural gas there is the need to reconstruct the boiling-houses and transfer them to the gas fuel. It is planned to construct the gas distribution pipelines, gasification and reconstruction of the heat supplying systems of the residential areas and energy equipment;
- Efficient use of the fuel types available locally. Reconstruction and construction of the boiling-houses and heat networks to use the renewable energy resources. Implementation of the projects on the transfer of the boiling-houses to the wood wastes will reduce the use of coal and masut and will solve the environment protection problems, prevent the accumulation of the wood wastes at the stock places.

- Modernisation of the heat sources and heat supplying systems. Reconstruction of outdated energy equipment at the boiling-houses, which will allow the increase of the coefficient of efficiency and decrease the costs for fuel.

Table 2. Financing of the Programme by Years, Sources and Directions

N	Name of the Sub-programme	Amount of financing, thousand RUB				
		2007	2008	2009	2010	Total
1	2	3	4	5	6	7
1	Modernisation of the Communal Infrastructure					
1.1	Local budget	43691	58715	45712	39758	187876
1.2	Regional budget	92460	144625	129653	131052	497790
1.3	Federal budget	5412	191960	84297	80226	361895
1.4	Off-budget sources	163918	224832	158043	160616	707409
	Totally	305481	620132	417705	411652	1754970
2	Efficient use of the natural gas					
2.1	Local budget	14951	5517	5617	5267	31352
2.2	Regional budget	43547	16551	18690	18170	96958
2.3	Federal budget	2684	30577	10534	10534	54329
2.4	Off-budget sources	65118	22567	22117	21067	130869
	Totally	126300	75212	56958	55038	313508
3	Efficient use of the fuel types available locally					
3.1	Local budget	15830	16600	16700	14700	63830
3.2	Regional budget	40750	49800	51810	49830	192190
3.3	Federal budget	25250	38726	34867	29867	128710
3.4	Off-budget sources	60720	65177	64940	59233	250070
	Totally	142550	170303	168317	153630	634800
4	Modernisation of the heat sources and heat supplying systems					
4.1	Local budget	69874	55104	38839	30207	194024
4.2	Regional budget	101934	106996	72776	71374	353080
4.3	Federal budget	11833	128289	37459	34325	211906
4.4	Off-budget sources	129872	147137	80816	68647	426472
	Totally	313513	437526	229890	204553	1185482

5	In total for Programme					
5.1	Local budget	144346	135936	106868	89932	477082
5.2	Regional budget	278691	317972	272929	270426	1140018
5.3	Federal budget	45179	389552	167157	154952	756840
5.4	Off-budget sources	419628	459713	325916	309563	1514820
In total for Programme		887844	1303173	872870	824873	3888760

Table 3. Demand of the Municipal Energy Sector in the Arkhangelsk Region for Energy and Fuel Resources

Type of fuel	Unit of measurement	Fuel demand to generate heat	
		2005	2010 (forecast)
1	2	3	4
Coal	Tons	398270	308410
Residual oil	Tons	131190	67102
Diesel fuel	Tons	17150	17150
Wood	Solid m^3	527520	554670
Liquefied gas	Thousand tons	0,213	0,213
Natural gas	Thousand m^3	7770	125904

As the result of this Programme implementation it is expected:

- Improvement of the efficiency level and quality of the public services;
- Improvement of the reliability of the engineering systems for life support;
- Improvement of life and security quality for the population;
- Reduction of the depreciation level of the fixed assets within the public service infrastructure by 10%;
- Reduction of coal use by 22,5%;
- Reduction of residual oil use by 48,6%;
- Increase of use of the local types of fuels by 5,1%;
- Increase of the natural gas use in 16,2 times;
- Decrease the level of subsidies to the public-services.

8. Summary

1. The distinctive feature is there are no programmes of the development of the energy sector in the Region for the previous period. There is the special department for the Fuel and Energy Sector and Housing and Utilities Infrastructure at the Administration of the Region. The only developed programme is – “Modernisation of Facilities of the Public-Service Infrastructure in the Arkhangelsk Oblast for 2007 – 2010”.

The programme combines four large sections: modernisation of the Communal Infrastructure, efficient use of the natural gas, efficient use of the fuel types available locally, modernisation of the heat sources and heat supplying systems. The programme is quite successful for the region, however it faces serious financial problems. No foreign investments are envisaged in the framework of this programme. The Administration of the region lacks the experience to work with the foreign investments. Besides, on the basis of the annual results the Committee of the Fuel and Energy Sector of the Administration in the region publishes the reporting fuel and energy balance, which contains the facts about the structure of the production and use of the energy resources in the region but without any analytical notes. As far as the perspective period is concerned the programme for the development of the energy sector or some if its sub-sectors for the medium term and moreover for the long-term perspectives does not exists. Furthermore there are no any serious analytical materials related to the issues of energy and energy saving sectors in the region.

2. One of the emergency issues related to the development of the regional energy sector – gasification at the regional level. It will inevitably trigger the serious changes for the structure of the fuel and energy balance. However there are no any forecasts, analytical materials and grounded calculations exist in the region. Meanwhile such materials have to be developed considering ambiguous consequences of the regional gasification and different attitude to it by the Federal as well as local governments. It is known that there are two contradictive trends in the country – widespread of gasification and diversification of the energy supplying sources instead of “being addicted to the gas”. The consequences of competition between gas and coal in the Arkhangelsk region have not been estimated and the optimal option has not been grounded. It should not be forgotten that starting from 2001 there will be introduced the principle of equal profitability of domestic and external prices for gas. In 2008 the price for gas will be increased by 25%, and in 2009-2010 it will be increase in 13% once in a half of a year. Such an environment may cause the changes for all economy of the energy sector in the region. By spring 2007 upon request of the Administration of the region Promgas (Gasprom) has to develop the General scheme of the gas supplies in the Arkhangelsk region for the perspective till 2020 with consideration of the construction the gas pipeline Niusenitsy-Arkhangelsk and transfer to gas of the power sub-sector in the region. Most likely after such a scheme is developed the situation will be more clear.

3. Arkhangelsk region imports 92% of the primary energy resources from other regions, and only 8% is available locally: wood, wastes from the papermaking and wood-chemical industries, peat. The high prices for the imported fuel leads to the situation when the tariffs for power and heat are found to be the highest in the Russian Federation. Thus the security of the energy supplies in the region through the diversification of the sources for supplies of the energy resources becomes the priority for the region. In this meaning local types of fuel and all “small energy sub-sector” in the Arkhangelsk region plays the special role. The energy efficiency project “Reconstruction of the Boiling-house at the Central Regional Hospital” finalised in Onega town is the case story for the Arkhangelsk region. Currently it is operated with the bark. Small residential areas in the region are located in the remote with the difficult access territories and have to have their own energy supplying sources: diesel generators or petrol generators. The combined schemes of the energy supplies have to be developed for these very areas. The combined energy supplies schemes include wind-driven aggregates, accumulators, photovoltaic array and diesel-power plants. Economic efficiency indicator for such schemes is the saving of

costs for the power supplies, which is grounded by the reduction of the purchased fuel volume, the price for which is high in the Arkhangelsk region and varies a lot including the cost of its delivery.

4. The Tariffs and Prices Department is the body of the executive power in the Arkhangelsk region, which pursues and implements the public tariffs (prices) policy within the territory of its responsibility. One of the problems for the tariff regulation in the region is the considerable share of the residual oil in the fuel balance of the region. The cost of the residual oil fluctuates a lot. All these make the Department to monitor the information about the outlined profit of the energy supplying organization and request the respective institutions to provide the financial support. Besides the regional budget estimates considerable amounts for subsidies to cover the costs of the energy supplying organizations when they generate power in the systems of the decentralized power supplies and heat supplies for heating for the needs of population. The basis to allocate subsidies is the excess of the economically grounded tariff over the set up tariff for population.

5. Energy efficiency and energy saving activities are conducted under the auspices of two organisations: Arkhangelsk Regional Energy Efficiency Centre (AREEC) and Arkhangelsk Regional Energy Efficiency Fund. The objective of the AREEC is the establishment in the Arkhangelsk region the united permanent center to organise and coordinate activities in the sphere of energy and resources saving as well as the selection and dissemination within the Northern region the most efficient energy and resources saving technologies, search and attraction of the foreign partners and investments to this particular sphere. The main objectives of the Fund – accumulating and allocation of the financial proceeds on the payback and non-performing basis to the projects and measures of the users and suppliers of the energy resources, directed to the improvement of efficiency of the resources use. These both structures are successful in heir inter-relations with the regional bodies of state authorities, trustworthy and involved into the international activities directly or indirectly (through workshops, conferences and trainings) related to the attraction of foreign investments. In particular, AREEC manages the operations (from the Russian side) within the framework of the international Russian and Scandinavian Energy Saving Programme within the social sector if the Barents region. To implement such a programme the Nordic Environment Finance Corporation (NEFCO) approved the credit line for the projects of the social sector of the municipal entities. Energy saving projects are ongoing in some municipal entities of the Arkhangelsk region. Within the framework of this programme were already attracted about 34,4 mln RUB of foreign investments. The total budget of five projects is 52,8 mln RUB with consideration of municipal and regional co-financing.

6. In the region there is the integrated and input-intensive (in total about 150 mln US Dollars) target programme developed for the Region. The programme is – “Modernisation of Facilities of the Public-Service Infrastructure in the Arkhangelsk Oblast for 2007 – 2010”. In spite of the preliminary expertise provided by the Department of Fuel and Energy Sector and Housing and Utilities Infrastructure and selection of the planned projects there are some doubts whether to include them to the programme, as the detailed analysis did not take place. Most likely it would be advisable if the Administration allocates some funds to develop the qualitative feasibility studies and grounds for investments because it will facilitate the attraction of the off-budget sources for financing. It is even more relevant as the financing of the programme is expected to be from the regional budget only by 29%, whereas the rest shares, including from the Federal and local budgets, are under bid question.