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"ENERGY BALANCE" OF THE POWER SECTOR OF GEORGIA: PART 2. BALANCES FROM 1960 TO 2006

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PART 1. BALANCES FROM 1960 TO 2006

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ANALYSIS OF "ENERGY BALANCE" OF THE POWER SECTOR OF GEORGIA

PART 2: BALANCES FROM 1960 TO 2006[1]

CONTENT

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1. GENERAL DATA ABOUT GEORGIA

Georgia is a country in the South Caucasus on the border of Europe and Asia. Since 1991 Georgia is an independent democratic country. State Governance is done by the President, Parliament of Georgia, and Courts of Georgia. The President is the head of state and executive government and the Parliament is the highest representative body of the country, which executes legislative policy and governance. The national currency is the Georgian Lari (GEL) applied since 1995. The exchange rate of GEL to US Dollars for the recent period is 1.8.

The total area of Georgia is to 69.7 thousand m^2 and a permanent population on January 1, 2005 is 4,5 million persons. The capital of Georgia is Tbilisi with 1,1 million population. Average density of population per m^2 is 65 persons. Total length of the state border is 1969 km, out of which length the land border is 1660 km. The neighboring countries are – from the north, in the Russian Federation: Krasnodar and Stavropol Regions, Kabardin-Balkania, North Osethia, Chechnia and Dagestan; from the east – Azerbaijan; from the south – Armenia and Turkey. From the west is bordered by the Black Sea and the total length of marine border is 308 km.

The longest rivers are the Alazani – 390 km, Mtkvari – 351 km, Rioni – 333 km, Enguri – 206 km. The largest lakes are Paravani with surface area of 37,5 km^2, Kartsakhi – 26,3 km2 and Paliastomi – 18,2 km^2. The highest peaks are Shkhara – 5068 m above sea level, Janghitau – 5058 m and Mkinvartsveri – 5047 m. 2/3 of the total territory of Georgia is covered with mountains and the Caucasus Mountain Range occupies 1/3 of the territory of Georgia. There are 6 climate zones. The duration of warm season in the first zone (zone adjacent to the sea) is 120 days, and average temperature is equal to -2 degrees of Celsius. As for the Alpine 6^{th} climate zone, duration of heating period is 200 days and average temperature is equal to -18 degrees of Celsius.

The administrative zones Georgia consist of two autonomous republics: Achara and Abkhazeti and 9 regions:

- Samegrelo-Svaneti with 475,8 thousand of population;
- Guria – 139 thousand;
- Imereti – 707,3 thousand;
- Racha – Lechkhumi – 48,9 thousand;
- Shida Kartli – 333,9 thousand;
- Mtskheta-Tianeti – 121,1 thousand;
- Kakheti – 386,5 thousand;
- Kvemo Kartli – 531,4 thousand;
- Samtskhe-Javakheti – 207, 9 thousand.

Georgia has significant potential of internal energy resources, though energy supply of national economy largely depends on the import of primary energy resources. Hydro energy sector is one of the important resources, technical potential of which is approximately estimated at 80 million kWh. In spite of this, only 12 % of total volume of hydro resources is yet used. Total installed capacity of hydro power plants is equal to 2800 MW and total installed capacity of thermal power plants amounts to 1800 MW. The fuel and energy complex is composed of natural gas transportation and distribution sectors, power generation plants, state electro system of Georgia, up to 50 natural gas distribution companies and 4 large power distribution companies.

Regulatory authority and market governance is held by The Ministry of Energy, the National Energy Regulatory Commission, the State Authority for Oil and Gas Regulation, and Wholesale Energy Market. The effective law is the Law of Georgia "On Electricity and Natural Gas". Reforms are being implemented in all spheres of the energy sector in order to introduce market principles.

2. HISTORICAL DEVELOPMENT OF FUEL AND ENERGY COMPLEX

2.1 Years 1960 – 1990

2.1.1 Power Sector

In the last 30 years of the soviet regime serious quantitative and qualitative changes took place in the development of the power sector of Georgia. As presented in Table 2.1 total capacity of power plants was increased by 4.6 times and total annual generation was increased by 3.8 times.

Relatively intensive period for power plants' construction was 1961 – 1980. During these years following plants were constructed and commissioned:

- 1961 – Ortachala HPP,
- 1963 – Tbilisi State District Thermal Power Plant (SRESI) and Khrami II HPP (in
- 1972 Tbilisi State District Thermal Power Plant reached its maximum capacity amounted to 1240 MW, after Unit No 8 was commissioned,
- End of 1962 – Unit No 6 of Thermal Electric Central within the Rustavi Metallurgical Factory,
- 1971 - 1980 – Hydro Power Plants of Enguri Cascade,
- 1977 – 1980 – Three stages of Vartskikhe Hydro Power Plant, new units in Tkvarcheli State District Thermal Power Plant (1977) and Thermal Electric Central of Batumi Oil Refinery Factory (1977-1978).

Total capacity of power plants exceeded 2 million kWh in 1970.

At the end of 1980 the total installed capacity for all types of power plants amounted to 4155 thousand kW, and total power generation reached 14,687.4 million kWh, which in comparison with level of 1960 was 4.3 and 4 times more relatively.

Table 2.1
Main Parameters of the Energy Sector of Georgia (1960 – 1990)

Years	Installed capacity by the end of the year, thousand kW			Power Generation, million kWh		
	Total	Incl. HPP	Share of HPP, %	Total	Incl. HPP	Share of HPP, %
1960	974	651	66,84%	3 702,0	2 223,0	60,05%
1965	1 584	778	49,12%	6 042,4	2 792,0	46,21%
1970	2 064	788	38,18%	8 964,0	2 642,0	29,47%
1975	2 708	1 122	41,43%	11 603,4	2 564,0	22,10%
1980	4 155	2 558	61,56%	14 687,4	6 410,0	43,64%
1985	4 389	2 688	61,24%	14 421,3	6 243,0	43,29%
1986	4 385	2 688	61,30%	14 570,8	6 056,0	41,56%
1987	4 391	2 688	61,22%	14 549,7	4 693,0	32,25%
1988	4 412	2 733	61,94%	14 599,7	7 748,0	53,07%
1989	4 412	2 733	61,94%	15 824,5	8 787,0	55,53%
1990	4 522	2 732	60,42%	14 238,0	7 594,0	53,34%
In percentages: Year 1990 compared to previous decades						
To 1960	464,2710	419,6621	-6,42	384,6029	341,6104	-6,71
To 1970	219,0891	346,7005	22,24	158,8353	287,4338	23,86
To 1980	108,8327	106,8022	-1,15	96,9402	118,4711	9,69

Development rate of power sector was significantly reduced during the next decade (1981-1990). In this time period capacity of power plants was increased only by 8, 8%, and power generation was even decreased by 3.1 %. During this period two power plants were commissioned - Zhinvali Hydro Power Plant (1985) and fourth step of Vartsikhe Hydro Power Plant (1988). Arch dam of Enguri Hydro power plant reached its design parameter (19899) that resulted in increased generation, reconstruction and expansion works were performed in State District Thermal Power Plants of Tkvarcheli and Tbilisi. In parallel new unit No 9 in Tbilsresi with the capacity of 300 thousand kW were commissioned in November of1990, but actually new plant did not appropriately participated in the total power generation for that specific year.

Prior to 1960 the power sector of Georgia was basically developing as a result of exploring new hydro resources, but in the following years the situation changed. The leading role in the power sector was taken by thermal power plants, from 1965. For that period share of thermal power plants in the total installed capacity was 50, 9 % and in power generation – 53, 8 %. In 1970 for the first time in the history of Georgia the energy Balance was positive, which resulted in power export. Maximum value of excess power was recorded in 1980 (1743, 8 million kWh). For that period capacity allocation in the power system was as follows: capacity of thermal power plants – 38, 4 %, capacity of hydro power plants – 61,6 %. From the point of view of power generation share of hydro power plants was 43,6 % and the same parameter for thermal power plants was 56,4 %.

Power generation in Georgia during 1981-1990 years was frozen at the same level, while power consumption increased significantly – annually in average by 0,5 billion kWh. The relative power deficit rapidly increased. In 1988 the country experienced a deficit of 3,6 billion kWh. This is the maximum parameter recorded in the history of Georgia. During the research period energy balance of Georgia was negative for 24 years. Total deficit amounted to 23,3 billion kWh. If this value is compensated by the eccess power, which was produced by our power plants in addition to the country demand during the remaining 7 years, it will appear that final total deficit is reduced down to 21,5 billion kWh. Deficit was catastrophically increasing especially for the period from the year 1984 to 1988, when this parameter was increased by 5.3 times.

In 1990 the country experienced a deficit of 3,2 billion kWh. Demand for this year was satisfied to only 81,6 %. But this can not be considered as actual supply level, because in this year share of thermal power plants in the total power generation was 46,7 % and plants were operating only with imported fuel.

For the last 30 years of soviet era power generation and consumption in Georgia basically is categorized as increasing, but exceptions were also noticed. For example, in 1977 and later in 1983 and 1985 power generation was reduced compared to the previous period. This was undesired fact in the development process of our power sector. It was resulted from the increase of share of hydro power plants in the total number of power plants and lower level of water in the rivers. Under such conditions as usual generation of power plants is reduced by 20-30%.

For the first time, in 1989 energy consumption of Georgia was reduced compared to the previous years. The difficult public and political situation created in the country and associated strikes resulted in forced power supply limitations especially for large industrial enterprises. The situation was made worse by shortages in power supply throughout the Caucasus region. In 1988 the total power generated by Georgia, Azerbaijan and Armenia amounted to 53,4, but consumption of these countries was 53,5 million kWh, due to curtailments of Georgian production.. The situation became even more critical after the Nuclear Power plant in Armenia was shut down (1989).

In addition to the fact that the new power plants were not connected to the network in Georgia, the level of use of existing capacities was reduced significantly during this period. The number of working hours for average annual installed capacity was reduced for both thermal and hydro power plants. The range of technical and economic parameters of the power sector for the years 1960-1990 is presented below (see table 2.2)

Table 2.2
Technical and Economic Parameters of Power Sector of Georgia

Parameters	Years				
	1960	1970	1980	1985	1990
1. Prime cost					
a) Per kWh of electricity, kopecks	0.743	1.44	1.088	1.486	1.716
b) Gigacalories of thermal energy, rubles.	2.504	4.20	6.02	8.124	8.0
2. Electricity production per industrial worker, thousand kWh	698	717	1377	1313	1319
3. Consumption rate of standard fuel:					
a) Per 1 kWh of electricity production, grams of standard fuel (coal equivalent)	621	390.0	372.2	388.35	471.6
b) per 1 gigacalories of thermal energy production, kg of standard fuel (coal equivalent)	182.8	189.3	178.8	176.3	187.0
4. Electricity losses					
In the network of general use, million kWhs	350	1321.6	2250.7	2494.6	2539
% compared to consumption	8.9	14.8	16.1	14.9	14.5
5. Electricity Consumption					
For Own consumption, million kWh	90.3	377.1	469.6	501.3	432.0
% compared to electricity generation	2.4	4.2	3.4	3.5	3.0

By 1990, the power supply as well as fuel supply included in the fuel and energy complex was experiencing significant crisis. This resulted in a deep crisis in industry and the entire national economy. For this period power sector measures generally declined..

2.1.2 Natural Gas sector

Natural gas deposits of industrial importance have not yet been found in Georgia, although there were several cases, when small gas deposits were discovered during the exploration- drilling works. For example, in February of 1967 strong gas flow discharge took place on the territory of gas content level located to the west of Tbilisi (at 2712 meter depth). Flow of No11 exploration well during 24 hours was producing about 250 thousand m^3 of gas, but the well was producing gas at this rate only for three days. Prior to this case during the years 1954-1963, three wells were discovered in Tbilisi producing intensive gas flows. So the case with No11 well can not be considered accidental. Data received from the wells, suitable composition of structures, their closed character and significant porous level illustrates that large territory adjacent to the city of Tbilisi is quiet prospective from the point of view of natural gas content. Based on the initial data from the wells, specialists calculated that minimum forecasted reserves of natural gas amounted to hundreds of billion m^3.

Forecasts made at that time expectedgas to be found in many other regions of the republic. Despite those forecasts, the Georgian economy still consumes only imported natural gas. Gasification in Georgia started in 1958. At the end of 1959

Tbilisi received natural gas from the republic of Azerbaijan. The capacity of the main gas pipeline amounted to 1,8 billion m^3, but after reconstruction this increased up to 4,6 billion m^3 per year.

Gasification in the country was rapidly from the beginning, which resulted in insufficient capacity of an exiting gas pipeline and available gas resources. New gas supply source was required. Thus the new Vladikavkaz-Tbilisi gas pipeline was constructed and commissioned in 1963. In 1970-1978 gas supply to Georgia was provided from Iran. In November, 1978 the political situation in Iran resulted in termination of gas supply from Iran. Consequently reconstruction of the Orjonikidze-Tbilisi gas pipeline became necessary. This work started in 1985 and was completed in 1991. Gas transportation capacity of the pipeline amounted to 20 billion m^3 per year.

Through this pipeline, countries located in the Caucasus region including Georgia started receiving Turkmenian gas. During this period Georgia was one of the leading countries from the point of view of level of gasification: 48 cities and 230 villages, almost 600 thousand apartments, up to 800 industrial and agricultural enterprises, 1500 central heating boilers, and 2000 municipal-household enterprises were gasified; 10 thousand km of gas pipeline was constructed, out of which 2 thousand kilometers were main pipeline and 8 thousand kilometer pipeline was part of the distribution network. Natural gas reached almost all the regions throughout the country (except highlands of Svaneti and Achara). Gas consumption in Georgia for the year of 1989 exceeded 6,0 billion m^3; It was equal to 60 % of total fuel balance of the country.

The dynamics of gasification of apartments, gas pipeline construction and natural gas consumption levels, also number of apartment gasified and length of gas pipelines by region are given in the table 2.3. As shown in the table, gas consumption in Georgia reached its maximum level in 1990 – 6040 million m^3. At that time 576,5 thousand apartments were gasified in Georgia and total length of gas pipeline amounted to 4802,8 km.

Table 2.3
Number of Gasified Apartments, Length of Gas Pipeline and Level of Natural Gas Consumption in Georgia for the Years 1960-1990

Years	Apartment gasification by the end of the years, thousand apartments	Length of the pipeline by the end of the year, km (quarterly and except --- network)	Natural gas consumption, million m^3
1960	4.0	81.1	453.3
1965	88.1	378.9	1480.8
1970	176.8	776.7	1911.6
1975	275.6	1504.4	3392.1
1980	369.8	2328.2	3012.1
1985	452.1	3177.7	4539.0
1990	576.5	4802.8	6046.0

2.1.3 Coal Industry

Coal production was one of the most important sectors of fuel industry of the Republic of Georgia according to the data for the year of 1990. The share of this sector in the total production of fuel industry was 20,0%. The number of employees in the sector was 79,6% of total employees working within the industry, while the share of this industry in the main assets of energy sector amounted only 53,4%. Coal production in Georgia has more than a 100 year history.

The highest year of production was 1958,at 3014 thousand tones of coal This was 3,1 times greater than the production level in 1990. This was caused by the fact, that the post war period saw intensive construction of coal production enterprises in Georgia connected to the introduction and development of cast iron, steel and rolled metal production in the republic. Thus the coal industry had a very important role in the development of the “people’s economy” of the Republic. It supplied the ferrous metal sector with technological fuel, and the power sector with power coal. Georgia was the only soviet republic in the Caucasus region having its own coal production and almost fully meeting its demand on this important technological and power resource.

In 1990 the total volume of coal produced in the republic amounted to 956 thousand tones; out of which 655 thousand tones or 69,6% of total volume was produced by Tkibuli mines and 290 thousand tones or 30,4 % of total volume was produced by Tkvarcheli mines (see table 2.4). Till May, 1987 there was one more operating mine in Akhaltiskhe, annual coal production of which was varying between 35-50 thousand tones. The mine was closed down because of relatively high prime cost of coal production and limited number of product consumers.

Thus over 30 years (1960-1990) coal production in Georgia decreased by 3 times, including coke coals decreased by 3,1 times. Coal production in Tkvarcheli, especially, was significantly reduced. Tkibuli production decreased by 2.1 times.

This trend in the coal industry of Georgia may be explained by the complicated mining and geological conditions of production process, together with the dramatic reduction of mine construction projects. From 1960 to 1990 only four new mines were constructed total capacity of which amounted to 400-450 thousand tones per year. At the same time, because of exhausted reserves and other reasons 7 mines with a total annual capacity of 1,1 million tones were closed down, and for the 6 mines coal production was decreased by 1,3 million tones.

Table 2.4
Coal Production in Georgia during 1960-1990, thousand tones

Years	Coal production		Coal production by deposits		
	Total	Including coke	Tkibuli	Tkvarcheli	Akhaltsikhe
1960	2850	2165	1398	1244	208
1965	2621	2047	1435	1006	180
1970	2298	1786	1238	952	108
1975	2050	1666	1241	758	51
1980	1860	1462	1212	598	50
1985	1675	1313	1181	469	24
1986	1712	1360	1216	459	37
1987	1620	1250	1165	438	17
1988	1426	1085	1000	426	-
1989	1152	844	870	282	-
1990	956	702	665	290	-

As coal production declined of the technical and economic parameters of the sector became worse: level of labor productivity in 1989 was 94,1% compared to 1960, and return on assets amounted to only 30,1% of the same parameter recorded in 1960.] The cost of coal production was systematically increasing and amounted 35,8 rubles per ton in 1989. This parameter increased more than 2 times over the last 20 years. In several years the union of manufacturing enterprises “Saknakhshiri” was in the list of unprofitable companies. Losses based on market prices exceeded 35 million rubles.

At the end of the 90’s the coal industry was experiencing both the absolute reduction in production capacities and decreased level of resource utilization. The levl of utilization of production capacities was reduced by 9 % for the period of 1985-1988. This was largely caused by the deterioration of environmental factors of coal processing, while in parallel working conditions became harder as the majority of the equipment was completely amortized and needed to be replaced.

By the beginning of 1990, 38,1% of main industrial-working capital was completely amortized. The condition of coal industry of Georgia and serious problems existed in the sector was requiring comprehensive research and development of long-term program of appropriate measures. At that time a strong scientific-research and design Institute with highly qualified engineers was operating, which was supporting the development of the sector.

2.1.4 Oil Industry

From ancient times there were many cases of oil discovery in Georgia, but in spite of this, quite intensive geological and exploration works performed since 1980 in order to find oil sources did not result in discovery of rich oil layers priori to 1974.

Annual oil production in Georgia for decades varied from 20 to 30 thousand tones. The situation completely changed in 1974-1975. In 1974 total oil production amounted to 44 thousand tones of oil, after a year this parameter was increased by 6 times (table 2.5). In 1974 two oil deposits were discovered in the suburbs of the city Tbilisi – Samgori-Patardzeuli and Shromisubani-Tskaltsminda deposits. Several other deposits were found as well in the process of a deep drilling. Oil production in Georgia reached its maximum point in 1982, at 3,331 thousand tones, which was 100 times more then the volume recorded in 1960.

Oil production in the republic was basically developed because of the Samgori-Patardzeuli deposit. The share of this deposit in total oil production of the country in 1982 was 92,8 % and the share of associated gas was 83%. Along with the increase of oil production technical and economic parameters of the sector also improved. During the period from 1976 to 1980 labor productivity increased by 4 times, return on equity by 3,0 times, and labor equity ratio by 19,4 %. Prime cost of item produced was decreased as well as expense per ruble of produced item. At that time prime cost of one ton of oil by “Saknavtobi” was lower then in similar enterprises throughout the Soviet Union.

Increased oil production required major improvement of the oil transportation sector. In 1975 Samgori-Gachiani pipeline was commissioned with a total length of 22 km. It was connected to the Baku-Batumi main oil pipeline and significantly increased the share of Georgian oil in the oil refinery factory of Batumi. In a short time period – in 1980 – an expanded new Samgori-Batumi pipeline was commissioned with greater transportation capacity. Its total length was 426 km.

Table 2.5
Oil Production in Georgia
(Including Gas Condensate)

Years	Total Production	Increase Rate
	(thousand t.)	1960 =1
1960	34	1,0
1965	30	0,9
1970	24	0,7
1975	261	7,7
1980	3186	93,7
1981	3322	97,7
1982	3331	98,0
1983	3308	97,3
1984	1718	50,5
1985	552	16,2
1986	178,9	5,3
1987	182,5	5,4
1988	185,6	5,5
1989	184,6	5,4
1990	186,4	5,5

Starting from 1984 a shsrply decreasing trend began in the oil production sector of Georgia. The total production decreased by 6 times during the years 1981-1985, and oil production reduced from 3186 to 552 thousand tons.

The main reason for this was the unexpected start of excess flooding of oil wells on the Samgori-Patardzeuli deposit, which was the main deposit in the country. It appeared that approved oil reserves were 33 %I greater then the volume actually existed on the field. Average debit of wells per 24 hours for that period was reduced from 5,1 down to 1,7 tones, i.e. by three times.

Georgian oil was distinguished with its high quality. For example sulfur composition in Samgori oil was very small (less then 0,5%). It was characterized with the high content of light fractions, low level of gum, less composition of biogenic acids and viscosity.

2.1.5 Oil Refinery Industry

This sector was one of the major fields in the fuel and energy complex of Georgia. It had leading position in the fuel industry of our country from the point of view of production volumes. Based on the data for the year 1989, the share of this sector in the total production of fuel industry of Georgia was 73,2 %. The number of employees in the sector was 11,9% of total employees working within the industry and its share in total value of main assets amounted to 12,9%.

At that time oil refinery industry in Georgia was represented by the oil refinery in Batumi. This enterprise was put into operation in 1929. A big variety of technological processes were taking place in the factory: in particular, primary refinement of oil, thermal cracking, gasoline ageing, cycle reforming, refinement of clear oil products, refinement of transformer oil with absorption method, production of oil bitumen.

Up to 1980 factory was gradually increasing the volume of refined oil. By 1980 oil refining had increased by 90,7 % compared to the same parameter recorded in 1960. Between 1971 to 1985 total refining increased by 20,4 %, and from 1976 to 1980 the increase amounted to 9%. Correspondingly other technical and economic parameters of the factory were also improved (see table 2.6).

It clear from the table, that refinery was improving performance from the points of view of quantitative as well as qualitative parameters. For 15 years (1966-1980) refining of feedstock increased almost by 60%, and production by 61,8%. An especially high increasing rate was recorded in the production of gasoline and fuel oil (mazut). But the number of industrial employees in the factory remained at the same level. This resulted in increase of labor productivity by 64%.

Table 2.6
Development Parameters for Batumi Oil Refinery Factory for the period from 1966 to 1989 in percentages (1965 = 100%)

Parameters	Years				
	1970	1975	1980	1985	1989
Total Production	122.5	157.5	167.8	139.8	71.9
Oil Refinery	116.9	146.5	159.8	153.0	76.5
Oil Products:					
Gasoline	151.1	239.2	281.9	219.4	99.5
Diesel Fuel	109.5	113.5	126.7	124.2	60.1
Burner Fuel	61.5	166.3	173.1	193.2	99.0
Value of Main Assets	155.8	184.7	210.5	258.1	268.7
Number of Employees	102.4	102.4	102.3	94.7	78.8
Labor Productivity	119.6	153.8	154.0	147.6	91.4
Return on Assets	78.6	85.2	79.7	54.2	27.1

Starting from 1980 production in the oil refinery industry began decreasing. This was, to an extent, connected to the reduction of oil production in Georgia. But the main reason for such trend was aggravation of environmental condition in the city from operation of the factory, as Batumi is one of the main resort cities in the Country.

2.2 Years 1990 – 2000

2.2.1 Power Sector

In spite of the existing problems independent Georgia inherited from the soviet period a significantly developed foundation for the power sector.

By the end of 1990 the total installed capacity for all types of power plants amounted to 4559,7 thousand kWh, and the total power generation reached the point of 14245,7

million kWh that was relatively 4,7 and 3,8 times more then the level recorded in the year 1960. For the year 1990 the share of hydro power plants in the total capacity was 59,9 % - 2733 thousand kWh, and its share in the total generation amounted 53,3% - 7599,7 million kWh.

In the same period the association of energy enterprises “Sakenergo” had overhead transmission lines with the total length of 98261 km in its balance sheet. Out of these lines the length of 500kV lines was 572 km, 330 kV – 21 km, 220 kV – 1456 km, 110 kV – 4940 km, 35 kV – 3502 km, 10 kV – 20371 km and 0,4-6 kV – 67399 km. In addition the total length of underground cables was equal to 1750 km.

In 1990 in Georgia energy generation per head amounted to 2,6 thousand kWh, while consumption was 3,2 thousand kWh per head, although as it is seen from these figures the country was experiencing an energy shortage. Starting from this period power generation in Georgia was frozen on the same level and then started decreasing. In the years from 1990 to 1995 power generation reduced by 50,3% and consumption by 2,2 times. Both hydro power and thermal power production decreased in that period: hydro power decreased by 16% and thermal power by 9,5 times. The level of use of available capacity of power plants decreased. In 1995 the total capacity of all types of power plants in the country was equal to 4800 thousand kW, while only 1800 thousand kW were operable, in percentages – 28,7 %. The number of working hours for average annual installed capacity was also reduced.

Under the conditions that existed at that time the Georgian energy system was forced to operate with nonstandard parameters with emergency limits. This had a deteriorating effect on system equipment and devices. Because of lack of funds rehabilitation of energy facilities was almost stopped and it became very difficult to supply power plants with fuel. Demand for electricity was completely unmanageable. Most energy metering points were out of order and the collection of amounts for consumed power was not done in a proper manner. In parallel electricity losses were increased significantly. Energy crisis reached its peak point. The country faced economic destabilization - there was no executive discipline in the sector, stealing of equipment from the energy facilities was rampant, qualified employees were leaving their work places, and other negative events were taking place.

Termination of natural gas supply also forced the power sector to take on new functions – electricity was used for heating of buildings, cooking and hot water supply. In some enterprises even the technological cycle was changed in order to replace fuel with electricity, especially in large factories and large number of small bakeries. Electricity consumers became unable to pay for their consumption; industrial enterprises drastically reduced their demand on electricity. But the level of consumption was significantly increased for the population. Power was supplied in the same way to everybody without differentiation of payers and nonpayers. Revenues in the sector varied between 15-20 %.

Because of deficit of available funds, implementation of major repair and maintenance works of energy facilities, commissioning of new capacities and payment of salaries to employees were postponed, and in most cases, even stopped. All above mentioned had logical negative impact on the production capacities and quality of service.

Starting from the year 1994 electricity generation in Georgia actually was frozen on the same level (see table 2.7). For this period maximum level of power generation was recorded in 1999 – 8119 million kWh. For the next years generation was decreasing gradually. It became half of what was previously for thermal power plants, but for hydro power plants it increased by 23,3%. But even this growth can not be considered as actual. Particularly, the lowest level of electricity generation by hydro power plants in the last 26 years was recorded in 1994. In that year total power generation for all hydro power plants amounted to 4923 million kWh, the lowest since 1979.

Table 2.7
Electricity Generation in Georgia
Years 1990-2000 (million kWh)

Years	Total	Including	
		HPP	TPP
1990	14 246	7 600	6 646
1991	13 376	7 041	6 335
1992	11 520	6 515	5 005
1993	10 150	7 011	3 139
1994	7 045	4 923	2 122
1995	7 082	6 383	699
1996	7 233	6 120	1 113
1997	7 172	6 053	1 119
1998	8 088	6 387	1 701
1999	8 119	6 467	1 652
2000	7 446	5 905	1 541

Reduction in power generation had relative impact on the parameters of the electrification of the country. Power generation per capita (see table 2.8) was reduced by 39,3%.over 10 years (years 1990 – 2000).

Table 2.8
Electricity Generation per Head
in Georgia, kWh

Years	Total Population, thousand persons	Electricity Generation per head, kWh	In % compared to 1990
1990	5 424,4	2 626,3	100,0
1991	5 453,3	2 452,8	93,4
1992	5 467,4	2 107,0	80,2
1993	5 345,8	1 898,7	72,3
1994	5 208,9	1 352,5	51,5
1995	5 061,7	1 399,1	53,3
1996	4 933,3	1 466,2	55,8
1997	4 808,8	1 491,4	56,8
1998	4 749,5	1 702,9	64,8
1999	4 710,6	1 723,6	65,6
2000	4 672,2	1 593,7	60,7

The development rate of power industry in Georgia was traditionally lower than the development rates for the economy including industry. The same rate was reported for the period under analysis.

The volume of electricity production decreased for power plants including such large plants as are Enguri HPP, Vardnili HPP, Lajanuri HPP, Khrami II HPP, Tbilsresi and others. The level of capacity used in these plants was low as well (see table 2.9)

Table 2.9
Parameters of Major Hydro Power Plants in Georgia
Year 2000

#	Power Plants	Installed Capacity, MW	Operating Capacity, MW	Actual Electricity Generation, million kWh	Level of use of installed capacity, %	Level of Available (ready) Capacity, %
1	Enguri HPP	1300	514.3	2724	23.92	39.56
2	Vardnili HPP	220	77.8	485	25.16	35.36
3	Vartsikhe HPP	184	83.6	494	30.67	45.43
4	Lajanuri HPP	118.8	30.2	191	18.33	25.42
5	Shaori HPP	38.4	14.5	80	23.82	37.76
6	Dzevrula HPP	80	23.1	104	14.90	28.88
7	Gumati HPP	66.8	21.9	173	29.63	32.78
8	Rioni HPP	49	33.1	265	61.75	67.55
9	Khrami I HPP	113.5	63	148	14.86	55.51
10	Zhinvali HPP	130	61.2	454	39.89	47.08
11	Zahesi HPP	36.8	16.9	132	40.85	45.92
12	Ortachala HPP	18	7.2	58	36.90	40.00
13	Atshesi HPP	16.6	6.4	44	29.92	38.55

The dynamics and structure of electricity consumption became worse. Total power consumption for the years from 1990 to 1997 was reduced by 2,3 times. This parameter for the industry was decreased by 8,8 times and for transport sector – 5,2 times. The same trend was recorded for the agriculture (in 1997 total electricity consumption for the agricultural sector amounted to 14,4 million kWh only), co9nstruction (consumption for 1997 was 38,1 million kWh), communal sector (384,1 million kWh) etc. During this period consumption increase was recorder only for population. In 1997 residential sector consumed 2,5 billion kWh of electricity, which amounted to 33,5 % of total consumption. Electricity used by the population during this year was 1,5 times greater then the consumption in industry, agriculture, transport, constriction and communal sectors taken together.

The electricity balance of Georgia was characterized by relatively high rate of “losses”. In 1990, for example, 2,6 billion kWhs were lost in the network of common use, i.e. 15,1 % of total electricity consumed in the country and 18,6 % of total generated power. For further years the share of “losses” was even increased and in 1994 it amounted 31,3 % and 35,4 % relatively. Serious energy crisis was accompanied by the Government policy being tolerant to non-payers and the most important wrong energy pricing policy.

Customers were supplied with power at artificially reduced tariffs. In the winter 1995. Georgia received electricity from the Turkish government on the condition that Georgia would return 1,7 times more electricity during summer months or pay 7,0 USD Cents per kWh of delivered power at high voltage side. At the exchange rate recorded at that time this tariff was 3,6 times less than the purchase tariff from Turkey.

The way power sector was operating could not be continued. IIplementation of fundamental economical reforms in the sector was required.

2.2.2 Gas Supply

Starting from 1990 gas consumption in Georgia decreased. By 2000 it reduced to 1094 million m^3 i.e. 5,5 times less than the same parameter recorded in 1990 (see table 2.10).

Events taking place during the recent years had a significant impact on gas facilities. Gas supply to the country was terminated for quite a long period. Starting from 1995 till the middle of 1996 there was no gas supply in Tbilisi like other regions of Georgia (except Rustavi and Kazbegi).

Termination of gas supply resulted in worsening of the technical condition of gas facilities. External corrosion started because unstable power supply was followed by the corrosion of internal surfaces of pipes. During the unstable period (years 1991-1993) parts of equipment protecting pipes from corrosion were stolen with the aim to take copper and other material out of them. No training was done in this sphere for engineering and mid-level personnel, nor for workers in order to improve their skills. The quality of rehabilitation and emergency services was poor.

Based on the experience of performing rehabilitation works on the gas pipeline it was discovered that 40-50 % of surveyed pipes required to be replaced.

Table 2.10
Gasification Parameters of Georgia for the period 1990-2000
(By the end of the year)

Years	Number of gasified apartments, thousand	Lengthen of gas pipeline, km	Natural Gas Consumption, million m^3
1990	576.5	4802.8	6046.0
1991	579.8	4937.8	4577.1
1992	587.2	4962.1	4633.7
1993	587.2	5158.4	3343.7
1994	587.4	5158.4	2595.2
1995	587.4	5158.4	910.5
1996	587.4	5151.9	947.0
1997	587.4	5151.9	830.0
1998	587.4	5151.9	846.0
2000	587.4	5151.9	1094.0

During this period in the city rehabilitation of gas distribution network damaged by the corrosion was done in accordance to the old traditional method – replacement of complete sections. This is far more expensive than new technologies applied in developed countries (Germany, France), which means putting polyethylene pipes in the damaged steel network, or coating internal surfaces of pipes with special cover..

The above resulted in reduction of gas supply from 6,1 billion m^3 recorded in 1989 down to 0,9 billion m^3 in 1998 (6,7 times). Large consumers (energy sector, chemical and metallurgical industries) consumption was reduced 15 times. Only 80 out of 587 thousand gasified apartments were using natural gas i.e. only 13,6 % of total consumers.

At the end of 1996 major structural changes took place in the gas sector. The department of "Sakgas" consisted of gas companies operating throughout Georgia was disintegrated. Gas facilities were transferred to municipalities supposing that these entities would be able to provided financial support to gas companies to perform rehabilitation work of gas supply systems, which did not happen. Gas companies were in poor situation. Municipalities themselves were experiencing financial crisis and relatively unable to provide any kind of support.

In 1998 the Ministry of State Property Management of Georgia started putting control packages of shares of gas companies on auction and sold share packages of the following companies: Rustavigas, Kutaisigas, Kaspigas, Gorigas, Bolnisigas and Tetritskarogas. The buyer was joint stock company "Intergas" (later renamed to "Sakgas").

The following problems put obstacles to increased gasification in Georgia:

1. Almost all gas companies experienced firm financial crisis. Particularly there was no gas company not having debt (from thousand up to millions of Laris);
2. Industrial enterprises were not operating, resulting in low revenues for the natural gas distribution companies;
3. Because the level of sales was very low, relatively the cost for natural gas distribution was quite high. Only a small part of the entire network was operational, but amortization and other taxes were charged in full;
4. Losses were quite high as well, i.e. there was a big difference between the amounts received and billed gas, it would be more correct to say that this value in percentages was high. Overconsumption by unremetered consumers, especially during the cold period of the year was added to the losses caused by technical reasons;
5. Part of residential customers had no funds required to install meters in order to measure amount of gas consumed for household purposes (approximately 100 USD);
6. No business plans were developed, complicating the attraction of investors;
7. As there was no prospect for central heating systems to be used in the future, complete replacement of technological equipment of gas supply systems in the cities and other settlements became necessary;
8. Effective construction standards and rules and other legal documents did not meet the requirements of a market economy.

2.2.3 Coal Industry

During the years of independence the coal industry in Georgia almost stopped (see table 2.11). Production decreased annually, and by 2000 was reduced to 7,3 thousand tons.

Table 2.11
Coal Production in Georgia
Years 1990-2000

Years	Thousand tones	Years	Thousand tones
1990	955	1996	23
1991	698	1997	5
1992	181	1998	15
1993	82	1999	12
1994	45	2000	7.3
1995	43		

So compared to 1990 production was reduced 130,8 times. The major reason was unavailability of funds to finance coal mines and absence of solvent consumers.

2.2.4 Oil Industry

Oil production in Georgia during the years from 1990 up to 2000 was characterized by decreasing trend. In total volume of production reduced by 40,9 % (see table 2.12).

Table 2.12
Oil Production in Georgia
Years 1990-2000

Years	Thousand tones	Years	Thousand tones
1990	186	1996	128
1991	181	1997	134
1992	125	1998	119
1993	88	1999	91
1994	67	2000	110
1995	43		

Taking into consideration the economic situation created in Georgia, the main objective of Georgian oil producers for this period was to stabilize volumes of oil production and further, step by step, increase production volumes after the new deposits are discovered. This was conditioned by the significant potential resources of oil on the territory of Georgia, on the land and within the black sea shelf. In spite of this, oil and gas deposit exploration works during this period were performed at a relatively slow pace in the East as well as in the West of Georgia.

After Georgia became independent from the former Soviet Union and the country chose the road of independent development, oil industry turned to be in a very difficult condition. There was no possibility to finance the sector and ensure material and technical control. Introduction of a market economy resulted in significant increase of the prices of technical means and materials used in oil and gas production and required to perform drilling of exploration and operating wells. These prices approached price levels worldwide.

The oil production sector in Georgia turned to start self-financing. This was automatically requiring the price regulation for produced raw materials. But the purchase prices for raw materials determined for that period, considering market prices, did not comply with the necessary volume of works to be performed in the filed of oil and gas exploration and well drilling. Hence development opportunities for the sector were not prospective.

In order to increase oil production rates, reasonable cooperation with foreign companies became required. Creation of joint ventures with foreign companies and start of exploration and processing work on oil and gas deposits was a new stage in the oil industry of Georgia and the development plans for the sector was greatly depending on this.

Oil production volumes in Georgia for the period from 1995 to 1999 by foreign operator companies were as follows (thousand tons)

Year	Georgian-British Company	"Ioris Veli"	"Frontera Eastern Georgia"
1995	1.7	3.6	-
1996	69.5	56.3	-
1997	86.2	42.6	-
1998	74.4	34.4	5.5
1999	55.4	26.5	6.1

Table 2.13
Oil Products Produced in Georgia
In Years 1990-2000, thousand tones

Name	Years			
	1990	1995	1998	2000
Primary refinement of Oil	2 323.0	38.7	53.5	56.5
Gasoline	399.0	6.7	-	1.8
Diesel Fuel	658.0	10.8	13.8	8.8
Burning Fuel (Mazut)	898.0	16.1	15.9	16.0
Bitumen	70.5	0.4	-	-

Up to recent years oil refinery processes were taking place in Batumi Oil Refinery, the purpose of which was to supply the country with gasoline, aviation, diesel and boiler fuel, bitumen and liquid gas for household purposes. The capacity of the factory (~3 million tons per year) was enough to satisfy demand of Georgia on oil products by 50%, although almost half of the products were exported (see table 2.13).

The Batumi refinery needed complete reconstruction. During last years of the period being analyzed two oil refinery factories were operating in Georgia: Georgian-American Oil Refinery Company and "Navtobi" Ltd, though the quality of products produced by these factories was law and relatively facilities were requiring modernization in accordance with the current standards.

2.3 Energy Potential and Actual Usage Data

Georgia is not rich in fuel and energy resources, but different quantities of nearly all types of resources can be found on its territory. Such resources are: coal, brown coal, peat, oil, associated gas, thermal water. Activities connected with these resources include usage of hydro energy resources, production of oil products, here are favorable conditions for the use of solar and wind energies.

From traditional fuel and energy resources of Georgia water power resources, coal and oil (table 2.14) are especially interesting. As it can be seen from the table their theoretical (geological) reserve greatly exceeds their technical balance, this is especially true in relation to the coal and oil resources, their reserves are 5, 5 and 4, 0 times less in comparison with the geological reserves. According to the data given in the table it is clear that despite the power deficit in Georgia natural resources are used very inefficiently. According to 2001 data, only 8, 0% of hydro-energy resources were used in the country, 0,001% of the balance reserve of coal and 0, 9% of extractable oil.

Table 2.14
Traditional Energy Resources of Georgia[2]

Reserve Type	Hydro Energy, Billion kWh	Coal, Billion tones	Oil, million tones
Theoretical reserves of hydro energy	135.8	235.5	438.3
Technical reserve of hydro energy and balance reserve of heat energy	68.5	430.0	110.9
Production of energy resources in 2001	5.5	0.005	0.1
Production compared to balance and technical reserves in %	8.6	0.0001	0.09

It is worth noting that in 1990 relevant indices equaled 11,1%; 0,2% and 0,8%; therefore the situation has worsened.

Below you will find main types of fuel and energy resources of Georgia, their short characteristics and data on their actual usage.

2.3.1 Hydro Energy Resources

[2] The table was developed based on the following publications “Natural Resources of Soviet Georgia” Publishing House AN USSR, M., Years 1962-1964 (8 volumes) also materials of State Statistics Department of Georgia

Georgia is especially rich in hydro energy resources. Our rivers contain a lot of hydraulic power which to some extent covers the deficiency of fuel and energy resources in the country.

Existence of big hydro energy resources is mostly due to the mountainous relief of the country. Watercourses falling down from the Caucasian mountains and Lesser Caucasian Mountains due to the slumping down on a short distance create huge potential of water power. This is especially true for Western Georgia.

On the whole there are 26 thousand rivers on the territory of Georgia with the total approximate length of 60 thousand km, some of these rivers are less than 25 km long, and they constitute 99, 3% of the total water potential and 76% of the total length of rivers. The cumulative runoff is 52.8, total water resources - 61.5 cubic km. If we take into account the reserve of fresh water, which consists of water resources of glaciers, lakes, water reservoirs and swamps, this figure will grow up to 96, 5 cubic km.

According to the data of Georgian research institute "Hydroproject" from the total number of rivers 319 are especially interesting due to their power potential, their aggregate annual potential is 15,63 million kW, annual average power-135,80 billion kWh, from them 208 average and big rivers have 14, 78 million kW aggregate potential and 129,5 billion kWh annual power. The power of remaining 111 small rivers is 851 kW (i.e. 7% of the total potential of rivers).

On the whole the energy of surface runoff for the total territory of Georgia is 228, 5 billion kWh and its relevant strength is 26, 1 million kWh.

According to the data of the same institute, if we review the theoretical hydro-energy resources of the main rivers of Georgia, we can find out that on each square km of the territory of Georgia on average comes 3, 27 million kWh of the total surface run-off, among them in Western Georgia it constitutes 5, 06 million kWh and in Eastern Georgia-1, 73 million kWh. As for the absolute data of power resources of Georgia, it can be seen that 228, 5 billion kWh is in Western part of Georgia and in Eastern part-63, 7 billion kWh (27, 9%).

If from these resources we consider separately potential resources of big, medium and small rivers, then about 60% (135,8 billion kWh) of the total amount of surface run-offs comes on them and the rest-40% (92,7 billion kWh) – on overland run-offs.

Hydro energy resources	Capacity, Million kWh	Energy, billion kWh	%
Theoretical resources of total surface run-offs, including:	26.08	228.5	100
Theoretical resources of big, medium and small rivers (319 rivers)	15.62	135.8	59.5
Theoretical Resources of overland run-offs	10.46	92.7	40.5

Theoretical energy resources of big and average rivers are approximately 136 billion kWh. Technical hydro-power resources of the country amount to 68, and economic hydro resources - 32 billion kWh. On each square km of the present territory of Georgia comes 1943 kWh of hydro-energy. This is one of the highest figures in the world.

40% of the technical hydro resources of 319 rivers come on the eight biggest rivers of Georgia (Mtkvari, Rioni, Enguri, Tskhenistskali, Kodori, Bzipi, Khrami and Aragvi). This creates favorable conditions for hydraulic power development in the country. Distribution of economic hydro power resources according to the rivers are given in table 2.15.

The amount of the above mentioned hydro power resources (135, 8 billion kWh) includes the capacity of 319 big and small rivers.

Table 2.15
Economic Hydro Power Resources of Georgia by Major Rivers[3]

Rivers	Billion kWh	% in Total
Enguri	10,0	31,3
Rioni	7,5	23,4
Tskhenistkali and Lajanuri	2,5	7,8
Shaori and Tkibula	0,3	0,9
Kodori	2,5	7,8
Bzipi	1,5	4,7
Mtkvari and Aragvi	3,0	9,4
Khrami and Paravani	1,1	3,4
Alazani in Tusheti	3,2	10,0
Others	0,4	1,3
Total	32,0	100,0

It should also be noted that most of the consideration on hydro energy potential, its evaluation and forecasts for their application is based on information dating back to the 60-ies of the last century and there is a need to process it according to the present

[3] Table is developed based on the materials of Academy of Science of Georgia

requirements. Though the work conducted in this direction is quite insignificant and it is virtually at its initial starting point caused by lack of corresponding resources for engineering provision of scientific-research and development work.

At present it is possible to conduct hydraulic power development work for construction of a dozen of big and average size economic hydroelectric power stations based on the achievements of modern hydro-electric construction. But as already mentioned currently water power resources are used on a very limited basis. In 1989 hydroelectric power stations of Georgia worked out 8787 mln kWh, which constituted 12, 9% of their technical capacity and 27, 5% of the existing economic water resources. In 2000 these indices relevantly decreased till 8, 6 and 18, 4 per cent. About 300 projects were developed in Georgia in the 90-ies for hydraulic power works on small and average rivers, including 229 projects for small rivers. It is possible to construct small hydroelectric power stations on them with unit power capacity of each from 1 to 20 megawatts. 229 small hydroelectric power stations can be developed in 47 regions of the country. Among them 155 can be built in 28 regions of West Georgia and 74 in 19 regions of East Georgia. The total power (capacity) of small hydro electric power stations constitutes 12, 3 million kWh of electric power. From this amount 66, 7% of the power and 68, 38% of output comes on West Georgia. With the new data these figures will further increase.

2.3.2 Coal Reserves

For the energy security of the country coal is especially interesting from locally existing resources due to the scale of its reserves and extraction experience. Georgia is the only country among the Transcaucasian republics possessing this resource. Based on the abovementioned and taking into account existing traditions coal reserves hold one of the important places in the country. There are seven coal fields in Georgia: Tkibuli-Shaori, Tkvarcheli, Akhaltsikhe, Gelati, Magani, Bziphi and South Kakheti. Besides this there are 7 perspective areas of coal-Bzipi-Gudauta, Gogoleti, Pakhulani, Kodori, Magana-Kharagauli-Chanistskhali, Partskhaniskanebi and Kvibia-Gorda.

Out of the listed coal fields only three have industrial importance. These are – Tkibuli-Shaori and Tkvarcheli coal and Akhaltsikhe brown coal deposits. These deposits are main resources of coal in Georgia. The data on each of these deposits their structure, balance and off-balance reserves are given in Table 2.16.

Table 2.16
Coal Reserves of Georgia[4]
(Million Tones)

Deposits	Balance Reserves by Categories					Without Balance
	A	B	C_1	A+B+C_1	C_2	
Total reserves	3.8	216.0	210.1	429.9	54.7	13.7
Including:						
Cock Reserves	3.8	175.7	175.3	354.8	47.1	5.0
By Deposits						
Tkibuli	3.8	170.3	164.9	339.0	49.8	3.7
Tkvarcheli	-	6.1	13.5	19.6	0.5	1.6
Akhaltsikhe	-	39.6	31.7	71.3	4.4	8.4

According to the situation on January 1 of 2000, Tkibuli-Shaori coal field accounted for 80,2% of coal balance reserve of Georgia, Akhaltsikhe deposit-15,7% and Tkvarcheli deposit-4, and 1%. According to the forecasts the country is richer in the reserves of coal. It exceeds the balance by 1,5 times; only in Tkibuli the predictable reserve is 1,5-2,0 times more than the balance. Based on official statistical data published in Georgia in the Soviet period, the forecasted amount of coal reserves in Georgia was 653 million tons. From this amount category P_1 constituted 71 million tons, P_2 category-43 million tons and P3 category-539 million tons. The mentioned reserve is distributed on the whole territory of the country. Especially noteworthy among them are: Bzipi, Gelati, Partskhanakanevi, Kodori, Gogoleti and other fields. Especially rich is Tkibuli-Shaori field-about 1 billion tons.

Tkibuli-Shaori coal field due to the size of the field is the most interesting and perspective from the existing coal reserves of Georgia. It is located between Tkibuli and Ambrolauri regions. The mine is being exploited at the moment. Its balance reserve, which belongs to category A+B+C_1 consists of 339, 0 million tons of coal, with 1, 1% of a category A. The coal field is studied in details as for the exact location of its fossils, its structure, conditions, quality and technological qualities. Quite a substantial amount-50, 2% of coal belongs to category B.

The geological conditions for extraction of coal in Georgia are quite difficult. Enrichment is allocated to a type of coal which is very difficult to enrich. The field is located at a great depth, the relief is mountainous, and content of methanol is quite significant (from 20 to 45 cubic meters per ton). Due to these and other reasons (insufficient financing, absence of consumers, costly extraction, etc) coal industry is nearly at a standstill at present.

[4] Table is prepared based on the materials of State Geological Department of Georgia (2000)

2.3.3 Oil

The geological study of oil fields in Georgia started in the 19-th century since 1868 and this works acquired systematic and intensive character in 1929-1930. But it did not result in discovery of oil rich fields.

By the beginning of 2002 there were 15 oil fields in Georgia, their extractable $B+C_1$ category balance reserve (see table 2.17) constituted 11,3 million tons. C_2 category reserves are in the amount of 20,7 million tons, and the off balance reserve equaled 1, 9 million tons. The geological reserve of oil was far more. The total reserve of B+C category in 1990 was 181,7 million tons.

These fields, except two are considered to be small fields, comparatively bigger are "Samgori-Patardzeuli" and "West Rustavi" is considered to be an average one. From 15 fields 11 were under exploitation and four were under exploration. "Samgori-Patardzeuli" field accounted for 87,6% of oil under exploitation and 57,2% of reserve for extraction. The depth of field bedding differed from 1360 to 2750 meters.

From 1991 to 2000 annual extraction of oil in Georgia dropped from 186 thousand tons to 109,5 thousand tons i.e. it decreased 1,7 times. In 2001 extraction came down to 98, 8 thousand tons. To be more definite some changes affected its reserves also. According to "Saknavtobi" as of January 1 of 2001, the oil balance constituted: A+B+C1 category geological reserve- 110, 4 million tons, among it for extraction 11,3. The average oil bedding was 1626 m. The actual use of fields is still low. As it has been already said, annual extraction of oil is between 100-200 thousand tons and it has the tendency to decrease. In 2005 only 68 thousand tons was extracted.

2.3.4 Alternative Energy Sources

With a view of power safety at the present stage it is important to have such energy carriers like: underground thermal waters, solar and wind energies, biogas, secondary power resources. Their application and rational usage could significantly improve power and energy balance of the country in future.

Our country is rich in alternative sources of energy. Despite this the works connected with their evaluation and their application started only in the 80-ies of the last century. Special organizations were set up for the wider use of thermal waters, solar and wind energies: "Sakburggeotermia" (Georgiadrillinggeothermy"), "Karis Energia (wind energy) and "Spetsheliotbomantazhi" (special helio and thermal works) (cooperative "Mze"-sun).All three of them carried out important work for use of the resources, but in view of the existing possibilities this was not enough. Widening of the scope of works in connection with the use of non-traditional sources of energy called for creation of a special basis and manufacture of specialized instruments, timely resolution of existing technical, economic and organizational difficulties, these issues are still very pressing today.

These types of energy are renewable and therefore practically unlimited. Through their transformation it is possible to receive energy with the characteristics similar to traditional power resources but in economic activity they are compatible with traditional

resources and save them. One of the important priorities of alternative sources of energy is the absence of their impact on ecology; they have no adverse affect on ecology. At the same time they belong to the local type of fuel and can have positive influence on local fuel-energy balance, transportation costs and improve fuel-energy safety of the country.

Thermal Waters. These resources, closely connected with the underground thermal waters are one of the best studied resources; Georgia is rich in thermal waters.

On the basis of hydro geological study of the territory of Georgia total forecasted reserves of thermal waters (with water temperature 50-110^{0}C) equals 250 million cubic meters. According to the Georgian scientific-research institute of Energy and Hydro Technical Constructions in case of complete use of this fuel it is possible to save 1.5-2 million tons of standard fuel. In 90-ies of the last century the State Commission for Reserves approved daily debit of thermal water and it constituted 200 thousand cubic meters. There were 59 water catchment bores at the beginning of 1990 in the Republic with daily capacity of more than 60 thousand cubic meters.

Before breaking up of the Soviet Union from 23 fields of thermal waters 17 were under development, they were: Kindga-Mokvi, Rechkhi, Saberio, Zugdidi-Tsaishi, Kvaloni, Menji, Samtredia, Vani, Tbilisi, Bichvinta, Kharagauli, Alazani, Kardanakhi, Chandari, Kvareli, and Eniseli.

Thermal waters were used for domestic needs (in Tbilisi, Zugdidi, Saberio, Rechkhi, Kindga), for warm-houses (in Okhurei, Kindga, Anara, Vani, Kodori), for technological needs in tea industry (Kindga, Zugdidi), balneological resorts (Tbilisi, Samtredia, Nakalakevi, Ujarma, Menji, Simoneti, Kvareli), in pig breeding farms (Khobi, Mtskheta), etc.

The forecasted reserves of thermal waters on the territory of Georgia can be found in the following basins (see table 2.17).

Table 2.17
Forecasted Reserves of Thermal Waters[5]

Basins	Million m^3 per year	% to Total
South Slope of Main Caucasus	2	0,8
Abkhazeti	34	13,6
Kolkhida	81	32,4
Imereti	50	20,0
Achara-Trialeti	36	14,4
Region adjacent to Tbilisi	40	16,0
South Georgia	7	2,8
Georgia - Total	250	100,0

Eastern Georgia is comparatively poor in thermal waters. It can be found in Kvareli, Gurdjaani, Lagodekhi, Gardabani, Ninotsminda, Kareli and other regions. During drilling works conducted in Kareli the so called sub-thermal water (25^0C) was discovered with mineralization of 0,53 grams per litre and daily debit 36,4 cubic meters.

In 90-ies thermal water was actively obtained and the volume was systematically increased over the years. For example, in 1985 total amount of water was 21,0 million, in 1990-9,8 million cubic meter. During consequent years this process nearly stopped, in 2001 it yielded only to 54, 6 cubic meters. The situation has not improved yet.

The reasons that hindered the use of thermal waters:

- Limited amount of consumers;
- Low quality of consumed water;
- Existing tariff on water, which was very low and was set with disregard to the temperature of water;
- Poor equipment and performance schemes.

For overcoming the existing difficulties it was necessary to widen its use the water more widely and use it for agricultural needs (warm houses, farms, etc), as well as for improvement of living standards of rural population. It was necessary to improve technological processes in boiler rooms during maximal load in residential and administrative buildings. One of the ways for increasing efficiency of water usage was pumping of the used water back into the existing water bores.

Thermal waters in Georgia have great potential due to the positive quality characteristics of the water and low mineralization (0,22-2,9 gram per litre).Besides this most of the waters do not cause intensive corrosion on metals and do not form salt deposits. All these are conducive to its wider use.

Solar Energy. One of the most perspective alternative sources of energy is solar energy. At the same time it is the most clean and permanent primary energy resource.

[5] Energy Resources of Georgia and Their Rational Usage. "Metsniereba", 1992, page 76

Georgia, as a southern country is rich in solar energy and is located at the so-called sun zone of the world (north latitude 45^0 and south latitude 45^0).

Theoretical amount of solar energy, reaching our territory during year is 10^{14} kWh or 32, 5 billion tons of standard fuel, which 1600 times exceeds the level of fuel-energy consumption in 1990.

In most localities of Georgia duration of annual sunshine is quite long and it fluctuates from 200 to 250 days. At the same time regions of East Georgia are sunnier than the regions on the Black Sea coast and Kolkhida Lowland. The highest figure of sunshine is in Rodionovka (2633 hrs), the lowest-in Sairme (1147 hrs). During winter months sun shining on average is 80-120 hrs (maximal possibility 25-40%), in summer months sometimes 285-300 hrs (50-65%) and in favorable years-300-360 hrs (70-75%).

Some of the regions of Georgia according to the duration of sun shining are ahead of those regions where helio-equipment is used successfully. The average characteristics of solar energy are comparatively better in Eastern Georgia than on the Black Sea and Kolkheti Lowland. Monthly and annual total amounts of solar radiation are determined for 28 points of Georgia; the territory of the country is divided into regions according to the similarity of radiation level;

- Optimal angle for positioning of water heaters are determined for Georgia;
- Performance factors of water heaters and their outputs are evaluated for similar zones of the country

Radiation characteristics of Georgia make very perspective the use of solar equipment. It is economically beneficial to use solar heaters for economic activity.

During last years solar systems were widely introduced in Georgia for heat supplying. With the use of solar energy water is heated to $40\text{-}50^0$C. Besides saving standard fuel atmospheric emissions are decreased and maintenance charges are reduced. By the end of 1990 about 65 thousand square meters of solar collectors were installed and used in 338 agricultural objects of Georgia. Due to their application it was possible to save 7, 8 thousand tons of high quality standard fuel.

Wind Energy. Georgia possesses significant energy potential, which is not used at the moment. Based on special researches, theoretically Georgia has 1, 3.1012 kWh of wind energy annually and the reserve of wind energy which is more than 4, 0 in separate zones exceeds 4, 5 billion kWh in a year.

According to the commission of the Presidium of the Academy of Sciences of Georgia annual average velocity of wind in Georgia is within 0,5-0,9 meters per second. These figures are lower in certain wind protected areas like Kakheti Lowlands and deep gorges. High speed is characteristic for open places of the Greater Caucasus and elevations of Southern Georgia. In certain regions of the country velocity of wind per second is greater than 15 m. Such regions are: Rioni and Mtkvari gorges. In the first case wind achieves its higher speed in Kutaisi and in the second case-in Tbilisi-Samgori. Annual windy days in these regions come up to 35. In Kutaisi - 88, in Tbilisi - 132, in some years the number of such days in Kutaisi is more than 120 and in Tbilisi - 170. Strong winds are observed on mountain peaks and mountain crossings. For

example, the number of strong windy days in Kazbegi is on average 98, in Mta-Sabuveti-142. 1954 was marked by the maximum number of windy days - 222.

The whole territory of Georgia is divided into the zones, according to the intensity of wind. There are 5 such zones. The first zone (more than 5000 hour work period) includes Ninotsminda, Akhalkalaki, Oni and Kutaisi regions. In these zones all types of wind equipment can be efficiently used. In the second zone (Kobuleti, Gardabani, Kazbegi and other regions) duration of active wind round the year reaches 4500-5000 hours. It is expedient to use average (having several hundred kW capacity) wind equipment. In some other zones like Khashuri, Gori, Tskhinvli and other regions, small wind engines can be used.

Georgia's micro relief is favorable for different wind regimes. It is especially true for the Mtkvari and Rioni gorges. In Western Georgia the windiest regions are located in Poti-Supsa and near Surami Range, in Eastern part of Georgia-Gori-Tbilisi. Despite such data, wind energy is not used in Georgia, though the Ministry of Fuel and Energy plans to construct wind electric station.

3. ENERGY BALANCE FOR THE PERIOD OF PLANNED ECONOMY (YEARS 1960 – 1990)

3.1 Cumulative Balance

Consumption of fuel and energy resources in Georgia during the soviet years was characterized by the increasing trend (see table 3.1). Consumption of fuel and energy resources in Georgia during the first 20 years (from 1961 to 1980) out of 30 year period, being analyzed in this report, was increased 2.1 times. According to years this increase is distributed as follows: years 1961-1965 – increase by 25,2%, years 1966-1970 – 20,6%, years 1971-1975 – 29,3% and years 1976-1980 – 4,5%.

As it is seen, consumption of fuel and energy resources in above given period had quite high rate of increase. The exception is the period from 1976 to 1980. Increase trend for fuel and energy consumption during this period started diminishing, which was basically conditioned by the relatively low development rate of energy-capacity sectors in the country. For example, during the years from 1976 to 1980 volume of production for entire industry was increased by 41%, while in high energy-capacity sectors (ferrous metallurgy, chemical and oil-chemical industry) the similar parameters only amounted to 0,7 and 1,0 %.

Table 3.1
Cumulative Fuel and Energy Balance of Georgia
1960-1990 (thousand tone of cond. Fuel – coal equivalent)[6]

	1960	1965	1970	1975	1980	1985	1990
1	2	3	4	5	6	7	8
Resources total	11 110,6	13 217,7	15 825,8	27 125,0	21 738,0	22 014,0	20 930,0
Including:							
Fuel production	2 001,3	1 457,9	1 283,9	1 490,0	5 925,9	1 531,0	910,0
Out of which:							
Oil	48,6	42,9	34,3	372,9	4 556,0	789,0	267,0
Coal	1 809,9	1 231,9	1 144,1	1 024,7	941,2	658,0	563,0
Wood and associated gas	142,8	183,1	105,5	92,4	428,7	84,0	80,0
Primary Consumption, total	273,5	343,4	324,9	315,3	806,4	825,0	1 020,0
Resources Import from abroad	7 813,9	10 639,4	13 604,0	23 876,7	14 277,9	18 411,0	17 790,0
Other Resources	342,7	293,8	21,0	13,0	38 724,0	38 782,0	10,0
Balance by the beginning of the year	679,2	483,2	592,0	1 430,0	720,7	1 104,0	1 200,0
Distribution, total	11 110,6	13 217,7	15 825,8	27 125,0	21 738,0	22 014,0	20 930,0
Including:	7 301,8	9 152,0	11 036,0	14 270,0	14 913,0	17 146,0	18 900,0
Consumed in the country							
Out of which:							
To produce electricity, heart energy and compressed air	2 049,1	3 184,6	4 643,0	6 182,0	6 827,0	7 835,0	8 600,0
For production and technological purposes (including losses)	5 252,7	5 967,4	6 393,0	8 088,0	8 086,0	9 311,0	10 300,0
Exported abroad	3 256,4	3 578,6	4 192,0	11 807,0	5 987,0	3 709,0	1 500,0
Balance by the end of the year	552,4	487,1	597,8	1 048,0	837,0	1 159,0	530,0
Deficit	5 027,0	7 350,7	9 427,2	12 464,7	8 180,7	14 710,0	16 970,0
Meeting the demand with own resources, %	31,2	19,7	14,6	12,7	45,1	14,2	10,2

[6] Prepared based on the materials of State Statistics Department of Georgia

From 1971 to 1975 total production for ferrous metallurgy was increased by 14% and the production for chemical and oil-chemical industries by 47%.

As shown in the table 3.1 the share of local resources was significantly increased in the total fuel and energy resources of Georgia for the given period (1961-1980). Especially the share of fuel production was increased (from 18 up to 27%). This basically resulted from the increased production of oil and associated gas, while the share of coal production and wood processing was decreased. The primary energy production also had a very positive role in the formation of fuel and energy resources. Its share in average was increased from 2,5% up to 3,7%. This increase is distributed as follows: share of hydro energy is 1,1% and share of geothermal energy is only 0,1%. It should be highlighted that it was first time in 1990 when the associated gas and geothermal energy had such a significant influence on the formation of fuel and energy resources of Georgia.

It is clear from the table that the import of fuel and energy resources to Georgia from other regions as well as export activities were performed quite intensively. In 1980 this tendency was a little bit reduced. During this year only 68,9 % of total fuel and energy resources existed in Georgia was consumed out of which 31,5% on production of electricity, heat and compressed air and 37,4% for production-technological purposes including losses associated with heat and energy conservation and transportation.

If we compare the volumes of produced and consumed fuel and energy resources in Georgia, the result will be: production of fuel and energy resources in Georgia for the years from 1961 to 1975 was decreasing. This parameter was drastically increased for the period from 1976 to 1980. As for consumption of fuel and energy it was characterized with an increasing trend for 20 years. What was the level from the point of view of satisfying demand of Georgia with the fuel and energy resources of local production?

It is clear from the calculations, that in 1960 Georgia was able to satisfy its demand with fuel and energy resources of own production by 31,2%, in 1965 this share was 19,7%, in 1970 – 14,6%, in 1975 – 12,7% and in 1980 - 45,1%. In recent years the ability of the country to satisfy its demand with own fuel and energy resources was decreasing.

Starting from 1980 such a significant increase in satisfying demand with local resources was caused by the increasing volumes of oil, associated gas, thermal water exploration and hydro power generation, also by the reduction of increasing rate of consumption of fuel and energy resources in the country for the same period.

The share of wood and other types of energy (agricultural wastes, secondary resources etc.) was traditionally insignificant in the cumulative fuel and energy balance of Georgia; In addition this was characterized with the decreasing trend during the soviet years.

Consumption of fuel and energy resources in Georgia during the last 10 years (from 1981 to 1990) out of 30 year period, being analyzed in this report, was increased by 26,7%. According to years this increase is distributed as follows: years 1981-1985 – increase by 15% and years 1986-1990 – 10,2%. For above defined period the level of

satisfying demand of the country with own resources was considerably reduced, which was basically caused by the reduction in fuel production. In 1985 this parameter only amounted to 14,2%, and the deficit reached its maximum point – 14,7 million tones of standard fuel.

The primary energy production always was one of the significant items in the fuel and energy balance of Georgia and its volume was constantly increasing since 1960. First of all it comprises electricity generated by the hydro power plants, and starting from 1980 thermal water energy is also included in it.

Before 1990 in the fuel and energy balance the item - electricity was expressed in standard energy units (coal equivalent) according to its theoretical calorific capacity – 1000 kWh was equal to 0,123 tone of standard fuel; it is clear that practically it is not possible to get electricity from this amount of fuel with that ratio. This parameter is different for different countries and it value depends on the technical progress reached by the country. In nineties for example in order to receive 1 kWh of electricity 381 grams of standard fuel was consumed in Bulgaria, 369 grams in Hungary, 346 grams in Poland, 369 grams Czechoslovakia and 325 grams in USSR. Taking into account above mentioned and based on the instruction of developing cumulative fuel and energy balance of USSR for the year of 1990, natural value of electricity should be converted to standard fuel with the following ratio: 0,325 tones of standard fuel per 1000 kWh. This decision was at some extent true within the USSR, but we think for some republics and specifically for Georgia it needed to be adjusted. For example, in 1990 rate of fuel consumption in electricity generation in Georgia was equal to 471 grams and of course this parameter should be used as a basis for converting natural amount of electricity generated by the hydro power plants into standard units. Otherwise the cumulative fuel and energy balance would contain misleading data. This is supported by the following calculations. In case if 0,325 is used as a conversion factor it will appear the in 1990 power generation in hydro power plants amounted to 2468 thousand tones of standard fuel, but if we base our calculations on the coefficient 0,471, then the similar parameter will be equal to 3577 thousand tones of standard fuel. So the difference as we see is quite big and amounts to 1109 thousand tones of standard fuel. For comparison it should be noted, that this difference is twice and more times higher then the total volume of coal produced in the republic of Georgia during this year.

The data given above clearly indicates that while developing actual cumulative fuel and energy balance for the accounting period, it was necessary to take into account really existed situation and energy balance would not be the subject to so called average Union rates.

Here it should be reviewed the issue of how frequently a cumulative fuel and energy balance used to be developed in the country.

We think it was definitely a negative fact that during the soviet period, cumulative fuel and energy balance used to be developed once per 5 years. Because of this, discussion regarding positive and negative tendencies of use of fuel and energy resources in Georgia was based on old statistical data, which had a negative influence on total performance results. It was necessary to develop such balances on the annual

basis. It would allow regularly and completely to evaluate the current condition and plan measures to be taken in order to improve the situation.

Moreover, fuel and energy balance is required to be done not only for the country but on the level of all enterprises or at least for large industrial consumers. In the energy balance of an enterprise it should be clearly indicated, from one hand the amount of energy required for its proper operation, and on the other hand the amount of actually delivered fuel and energy resources. By means of comparing above mentioned data it will be possible to review the level of efficiency of fuel and energy usage and other relative and very important issues as well. In addition it would be reasonable to create energy passports for enterprises in order to do more detailed analysis of energy consumption of large companies.

3.2 Fuel Balance (except clear oil products)

Fuel balance is the most important part in the system of fuel and energy balance. As it is known, except clear oil products it contains solid as well as liquid and gas type of boiler and heater fuel. First in the list are: coal, burning mazut, naval mazut, natural gas, shale, peat, wood, liquefied gas etc. The development of industry especially metallurgy, power, chemical, cement and other sectors, also railway and water transport is directly dependent on the fuel. It plays very important role in supplying fuel to the communal-household economy.

In the table 3.2 is given boiler and heater fuel consumption in Georgia by its different types for the soviet period.

Table 3.2
Boiler and Heater Fuel Consumption in Georgia
(Thousand tones of standard fuel – coal equivalent)[7]

	1960	1965	1970	1975	1980	1985	1990
1	2	3	4	5	6	7	8
Coal	2 589,3	2 591,0	1 905,0	1 545,9	1 705,6	1 235,0	1 100,0
Natural Gas	540,5	1 667,9	2 256,1	4 374,0	4 167,1	5 559,0	6 490,0
Mazut	1 363,3	1 764,6	3 419,1	3 832,7	4 279,6	4 313,0	4 400,0
Wood	143,1	165,2	115,0	77,4	94,9	84,0	80,0
Liquid Gas	-	36,2	118,8	236,0	247,6	333,0	380,0
Other types of Fuel	219,8	207,5	354,4	599,6	332,3	327,0	350,0
Consumption, total	4 856,0	6 432,4	8 168,4	10 665,6	10 827,1	11 851,0	12 800,0
Including:							
Local Production	2 950,5	2 920,7	3 064,3	3 355,7	3 706,2	3 376,0	2 100,0
Local Extraction	2 007,8	1 647,9	1 491,8	1 345,9	2 923,7	1 153,9	910,0
Deficit in Fuel Production	1 902,5	3 511,7	5 104,1	7 309,9	7 120,9	8 475,0	10 700,0
Meeting Demand, %							
With local production	60,8	45,4	37,5	31,5	34,2	28,5	16,4
With local extraction	41,3	25,6	18,3	12,6	27,0	9,7	7,1

[7] Prepered based on the materials of the State Statistics Department of Georgia

The data of this table demonstrates that during the first 20 years of the analyzed period (1961-1980) fuel consumption in Georgia increased 2.2 times, namely: in 1961-1965- 32.5%, 1966-1970 – 27%, in 1971-1975 and 1976-1980 – 30,6% and 1,5% accordingly. During these 20 years increase of natural gas and mazut consumption was especially significant, while consumption of firewood and coal decreased. Therefore, the share of the latter two types of fuel in the total fuel consumption was reduced: in case of firewood – by 2% and for coal - by 37.5%.

The same table explicitly shows that gradually the role of gas was increasing. In 1975 gas consumption was on the first place; in 1980 – mazut moved to the first place and gas to the second place, but this was a temporary event, caused by the termination of gas supply from Iran (mainly from 1979). Later on Georgia received gas supply from the North Caucasus and Azerbaijan (small quantity). It was not surprising that at the beginning these changes caused certain temporary difficulties in gas supply, which was corrected later on.

International experience proves that priorities of using natural gas are as follows: in the first place natural gas should be used as raw material in industry and for household purposes; after satisfying this demand it is justified to burn natural gas in small and medium boilers; and the last application would be fuel for power plants and large industrial boilers. It must be noted that in 1988 5690 million m^3, i.e. 11.4% of the total gas consumption in Georgia was used for the technological process of the chemical plant “Azoti”.

During the first 20 years of the analyzed period (1961-1980) the share of consumed domestic fuel dropped from 41.3% to 27%. The situation improved again significantly in 1976-1980, when this parameter increased twice and even more. The situation with production of domestic fuel is very similar. Besides locally produced fuel the domestic fuel includes oil products produced from crude oil at the Batumi Oil Refinery. The increase of the domestic resource share was caused by an abrupt increase of oil and gas production during this period.

In Georgia, fuel consumption structure (excluding transparent oil products) in different sectors has also undergone significant changes. Analysis of the existing statistical materials demonstrated that consumption of this type of fuel increased 2.2 times during the last 20 years, namely: 2.3 times in industry, 4.7 times in agriculture, 27.2 times for household purposes. In transport it was reduced by 53%.

Big increase of fuel consumption in agriculture can be explained by the fact that operation of new facilities started. Increase of fuel consumption for household purposes was caused by the growth in gas and high quality coal supply to the population. Reduction of fuel consumption in the transport sector was the result of the complete electrification of the railway.
The biggest consumers of boiler/furnace fuel are the power sector and ferrous metallurgy. In 1971-1980 fuel consumption of thermal power plants doubled. In 1980 Georgia consumed 3493 million m^3 gas, 3003 thousand tons of mazut and 2.3 million tons of coal.

Analysis of fuel consumption level and dynamics in Georgia during the soviet period shows substantial increase of the natural gas share in the fuel balance of the country

(excluding transparent oil products). At the same time, the share of oil products and coal was still significant. There was certain growth technological fuel consumption. Consumption of coke remained approximately at the same level (670-710 thousand tons of conventional fuel) and its share in the fuel balance equaled 5.6%.

During the last 10 years of the analyzed period (1981-1990) consumption of boiler/furnace fuel in Georgia increased by 18.2%. Annual consumption reached 12.8 million tons of conventional fuel. In the total consumption, the natural gas and mazut still occupied the first two places. At the same time, due to the reduction of oil products the share of domestic fuel dropped even more. In 1985 the percentage of Georgia's demand covered with domestic fuel was as follows: coal - 38.6%, mazut – 4.3% (including oil products produced at the Batumi Oil Refinery – 50.7%), firewood – 100%, liquid gas – 11.4% (Batumi Oil Refinery). Gas consumption fully relied on imported gas. The industrial sector traditionally had the biggest share of the total consumption, the power sector being the largest industrial consumer.

In order to improve the fuel balance it is extremely important to raise the share of oil and oil products. It is well known that 20 000 different new types of valuable products can be produced from crude oil. Besides, oil and gas considerably increase specific heat rate. There are certain processes where 1 ton of diesel can replace 13-14 tons of coal, even though according to caloric value 1 ton of diesel is only equivalent to 1.8 ton of coal.

Increase of the share of transformed types of energy in the consumption balance considerably increases the possibility of replacing one primary energy source with another. This creates an opportunity to use relatively low quality types and therefore be less dependent on scarce types of energy resources. To a certain extent this was the trend in our fuel and energy balance: in 1971-1985 the share of energy resources used for energy transformation increased from 42.1% to 45.7% i.e. by 3.6 points. It is necessary to point out that the above mentioned growth rate and the achieved level were not satisfactory. For the whole Soviet Union the same parameter increased by 4.8 points, reaching 46.3% by the end.

3.3 Balance of Clear Oil Products

It is well known that clear oil products are the main type of fuel for combustion engines. This is due to especially high heat capacity and low ash content. The main types of motor fuels are diesel fuel, different kinds of automobile petrol and aviation gasoline, also kerosene, fuel for household stoves etc. The country's transportation system development almost completely depends on production and consumption of clear oil products.

Transparent oil products were mainly produced in the Batumi Refinery from imported raw materials. In 1965 this refinery processed 4 636 thousand tons of crude oil out of which 530 000 tons i.e. 11.5% were produced in Georgia. In 1990 the production dropped to 2.3 million tons and the share of local Georgian crude went down to 6.5%. In 1985 the volume of oil products produced in Batumi was as follows (in thousand tons): automobile petrol – 890, diesel fuel – 1 326, aviation gasoline – 168.8, fuel for

household stoves – 141; in 1990 the production volume dropped together with the reduction of crude.

Analysis of transparent oil product consumption in Georgia (see tables 3.3 and 3.4) shows that during the first 20 years of the analyzed period the growth rate of transparent oil product consumption was relatively high. In total it increased 2.4 times, namely: automobile petrol – 3.2 times, diesel fuel – 1.8 times, kerosene – 168.8, consumption of aviation gasoline considerably dropped, because reactive aircrafts prevailed. These aircrafts use a special type of kerosene instead of aviation gasoline.

Table 3.3
Clear Oil Product Consumption by Public Service Sectors in Georgia (thousand tones of conditional fuel)

Consumers	1960	1975	1985	1990
Industry	93,0	548,5	33,0	55,0
Construction	57,1	321,4	37,0	65,0
Agriculture	162,4	445,6	584,0	660,0
Transport	907,4	960,0	1 993,0	2 225,0
Demand for household purposes	3,9	321,8	628,0	625,0
Other consumers	45,2	128,8	14,0	20,0
Consumption, total	1 269,0	2 726,1	3 289,0	3 650,0

There were no further large changes of shares of each transparent oil product in the total balance. More than half was automobile petrol; diesel fuel was on the second place and kerosene on the third. Aviation gasoline was an exception from this rule due to the above circumstances. Its share was reduced from 1.2% to 0.2% during 20 years i.e. it dropped 6 times.

During this period in industry and construction consumption of transparent oil products increased 4.4 times, in agriculture – 3.4 times, in transport – 1.2 times, in households 160 times. Of coarse transport sector was the largest consumer of these types of fuel, households were on the second place, 3rd - agriculture, then industry and the last construction. Such a substantial increase of household consumption was caused by the increase of the number of automobiles. Namely, in 1985 consumption of transparent oil products reached almost 2 million tons of conventional fuel which equaled 60.6% of the total consumption. In 1961-1985 the fastest growth of transparent oil product consumption took place. In return it dropped in industry and construction, where other types of fuel and energy became dominant.

Table 3.4
Change in the Structure of Clear Oil Product Consumption in Georgia (thousand tones of conditional fuel)

Types of oil products	1960	1975	1985	1990
Diesel fuel	471,6	910,6	950,0	1 008,0
Gasoline	545,4	1 405,2	1 820,0	2 100,0
Aviation petrol	15,2	15,3	2,0	2,0
Kerosene	236,8	356,8	479,0	490,0
Household-heating				
Fuel	-	38,2	38,0	50,0
Consumption, total	1 269,0	2 726,1	3 289,0	3 650,0

It must be noted that during those years the Batumi Refinery would have been able to satisfy Georgia's demand for transparent oil products if it had had sufficient supply of crude oil. Besides, significant reconstruction of the Refinery was needed in order to increase the depth of processing crude oil. Unfortunately this was not carried out during the soviet era.

During the soviet period clear oil products in Georgia basically were produced from imported raw materials. In spite of this, the demand of the Republic on these products was sometimes not met (see table 3.5). Frequently produced oil products used to be exported to other republics.

Table 3.5
Production and Consumption of Clear Oil Products in Georgia
Years 1975-199, thousand tones

Type	1975		1980		1990	
	Production	Consumption	Production	Consumption	Production	Consumption
Diesel fuel	1 210,6	624,3	1 351,6	593,2	638,0	573,0
gasoline	971,4	941,7	1 144,8	1 165,3	400,0	940,0
aviation petrol	-		-		-	-
Kerosene	428,9	242,6	459,0	277,9	4,0	67,0
Household-heating	-	26,4	-	65,6	-	43,0

3.4 Electricity Balance

Electricity Balance has special value in System of fuel and energy balances. It illustrates the comparison of electricity demand of the country and amount of electricity generated by the different types of power plants. The electricity balance of Georgia for the years 1960-1990 is presented in the table 3.6. Georgia for the last 30 years of the period being analyzed, basically, was experiencing a deficit. Based on this the existing situation can be divided into two stages.

Table 3.6
Electricity Balance of Georgia (million kWh)[8]

Parameters	1960	1970	1980	1985	1989	1990
Electricity generation	3 702,0	8 964,2	14 687,2	14 421,3	15 824,5	14 245,7
Imported	228,1	368,1	1 295,5	3 352,6	3 999,5	4 373,6
Consumed	3 916,4	8 915,1	13 948,4	16 757,7	17 984,8	17 450,3
Including:						
Industry	2 230,4	4 831,0	6 895,7	8 278,2	8 312,1	8 054,4
Construction	139,1	255,3	355,2	431,6	415,3	313,9
Transport	470,2	587,0	818,8	1 046,9	1 088,3	1 040,1
Agriculture	53,1	437,1	1 108,1	1 447,1	2 119,0	2 114,3
For communal-household purposes	482,5	885,4	1 769,9	2 222,8	2 370,7	2 315,1
Other consumers	191,1	597,7	750,0	836,5	992,8	969,2
Looses in the network of common use	350,0	1 321,6	2 250,7	2 494,6	2 686,6	2 643,3
Exported	38 911,0	417,2	2 039,1	1 016,2	1 839,2	1 169,0
Including:						
Export to Turkey	_	_	590,8	695,5	558,5	51,0
Access (+)	_	49,1	743,8	_	_	_
Deficit (-)	214,4	_	_	2 336,4	2 160,3	3 204,6
Level of demand satisfaction with locally generated electricity, %	94,5	100,6	105,3	86,1	88,0	81,6

The first stage covers years from 1961 to 1980, during which Georgia had excess electricity for several years (1970, 1974, 1975, 1980); and the second stage covering the period beyond 1980, during which excess power still was recorded for the first two years (1981 and 1982) although in smaller amount and afterwards the electricity balance became negative for the rest of the period.

For the 20 years of the period being analyzed electricity consumption in Georgia increased 3,56 times, particularly, for the years from 1961 to 1965 – when the increase amounted 57,6%, in 1966-1970 – 44,4%, in 1971-1975 – 29,9% and 1976-1980 – 20,3%. The highest consumption increase rate was recorded in the agriculture (20,7 times) and communal-household sector (3,67 times), increase for the industry approximately was at the same level as the average consumption increase rate (3,1 times), construction (2,55 times), transport (1,74 times). The volume of own consumption of power plants was also big, and a significant amount of electricity was lost in the network of common use.

Such a high rate for consumption increase in agriculture was conditioned by the fact, that during 60-ies this sector was characterized by a low level of power consumption. This parameter started increasing only for recent years, when the level of electrification of villages increased, playing an important role in the increase of total production of agriculture for the period from 1961 to 1980 (2,2 times).

From the point of view of electricity usage, a communal and household economy was far behind prior to the recent period. Electricity started to be used more intensively in

[8] Prepared based on the materials of State Statistics Department of Georgia.

this sector. It is enough to say, that during the years from 1961 to 1980 the level of household services provided to the population increased on average 7,1 times per persons, and in the villages – 28,1 times.

According to the table we see that the structure of electricity consumption in Georgia was characterized industrial use. For example, in 1989 the share of industry in the total electricity consumption was 46,2%, thought it should be highlighted that this level is by 10,7 percentage units less compared to the similar parameter for the year 1960.

From the same table we can see, that during the period from 1961-1980, excluding industry, the share of the following sectors in the total consumption of Georgia was reduced as follows: construction (from 3,6 % down to 2,5 %), transport (from 10,8% down to 5,84%); it was increased for the agriculture (from 1,4% up to 7,9%) and communal-household economy (from 12,3% up to 12,6%).

Note that the share of electricity losses in the networks and electricity consumed by power plants for own purpose was considerably increased in the total consumption. For the years 1961-1980 first parameter moved from 8,9% up to 16,1%, and the second parameter – from 2,3% up to 3,4%.

Almost half of the power, as we noted, used to be consumed by an industrial sector. In this sector 32,1% of electricity was consumed for technological needs, 52,7% - in motors and 15,2 % for lighting and other purposes.

Since 80-ies Georgia has experienced progressively increasing electricity deficit. Similar conditions were created in the power systems of neighboring countries, aggravating the situation. In 1990 the Trans Caucasus energy system generated 47656,4 million kWh of electricity, while consumption was 50176.8 million kWh. Deficit amounted 2520,4 million kWh. In this year Georgia experienced short of electricity equal to 3204,6 and Armenia – 919,9 million kWh. Excess power was recorded only for Azerbaijan – 1604,1 million kWh. All above mentioned caused limitations in electricity consumption. During the years 1981-1990 electricity consumption was increased only by 25,1%, while for the previous decade (1971-1980) an increase amounted 56,4%.

In the years from 1961 to 1989 ferrous metallurgy was the largest electricity consumer of industrial sectors in Georgia. In 1980 the power consumption of this sector was more then 2 billion kWh, which was more then one third of total consumption for an entire industry. Such a big share of ferrous mettalurgy in the electricity consumption was conditioned by the fact that this sector consists of large power consuming factories, namely Ferroalloy Factory in Zestaponi. From 1975 to 1980 the share of ferrous metallurgy in the total electricity consumption was dropped by 2,5 %, which was basically caused by the reduced volume of production in the factory. Besides ferroalloy, share of consumed electricity was also significant on electric steel, steel pipes, oxygen, magnum ores, agglomerates etc.

Chemical and petrochemical industry was on the second place with the volume of electricity consumption. In 1980 enterprise within this sector consumed more then 1 billion kWh of electricity, out of which the share of factories operating in chemical industry was 97,7%, and the remaining 2,3% was the share of petrochemical industry.

Especially big amount of power was consumed by ammonia, caprolactam, artificial fiber, nitrogen acid, potassium per manganate, electrolyte dioxide of magnum.

Quickly progressing sectors of an industry - Machinery Building and Metal Processing were consuming more and more electricity (621 million kWh i.e. 10,2%).

One of the largest power consumers was industry of construction materials including cement production factories. In 1980 enterprises within this sector approximately consumed 500 million kWh of electricity, so the share of production of pasteboard, cement, slate, and wall materials was quite high etc.

During the period from 1981 to 1990 electricity consumption was more rapidly increasing on drives (by 34,9%), then for technological needs (27,5%), lighting and other purposes (22,9%). For this period heist rate of increase was recorded for the metallurgy (9,5 times), oil exploration (6,7 times) and petrochemistry (3,2 times). During the years 1971-1980 quick increase of electricity consumption in a nonferrous metallurgy was caused by the commissioning of ore dressing and mining plant, but in oil production the reason of increase were those positive changes which Georgia obtained during these years, namely starting from 1974 in the field of oil exploration. In parallel, introduction of deep drilling technologies at some extent increased the rate of power consumption per each tone of oil. For example, if in 1978, 2,3 kWh of electricity was spent on production of one tone of oil, this figure for the year 1980 increased up to 2,5 kWh. During this period in the petrochemical industry increase of power consumption by 3,2 times was caused by the commissioning of new capacities. The Kutaisi rubber-technical products factory should be noted.

Besides above listed sectors, electricity consumption was considerably increased in oil refinery, machinery building and metal processing, industry of construction materials as well as food and light industry. While for many products the share of electricity was reduced. Fore example, the share of electricity was reduced on the products of machinery building and metal processing, cement, assembling reinforced-concrete products, shoes, knit work and bakery products etc.

The analysis of regional structure of electricity consumption in the industry of Georgia shows, that among different regions Zestaponi was the largest energy consumer, because of Ferroalloy Factory located in the region.

Among the industrial enterprises of large cities Rustavi is the largest from the point of view of electricity consumption. Factories located in this city used to consume billions of kWh of power. Out of these enterprises chemical factory, Rustavi Metallurgical factory Chemical Fiber and cement factories were consuming much more electricity then other industrial enterprises.

Among the cities of the Republic of Georgia Tbilisi is the second largest power consumer. The second industrial city Kutaisi used to consume billion of kWh of electricity annually, the largest power consumers in the city were automobile, mechanical, metal working and other factories.

During the soviet period the power deficit taking place during autumn-winter season of the years 1990-1991 was extremely critical and deep. This required special measures

to be undertaken. For example, duration of TV programs of Georgian TV channels as well as Central Broadcasting Company was abruptly (down to 4 hours) reduced. Such large energy consuming enterprise like Zestaponi Ferroalloy and Rustavi Metallurgical Factories, Complex of Industrial Enterprises “Azoti”, “Chemical Fiber” etc. were forced to reduce production capacity, but many other enterprises in the field of machinery building, light and local industry completely were stopped.

In Tbilisi, also in other cities and regional centers of the country, special electricity load-shedding schedule was introduced: only 2-3 hours per day, entire micro-regions, dwelling blocks, streets, commercial, cultural and other facilities were supplied with power one after another; The Board of Ministers of Georgia approved the special resolution regarding this issue. Quiet critical situation was created. Own hydro and thermal power plants were able to satisfy only 60% of the country demand. Because of low level of water resources, Enguri HPP was about to stop. Having no fuel was the reason why new Unit No9 of Tbilisi state owned thermal power plant could not generate electricity. Lack of natural gas made population to use more electricity. As a result, by the end of 1990 the economy of Georgia was in extremely critical condition, the main reason of which was insufficient amount of available electricity.

3.5 Thermal Energy Balance

Thermal Energy Balance reflects those consumers, which during the soviet period were supplied with this type of energy from power plants, industrial and district boilers, also from local thermal networks, the capacity of which used to be equal or not exceed 20 gcal per hour.

The total volume of thermal energy supplied to the population of Georgia during 25 years (1961-1985) was increased 4,8 times, including communal–household services – 18,6 times. This particular parameter for an industry was increased 3,5 times, construction – 4,7 times, transport – 5,6 times, agriculture 56,6 times (see table 3.7).

Table 3.7
Thermal power consumption in the public economy of Georgia
(Thousand gcalories)

Sector	1960	1970	1975	1980	1985	1990
Industry	3 990,8	7 741,4	9 619,6	11 411,3	13 841,0	14 320,0
Construction	75,6	285,3	610,5	134,8	354,0	400,0
Transport	39,4	95,4	187,7	49,0	220,0	300,0
Agriculture	11,7	10,0	11,0	611,8	665,0	730,0
Communal-household services	367,7	1 696,3	1 530,4	3 842,7	6 855,0	9 100,0
Other Sectors	202,9	539,9	430,1	1 197,5	500,0	450,0
Consumption, total	4 688,1	10 368,3	12 389,3	17 247,1	22 435,0	25 300,0

So, high increase rate thermal energy consumption was recorded for agriculture and communal-household sector. This fact taking place in the sphere of agriculture can be explained by the construction of many greenhouses, poultries, cattle-breeding complexes and other types of facilities during these years. Significant increase in

thermal energy consumption for communal-household purposes during the recent years was conditioned by the putting into operation large number of district heating boilers. The volume of thermal energy supplied to consumers was also increased by the operation of Tbilisi Heat and Power Plant and existing industrial boiler houses. All above described considerably improved the level and quality of heat supply in Tbilisi, Kutaisi, Sokhumi, Batumi, Rustavi and other cities.

For example, in 1988, 94,3 % of the total dwelling area of Georgia was connected to the central heating system, and 57,9% was supplied with hot water, while the same parameters for the year 1970 was 63,8% and 21,8 % relatively. This increase mostly affected Tbilisi.

Out of industrial sectors large thermal consumers were food, light and chemical industries, also ferrous metallurgy, machinery building and metal processing. Relatively high rate of heat energy consumption increase was recorded in the non-ferrous metallurgy, chemical, construction materials and food industries. The share of heat energy for different type of products in Georgia, basically, was characterized with the reduction trend.

4. EVELUATION OF CURRENT CONDITION (YEARS 2001-2005) OF FUEL AND ENERGY COMPLEX

4.1 Power Sector

Electricity production in Georgia during the years from 2001 to 2005 was not increased, on the contrary it dropped by 4,6% (see table 4.1)

Table 4.1
Electricity Generation in Georgia for the Years 2001-2005 (million kWh)

Parameters	Years						Y2005 compared to 2000	
	2000	2001	2002	2003	2004	2005		
Electricity Generation	7446,0	6942,0	7045,6	7163,0	6706,0	7100,6	95,4	
Including:								
TPP	1540,4	1370,5	513,5	635,1	813,2	1030,6	66,9	
out of which:								
Tbilsresi	1520,1	139,8	245,8	18,7	21,5	318,2	227,6	*
"Mtkvari"		1226,4	267,7	616,4	791,7	712,4	58,1	*
Tbiltetsi	20,3	4,3	_	_	_	_	_	
HPP	5905,6	5571,5	6532,1	6527,9	5892,8	6070,0	102,8	
Out of which:								
Enguri	2742,6	2344,2	2989,0	3066,1	2728,1	2578,9	94,0	
Vardnili	487,5	457,3	509,9	356,0	384,2	425,0	87,2	
Lajanuri	194,6	186,7	134,0	216,0	86,3	125,3	64,4	
Vartsikhe	665,7	657,1	840,7	738,0	606,6	674,0	101,2	
Shaori	81,9	90,4	146,1	138,0	96,9	109,4	133,6	
Dzevrula	109,7	70,9	171,5	139,0	84,3	128,0	116,7	
Gumati	176,6	184,4	181,9	181,2	204,3	203,0	114,9	
Rioni	267,5	259,2	226,6	290,0	288,8	296,0	110,7	
Khrami I	149,1	158,8	151,7	313,0	238,8	197,0	132,1	
Khrami II	228,3	239,8	210,.4	104,0	3,0	126,6	55,5	
Zhinvali	292,9	362,2	476,1	353,0	437,9	402,0	137,2	
Others	509,2	560,5	704,6	633,6	733,6	804,8	158,1	
* 2005 compared to 2001								

It is obvious, the volume of power generation was decreasing in some power plants, including such large plants as Enguri HPP, Vardnili HPP, Lajanuri HPP, Khrami II HPP, Tbilsresi etc. For these plants electricity generation was reduced by 6%, 12,8%, 35,6%, 54,6% and 32,2% relatively.

During the period being analyzed, significant reduction in total power generation was recorded in 2001, when this indicator was dropped down to 6942 million kWh. This is the same level as in 1967, so from this respect the Country moved back by 38 years.

Reduction in electricity generation in hydro power plants during the years from 2000 to 2005 basically was conditioned by the unsatisfactory operational conditions of hydro units. Namely: during 17 months hydro power plant Khrami II was stopped, as a result the plant was not able to generate electricity in amount of 350 million kWhs. Because of unstable regime of operation of Lajanuri HPP power system could not receive approximately 200 million kWhs of electricity. Total amount of electricity equivalent to idly discharged water in HPPs was more then 1 billion kWh. This was caused by the emergency stop of hydro units (Vardnili HPP No1,2 and 3 units, Vartsikhe HPP No2 and 5, all four units of Shaori HPP and No3 unit of Gumati HPP) poor condition of hydro technical facilities.

But the increase in electricity generation by thermal power plants was conditioned by the relatively stable operational regime of Unit No9 of JSC "Mtkvari-Energetika" and putting into operation Unit No3 of "Tbilsresi". Electricity import in 2005 was increased by 16,7%. Import was done from power systems of Russia as well as Armenia, 732,9 and 475,4 million kWh relatively.

Inefficient water usage has significant negative impact on the performance indicators of the sector. For example, by 1st January, 2005, in the reservoirs of regulating hydro power plants it was planned to have accumulated water reserves equivalent to 502 million kWhs of electricity. Actually by that time volume of water reserves amounted only to 277,07 million kWhs, i.e. 55% of planned level.

Technical condition of power plants connected to the energy system, generally, can be evaluated based on the following information: out of 4600 MW of total installed capacity total operational capacity by the end of 2005 was equal to 1766 MW only, i.e. 38,4%. From the given data it can be concluded that technical condition of generation facilities is very bad, that makes electricity deficit even more considerable, increases weighted average tariffs, reduces payments to the state budget and negatively influences economy and financial condition of the country.

It is obvious that the share of Enguri HPP in the structure of electricity generation by the power plants of Georgia is very important. In 2005 total amount of electricity generated by the hydro plant amounted to 2535 million kWh; out of 5 units (with total installed capacity equal to 1300 MW) only four of them are operational with the total operational capacity amounted to 920 MW. Out of four Vardnili power plants within the Enguri Cascade only one is under operation with the installed capacity equal to 210 MW, but operational capacity amounted to 110 MW. Other three power plants Vardnili II, III, IV are completely flooded and stopped. According to the estimations of specialists these plants would in average generate more then one billion kWh of cheap electricity annually. For several years large amount of water used to be spilled from Enguri HPP dam because of fallen shutoff gate. Relatively small amount of funds are required to lift up the gate and install and this was supposed not be the problem. Complete rehabilitation of hydro power plants within the Enguri Cascade would allow the power sector to generate more then 5 billion kWh of cheap electricity, which would considerable reduce power deficit, import and currency outflow from Georgia; it would also increase revenues of state budget and efficiency of the sector. Capacity deficit would also be reduced that would improve reliability of system operation, reduce number of damages and make system regime management easier. Based on above

mentioned, the following measures need to be taken urgently in the first place: to accelerate attraction of local and foreign investments in order to rehabilitate HPPs within Enguri Cascade and start repair works in time. Undergoing rehabilitation works in Enguri HPP are financed by the European Bank for Reconstruction and Development.

If compared with other HPPs Khrami I HPP is in a relatively good technical condition. From its installed capacity of 113,5 MW, the actual capacity of Khrami I is 110 Mw. Rehabilitation of Khrami II had started with the Japanese credit, installations and equipment were purchased but repair and assembly works are not conducted due to the financial problems with the Bank.

Four stations of Vartsikhe HPP cascade with 184 MW capacity and total estimated average annual capacity of 1,0 billion kWh are one of the most important form regulating HPPs. By the end of the year 2005 total working capacity of cascade HPPs was 100,0 MW. In 2004 the plant generated 680,251 million kWh of electricity. According to the opinion of experts technical conditions of plants (I, II, III and IV) does not allow for their further operation; hydro engineering constructions of the HPP need rehabilitation. Due to their poor conditions there is a great threat for the population of nearby villages during floods. With the credit of German Reconstruction and Development Bank (KFW) rehabilitation works have started in the plant, control indices of the plant shall be the projected generation of electricity (1 billion kWh).

The technical conditions of the generating units of Gumati HPP cascade and hydro engineering constructions are also unsatisfactory. It is necessary to develop design-technological plan for the priority repair works and financing of these works.

Situation is also difficult in Lajanuri HPP, where rehabilitation works financed by Japanese credit are being conducted, but due to it that Georgia could not in due time finance its share rehabilitation works went on slowly. By the end of 2005 two generating units were stopped in the plant. Only after allocation of the required funds by the Ministry of Energy it became possible to repair the third generating unit.

In 2005 with the support of the government and efforts of the Ministry of Energy with the funds allocated from the State Budget it became possible to rehabilitate a number of hydroelectric plants, thermal stations and electric network of the power system. All these guaranteed reliable functioning of the power system and sustainable supply of electricity to the customers, expediting of the process of remetering works resulted in increase of collections

As for the privately owned plants, at the moment about 20 HPPs are in private possession with the total installed capacity of 105,7 MW and with total actual capacity for the accountable year of 37,7 MW. In other words only the third i.e. 35, 7% of the installed capacity is used.

Virtually no rehabilitation works are carried out in privatized HPPs. Sioni and Dzevruli HPPs are exceptions (Ltd “Moon Lake Georgia”), as for Khrami I and Khrami II given out to JSC Telasi with 25 year management right, rehabilitation works have been conducted on Khrami I and it is working with full capacity; as for Khrami II, as it has already been mentioned, primary equipment is already in the station.

For sustainable functioning of Georgian power sector it is very important to have several basic working thermal power plants with optimal capacity and their stable supply with primary power resources. From basic plants (Tbilsresi, "Mtkvari Enetgetika") by the end of 2004 only unit N9 of "Mtkvari Energetika" operated at 270 MW capacities with working capacity 200 MW, its installed capacity is 300 MW. As for unit N 10 which after blowing up of the boiler came out of order, the issue of its restoration has not yet been decided.

Tbilisi Tboelectrocentral is stopped; with the help of Tboelectrocentral it could have been possible to resolve not only electricity problem but heating and hot water problems in the central parts of Tbilisi.

There are serious problems in the operation of technical facilities for regulation of frequency and voltage. RPM automatic governors do not function in any of the hydroelectric power plants; due to the absence of operative and reserve capacities frequency regulation and system management in emergency situations in the system is very complicated.

More than 90% of h/v network (35-110-220-330-500 kV) transmission lines and substations are under management of two licensees: Ltd "Georgian State Electrosystem" and Ltd "Sakrusenergo". Accordingly, technical conditions of electric networks of the mentioned licensees, good functioning of management facilities, determine technical conditions of high voltage network and its reliability level.

High voltage network of power system (35-110-220 kV transmission lines and 35-110-220-500 kV substations) and basic management facilities of the total power system belong to Ltd "Georgian State Energosystem". It was formed in 2002 after merging of JSC "Electrogadatsema" and Ltd "Electrodispatcherizatsia-2000" and it was given out with 5 year management right to Irish company (ESBI), who started carrying out management contract on March 3 of 2003.

"Sakrusenergo" manages 500 kV electric transmission lines: "Kavkasioni", "Kartli-I", "Kartli-II", "Imereti", "Mukhrani", 300 kV "Gardabani" and 220 kV "Adjara".

The majority of primary equipment of power transmission objects and of the dispatch supervision facilities are physically and morally outworn and outdated and thus it is necessary to renovate and upgrade them. During last years some rehabilitation work had been doe with the investments, though it did not have any substantial impact on the improvement of the reliability of power system.

The level of technical maintenance of electricity transmission network and reliability of dispatch supervision automatic equipment do not satisfy requirements even on a minimal level.

Accelerated depreciation of electric appliances and equipment caused by instability of curtailment and frequency also due to impermissible switch on and switch offs adversely effect operation and reliability of energy system. The situation is even worsened due to it that certain amount of 35-100 and 220 kV voltage power

transmission lines and substations are totally or partially plundered and substantial finances and time is needed for their restoration.

Sustainable functioning of electricity system requires modern technologies of relay protection and automation. But the majority of 220-500 kV voltage network relay protection and automation installations are outdated. Differential-phase protections of rapid action of 220 kV voltage power transmission lines are out of action in a great quantity; only standby protection facilities are operative. The same situation is with 500 kV power transmission line relay protection and automatic facilities.

The system has no anti emergency channels and equipment, nor automatic re-connection equipment. The most pressing task at the moment is gradual repair and upgrade of automatic equipment of relay protection and anti-damage equipment, in the first case it is necessary to equip 500 kV voltage transit network with relay protection and modern automatic microprocessor digital devices. Also there is an urgent need to repair in the power plants primary regulators and modern systems of secondary regulation, its assembling and putting into operation.

Substantial investments are required for improvement of reliability of Georgian power system and for its maintenance and carrying out urgent works. Additional funding shall be required for safety measures, material-technical and organizational provision of safety technique and labour protection. Regional branches of electricity system are not even at a minimal level provided with normative-technical documentation and renovation and operation instructions; personnel training and re-training needs new approaches. In this respect it is quite hopeful that in the nearest future (years 2005-2006) it is planned to equip 500 kV magistral network with modern digital relay protection automatic devices. For it German bank (KFW) has allocated credit in the amount of 12, 3 million euro. It is intended to install the above mentioned equipment in 500 kV substations of Zestaphoni, Ksani and Gardabani, also to rehabilitate partially 500 kV Zestaphoni substation. On the basis of international tender the consulting company “FICHTNER” was selected for preparation of tender documentation for master executor and invited bidders for tender, SIEMENS Company won the bid. The works started in 2005 and shall be finished by 2006.

Not less important is the credit allocated by International Development Association (IDA) to the Ltd “Georgian State Electricity System” for support of Georgian electricity wholesale market in the amount of 27, 4 million USD. The credit will cover expenses for rehabilitation of meterting points and telecommunication facilities. Besides this grants are allocated for putting into order metering points at balance division points of JSC “Georgian United Distribution Company”: and JSC “Georgian State Electricity System”. In the sector of power generation it is noteworthy that during independence years of Georgia new generation stations were put into operation: it was “Khadori HPP with 24 MW capacity, then gas turbine generating unit with 55 MW capacity and there is a perspective to double this capacity.

4.2 Gas Sector

Gas supply system of Georgia as of January 1 of 2005 included 32 enterprises, from which 3, i.e. 9,4% from the total quantity belonged to the category of big enterprises,

14 (43,7%)-to the average and 15 (46,9%)-to the small enterprises. As for the structure of the production (service), 72, 2% is produced by big enterprises, 23, 2% by average and 4.6% by small ones. In 2005 the industry produced goods for 35, 5 million GEL and employed 3, 2 thousand people. In comparison with the year of 2000 the volume of production increased 3.8 times and the number of employees by 33, 3% (see Table 4.2).

Table 4.2
Basic technical-economical parameters of gas production-supply in Georgia for the years 2000-2005[9]

Parameters	2000	2001	2002	2003	2004	2005
Number of enterprises (units)	30	29	29	30	33	33
Average annual number of employed persons (thousand person)	2.4	2.4	2.3	2.5	2.9	3.2
Volume of production (million GEL)	9.4	10.9	8.2	8.6	28.2	35.5
Natural Gas Consumption (million cub.m)	1094	880	700	1011	1231	1440

Provision of gas in Georgia is done on the basis of licenses, according to it the enterprises of the sector have licenses on provision, transportation and distribution. Especially important enterprises are listed below: Ltd “Company for Transportation of Gas” (Transportation Licensee), JSC “Itera-Georgia” (Provision Licensee), JSC “Tbilgazi” (Provision and Distribution Licensee), regional gas distribution companies, etc.

As it is clear from the Table the sector is not characterized with the stability of economic indices. During certain years the quantitative as well as qualitative parameters were not stable, e.g. in comparison with previous year the volume of production during 2001-2002 decreased, though there was increase in production during next five year period.

Special role in formation of technical-economic parameters of the sector belongs to the enterprises included in the sector. In this regard one of the important companies is Georgian Natural Gas Transportation Company. It is engaged in transportation of natural gas to the regions of Georgia or to the whole of its territory and ensures transit within the territory, management and maintenance of existing pipelines and its infrastructure, sale of natural gas. It is the affiliate of Georgian Gas International Corporation. It is the Gas Transportation and Delivery Licensee. The company has 5 maintenance branches on the territory of Georgia – in Saguramo, Kazbegi, Kvesheti, Terjola and Gurdjaani. Total length of gas pipeline as of January 1 of 2005 was 1940 km.

[9] Table is prepared based on the materials of State Statistics Department of Georgia.

Table 4.3
Technical-economic Parameters of Natural Gas Transportation Company[10]

Parameters	2000	2005	2005 compared to 2000
Volume of received natural gas (million cub.m)	2601.5	3125.1	120,1
Including transit	1403.6	1685.0	120,0
Technological losses	176.5	85,9	48,7
Same in %	6,78	2,75	-4,04

Table 4.3 shows dynamics of technical-economic parameters of the Gas Transportation Company during 2002-2005. It is clear from the given Table that currently the company transports 3, 1 billion cub.m of natural gas, whereas its capacity is 20 billion cubs. m. i.e. its capacity is used only by 15%.

1, 4 billion cub.m. of the transported gas or more than a half of it is a transit gas supplied to Armenia. During last years the share of transit in the total volume of gas has a tendency to growth in comparison with planned parameters and the share of gas left in Georgia decreases. Namely, in comparison with the year of 2000 the volume of transit increased by 20%, correspondingly decreased the specific weight of the gas supplied to the consumers in Georgia. If we disregard VAT decrease, tariff for transportation of gas in Georgia (16, 6 Lari per 1000 cub.m. of gas) has not changed since 2000.

"Tbilgazi" is the biggest among the gas distribution companies. It was established in 1958. The length of gas pipelines in one direction is 2040 thousand kilometers. It provides gas to 205 gasified flats and 3350 enterprises. It has on its balance pipelines at the cost of 4, 8 million Lari, among them 1, 6% of high pressure, 26, 7% of average pressure and 71, 7% of low pressure.

"Tbilgazi" is in municipal possession and a joint stock company is organized on its basis. In 2006 "Tbilgazi" was purchased by Kazakh company. The dynamics of technical-economic parameters for the years 2000-2004 are shown in Table 4.4.

[10] Table is prepared based on the materials of Natural Gas Transportation Company of Georgia.

Table 4.4
Technical-economic Parameters of JSC "Tbilgaz" for the Years 2000-2004[11]

Parameters	2000	2001	2002	2003	2004	2004 compared to 2000
Total amount of received gas (million cub.m)	96.4	155.9	206.8	289.7	353.1	366.3
Losses, total (million cub.m)	40.7	85.3	142.6	202.5	217.8	535.1
Same in %	42.2	54.7	68.9	69.0	61.7	19.5
Collection rate for consumed gas (%)	35.1	34.8	34.9	30.4	33.3	1.8
Number of employed persons (persons)	1050	1344	1409	1437	1663	158.4
Residual Value of main assets (thousand GEL)	6010.8	6060.3	5424.5	5483.1	6406.6	106.6
Operating expenses, total, (thousand GEL)	8685.6	4479.7	28215.5	52411.1	62836.4	7.23-times
Profit (+), Losses (-), (Thousand GEL)	-5.7	-41.9	-29.31	-42.0	-19.8	3.47-times
Retail tariff, without VAT, tetris cub.m	20.8	20.8	22.5	22.5	22.5	108.2

According to the Table during the years of 2000-2004 the volume of gas received by the enterprise increased by 3, 66; number of employees increased and the cost of fixed assets became 58, 4 and 6, 6% correspondingly. During years "Tbilgazi" was an unprofitable enterprise, the debt of the company in 2003 reached 42 million Lari. In 2005 the enterprise received 486, 8 million cub.m of gas.

Since 90-ies of the last century the events developed in the country and stoppage of gas supply adversely effected technical conditions of the company. Since that period crisis is getting deeper and deeper from day to day.

Due to the absence of funds it was impossible during years to carry out rehabilitation, network separation and metering works. All these caused increase of losses, which worsened economic parameters of the enterprise and financial situation of the company. Ineffective and unsuccessful activity of the Company was also due to the management system, which could not meter accurately the consumed gas. Annual volume of regional gas distribution companies is 1-6 million, somewhere less than 1 million cub.m.

During years certain works were carried out in the regions for improvement of gas supply. Especially noteworthy are the following: in Ltd "Borjomigazi" was installed 8000 meter long air gas lines, control meters were installed; In Ltd "Vanigazi"

[11] Table is prepared based on the materials of Natural Gas Transportation Company of Georgia

rehabilitation recovery works were carried out in the villages of Dikhashkho and Salkhino gas pipelines, gas control and sub-region meters were installed. Similar works were carried out in Ltd "Samtredigazi", JSC "Samtrediagazi", JSC "Rustavigazi", "Gorigazi", "Kutaisigazi", "Tetritskarogazi", "Bolnisigazi". Due to these works volume of the received gas increased and losses were decreased. Analysis of the received results show that the losses were decreased in the following amounts: „Vanigazi" by 2, 2%, in „Samtrediagazi" by 2, 4%, in "Rustavigazi" by 7, 3%, in "Kaspigazi" by 0, 2%. The volume of the performed work was especially big in "Rustavigazi" and "Gorigazi", though the work to be carried out is still significant. In 2005 significant funds shall be allocated for carrying out rehabilitation and metering works and activities for decrease of gas losses in "Kutaisigazi, from this amount 45 thousand lari shall be allocated from Kutaisi municipal budget and from JSC "Itera-Georgia" – 50 thousand USD; within possibility some funds shall be allocated by "Kutaisigazi".

In Table 4.5 shows natural gas supply parameters in regional gas distribution companies. Most of the gas distribution companies experience financial difficulties. Part of enterprises is non-profitable and their annual volume can be appreciated in several thousand lari. In Table 4, 5 are given parameters of regional gas distribution companies during the years of 2000-2004 from which it is clear that the biggest from regional gas distribution companies is "Tbilgazi" with 3.2 fold increase in the supplied gas for the last four years. In 2005 it distributed about 490 million cub.m. of gas though this parameter is 4,2 times less than the similar parameter of 1989 when the use of natural gas in Tbilisi was 2040,7 million cub.m.

Table 4.5
Natural Gas Supply to Regional Distribution Companies of Georgia, million cub.m[12]

Regional Distribution Companies	2000	2002	2004	2004 compared to 2000
Total for Georgia	1197,90	812,40	1231,30	102,80
Including:				
"Tbilgazi"	109,20	206,80	353,10	323,30
"Rustavgazi"	0,78	6,97	15,97	20.5 times
"Mtskhetagazi"	0,59	12,38	20,86	35.4 times
"Kvareligazi"	0,097	0,15	0,33	3.3 times
"Zugdidigazi"	0,73	0,36	-	-
"Marneuligazi"	1,20	1,70	2,31	192,50
"Telavigazi"	0,74	2,00	1,04	140,50
"Dmanisigazi"	0,09	0,25	0,13	144,40
"Gurjaanigazi"	0,99	2,81	1,24	125,20
"Kaspigazi"	0,30	1,70	3,46	11.5 times
"Tskaltubogaz"	0,07	0,56	0,74	10.6 times
"Sachkheregazi"	-	-	1,12	-
"Acharagazi"	-	-	0,13	-
"Borjomigazi"	1,70	2,80	4,47	2.6 times
"Khashurigazi"	0,91	0,95	1,45	159,30
"Kutaisigazi"	11,00	10,00	13,33	121,20
"Gorigazi"	2,38	2,04	3,97	166,80
"Vanigazi"	-	0,06	0,31	-
"Terjolagazi"	0,06	0,692	0,92	15.3 times
"Baghdatigazi"	0,15	-	0,10	66,60
"Zestaponigazi"	0,79	0,48	0,24	36,30
"Samtrediagazi"	1,81	1,23	2,19	121,00
"Dedoplistkarogazi"	0,19	0.26	0,48	2.5 times
"Bolnisigazi"	0,77	0,74	1,68	218,20
"Dushetigazi"	3,03	2,18	2,10	69,30
"Tetritskarogazi"	-	0,28	2,02	-
"Kazbegigazi"	24,00	23,10	50,90	212,10
"Kareligazi"	0,13	0,14	0,15	115,40
"Lagodekhigazi"	0,283	0,05	-	-
"Signaghigazi"	0,15	0,11	0,21	140,00
Others	1035,76	531,87	746,35	72,06

From regional gas distribution companies special attention is to be paid to "Kazbegigazi", with the help of which gas consumption in 2004 exceeded 50 million cub.m. Gas consumption in this region increased 2, 1 times for the last four-year period. "Rustavigazi", "Mtskhetagazi", "Kutaisigazi" are also big consumers of gas. In 2004 gas supply started in Adjara, in Sachkhere. During period under investigation gas supply increased in Mtskheta, Rustavi, Kaspi, Tskhaltubo, Borjomi, Terjola,

[12] Table is prepared based on the materials of Natural Gas Transportation Company of Georgia.

Dedoplistskharo, Kvareli, etc. Gas consumption is decreased in Bagdadi, Zestaphoni, and Dusheti. .

The given data does not include big industrial consumption of separate industries. In this sphere especially big consumers energy sector and chemistry. In consideration of the abovementioned especially big consumers of gas together with Tbilisi are Gardabani and Rustavi.

4.3 Oil Industry

Currently oil production is connected with the use of existing oil fields. Some of them are being developed since 1930. According to the expert evaluation those oil and gas fields that are being developed are almost exhausted, which means that the perspective of the increase of extraction of hydrocarbons from these fields is very little though with the use of new technologies and innovative methods it might be possible to increase extraction of oil and gas.

Transitional economy made vivid many problems connected with the supply of power. Increase of market prices on provision of power resources necessitated radical changes in the energy policy of the country and put them as priority issues on the agenda, investment policy became more demanding.

Experienced oil and gas extracting foreign companies have been invited. Tender will be held for issuing licenses.

At present five joint venture oil companies are engaged in Georgia: “Canargo Energy Group”, who participates in five share distribution agreements, among them Ninotsminda, Manavi, and West Rustavi section. Canargo company investigates three blocks of the Black Sea shelf with the length of more than 50 km.

The company “Frontera” is active in Georgia since 1997. It is awarded exclusive right to search and extract oil in Western Georgia on the territory of 5,5 thousand sq.km. At present 15 oil and 3 gas fields are under development. The number of perspective units reaches 14.

No new fields have been found during activity of foreign companies in Georgia, but on the basis of intensive search and investigations it became clear that out of the 69, 7 thousand square kilometers of Georgia 26, 5 thousand kilometers are considered to be perspective on the land and 9 thousand square kilometers on the water area of the Black Sea.

On the basis of the conducted researches experts make prognosis that the total reserves of oil constitute 2.4 billion tons, out of which 1.15 billion tons are in the Black Sea basin. Experts also denote that it will be possible to find at least one field in Georgia during following years with the maximum productivity of 2, 5 million tons.

It is also supposed that during following 7-9 year period it will be possible to extract 3-3.5 million tons of oil from the shelf of the Black Sea. Oil extraction data for the years

2001-2005 (in thousand of tons) are following (in thousand tons): 2001 – 98.8, 2002 – 73.9, 2003 – 139.7, 2004 – 97.6, 2005 – 66.6. These amounts are not sufficient for resolving the existing power problems.

As it has been already mentioned technology of oil processing has a rich history in Georgia. It is the so called product of the planned economy and was mainly located in Batumi. Its annual productivity was 5 million tons of raw oil, and the products included nearly all petroleum products. In the course of time due to the development of oil processing industry in the neighbour countries and ecological problems of Batumi operational capacity of the factory had gradually reduced. The obsolete technological equipment had not been replaced with a new one and thus in 1990-ies the factory had decreased range of products and ceased to work. Oil processing had been transferred near Tbilisi in a new factory, which worked during 2001-2005 with small productivity and periodic stoppages.

In different regions of Georgia the so called “mini” factories are operating but they have problems due to the taxation system.

With high VAT and an excise tax small oil processing enterprises are not profitable, therefore they are trying to import from the neighbour Azerbaijan remains of oil products and produce diesel fuel. Due to this most of the petroleum products consumed in Georgia are imported and the share of locally produces goods is insignificant. Production of petroleum products in Georgia during 2001-2005 (in thousand tons): 2001 – 11.8, 2002 -16.7, 2003 – 18.6, 2004 – 41.9, 2005 -1.7.

4.4 Coal Production

During 2001-2005 economic years coal production could not place itself on the consumer goods market to sell its products.

Despite it that in the South Caucasus Georgia is the only country with the proved coal reserves and acting deposits of coal, it was impossible for the country to develop coal industry. As it is clear from the energy balance, parameters of coal excavation during the mentioned period were gradually decreasing and in 2005 Tkibuli coal deposits stopped excavation works.

Notwithstanding it that the reserves of coal in Georgia are evaluated as 400 million tons it was not possible for a long period to rehabilitate and expand coal deposits. Currently the situation is changing. Tkibuli coal deposits were sold at the beginning of 2006. The investor plans to renew coal extraction in the nearest future. Due to it that most of the territory of Georgia is mountainous use of coal by local population is perspective. It is also perspective to use coal in cement production and what is even more important revival of coal industry and its development will help to increase employment. Based on the above mentioned coal won’t be included in the energy balance till 2010 and it is considered to be a part of power policy in future. Here is information on coal extraction in Georgia during the years of 2001-2005 (in thousand tons): 2001 – 5.0, 2002 – 6.1, 2003 – 8.0, 2004 – 8.1, 2005 – 5.1.

4.5 Renewable Energy Production

At the present stage the basic source of renewable energy as indicated above are hydro energy resources, but according to the evaluation of experts, non traditional sources of energy are not less important, among them potential of wind, solar, thermal and biomass energy.

At present parameters of use of non traditional sources of energy are not significant though the existing potential is evaluated as 6 thousand tons.

Now the use of wind energy is limited by two experimental generators, total capacity of which is 12 kW. The Caucasus high mountain regions, Mtkvari Gorge, South Georgia mountain slopes and the southern part of the Black Sea have a great potential of wind.

It is proved by the wind cadastre of local specialists that in the above mentioned regions wind velocity is more than 6 meters per second at the height of 30 meters and windy periods are quite long.

Georgia disposes with a significant potential of thermal water with average temperature of 33-108^0
C. At present thermal energy is not used on a large scale and it does not exceed 10 thousand ton Pascalls per year, though the existing potential is about 1800 MW and it is very attractive for future use.

Georgia can be attributed to agricultural countries, thus is has bio-energy potential connected with the use of the energy of agricultural remnants.

In the years of 1993-2005 with the help of TACIS Technical Assistance programme about 200 units equipment for utilization of biogas started to operate and there is a good potential for its development.

On the basis of adequate potential of non-traditional sources of energy in the country and Kyoto Protocol for production of clean energy there was issued a Decree of the President of Georgia of March 3, 1998 on “Development of Renewable Sources of Energy”, which is a part of government programme in poser sector. It is foreseen by the programme:

- to subsidize production of ecologically clean energy within 10-12% range;
- to stimulate clean energy producers, that means energy purchase at lower prices;
- to decrease taxes for clean energy production, etc.

Due to the prolonged period of transitional economy, different obstacles were created that hinder development of renewable sources of energy, among them - non-traditional sources of energy.

5. ENERGY BALANCES DURING THE YEARS OF INDEPENDENCE

5.1 Preconditions for Drawing-up Balances

As already mentioned, after the break up of the Soviet Union the fuel and energy balance of Georgia was very strained. The country could satisfy its own demand only for 15% and 85% was imported; annual deficit was more than 15 million "TPS"-tons of conditional fuel (coal equivalent). The balance was deficient nearly for nearly all sources of energy. Georgia satisfied its own requirements for fuel by local resources: in 1990 by 16, 4%, including 7, 1% of local resources. Thus since the soviet period the Georgian economy was mainly oriented to import of primary fuel.

In the transitional period from planned economy to market economy additional economic problems appeared in the country connected with the rapid increase of prices on primary fuel. The problems that appeared were partly connected with the increase of prices on energy resources sometimes they increased as minimum 4 times in comparison with the planned economy prices, whereas the prices on production in the material production sphere in many cases remained unchanged or they had changed insignificantly. The situation was even more complicated since most enterprises of Georgia used existing technologies characterized with high energy requirements. Due to the existing situation net income from the products made in certain enterprises could not cover costs for purchase of primary fuel and its conversion.

Significant problems appeared in the metering of energy resources and working out balances. From the beginning of transitional period (from 1990) the State Department of Statistics did not receive primary information on the production and consumption of fuel and energy resources. Due to these reasons during 1991-2000 no periodic balances were developed; due in part to the fact that the statistical forms used during the planned economy were different from the similar forms of international statistics services.

For resolution of these problems we have developed a methodology for fuel and energy balance of Georgia on the basis of international standards and units of measures adopted in international practice.

Transformation of fuel resources from natural units into conditional units which were different from planned economy standards (where coal equivalent was used) was carried out with the use of oil equivalent (10000 cal per kg). The materials prepared by Georgian and foreign specialists working in the technical assistance projects and different organizations, among them "TACIS" technical assistance, World Bank and International Monetary Fund experts were used. On the basis of the above, in the development of the expenditure part of the energy balance no primary information from enterprises was used. There was no actual reliable information, or if it existed, many inaccurate parameters were included. .

Instead of this we have used:

- data on resources accounted by sector ministries and separate organizations;

- accounting materials from power consuming and other big enterprises;
- materials presented by the customs services to the State Statistical Department and other organizations;
- accounts and specific data developed by "TACIS" projects;
- notes, memorandums, etc made by the experts of the World Bank and International Monetary Fund;
- parameters included into the Indicative Plan worked out by the Ministry of Economy and Fuel and Energy;
- data from specific contracts and agreements on the import of fuel and energy, etc;

The information given in the list was checked and compared with the reference books issued by the International Statistics Agency for last few years and the basic data on import and export, its production and consumption was determined.

The database was brought into relevance with international standards; the energy balance of 1990-2003 was restored to the initial level. The following unit measures were used in the fuel and energy balance:

	T_j	GCal	Mt(oe)	MBtu	GWh
T_j	I	238.8	$2.388.10^{-5}$	947.8	0.2778
G(Cal)	$4.1868.10^{-3}$	I	10^{-7}	3.968	$1.163.10^{-3}$
Mt(oe)	$4.1868.10^{-4}$	10^{7}	I	$3.968.10^{7}$	11630
MBtu	$1.0551.10^{-3}$	0.252	$2.52.10^{-8}$	I	$2.931.10^{-4}$
gWh	3.6	860	$8.6.10^{-5}$	3412	I

Thus it is taken into account that 1 terrajoule=238, 8 gcalory=2,388X10^{-8} megatones (oil equivalent) =0, 2778 gWh, etc.

In order to understand the connection of the power-energy balance of the soviet period with the new (1990-2000) energy balance it should be taken into account, that:

1 kg of conditional fuel (oil equivalent) =1,428 kg of conditional fuel (coal equivalent)

Due to a number of unpredicted difficulties that appeared in the transitional period as it had been mentioned earlier, since 1990 statistical accounting area had been limited. . The State Statistical Department had actually lost its primary information traditional channels, therefore existing energy database does not allow for systematize energy balances.

The State Statistical Department possesses basic information on locally produced energy resources but the Department does not have reliable data on import and export, which makes it difficult to obtain detailed information from energy consumption spheres. Therefore the following sources of information are used for the project:

1. Local production of energy resources – determined on the basis of information of statistical department, which was verified against operational-commercial parameters of active energy structures.

2. Information on export and import – determined on the basis of officially declared information existing in the Statistics Department, which was verified with the information of customs service, due to it that the free energy market is not yet fully provided with cash registers.

3. The database on natural gas and electricity is based on the documentation existing in energy generating, transportation and distribution companies, also on operative and commercial data of electricity wholesale market.

4. Energy balance of the separate years is based on the information from the TA projects of international donor organizations, World Bank and International Monetary Fund.

5. Information on the consumption of energy resources in the regions is based on the information which is obtained from the following sources: joint-stock and limited liability companies, Electricity Wholesale Market of Georgia, from Georgia State Electricity System, Gas Transportation Company, regional gas distribution companies.

6. The project also uses materials of sampling inquiries carried out by the Department of Statistics in 2001.

7. Data obtained from international organizations and local experts, which at different periods were presented to the Ministry of Energy and they were made a subject of public discussions.

8. Publications of the Statistics Department and materials of the Ministry of Economic Development were found and some parts of them used, in the first place “Statistical Year of Georgia, 2005” “Industry in Georgia, 2005”.

9. Considerations of the expert-specialists and their approaches were used for evaluation of suspect data.

During transition to market economy in many post soviet republics, including Georgia developed stagnation processes in economy with involvement of all spheres of economy including domestic and industrial sectors. The situation in Georgia was even worse due to the deficiency of energy carriers of the local production and dependence on the import of energy.

Due to the above mentioned reasons it was not possible during the years of independence to satisfy the demand of electricity market. Though even today energy deficit is felt during autumn-winter period, accompanied by significant curtailment in electricity supply and non-provision of natural gas and in certain cases forcible switch offs. Provision of different branches of economy with energy actually depends on the import from neighbour countries.

Despite existing difficulties there is certain stability lately in provision of electricity but the parameters of consumption are lower than the assumed consumption levels. The share of industry in the total consumption is especially low. This is mostly caused by standstill of many power consuming enterprises, just like metallurgical plant which

does not work at all, other big enterprises decreased their capacities. It is clear from the balance that the main consumer of oil products is the transport sector and among the natural gas consumers are distinguished electricity generation and residential-communal sectors.

5.2 The Goal of the Energy Balance

As it is known, the soviet model of energy balance significantly differed from the statistical accounting rules existing in the world. During the years of planned economy (1960-1990) there existed a complex system of production, transportation, distribution and consumption of fuel and energy resources, which represented information basis for the Planning Committee. Since all the enterprises and organizations that operated in the country belonged to the state and were actually managed by the Planning Committee, any consumer of energy, whose consumption was more than 50 kW conditional fuel in a year (except population) was accountable in front of the statistic department and systematically submitted reports to this body according to the established form.

The accounting period was a month, quarter and year, between the five year periods Statistics Department provided to the relevant organs five year summary energy balance with the corresponding information attachments. During the whole period of planned economy the coal caloricity equivalent was used for energy balance (7000 ccal/kg) and the forms of balance were developed according to the territorial principles.

The existing practice stopped in 1990. During transition of Georgian economy to the market economy that started in the 90-ies it became clear that there existed an urgent need for working out new model of energy accounting, though the existing channels of information could not be restored and it was not possible to set up the database necessary. Due to the absence of local resources for primary fuel and chronic dependence on import of energy carriers national economy experienced decline in all spheres, existing technologies and management systems were destroyed as well. This situation affected adversely all statistical activities including accounting and other reporting procedures.

It should also be taken into account that in 1990-ies Georgia faced the power market with the price on primary energy 4-5 times more than earlier, but the prices of products made on the basis of these resources did not increase. Power consuming enterprises found themselves in a very difficult situation as they used ineffective and power-consuming industrial technologies. It became clear that due to the price increase on energy the share of the cost of energy in the net cost of production had to increase from 7-10% that existed during the planned economy to 40-60%. Negative impacts of the transitional period penetrated in almost every sphere of the economy, but it had the most severe impact on the functioning of industrial and domestic sectors. Due to the rapid increase of market prices on energy most of the enterprises ceased their work and there were radical changes in domestic sector like abolition of the centralized system of supply of central heating and hot water. This situation resulted in damage to infrastructure, which is not restored even today.

Due to the abovementioned the procedure for working out fuel and energy balance was broken up. The problem of metering of the consumed energy became especially critical in the regions because of the tendencies for the theft of electricity and its unmetered consumption.

5.3 Degree of Accuracy of Energy Balance

Procedure for accounting energy resources is connected with the practical activity and commercial interests of all the branches of economy.

In contrast to operative accounting, commercial accounting is diversified and represents a basis for working out a database on the basis of proper functioning of several accounting instruments.

The project includes two types of data characterizing two different periods. The first belongs to the period of planned economy and the second is connected with the transitional period to market economy. During half a century of the planned economy there was not a high level of accuracy in accounting of energy carriers. The reason for it was low technical level of accounting facilities and the syndrome of a cheap energy. In the context of symbolic tariffs acting during the Soviet period all the attention was paid to the priority of wholesale accounting and the retail trade was characterized with symbolic accounting.

In 1990-ies when Georgia became independent all the sectors of the country faced acute problems connected with the energy and in the conditions of permanent import of primary energy there appeared a problem of accurate metering of the consumed energy. Despite the urgency of the problem, its implementation was delayed due to the simple reason connected with the old metering devices.

Problems exist in measuring of oil products and search of relevant information. Today free retail market of oil products are equipped with relevantly accurate measuring facilities but due to the absence of the cash registers and information channels it is difficult to receive precise information and form a database. Besides this technical conditions of measuring devices are not satisfactory. Gas meters operating in domestic sector are not equipped with temperature and pressure correction elements due to it actual expenditures at low temperature during autumn-winter period are not accurate. Despite it that there is not a high level of metering in power engineering metering procedures are better in this sphere. Due to the problems connected with the remetering nearly in all regions of Georgia there are many facts of metering fraud and illegal use of energy resources.

Periodic information obtained for the group working on the balance helped to improve the degree of accuracy. Therefore the degree of accuracy of the energy balance is not on the level of international standards, .

5.4 Transitional Period (1991-2000) Balances

Taking into account the above mentioned circumstances summary fuel-energy balances of the years of 1990, 1995 and 2000 are as follows (see Table 5.1)

Table 5.1
Fuel and Energy Balance of Georgia
(thousand tones, oil equivalent)

	Sector	1990	1995	2000	2000 in % compared to 1999
1	Production of Energy Resources, **Total**	1 499,0	580,0	880,0	58,7
	Including:				
	Hydro Energy	653,0	460,0	512,0	78,4
	Oil and associated gas	224,0	50,0	126,0	56,3
	Coal	398,0	20,0	7,0	1,8
	Others (wood, geothermal)	224,0	50,0	235,0	104,9
2	Import	13 000,0	921,0	1 419,0	10,9
3	Export	2 515,0	21,0	86,0	3,4
4	Expense from Reserves	-	80,0	-	-
5	Consumption, **Total**	11 752,0	1 560,0	1 852,0	15,8
6	Creation of Reserves	232,0	-	-	-

New market model of fuel-energy balance outwardly does not greatly differ from the model of the planned economy but there is a substantial difference between these two models by the content. According to international standards the new model is better and is associated with the market opportunities of power-consuming resources.

As distinct from previous years in 1990 consumption of energy resources dropped. Namely, in comparison with 1985 when the energy resources of the country reached 15, 4 million conditional tons, in 1990 its consumption decreased and equaled 11, 7 millions tons. At the same time local production of power resources which was quite insignificant even before dropped by 200 thousand tons; significantly decreased import at the expense of natural gas and oil products. By that period Georgian oil refining industry was still active and it was possible to export oil products in the amount of 2, 6 million tons.

In 1990 the complication of the situation in the industry sector could not yet be felt. Thus in 1990 the industrial sector of the country consumed 4030 thousand conditional tons of thermal resources.

Stability of other power parameters is noteworthy. Namely, energy conversion parameter in 1990 constituted 5, 48 million tons, which was demonstrated by the fact that the thermal stations generated 7, 6 billion kWh electricity and all the facilities of thermal generation generated 93, 8 thousand terajoules of thermal energy.

It is clear from the fuel-energy balance that since 1991 permanent crisis took place in the industry. This was caused by rapid increase of prices on fuel and energy resources, especially on primary fuel; it should also be noted that petroleum products and gas fuel which constituted basic resources of Georgian import increased in price 3, 5-5 times. But the income of the enterprises which produced commodity goods from these resources decreased instead of increase, due to it that the power-consuming enterprises engaged in production could not operate with full capacity and in the

changed economic conditions and produce competitive production. Georgian heat and power engineering enterprises decreased or practically stopped generation of electricity and thermal energy. Primarily hydroelectric generation stations were operating, and thus due to the complete stoppage of centralized heating system and deficiency of fuel for individual thermal generation facilities the population of the country was left without traditional sources of heating. Intensive use of electricity and wood for domestic needs and heating was very characteristic for this period; it was accompanied by irrational use of energy and intensive devastation of wood massifs.

As it can be seen from Table 5.1 production of power resources in Georgia in the years of 1990-2000 decreased by half and consumption reduced by 84, 2%. At the same time share of local resources in total consumption of power resources increased by 34, 7% (from 12, 8% it increased to 47, 5%). Local production decreased for all power resources: hydraulic energy by 21, 6%, oil and accompanying gas – by 43, 7%, coal – by 47, 5%. There was decrease also in export and import, the export decreased by 29, 2% and import - by 9, 2%.

Consumption of fuel and energy resources in Georgia in 1990-2000 decreased in all spheres of economy: in industry-11, 6 times, in communal economy-6, 1 times, in population-4, 0 times. In 2000 Georgia produced power resources only in the amount of 880 thousand ton of conditional fuel, among it 58, 2% comes on hydraulic energy and 14, 3%-on oil. The consumption constituted only 1852 thousand tons, from which the greatest amount (28, 6%) was consumed by the population, then by transport (23, 1%), on the third place industry (13, 3%) and on the fourth-communal services (11, 8%).

If we consider the year of 1990 as a starting period of economic reforms, when resources constituted 14,5 million conditional tons in annual fuel-energy balance (oil equivalent), for the year of 2000 this level decreased till 2,3 million tons, i.e. decrease amounted to 6,3 times during 10 year period. Quite noteworthy is the fact that production of local resources during the same period decreased from 1, 5 million tons till 0, 88 million tons; decrease is 2-fold. Despite it that during the mentioned year power engineering sector could not overcome the critical situation, its separate industries, notwithstanding the most critical situation, managed to function at the level of 75-77%. Namely, hydro electric generating stations generated 5, 9 billion kWhs of electricity in 2000 instead of 7, 6 billion kWhs in 1990.

At the beginning of economic reforms the crisis had already started in oil industry; the volume of oil production from 3 million tons in 1980 decreased till 186 thousand tons in 19990 and coal production appeared in the “depressive” situation and its production decreased from 1 million tons to 14 thousand tons.

Due to the existing situation there was a significant decrease in the import of primary fuel; namely, if in 1990 import came up to 13 million conditional resources, by 2000 import constituted only 1.4 million conditional tons and the export of power resources in the same period decreased from 2,5 million tons to 86 thousand tons. Till 1990 import of primary fuel according to the balance was about 7 million conditional raw oil and petroleum products, and the natural gas exceeded 4 million conditional tons.

In 1990 the share of local resources in the general consumption was only 13%, but by 2000 it increased up to 29%, though volume of local resources decreased almost twice.

During transition to market economy radical changes took place in the consumption structure. Namely, as it had been noted, industrial sector in 2000 decreased consumption of power resources 11,6 times in comparison with 1990; the same was the case with transport and agriculture they decreased consumption 2,3 and 5 times correspondingly. There was a significant decrease in consumption in a housing sector, where consumption has decreased 4 times, but it does not refer to electric energy. Electricity consumption in domestic and communal sectors has, on contrary, increased and it became the only resource for balancing the family energy basket.

During the years of independence the power balance of Georgia was even more deficient. It was especially true for the autumn-winter periods of 1990-1995. In the year of 2000 actual deficit of electricity in Georgia was 400 million kWh, whereas in 1990 it was 3204, 6 kWh, i.e. it decreased 8 times (see Table 5.2). Decrease of deficit was achieved through decrease of consumption which during 1990-2000 dropped 2, 2 times. In parallel to this process there was significant drop (almost two times) in electricity generation. This in turn caused forcible decrease in the consumption of electricity. In industry it decreased by 11, 5 times, in transport-about 4 times. The tendency is the same in agriculture (in 2000 annual consumption of electricity was only 7, 2 million kWh) and in construction (consumption of the year of 2000 was 9, 0 million kWh), etc.

During the period under investigation increase of electricity consumption was denoted only in the population. In 2000 population consumed 2,9 billion kWh of electricity, which constituted 37, 6% from the total consumption (including losses)

Table 5.2
Electricity Balance of Georgia (million kWh)

Electricity Balance of Georgia, million kWh					
Sectors	**1990**	**1995**	**1998**	**2000**	**2000 in % compared to 1999**
Production, total	14 245,7	7 082,0	8 088,4	7 446,5	52,3
Including:					
HPP	7 600,0	6 383,0	6 102,0	5 860,0	77,1
TPP	6 645,7	699,0	1 986,4	1 586,5	23,9
Import	4 373,6	754,1	810,4	599,5	13,7
Consumption (net)	14 807,0	5 843,6	7 677,8	7 013,3	47,4
Including:					
Industry	8 054,4	953,2	1 234,7	760,0	9,4
Agriculture	2 114,3	65,6	13,7	7,2	0,3
Construction	313,9	51,3	12,3	9,0	2,9
Transport	1 040,1	253,6	315,1	370,0	35,6
Other Sectors	1 711,5	2 115,6	3 155,1	2 767,1	161,7
Internal Services	1 572,8	2 404,3	2 946,9	3 100,0	197,1
Losses in the Network	2 643,3	1 992,5	1 101,2	828,1	31,3
Export	1 169,0	-	119,8	204,6	17,5
Deficit	3 204,6	754,1	690,6	394,9	12,3

During this year population consumed 2,6 times more electricity than industry, agriculture, transport and construction taken together. Such situation can not be considered to be normal.

Characteristic features for Georgia's electricity balance is relatively big "losses". In 1990 losses in general network came up to 2,6 billion kWh or 15,1% of the whole consumed energy in the country and 18, 6% of the generated electricity. "Losses" increased in consequent years and in 1994 they reached 31,1% and 35,4% correspondingly. Only in 1997 it became possible to decrease losses till 14,1% and 14,7%.

There were significant changes in export-import volumes of the electricity balance of Georgia. If in 1990 the amount of electricity received by import was 4,4 billion kWh, in 2000 it was 599,5 million kWh or it decreased by 7,3 times. There was decrease in the export of electricity: from 1169 to 204,6 million kWh i.e. 5,5 times. During the mentioned years (1990-2000) power balance of Georgia was permanently deficient, though its level decreased 10 times. But this is a visible deficit. In reality electricity deficit in Georgia is bigger and deeper. This also refers to the regions of the country.

As it is known Georgia is provided with electricity mainly done from Abkhazeti (Enguri hydroelectric generation station), Kvemo Kartli (Tbilsresi and RAO EES Mtkvari), from Imereti (Rioni, Tkibuli, Vartsikhe, Shaori, Gumati hydroelectric generation stations) and

Mtskheta-Mtianeti (Zhinvali hydroelectric generation station, etc). If we make analysis of the regional electric balances, we shall see that these regions are non-deficient in electricity. The same can be said about Samtskhe-Javakheti and Racha-Lechkhumi. Electric balances of other regions are mostly deficient. Such regions are: Adjara, Guria, Shida Kartli, Samegrelo-Zemo Svaneti, Kakheti, Kakheti, Tbilisi. This creates certain difficulties for their provision with electricity and power safety.

Due to the electricity deficit during this period it became necessary to import 792 million kWh electricity, mainly during autumn-winter periods, in spring and summer there was exported 537 million kWh electricity. Net consumption of electricity (except losses in network and self-consumption) came up to 3 752 million kWh, including 609 million kWh in industry (16,2% of the final consumption), in construction – 11 (0,3%), transport 298 (7,9%), agriculture – 1,0 (0,03%), household economies - 1060 (28,3%) and public-administrative sector-1 732 (46,2%) million kWh of electricity. As it can be seen main consumption of electricity comes on the latter, also very important is the share of household economies – 28,3%.

Electricity balance was relatively good in Tbilisi. During the period under analysis there was an attempt to provide 24 hour supply of the capital with electricity and 6-8 hour supply in the regions, but none of them could be carried out. Relatively it was impossible to supply enterprises with electricity.

During soviet years thermal energy supply was considerably better, generation of thermal power in 1990 was 25 300 thousand g.calory and during the period under consideration this parameter was 4,4 thousand g.calory, or 6,0 thousand less. During the year under discussion 1150 thousand cub.m primary and 4,4 thousand g. calory of secondary thermal energy was produced. Under primary thermal energy is understood natural thermal hot water (thermal water), and under secondary thermal energy-thermal energy generated by thermal stations. According to the Georgian Statistical Department by the end of the period under analysis within the total quantity of power generated in the country the share of primary thermal energy was only 0,43% and the secondary thermal energy-0,02%; as for their share in the final consumption of energy, it is as following: on the primary thermal energy comes – 0,3%, on the secondary thermal energy – 0,01%. As it can be seen the situation is critical also in this respect and it is unreal to speak about the power safety.

More detailed information on fuel and energy balances of Georgia are presented in the attachments.

5.5 Energy Balances for the Years 2001-2005

This five year period of the project is represented by the third stage of the balance period, which is considered to be an active period of transitional economy.

In 2001-2005 organizational measures were carried out in electric power engineering, after which operation of power engineering sector which at this stage is considered the only reliable and cheap source of energy generation in the energy sector of the country became more stable.

The model and standards for power engineering accounting accepted by the international statistics agency given in paragraph 5.4 created the basis for working out the present balance. The given document differs considerably from the analogical accounting and balance documents used during the planned economy period.

For energy balance of years 2001-2005 are used the same unit measures as for the previous paragraph (5.4):

1. Despite it that the oil materials and petroleum products caloricity is not absolutely unchangeable, their insignificant difference is not taken into account. Thus, caloricity content for all kinds of petroleum products is accepted to be 1000 ccal/kg, i.e. equivalent to conditional fuel.

2. Natural gas caloricity for imported gas in Georgia is 800-8050 ccal/cub.m, and the coefficient of its transfer to conditional unit in the balance is of 1,24 order, i.e. 1249 cub.m natural gas is equivalent to 1000 tons of conditional fuel.

3. For transfer of electricity into conditional units the well known formula of Joule-Lents is used, according to which heat given out by the current $\mathbf{Q=0.24I^2Rt}$ (1), the final formula is **Q=0.24Pt, P** is the capacity, **t** - time in seconds. Due to this 1 kWh electricity in conditional units is 860 ccal, or 1000 kWh which is equivalent to 86 kg of conditional fuel.

4. Conditional unit for firewood is 7.1 cub. m. which is equivalent to 1 tone of conditional fuel.

5. For transfer of the thermal energy (primary energy) and thousand tons of conditional fuel in tera-joules coefficient 41.868is used, i.e. 1000 tons of cf=4189.8tj.

6. Conversion factor for the coal produced in Georgia is 0.47, i.e. natural ton of coal=0.47 conditional fuel.

Summary energy balance for the years of 2001-2005 is given in Table 5.3

Table 5.3
Cumulative Fuel and Energy Balance of Georgia for the Years 2001-2005
(thousand tones of conditional fuel)

	Indicators	2001	2002	2003	2004	2005
1	Production of Energy Resources, **Total**	936,0	1 000,0	1 054,0	971,0	972,0
	Including:					
	Hydro Energy	479,0	580,0	561,0	507,0	522,0
	Oil and associated gas	131,0	87,0	155,0	106,0	79,0
	Coal	5,0	6,0	8,0	7,0	-
	Others (wood, geothermal)	321,0	327,0	330,0	351,0	371,0
2	Import	1 434,0	1 332,0	1 599,0	1 780,0	2 030,0
3	Export	117,0	77,0	131,0	84,0	74,0
4	Expense from Reserves	6,0	-	-	-	-
5	Consumption, **Total**	1 940,0	2 060,0	2 300,0	2 419,0	2 444,0
6	Creation of Reserves	-	-	5,0	2,0	2,0
7	Share of local resources in the consumption (%)	41,4	44,3	41,9	36,4	33,2
8	Deficit	1 323,0	1 255,0	1 464,0	1 694,0	1 954,0

As it can be seen from the Table during the mentioned period the balance was still deficient and it has grown. Namely, the local production of energy resources has increased by 3, 8%, consumption by 26%. As a result of this, total volume of deficiency increased by 47.7%. Respectively share of local resources in consumption has decreased by 8, 2%. Therefore the deficiency volume was still high-about 2 million conditional fuel and accordingly the amount of imported energy resources.

Below is given a discussion on the resources of energy balance of Georgia during 2001-2005. 2001-2005 indices of local production and production of energy carriers are given in Table 5.4 in natural quantities.

Table 5.4
Local Production of Energy Resources

Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thousand tones	10,6	12,7	17,0	14,9	0,0
Oil	thousand tones	98,7	74,3	139,8	97,6	67,3
Natural Gas	mln cub.m	39,7	16,1	18,6	9,9	14,9
Wood	thousand cub.m	2236,5	2264,9	2279,1	2428,2	2563,1
Nontraditional	thousand cub.m	63,9	59,7	62,5	66,4	69,1
Hydro Power	mln kWh	5571,5	6742,5	6527,9	5892,8	6070,0

As it can be seen from the Table the volume of local production is quite low and its main components are water power, wood and oil raw materials. As for the coal its resource potential is more than 400 million tons but due to the abovementioned reasons coal industry could not compete with hydro carbons and degraded. Coal production from ten thousand tons in 2001 has stopped in 2005; despite it that 5 joint oil companies set up together with foreign investors are operating in the country the situation with raw oil production is critical. The maximum figure of the balance period (139,8 tons in 2003) has dropped till 67 thousand tons in 2005.

It is well seen from the Table that due exactly to this fact the hydroelectric generation could not exceed 6,7 billion kWh. Though, even the mere rehabilitation of the existing capacity (and not technical upgrade) makes it possible to generate 8-9 billion kWhs of electricity in Georgian hydro power plants. It is well justified by the Table that the wooden resources hold the second place in local energy balance. Georgia is rich in forests, but some of the regions are poor in firewood and on the whole wood cutting volumes significantly exceed the norms permitted for wood cutting.

It is also quite alarming that due to the management of wood cutting valuable species of woods are used for firewood, there are many cases of unlawful cutting and seizures, which makes it real that forest massifs will disappear. Based on the unspecified statistical data received mainly on the basis of inquires, wood use in 2005 reached 2563 thousand cub, m and in comparison with 2001 use of wood has not decreased, but it has increased by 9%.

Due to financial destabilization there appeared some problems in the field of rational use of energy. Decrease of repair works facilitated increase of power losses. For fuel importer countries where market prices are growing rapidly, the problem of losses are very important, because 20-25% of the resources generated in the country and received through import do not actually reach the consumer.

Data on import for the years from 2001 up to 2005 are given in Table 5.5.

Table 5.5
Import of Energy Resources

Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thousand tones	4,3	6,4	6,4	4,3	6,4
Oil Products	thousand tones	680,4	694,1	708,9	731,2	745,8
Natural Gas	thousand cub.m	832,2	699,3	1 009,4	1 169,3	1 439,6
Electricity	mln kWh	877,6	713,2	844,3	1 210,0	1 399,0

The main resource of Georgia's import is oil products, as for coal and natural gas seasonal and imported resources of single use. The Table gives them in natural expression. The Table shows that the consumption rate is quite high. For example, import of petroleum products in 2005 in comparison with 2001 has increased by 10% and reached 745,8 thousand tons, and the volume of natural gas import has increased 1,7 times. Liquid gas is included in the oil products and its import is limited due to the high rate of VAT and ecsize payment on them.

The structure of conversion of primary energy into secondary energy is given in Table 5.6, which shows conversion of oil and natural gas into petrolium products and electricity.

Table 5.6
Energy Conversion

Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Oil	thousand tones	31,2	24,1	19,8	16,2	5,1
Oil Products	thousand tones	9,9	6,2	22,9	23,1	23,9
Natural Gas	thousand cub.m	429,1	197,2	215,8	270,3	229,4
Electricity	mln kWh	651,1	569,7	534,8	295,3	418,6

As it can be seen from the table, imported oil products, natural gas and electricity are basically used for conversion of primary energy into different types of energy, the volumes of which mainly covers autumn and winter months and the heating – connected to the hot water supply.

It should be also noted that the production of heat energy is decentralized and quite limited, so in the regions firewood and wastes are considered as the resources for heat energy generation.

Energy losses are reflected in the cumulative part of the balance as items – conversions and losses.

Energy Export in Georgia based on the existing potential of resources does not generate revenues. It is basically characterized with seasonality and often it means reimbursement of seasonal resources received from the neighboring countries in a natural form.

Table 5.7
Energy Export

Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thousand tones	-	6,2	4,2	2,1	-
Oil	thousand tones	70,1	51,8	117,9	80,2	61,1
Oil Products	thousand tones	2,1	1,1	1,9	3,1	2,9
Electricity	mln kWh	523,3	244,5	109,3	-	120,0

From Table 5.7 it is clear that coal export is quite modest and it covers only 3 year of balance period and since 2005 Georgia did not have coal for export. As for the oil raw materials it is distributed by producing joint enterprises according to the shares and its most part depends on export. Maximum export of oil came on 2003 with 118,0 thousand tons, though in following 2004-2005 years it decreased till 80 and 61 thousand tons.

The variability of the reserves of oil, coal, petroleum products and natural gas is foreseen by the balance: though in the conditions of constant deficiency of power it is not possible to use effectively small reserves.

Bunker reserves change in autumn and winter periods and in summer it is possible to fill them. But the potential for the use is quite restricted.

It should be noted that the reserves of petroleum products are mainly accumulated in Gardabani thermal stations, where 16 units of mazut reservoirs with 150 thousand tons of capacity are located.

Unfortunately the above mentioned reservoir is not actually used due to it that the condition of the fixed assets of thermal station is not good and they can't work normally on oil fuel; thermal electric stations work on natural gas and have no reserves.

The limits of the use of bunkers indicated in the balance are limited with the small volume reservoirs belonging to oil companies and the magistral gas pipeline is considered to be a bunker of natural gas.

In Table 5.8 is given the total primary energy structure according to the actual data of 2001-2005 economic years. It includes various petroleum products.

Table 5.8
Initial Resources of Primary Energy

	Name	Unit of Measure	Years				
			2001	2002	2003	2004	2005
1	Coal	Thous.Tones	14,9	15,1	17,0	17,1	6,4
2	Oil Products	Thous.Tones	673,1	690,3	702,0	727,8	729,8
	Including:	Thous.Tones					
2.1	Gasoline	Thous.Tones	282,8	289,9	294,9	305,8	310,5
2.2	Diesel Fuel	Thous.Tones	221,6	227,2	231,1	239,6	234,2
2.3	Kerosene	Thous.Tones	82,7	84,8	86,3	89,4	90,8
2.4	Liquid Gas	Thous.Tones	26,7	27,4	27,8	28,9	29,3
2.5	Naphtha	Thous.Tones	3,4	3,5	3,5	3,6	3,7
2.6	Aviation Fuel	Thous.Tones	12,8	13,2	13,4	13,9	14,1
2.7	Mazut	Thous.Tones	17,3	17,8	18,1	18,7	19,0
2.8	Lubricant	Thous.Tones	2,4	2,5	2,5	2,6	2,6
2.9	Bitumen	Thous.Tones	23,4	24,0	24,4	25,3	25,6
3	Natural Gas	mln cub.m	886,6	713,0	1 030,4	1 168,1	1 455,7
4	Nontraditional Energy (Thermal Waters)	thous. cub.m	63,9	59,7	62,5	66,4	69,1
5	Wood	thous. cub.m	2 236,5	2 264,9	2 279,1	2 428,2	2 563,1
6	Electricity	mln kWh	7 302,3	7 837,2	7 906,9	7 906,9	8 395,3
7	Thermal Energy	Tone Joule	1 717,9	1 592,2	1 759,8	1 466,5	1 592,2

Consumption of petrol and diesel fuel is mainly concentrated in the transport sector and their annual consumption constitutes 73% from the total consumption. The parameter of their use is very low, It is clear from the Table that in 2001-2005 volume of petroleum products consumed in Georgia, though with slow rates, but increased and from 673,1 thousand tons increased till 729,8 thousand tons (8,4%).

National economy of Georgia in 2001-2005 economic years through existing facilities of energy supply received all the resources in the quantities shown in Table 5.9 which afterwards was distributed to all categories of energy consumers.

Table 5.9
Distributed Energy Resources

Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	Thous.Tones	14,9	15,1	17,0	17,1	6,4
Oil Products	Thous.Tones	694,1	708,9	699,1	721,8	720,9
Natural Gas	mln cub.m	457,5	515,8	814,6	906,4	1 226,4
Nontraditional	thous. cub.m	63,9	59,7	62,5	66,4	69,1
Wood	thous. cub.m	2 236,5	2 264,9	2 279,1	2 428,2	2 563,1
Electricity	mln kWh	6 651,1	7 267,4	7 372,1	7 511,6	7 965,1
Thermal Energy	Tone Joule	1 590,0	1 590,0	1 730,0	1 465,0	1 590,0

Energy supply in 2001 summary energy balance (in conditional units) reached 1940 thousand tons, from which 694 thousand tons came on petroleum products, 348 thousand

tons on natural gas, 532 thousand tons on electricity, 315 thousand tons on firewood and on other types of fuel resources – 51 thousand tons of conditional fuel. In 2001 the primary resources reached 2259 thousand tons of conditional fuel, from which 319 thousand tons of conditional fuel was used for conversion. For 2005 the energy resource has increased significantly and reached 2926 thousand tons. So, the primary production in the five year period increased 1,29 times and energy provision 1,26 times, which indicates to considerable energy losses.

Energy Consumption by Sectors

Table 5.10 provides information on energy consumption according to separate sectors

Table 5.10
Energy Concumption by Sectors (thousand tones ofconditional fuel/%)

Years	Energy Supply	Industry	Transport	Agriculture	Services	Population	Others
2001	1940	264	456	101	100	855	164
	100	13.6	23.5	5.2	5.1	44.2	8.4
2002	2060	283	470	106	107	914	180
	100	13.8	22.8	5.1	5.2	44.4	8.7
2003	2300	307	466	158	123	956	290
	100	13.4	20.3	6.9	5.3	41.5	12.6
2004	2419	337	491	164	123	1007	297
	100	13.9	20.3	6.8	5.2	41.6	12.2
2005	2444	352	493	167	132	1035	265
	100	14.4	20.3	6.8	5.4	42.3	10.8

As it can be seen from Table 5.10 supply (consumption) of energy during the period under consideration increased by 26%. The rate of increase is especially high in agriculture (65,3 %). In industry and domestic sectors the rate is approximately equal - 33,3% and 21%. In transport sector it on average increased only by 8%; in this respect comparatively high rate is observed in aviation and maritime transport (27%). As for the domestic-communal service, it has increased by 32%.

Orientation of the economy of the country towards market economy significantly changed volumes of energy consumption in all the spheres of economy, though during last years there were not substantial changes in the structure of consumption of energy carriers. Petroleum products are still considered to be priority resources, share of which in general consumption comes to 90%, though summary volumes of energy consumption are significantly behind the historical level of consumption.

Industrial sector (metallurgy, mining industry, chemical enterprises, machine building, etc) is considered to be the major consumer of energy at all stages of planned economy.

The situation has radically changed in new conditions. According to the data of balance years relatively high level of energy consumption was denoted on transport, domestic-communal sector, where the historical level of energy consumption was maintained.

In comparison with other consumers consumption of petroleum products is more stable in transport sector and the demand on electricity is significantly high in communal and service spheres.

Unfortunately in all the sectors of industry appeared digressive processes. The situation was especially difficult for big energy consuming enterprises, the majority of which are either stopped or are functioning at very low capacities.

In this part of the balance is given a sectoral structure of the distribution of petroleum products, natural gas and electricity in natural and conditional units. The attached tables show the classification of natural economy charges according to sectoral classifiers. It is clear from the tables that rates of increase of energy consumption during 2001-2005 economic years are significantly low. It indicates to the existence of sharp problems in the economy sphere besides the difficulties caused by energy crisis.

Consumption of electricity, petroleum products and natural gas according to the sectors is given below.

a) Oil Products

As it has been mentioned this part of energy balance is represented by several tables where energy consumers of the national economy are differentiated according to the industrial, transport and other sectors and non-energy consumers.

The industrial sphere includes: metallurgical enterprises, chemistry and petrochemical objects, non-metal enterprises and all the others, among them small enterprises. This sort of classifier is used by the International Statistical Agency due to it that the sequence of these enterprises is in relevance with their power consumption. According to the attachments and summary balances, in 2001 economic year 680 thousand tons of conditional fuel raw material was imported to Georgia. 694 thousand tons of petroleum products were supplied to the national economy after processing and conversion. From this amount the industry used 91 thousand tons, transport 402 thousand tons, 201 thousand tons of fuel was consumed by other enterprises and used for non-power needs. Thus the industry has consumed almost twice less petroleum products than transport.

It should also be noted that in 2001 the auto transport used 360 thousand ton of petrol and diesel fuel, which indicates to non-adequate development of the transport fleet.

According to the 2001 data of State Statistic Department of Georgia, the turnover of all types of general transport was 5077,3 million ton km, among it on railway comes 4480,6 million ton km, and on automobile transport – 530 million ton km. The rest - 76,7 – on maritime and air transport.

As for the car fleet registered by that periods it comprised only of 391, 6 thousand units of transport means. Among them 47 thousand trucks, 22,7 thousand buses, 21 thousand special transport units and 247,8 motor cars.

According to the analytical evaluation of the interrogated experts, energy consumption in transport is quite high and if we take into account that the actual costs are higher than the

declared ones, it will be clear that the transport fleet of Georgia is characterized with low efficiency.

It should also be noted that the data from the tables of consequent period do not differ significantly from previous year information and indicates to the existence of deep problems in all the sectors of national economy.

b) Natural Gas

Sectoral distribution of the natural gas is given separately for all the years of the balance period (see attachments). As it has been mentioned for unit measure in these tables are used natural unit m^3 and conditional unit ton. (1 ton =1240 m3, coefficient 1,24). As it can be seen from the balance of the previous period the big consumer of gas energy was heavy industry (power sector, metallurgy, chemistry). At present the only distinguished consumer of the gas resource is the energy sector, though even here the consumption volumes are considerably decreased and the highest rate of gas consumption comes mainly on autumn-winter seasons.

Comments on petroleum products refer only to 2001 due to it that the data of consequent years do not significantly differ from this year and it is easy to understand them.

In 2001 the resource basis of the natural gas came up to 714 thousand tons of conditional fuel-886 million m^3 (see the cummulative balance), in which the share of local production is only 32 thousand conditional fuel. The significant amount of natural gas was needed for energy conversion and compensation of losses – 367 thousand tons, and to all other category of consumers were supplies 348 thousand tons of conditional fuel. The share of industry in the consumption of this share was thousand tons or 10,5% of the total resources. As for the population, annual consumption of gas was 120 thousand tons of conditional fuel. It should be taken into account that the only big consumer was represented by Rustavi azot fertilizers production, but the factory uses natural gas as a resource for production of ammonia. The non-energy consumption of natural gas in 2001 constituted 84 thousand conditional fuel. 2001 summary balance (N 23 column “no energy”) shows consumption for rehabilitation of natural gas economy and infrastructure and expansion of its consumption, it has a strategic importance for the country and the rate of economic upgrade of the country greatly depends on gas as well as the gasification of the sector which has a social significance as well.

As it is made clear from next Tables, despite it that the different problems are connected with the import of gas (economic situation, policy, social situation, etc) its expansion is an irreversible process.

For 2005 gas consumption reached 1174 thousand tons of conditional fuel and actually increased 1,64 times, though it had been unevenly redistributed among the sectors. As for example, conversion costs increased by 36% and other sectors consumption by 93 per cent, which indicates to the fact that in critical situation it is better to expand direct consumption of natural gas than use the electricity received from it as a thermal energy. More detailed data on the natural gas are reflected in the relevant summary tables (see attachments).

c) Electricity

As it has already been mentioned Georgian power engineering sector has a lot of sharp and unresolved problems that are mainly connected with the situation in electricity consumer market. Electricity consumer's categories in Georgia, like in other countries, are varied (diverse), though it was not possible to satisfy the demand of the consumer market. Unfortunately, in the category of main consumers of electricity we have a case of negative changes due to it that the formation of energy market into free and regulated market is accompanied by deviation of proportions of prices. As for example, during balance period on the free market of energy resources (petroleum products, among them liquefied gas, solid fuel, etc) retail tariff was 2,5-3 times more than on the equal caloricity and alternative regulated market resources (natural gas, electricity). As a result of this the main resource of domestic household is the natural gas and electricity. Due to it that on the regulated market the main operator is a state it became more comfortable to exercise influence on it than purchase expensive resources on free market.

Main reason for such disproportion of prices is irrelevant tax system, as a result of which for domestic thermal energy production are not used kerosene, diesel fuel and fire fuel. There are many cases when for heating and getting hot water electricity is used (see graphs of price formation in the attachments).

For example, in 2001 economic year the summary resource of electricity in Georgia reaches 6,94 million kWh and with the exclusion of conversion 6,18 million kWh was distributed. The main consumer of electricity was domestic sector -67,7 %, which does not allow making comparison with analogies in other countries. The share of industry in this balance is quite small and has not changed significantly during last 5 year period (from 1,023 billion kWh to 1,220 billion kWh). Among the industrial branches given in 2001 electricity balance, the biggest electricity consumer is Zestaphoni ferro-alloy factory, also Rustavi mineral fertilizers factory (232 million kWh). In the present summary part of the balance network losses of electricity are given in the energy conversion part and losses in the distribution network are foreseen in the charges. Like petroleum products and natural gas sectoral structure of electricity according to the years are given in attachments.

As a summary form Georgian electricity balance of 2001-2005 is as follows (see Table 5.11)

Table 5.11
Electricity Balance of Georgia for the years 2000-2005 (million kWhs)

Indicators	2000	2001	2002	2003	2004	2005
Production, total	7 446,0	6 942,0	7 256,0	7 163,0	6 706,0	7 100,0
HPP	5 905,6	5 571,5	6 742,5	6 527,9	5 892,8	6 070,0
TPP	1 540,4	1 370,5	513,5	635,1	813,2	1 030,6
Import	611,5	877,6	713,2	844,2	1 210,0	1 399,0
Export	210,5	523,3	244,5	109,3	-	120,0
Consumption	7 847,0	7 296,3	7 724,7	7 898,0	7 916,0	8 379,0
Deficit	401,0	354,3	468,7	735,0	1 210,0	1 279,0

The characteristic tendency of the modern electricity balance of Georgia is to satisfy the growing demand on energy not with the increase of local production, but with imported

energy. As it is seen from the Table volume of import during separate years increased systematically and from 611,5 million kWh in 2000 reached 1399 million kWh in 2005, or it has increased almost 2,3 times. Such increase takes place in the situation when the capacities of existing hydroelectric stations are not fully used and most of them decreased electricity generation. Despite great efforts it is not possible to carry out rehabilitation works on the power engineering objects.

Due to the mentioned reasons electrification indicators of the country are low.

It can be seen from the Table that in 2005 in comparison with 2000 generation of electricity has decreased by 4,6%, it increased on hydroelectric power plants by 2,8% and in thermal stations it decreased by 1,5 times. Electricity consumption increased by 6, 8% and the deficit by 3,2 times. There is a decrease tendency in electricity export and the import increased by 2,3 times.

The modern energy balance of Georgia greatly differs from the last century balance, namely, from 1980-1990 electricity balance when the energy resources were spent wastefully. Introduction of market economy principles changed the affairs in all the spheres and among them in electricity power generation. In the conditions of limited resources the economical consumption regime is even more important; this affected the energy balance as well.

Regional Consumption of Energy Resources

Taking into account the fact that in the market economy conditions the structures that are in economy complex are not managed vertically and the separate regions of the country are formed as independent economic units regional distribution and consumption of energy resources are one of the priority issues.

The administrative model of the territory of Georgia includes 9 regions, Tbilisi with its regions and three autonomous territories, in two autonomous territories there is no Georgian jurisdiction at present (Table N 5.12). The Table gives also data on the quantity of regional population according to 2002 census.

As it can be seen from this data Tbilisi is a big regional unit where there is a great majority of the population of the country and it is the big consumer of energy. As for the regions, the biggest regions regarding number of population is Imereti, Kvemo Kartli, Samegrelo Zamo Svaneti, Kakheti and Adjara.

The regional balance showed problems connected with the deviation of energy consumption proportions, due to the limits on energy supply on the energy market.

Table 5.12
Regional Structure within the Current (2005) Jurisdiction of Georgia

	Region	Population, thousand persons	Administrative Region
1	Tbilisi	1 081,7	Vake-Saburtalo, Gldani-Nadzaladevi, Didube-ChugureTi, Mtatsminda-Krtsanisi, Isani-Samgori
2	Imereti	699,6	Kutaisi, Tskaltubo, Khoni, Bagdati, Tkibuli, Vani, Samtredia, Zestaponi, Terjola, Kharagauli, Sachkhere, Chiatura
3	Guria	143,4	Ozurgeti, Lanchkhuti, Chokhatauri
4	Samegrelo-Zemo Svaneti	466,1	Poti, Zugdidi, Tsalenjikha, Chkhorotsku, Mestia, Senaki, Abasha, Martvili, Khobi
5	Racha-Lechkhumi, Kvemo Zvaneti	50,9	Ambrolauri, Oni, Tsageri, Lentekhi
6	Shida Kartli	314,0	Gori, Khashuri, Kareli, Kaspi
7	Kvemo Kartli	497,8	Rustavi, Gardabani, Marneuli, Bolnisi, Dmanisi, Tsalka, Tetritskaro
8	Kakheti	407,2	Gurjaani, Signagi, Dedoplistskaro, Telavi, Sagarejo, Akhmeta, Kvareli, Lagodekhi
9	Samtskhe-Javakheti	207,9	Akhaltsikhe, Akhalkalaki, Ninotsminda, Aspindza, Adigeni, Borjomi
10	Mtskheta-Tianeti	125,4	Mtskheta, Dusheti, Kazbegi, Tianeti, Akhalgori
11	Ajara	376,1	Batumi, Kobuleti, Khulo, Shuakhevi, Keda, Khelvachauri
	Total Georgia	4 370,1	

Below are given regional consumption data on petroleum products, natural gas and electricity.

a) Petroleum Products

Consumption of petroleum products in the regions means redistribution of existing resources among territorial units during the balance period, but this sort of balance is possible only for big regions, as for the districts included in the big regions, there is no data on them at present. The comments refer to 2001, which is easily understandable for following years with the help of indicated tables given in the attachments. From this data it is clear that in 2001 economic year in Georgia was imported 680 thousand tons of petroleum products and 674,8 thousand tons were distributed in the regions, among them: petrol-282,8; diesel-221,6; kerosene-95,5; mazut-17,3; liquefied gas-26,7 and others-30,9 thousand tons.

Petroleum products include conversion costs as well. The biggest consumer is Tbilisi with its regional division (134, 1 thousand tons). It is clear from the Table that the rate of increase in the consumption of petroleum products is not high, but still it is noticeable. During the balance 5 year period demand of Georgia on petroleum products from 674

thousand tons in 2001 has increased to 741,2 thousand tons in 2005 i.e. it increased by 9,8%. The main consumers of light petroleum products are auto transport (petrol, diesel, oils). The quantity of it systematically increases. It should also be noted that the maintaining of natural gas retail price on a low level significantly expedited development of auto fleet working on the gas.

b) Natural gas

The attachments show dynamics of the consumption of natural gas over the years in the regions, as for the distribution of gas according to the quarters, data of 2005 is given, from which it is clear that the consumption of gas has a seasonal character. Namely, in the I quarter of 2005 consumption constituted 44,5% from the annual consumption and in IV-29%, which indicates to the seasonal character of the consumption.

It is clear from the Table that the biggest consumer is Kvemo Kartli region, where there are electricity generation facilities (Gardabani) and the second big consumer of gas is Tbilisi, volume of consumption of which in 2001-2005 increased from 180, 4 million m^3 to 422,3 million m^3 (2,34 times), as for the big power consumers, its consumption volumes during the same period increased only by 11,5%, which indicates to the non-use of the capacities of thermal electric stations. Gas consumption in other regions is significantly small.

Unfortunately, development of natural gas network is significantly limited and the majority of districts of these regions are devoid of any possibility to receive gas supply. The level of gasification is especially low in West Georgia, Meskhet-Javakheti and in Abkhazeti there is no gas supply at all. Georgia has not its own gas resources and it is oriented towards import.

c) Electricity

Regional balance of electricity in 2001-2005 is given in the attached tables, where for all tables are characterized consumption concentration during autumn-winter period and big consumers are Tbilisi with its regional units (2,36-2,27 million kWh). It is clear from the regional distribution tables that the level of consumption during past 5 years has changed insignificantly.

Relative stability of electricity consumption, as it had been said, is regulated through organizational measures and not by market principles: according to the data of 2005 economic year, electricity summary loss made 31,2%, among them normative loss was 12,5% and above the norm or the so called commercial-18,7%. So, without establishing due order in electricity retail market rehabilitation of the sector, its upgrade and investment attraction is very problematic.

Detailed information on the fuel and power balance of Georgia in 2001-2005 can be found in the attached tables.

6. CONCLUSIONS

Study of energy balance of Georgia is the objective of the presented report. For this purpose development of entire fuel and energy complex is analyzed for the last 50 years. It covers actual parameters for 45 years including soviet period (years 1960-1990) and years of independence (years 1991-2005).

For this period of time the development of all areas of the complex (power sector, coal, oil and gas industry, nontraditional sources of energy), its resource potential and prospective to explore are described in detail. Production rates and volumes of energy resources are compared to the consumption of entire country as wells as of specific regions. The analysis is done for each type of energy resource and according to the specific branches of the sector. Export and import volumes for energy carriers, the level of meeting demand of the country with local resources and its dynamics are also presented within this report.

The study demonstrated that fuel and energy balance in Georgia for the period starting from 1960 up to 2005 was always negative. For specific years, demand of the country was met with local production resources as follows (in %): 1960 – 31,2%; 1970 – 14,6%; 1980 – 46,2%; 1990 – 10,2%; 1995 – 37,2%; 2000 – 47,5% and 2005 – 33,2%. This parameter is expected to be increased up to 46,2% by the year 2010. The deficit in terms of absolute as well as relative values was especially large in the soviet period. For the period from 1960 to 1990 it amounted to 5-10 million tones of conditional fuel, and during the years of independency – 1,0-1,5 million tones of conditional fuel, which, it is obvious, was recovered through imports. Out of different types of energy the balance for natural gas was always negative. Negative balance was smaller for oil products compared to natural gas and even smaller for the electricity. At the same time there were years when country used to experience surplus of electricity. During the soviet years (1960-1990) consumption of fuel and energy resources was increased 2,6 times, while their production decreased 15,2%. It resulted in a larger deficit, which was basically conditioned with the irrational and inefficient use of fuel and energy resources.

Based on the above mentioned, it may be concluded that although the Georgian economy was always energy import oriented during the soviet period, country was not experiencing different economic and social problems associated with the energy deficit. The reason for which was that most of vertically managed and energy-intensive enterprises were supplied with energy resources by means of vertically managed channels and funds. Relatively the government of Georgia actually was not responsible for stopped industrial enterprises. Especially cheap energy mentality existed during the whole period of planned economy played a negative role in the development of the sector. Georgia was not interested to explore and develop local production of energy, which is clearly illustrated in the energy balance developed on each stage within the soviet period.

Dynamics of energy production and consumption in Georgia for the years 1960-2005 is presented in the table 6.1.

Table6.1
Dynamics of Energy Production and Consumption in Georgia for the Years 1960-2005

	Energy Resources	Unit of Measure (coal equivalent)	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
1	Local production in natural units											
	Coal	thous. tones	2 850	2 621	2 298	2 050	1 860	1 674	955	43	7	-
	Oil	thous. tones	34	30	24	261	3 186	522	186	43	110	67
	Associated gas	million cub.m	-	-	-	35	280	70	60	-	20	15
	Hydro power	million kWh	2 223	2 792	2 642	2 564	6 410	6 243	7 600	6 383	5 953	6 070
	Wood and wastes	thous. cub.m	710	912	525	462	441	419	397	1 590	1 669	2 563
2	Local production in conditional units	thous. tones of cond. fuel	1 529	1 498	1 290	1 435	4 805	1 877	1 345	819	880	972
	Coal	thous. tones of cond. fuel	1 197	1 100	965	861	781	703	401	17	3	-
	Oil	thous. tones of cond. fuel	34	30	24	261	3 186	522	186	43	110	67
	Associated gas	thous. tones of cond. fuel	-	-	-	28	225	56	48	-	16	12
	Hydro power	thous. tones of cond. fuel	191	240	227	220	551	537	654	549	512	522
	Wood and wastes	thous. tones of cond. fuel	107	128	74	65	62	59	56	210	239	371
3	Net import	thous. tones of cond. fuel in natural units	3 588	4 911	6 438	8 558	5 638	10 130	11 890	1 153	1 330	1 954
4	Consumption	thous. tones of cond. fuel in natural units	5 117	6 409	7 728	9 993	10 443	12 007	13 235	1 972	2 210	2 926

During the years of independency, if the data obtained from the research done in 2001 is ignored; we might say that the fuel and energy balance was not developed at all for the entire country. This gap in data was at some extent recovered by the authors of the report. In particular, while developing balance and in the process of creation of a database for the study, different types of informational and analytical materials, as well as expert evaluations and other types of reports were used and analyzed. Such data exists in some factories and organizations, energy facilities and department of statistics. The accuracy of available data was verified by the authors based on the operation data of energy-intensive enterprise. Different surveys and experiments were held etc.

Analysis of above mentioned materials showed that for the transitional period (years 1991-1995) energy production as well as consumption in Georgia was characterized with the decreasing trend. But for the following period (years 1996-2005) this parameters started increasing. Particularly, energy production for the period from 1991 to 1995 was reduced 2,6 times, and the consumption – 7,3 times, while these parameters were increased by 67,6% and 51,4% relatively for the period from 1996 to 2005. So, for the recent period of time tendency of gradually decreasing deficit is evident.

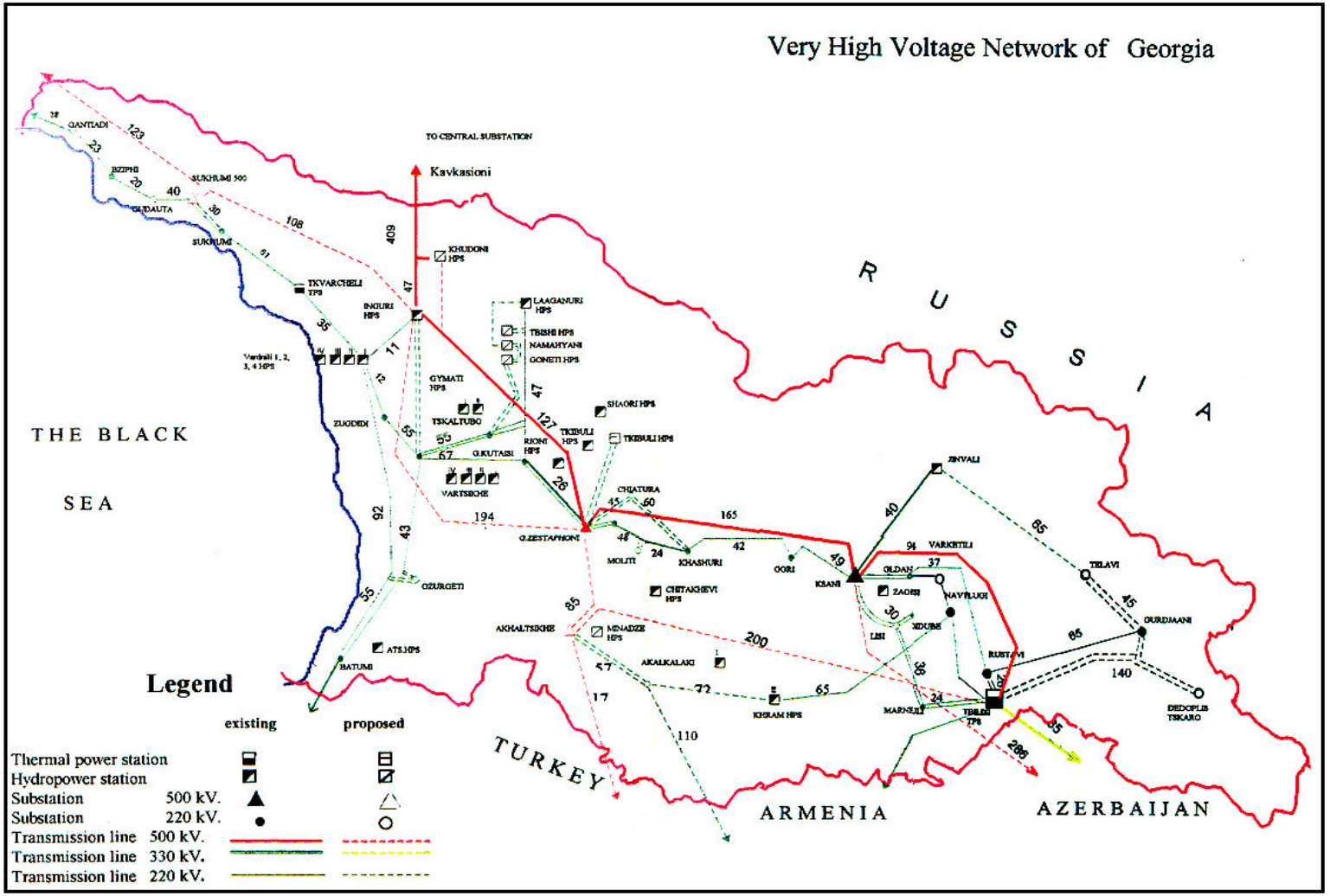
Detailed values of fuel and energy resources produced and consumed in Georgia are presented in the study as totals for the entire country as well as separately for the regions. Energy consumption is presented by types of energy and different sectors within the economy etc.

Authors believe that the Department of Statistics of Georgia needs to start developing fuel and energy balances, as before, for the country in compliance with international standards. This report may serve as a good guideline in this case.

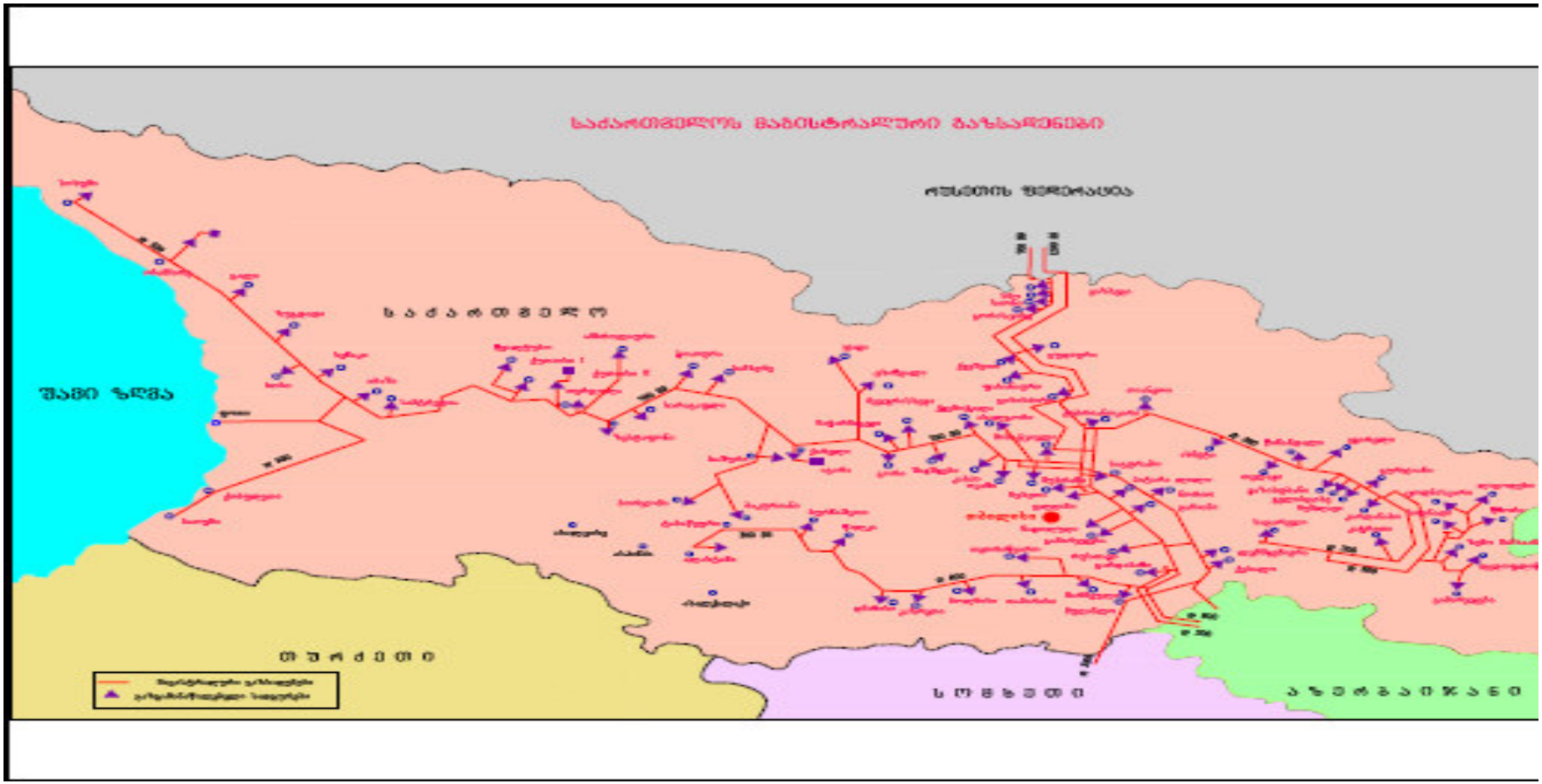
7. ANNEXES

7.1 Maps

7.1.1 High Voltage Network of Georgia (220-500 KV)



7.1.2 Main Gas Pipelines of Geogria



7.2 Tables

7.2.1 Soviet Period (Years 1960-1990)

Table 1
Fuel Resources of Georgia (thousand tones of conditional fuel)

Name	1965	1970	1975	1980
Resources, total	12 841	15 777	26 938	20 847
Out of which:				
Natural Fuel Resources	8 991	9 620	16 418	13 687
Including:				
Oil	4 363	5 131	6 804	7 175
Gas	1 742	2 256	7 499	4 415
Coal	2 682	2 076	1 985	1 976
Wood	195	147	125	114
Others	9	10	5	7
Fuel Processing Products	3 565	5 833	10 271	6 944
Including:				
Metallurgical Coke	57	271	314	203
Fuel Mazut	755	2 426	2 115	2 230
Fleet Mazut	265	290	2 101	1 282
Diesel fuel	1 658	773	3 892	1 698
Engine fuel	31	28	194	37
Automobile fuel	574	704	928	836
Kerosene	170	1 181	451	399
Aviation gasoline	23	65	59	39
Liquid gas	32	95	217	220
Associated energy resources, total	285	324	249	216

Table 2
Consumption of Fuel Resources in Georgia by Sectors (thousand tones of conditional fuel)

Name	1970	1975	1980
Total	10 386,1	16 301,3	13 719,1
Including:			
Industry	7 647,5	11 570,5	8 400,4
Agriculture	239,6	588,5	767,5
Transport	846,2	1 435,2	1 458,7
Construction	301,1	471,7	289,1
Household Services	872,6	1 524,1	2 290,4
Others	479,1	711,3	513,0

Table 3
Electricity Consumption by Sectors (million kWh)

Name	1970	1975	1980	1985	1990
Total	8 915,0	11 588,0	13 944,0	16 758,0	17 450,3
Including					
Industry	6 153,0	7 868,0	9 147,0	10 773,0	106 977,0
Agriculture	437,0	602,0	1 108,0	1 447,0	2 114,3
Transport	587,0	756,0	819,0	1 047,0	1 040,1
Construction	255,0	283,0	355,0	432,0	313,9
Household Services	885,0	1 333,0	1 770,0	2 223,0	2 315,1
Others	598,0	746,0	750,0	836,0	969,2

Table 4
Fuel and Energy Balances of Regions of Georgia for the year 1980 (thousand tones of conditional fuel)

Name	Tbilisi	Abkhazia	Ajara	South Osetia
Resources, total	7 877,6	1 763,0	9 516,2	107,1
Fuel production (exploration)	4 890,0	223,7	3,2	_
Hydro Power Sector	9,3	465,6	10,0	0,3
Thermal Waters	13,2	0,6	_	0,6
Import, total	2 884,4	967,1	9 326,2	101,5
Out of which:				
From the regions of the republic	1 842,4	130,6	4 400,8	76,1
From other republics	1 042,0	836,5	4 925,4	25,4
Others	2,4	_	0,5	0,5
Balance at the beginning of the year	78,3	106,0	176,3	4,2
Distribution, total	7 877,6	1 763,0	9 516,2	106,8
Consumed, total	2 970,7	984,2	1 476,0	102,1
Including:				
On electricity generation	34,1	763,5	28,3	0,4
On thermal energy generation	1 194,3	121,2	303,6	17,9
Other Cost	1 742,3	99,5	1 144,1	83,8
Import, total	4 770,6	670,8	7 784,5	0,0
Out of which:				
To the regions of the Republic	4 608,5	670,8	2 582,9	_
To other Republics	162,1	_	5 201,6	_
Balance at the end of the year	136,3	108,0	255,7	4,7

Table 5
Fuel and Energy Resources of the Regions of Georgia for the year 1980 (thousand tones of conditional fuel)

Resources	Tbilisi	Abkhazia	Achara	South
Total	7 875,2	1 763,0	9 511,9	106,6
Including:				
Natural fuel and energy resources, total	6 211,4	1 172,2	6 990,2	34,8
Out of which:				
Coal	129,9	695,8	9,1	12,1
Oil	4 563,9	_	6 971,1	_
Wood	5,2	10,2	_	1,5
Natural Gas	1 489,9	_	_	20,3
Hydro energy	9,3	465,6	10,0	0,3
Thermal waters	13,2	0,6	_	0,6
Others	0,0	0,0	0,0	0,0
Fuel Processing products	1 359,1	590,8	2 486,9	61,4
Out of which:				
Coal, peat processing products	10,1	0,3	1,9	_
Oil processing products	1 342,5	549,3	2 452,2	54,6
Liquid gas	6,5	41,2	32,8	6,8
Imported electricity	304,7	_	34,8	10,4

Table 6
Thermal Energy Consumption in the Regions of Georgia by Sectors for the year 1980 (thousand gigacalories)

Sectors	Tbilisi	Abkhazia	Achara	South Osetia
Total for Public Economy	6 130,8	611,2	1 231,8	103,1
Including:				
Industry	2 440,0	370,5	949,5	45,2
Agriculture	10,7	47,8	16,9	8,7
Transport	42,9	1,2	0,4	-
Construction	53,3	13,6	1,5	0,1
Household Services	3 034,6	137,2	137,8	40,4
Others	549,3	40,9	125,7	8,7

Table 7
Electricity Consumption in the Regions of Georgia by Sectors for the year 1980 (million kWh)

Sectors	Tbilisi	Abkhazia	Achara	South Osetia
Total for Public Economy	2 629,7	927,8	418,4	87,1
Including:				
Industry	900,3	397,1	202,1	43,6
Agriculture	6,2	63,7	32,7	10,6
Transport	360,9	156,7	80,3	1,3
Construction	72,3	29,7	5,3	3,2
Household Services	664,7	150,1	21,4	8,6
Others	625,3	130,5	76,6	19,8

Table 8
Consumption of Fuel Resources in the Regions of Georgia by Sectors for the year 1980 (thousand tones of conditional fuel)

Sectors	Tbilisi	Abkhazia	Achara	South Osetia
Total for Public Economy	2 643,5	947,4	1 176,0	90,9
Including:				
Industry	715,7	515,1	514,6	18,0
Agriculture	3,9	59,5	24,5	15,8
Transport	477,7	165,6	276,5	14,5
Construction	1 137,8	135,2	244,2	31,1
Household Services	134,0	21,5	4,0	5,2
Others	174,4	50,5	112,2	6,3

Table 9
Consumption of Fuel and Energy Resources in South Osetia by types for the year 1980

Types of Fuel	Unit of Measure	Total	Including		
			Material Production	Household Sector	Other sectors
Coal	thousand tones	16,3	3,1	12,7	0,5
Wood	thousand tones	4,3	0,6	2,5	1,2
Natural Gas	million cub.m	8,2	0,8	7,4	-
Fuel Mazut	thousand tones	2,2	2,2	-	-
Diesel Fuel	thousand tones	7,6	7,4	0,1	0,1
Automobile Gasoline	thousand tones	19,6	16,9	2,7	-
Kerosene	thousand tones	1,0	-	1,0	-
Liquid Gas	thousand tones	3,2	0,6	2,6	-

Table 10
Consumption of Fuel and Energy Resources in Achara by types for the year 1980

Types of Fuel	Unit of Measure	Total	Including		
			Material Production	Household Sector	Other sectors
Coal	thousand tones	10,2	2,0	6,0	2,2
Wood	thousand tones	11,2	1,6	4,8	4,8
Metallurgical coke	million cub.m M	1,1	1,1	-	-
Fuel Mazut	thousand tones	121,6	106,8	12,6	2,2
Diesel Fuel	thousand tones	50,5	50,2	-	0,3
Automobile Gasoline	thousand tones	44,7	43,8	-	0,9
Kerosene	thousand tones	8,9	0,1	8,8	-

Table 11
Consumption of Fuel and Energy Resources in South Osetia by types for the year 1980

Types of Fuel	Unit of Measure	Total	Including		
			Material Production	Household Sector	Other sectors
Coal	thousand tones	56,7	12,1	41,7	2,9
Wood	thousand tones	18,5	6,9	10,4	1,2
Metallurgical coke	million cub.m M	0,2	0,2	_	_
Fuel Mazut	thousand tones	34,8	26,0	7,0	1,8
Diesel Fuel	thousand tones	40,9	39,9	0,5	0,5
Automobile Gasoline	thousand tones	103,5	79,7	23,7	0,1
Kerosene	thousand tones	60,7	54,4	6,3	_

Table 12
Consumption of Fuel and Energy Resources in Tbilisi by types for the year 1980

Types of Fuel	Unit of Measure	Total	Including		
			Material Production	Household Sector	Other sectors
Coal	thousand tones	25,7	4,3	19,8	1,6
Wood	thousand tones	12,0	5,6	5,6	0,8
Natural gas	million cub.m	412,7	85,0	321,1	6,6
Fuel Mazut	thousand tones	19,8	18,1	0,2	1,5
Automobile Gasoline	thousand tones	263,4	197,5	65,7	0,2
Kerosene	thousand tones	137,9	133,5	4,3	0,1
Diesel Fuel	thousand tones	102,0	101,1	0,3	0,6

Table 13
Fuel Consumption in the Sphere of Economy in Georgia

Name	Unit of measure	Years	Total	Including:					
				Industry	Construction	Agriculture	Transport	Household Sector	Other Sectors
Natural Gas	million cub.m	1965	1 489,2	1 264,1	32,5	0,5	0,2	77,5	114,4
		1970	1 928,3	1 504,4	39,3	1,0	8,0	289,0	86,6
		1975	5 811,9	4 831,5	44,8	17,2	6,0	668,3	244,1
		1980	3 492,8	2 226,5	2,4	61,6	176,2	978,5	47,6
Coal	thousand tones	1965	3 392,7	2 935,5	38,3	28,0	21,2	149,9	219,8
		1970	2 764,9	2 235,4	15,4	12,0	170,6	170,6	160,9
		1975	2 225,0	1 790,6	38,9	22,6	100,3	100,3	172,3
		1980	2 393,3	1 926,5	32,5	12,4	151,7	151,7	118,5
Wood	thousand cub.m	1965	621,2	88,6	16,2	167,1	14,9	170,6	163,8
		1970	432,2	46,7	7,0	30,7	4,7	166,3	176,8
		1975	290,7	65,8	12,2	57,5	2,4	55,7	97,1
		1980	356,6	173,0	0,7	45,6	0,6	44,7	92,0
Fuel Mazut	thousand tones	1965	1 189,7	928,1	24,1	1,4	190,0	7,0	39,1
		1970	2 390,9	2 254,5	21,6	4,7	63,5	14,3	32,3
		1975	2 538,6	2 320,4	55,3	35,1	40,8	27,5	59,5
		1980	3 002,3	2 690,4	16,9	47,3	42,3	106,9	98,5
Diesel Fuel	thousand tones	1965	443,9	75,7	42,2	156,0	160,7	1,5	7,8
		1970	382,0	197,4	59,0	62,8	46,3	3,1	13,4
		1975	628,0	288,3	92,2	97,5	127,6	4,0	18,4
		1980	593,2	125,4	93,1	187,7	163,4	3,4	20,2
Automobile Gasoline	thousand tones	1965	508,7	68,5	38,0	135,6	215,5	7,1	44,0
		1970	748,2	159,9	79,6	81,1	294,6	73,7	59,3
		1975	943,0	70,2	124,8	192,7	338,3	149,8	67,2
		1980	1 165,3	114,5	77,4	200,5	325,4	338,5	109,0

7.2.2 Years of Independancy (1991-2005)

Table 14
Fuel and Energy Balance of Georgia in 1991 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	278	181		33	639		330			1 461
2	Import	385	2 474	4 225	3 687				220		10 991
3	Export	-41	-145	-1 625					-72		-1 883
4	Bin	-12	-18	-140							-170
5	Changes in reserves										0
6	Primary production 6=1+2-3±4±5	610	2 492	2 460	3 720	639	0	330	148	0	10 399
7	Power plants, boiler houses	-106		-1 142	-105	-639			1 064	2 000	1 072
8	Oil refinery		-2 492	2 292							-200
9	Other conversions and losses								-160		-160
10	Energy supply 10=6±7±8±9	504	0	3 610	3 615	0	0	330	1 052	2 000	11 111
11	Industrial Sector 11=12+13+14+15	386	0	1 520	1 315	0	0	0	386	0	3 607
12	Metallurgy	361		820	490				160		1 831
13	Chemistry, oil chemistry			654	475				136		1 265
14	Nonmetal materials	15		20	150				41		226
15	Other enterprises	10		26	200				49		285
16	Transport sector 16=17+18+19	22	0	1 280	0	0	0	0	70	0	1 372
17	Aviation, sea			202					6		208
18	Railway and motor transport	22		976					60		1 058
19	Others			102					4		106
20	Other sectors 20=21+22+23+24	96	0	810	1 390	0	0	330	596	2 000	5 222
21	Agriculture	16		270	142				62		490
22	Public/household services	20		308	460			34	138	600	1 560
23	Population	20		220	686			296	385	1 400	3 007
24	Others	40		12	102				11		165
25	Non energy consumption				140						140
26	Power generation (supplied) GWH			3 100	1 844	7 430					12 374
27	Heat energy generation TJ										83 736

Table 15
Fuel and Energy Balance of Georgia in 1992 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	90	100		30	560		520			1 300
2	Import	96	65	1 300	3 930				90		5 481
3	Export			-60					-3		-63
4	Bin	-6	-5								-11
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	180	160	1 240	3 960	560	0	520	87	0	6 707
7	Power plants, boiler houses			-422	-1 200	-560			1 142	1 100	60
8	Oil refinery		-160	152							-8
9	Other conversions and losses								-240		-240
10	Energy supply 10=6±7±8±9	180	0	970	2 760	0	0	520	989	1 100	6 519
11	Industrial Sector 11=12+13+14+15	90	0	120	1 600	0	0	0	320	0	2 130
12	Metallurgy			48	638				130		816
13	Chemistry, oil chemistry			42	683				120		845
14	Nonmetal materials			18	100				30		148
15	Other enterprises	90		12	179				40		321
16	Transport sector 16=17+18+19	0	0	430	0	0	0	0	53	0	483
17	Aviation, sea			48							48
18	Railway and motor transport			346					48		394
19	Others			36					5		41
20	Other sectors 20=21+22+23+24	90	0	420	850	0	0	520	616	1 100	3 596
21	Agriculture			78	40				125		243
22	Public/household services			180	280				175		635
23	Population			130	358				280	1 100	1 868
24	Others	90		32	172			520	36		850
25	Non energy consumption				310						310
26	Power generation (supplied) GWH			443	4 567	6 510					11 520
27	Heat energy generation TJ										46 100

Table 16
Fuel and Energy Balance of Georgia in 1993 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	40	100		40	600		350			1 130
2	Import	98	90	590	2 970				98		3 846
3	Export			-25					-37		-62
4	Bin	-10	-5								-15
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	128	185	565	3 010	600	0	350	61	0	4 899
7	Power plants, boiler houses			-179	-790	-600			859	800	90
8	Oil refinery		-185	174							-11
9	Other conversions and losses								-230		-230
10	Energy supply 10=6±7±8±9	128	0	560	2 220	0	0	350	690	800	4 748
11	Industrial Sector 11=12+13+14+15	70	0	55	1 300	0	0	0	185	0	1 610
12	Metallurgy			24	450				85		559
13	Chemistry, oil chemistry			22	610				94		726
14	Nonmetal materials										0
15	Other enterprises	70		9	240				6		325
16	Transport sector 16=17+18+19	0	0	260	0	0	0	0	52	0	312
17	Aviation, sea			20							20
18	Railway and motor transport			235					46		281
19	Others			5					6		11
20	Other sectors 20=21+22+23+24	58	0	245	606	0	0	350	423	800	2 482
21	Agriculture			41					80		121
22	Public/household services			90	210				59		359
23	Population			85	380				258	800	1 523
24	Others	58		29	16			350	26		479
25	Non energy consumption				314				30		344
26	Power generation (supplied) GWH			157	3 013	6 980					10 150
27	Heat energy generation TJ										33 530

Table 17
Fuel and Energy Balance of Georgia in 1994 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	20	70			410		230			730
2	Import	50		346	1 990				73		2 459
3	Export	-3	-46						-4		-53
4	Bin										0
5	Changes in reserves										0
6	Primary production 6=1+2-3±4±5	67	24	346	1 990	410	0	230	69	0	3 136
7	Power plants, boiler houses			-156	-690	-410			590	450	-216
8	Oil refinery		-24	20							-4
9	Other conversions and losses								-199		-199
10	Energy supply 10=6±7±8±9	67	0	210	1 300	0	0	230	460	450	2 717
11	Industrial Sector 11=12+13+14+15	0	0	15	630	0	0	0	120	0	765
12	Metallurgy			7	320				60		387
13	Chemistry, oil chemistry			6	270				50		326
14	Nonmetal materials										0
15	Other enterprises			2	40				10		52
16	Transport sector 16=17+18+19	0	0	80	0	0	0	0	50	0	130
17	Aviation, sea			15							15
18	Railway and motor transport			60					42		102
19	Others			5					8		13
20	Other sectors 20=21+22+23+24	67	0	115	670	0	0	230	290	450	1 822
21	Agriculture			25					30		55
22	Public/household services			16	340				40		396
23	Population			74	320			230	220	450	1 294
24	Others	67			10						77
25	Non energy consumption				140						140
26	Power generation (supplied) GWH			96	1 940	4 767					6 803
27	Heat energy generation TJ										28 810

Table 18
Fuel and Energy Balance of Georgia in 1995 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	20	50			460		50			580
2	Import	17		94	740				70		921
3	Export	-5		-4					-12		-21
4	Bin										0
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	32	50	90	740	460	0	50	58	0	1 480
7	Power plants, boiler houses	-2		-34	-260	-460			596	410	250
8	Oil refinery		-50	44							-6
9	Other conversions and losses								-164		-164
10	Energy supply 10=6±7±8±9	30	0	100	480	0	0	50	490	410	1 560
11	Industrial Sector 11=12+13+14+15	0	0	10	390	0	0	0	90	0	490
12	Metallurgy			3	155				40		198
13	Chemistry, oil chemistry			2	170				44		216
14	Nonmetal materials			1					4		`
15	Other enterprises			4	65				2		71
16	Transport sector 16=17+18+19	0	0	50	0	0	0	0	37	0	87
17	Aviation, sea			10							10
18	Railway and motor transport			40					32		72
19	Others								5		5
20	Other sectors 20=21+22+23+24	30	0	40	90	0	0	50	363	410	983
21	Agriculture			12					29		41
22	Public/household services			8	10				100		118
23	Population			20	80			50	224	410	784
24	Others	30							10		40
25	Non energy consumption										0
26	Power generation (supplied) GWH			100	1 487	5 310					6 897
27	Heat energy generation TJ										17 138

Table 19
Fuel and Energy Balance of Georgia in 1996 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	23	128			520		70			741
2	Import	10		305	763				48		1 126
3	Export	-3	-68	-2					-37		-110
4	Bin	2		4	-1						5
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	32	60	307	762	520	0	70	11	0	1 762
7	Power plants, boiler houses			-6	-363	-520			629	31	-229
8	Oil refinery		-60	57							-3
9	Other conversions and losses				-36				-63		-99
10	Energy supply 10=6±7±8±9	32	0	358	363	0	0	70	577	31	1 431
11	Industrial Sector 11=12+13+14+15	16	0	51	62	0	0	0	84	6	219
12	Metallurgy	7		3	4				31		45
13	Chemistry, oil chemistry			14	13				24	3	54
14	Nonmetal materials	4		5	18				19		46
15	Other enterprises	5		29	27				10	3	74
16	Transport sector 16=17+18+19	5	0	236	6	0	0	0	37	0	284
17	Aviation, sea			7	1				2		10
18	Railway and motor transport	3		215	3				31		252
19	Others	2		14	2				4		22
20	Other sectors 20=21+22+23+24	11	0	71	261	0	0	70	456	25	894
21	Agriculture	3		15	14				33		65
22	Public/household services	2		3	7				24	7	43
23	Population	4		48	236			70	358	10	726
24	Others	2		5	4				41	8	60
25	Non energy consumption			3	34						37
26	Power generation (supplied) GWH			41	1 072	6 120					7 233
27	Heat energy generation TJ										1 296

Table 20
Fuel and Energy Balance of Georgia in 1997 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	5	134		6	521		138			804
2	Import	6		341	631				53		1 031
3	Export		-70	-2					-24		-96
4	Bin	-1		3	2						4
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	10	64	342	639	521	0	138	29	0	1 743
7	Power plants, boiler houses			-7	-312	-521			615	30	-195
8	Oil refinery		-64	61							-3
9	Other conversions and losses				-39				-76		-115
10	Energy supply 10=6±7±8±9	10	0	396	288	0	0	138	568	30	1 430
11	Industrial Sector 11=12+13+14+15	4	0	59	57	0	0	0	76	5	201
12	Metallurgy	2		1	1				28		32
13	Chemistry, oil chemistry			13	12				23	2	50
14	Nonmetal materials			9	16				4		29
15	Other enterprises	2		36	28				21	3	90
16	Transport sector 16=17+18+19	3	0	279	6	0	0	0	39	0	327
17	Aviation, sea			9	1				2		12
18	Railway and motor transport	2		258	3				32		295
19	Others	1		12	2				5		20
20	Other sectors 20=21+22+23+24	3	0	59	190	0	0	138	453	25	868
21	Agriculture			21	11				34		66
22	Public/household services	1		3	3			5	26	7	45
23	Population	2		31	167			126	355	10	691
24	Others			4	9			7	38	8	66
25	Non energy consumption				35						35
26	Power generation (supplied) GWH			46	1 073	6 053					7 172
27	Heat energy generation TJ										1 296

Table 21
Fuel and Energy Balance of Georgia in 1998 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	15	119		11	549		160			854
2	Import	4		370	682				36		1 092
3	Export	-1	-41	-2					-44		-88
4	Bin	2		-3	1						0
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	20	78	365	694	549	0	160	-8	0	1 858
7	Power plants, boiler houses			-51	-352	-549			695	30	-227
8	Oil refinery		-78	75							-3
9	Other conversions and losses				-41				-93		-134
10	Energy supply 10=6±7±8±9	20	0	389	301	0	0	160	594	30	1 494
11	Industrial Sector 11=12+13+14+15	16	0	62	62	0	0	0	76	5	220
12	Metallurgy	4		1	2				30		37
13	Chemistry, oil chemistry			12	13				24	1	50
14	Nonmetal materials	3		11	15				5	1	35
15	Other enterprises	9		38	31				17	3	98
16	Transport sector 16=17+18+19	4	0	284	6	0	0	0	41	0	335
17	Aviation, sea			9	1				2		12
18	Railway and motor transport	2		264	3				33		302
19	Others	2		11	2				6		21
20	Other sectors 20=21+22+23+24	0	0	43	199	0	0	160	477	25	904
21	Agriculture			22	12				36		70
22	Public/household services			2	4			9	30	7	52
23	Population			16	173			141	375	10	715
24	Others			3	10			10	36	8	67
25	Non energy consumption				35						35
26	Power generation (supplied) GWH			218	1 483	6 387					8 088
27	Heat energy generation TJ										1 255

Table 22
Fuel and Energy Balance of Georgia in 1999 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	12	91		15	556	3	169			846
2	Import	3		412	805				37		1 257
3	Export	-2	-37	-2					-33		-74
4	Bin	1		3	-2						2
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	14	54	413	818	556	3	169	4	0	2 031
7	Power plants, boiler houses			-9	-295	-556			694	34	-132
8	Oil refinery		-54	51							-3
9	Other conversions and losses				-59				-94		-153
10	Energy supply 10=6±7±8±9	14	0	455	464	0	3	169	604	34	1 743
11	Industrial Sector 11=12+13+14+15	5	0	81	68	0	0	0	79	11	244
12	Metallurgy	3		2	3				35		43
13	Chemistry, oil chemistry			16	16				22	3	57
14	Nonmetal materials	1		14	15				6		36
15	Other enterprises	1		49	34				16	8	108
16	Transport sector 16=17+18+19	3	0	334	10	0	0	0	44	0	391
17	Aviation, sea			11	1				3		15
18	Railway and motor transport	2		308	5				34		349
19	Others	1		15	4				7		27
20	Other sectors 20=21+22+23+24	6	0	40	318	0	3	169	481	23	1 040
21	Agriculture			35	19				34		88
22	Public/household services	2		1	36			11	31	10	91
23	Population	3		2	236		3	155	376	9	784
24	Others	1		2	27			3	40	4	77
25	Non energy consumption				34						34
26	Power generation (supplied) GWH			52	1 600	6 467					8 119
27	Heat energy generation TJ										1 423

Table 23
Fuel and Energy Balance of Georgia in 2000 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	7	110		16	512	5	230			880
2	Import	3		481	882				53		1 419
3	Export	-1	-65	-2					-18		-86
4	Bin	-1		-1	-1						-3
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	8	45	478	897	512	5	230	35	0	2 210
7	Power plants, boiler houses			-5	-368	-512			640	34	-211
8	Oil refinery		-45	43							-2
9	Other conversions and losses				-61				-84		-145
10	Energy supply 10=6±7±8±9	8	0	516	468	0	5	230	591	34	1 852
11	Industrial Sector 11=12+13+14+15	3	0	83	75	0	0	0	80	10	251
12	Metallurgy			2	3				37		42
13	Chemistry, oil chemistry			18	15				21	2	56
14	Nonmetal materials	1		13	17				8		39
15	Other enterprises	2		50	40				14	8	114
16	Transport sector 16=17+18+19	2	0	378	12	0	0	0	42	0	434
17	Aviation, sea			14	2				2		18
18	Railway and motor transport	2		348	6				30		386
19	Others			16	4				10		30
20	Other sectors 20=21+22+23+24	3	0	52	306	0	5	230	468	24	1 088
21	Agriculture			50	21				36		107
22	Public/household services	1			40			20	26	11	98
23	Population	1		2	215		5	205	390	10	828
24	Others	1			30			5	16	3	55
25	Non energy consumption				34						34
26	Power generation (supplied) GWH			200	1 293	5 953					7 446
27	Heat energy generation TJ										1 423

Table 24
Fuel and Energy Balance of Georgia in 2001 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	5	99		32	479	6	315			936
2	Import	2		680	676				76		1 434
3	Export		-70	-2					-45		-117
4	Bin		2	-3	7						6
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	7	31	675	715	479	6	315	31	0	2 259
7	Power plants, boiler houses			-10	-321	-479			597	38	-175
8	Oil refinery		-31	29							-2
9	Other conversions and losses				-46				-96		-142
10	Energy supply 10=6±7±8±9	7	0	694	348	0	6	315	532	38	1 940
11	Industrial Sector 11=12+13+14+15	1	0	91	75	0	0	0	88	9	264
12	Metallurgy			2	3				41		46
13	Chemistry, oil chemistry			20	16				20	2	58
14	Nonmetal materials	1		15	17				11	4	48
15	Other enterprises			54	39				16	3	112
16	Transport sector 16=17+18+19	0	0	402	11	0	0	0	43	0	456
17	Aviation, sea			16					2		18
18	Railway and motor transport			360	6				31		397
19	Others			26	5				10		41
20	Other sectors 20=21+22+23+24	6	0	198	178	0	6	315	401	29	1 133
21	Agriculture			64	10			6	21		101
22	Public/household services	2		12	31			25	14	16	100
23	Population	3		86	120		2	274	360	10	855
24	Others	1		36	17		4	10	6	3	77
25	Non energy consumption			3	84						87
26	Power generation (supplied) GWH			357	1 013	5 572					6 942
27	Heat energy generation TJ										1 590

Table 25
Fuel and Energy Balance of Georgia in 2002 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	6	74		13	580	8	319			1 000
2	Import	3		694	564				71		1 332
3	Export	-3	-52	-1					-21		-77
4	Bin	1	2	-1	-2						0
5	Changes in reserves										
6	Primary production 6=1+2-3±4±5	7	24	692	575	580	8	319	50	0	2 255
7	Power plants, boiler houses			-6	-138	-580			624	38	-62
8	Oil refinery		-24	23							-1
9	Other conversions and losses				-39				-93		-132
10	Energy supply 10=6±7±8±9	7	0	709	398	0	8	319	581	38	2 060
11	Industrial Sector 11=12+13+14+15	1	0	90	85	0	0	0	95	12	283
12	Metallurgy			2	3				43	1	49
13	Chemistry, oil chemistry			19	21				21	4	65
14	Nonmetal materials	1		16	10				14	4	45
15	Other enterprises			53	51				17	3	124
16	Transport sector 16=17+18+19	0	0	410	13	0	0	0	47	0	470
17	Aviation, sea			15					3		18
18	Railway and motor transport			365	8				38		411
19	Others			30	5				6		41
20	Other sectors 20=21+22+23+24	6	0	203	201	0	8	319	439	26	1 202
21	Agriculture			62	14			8	22		106
22	Public/household services	3		16	32			26	16	14	107
23	Population	2		91	139		4	276	393	9	914
24	Others	1		34	16		4	9	8	3	75
25	Non energy consumption			6	99						105
26	Power generation (supplied) GWH			215	298	6 742					7 255
27	Heat energy generation TJ										1 590

Table 26
Fuel and Energy Balance of Georgia in 2003 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	8	140		15	561	9	321			1 054
2	Import	3		709	814				73		1 599
3	Export	-2	-118	-2					-9		-131
4	Bin	-1	-2	-3	2						-4
5	Changes in reserves										0
6	Primary production 6=1+2-3±4±5	8	20	704	831	561	9	321	64	0	2 518
7	Power plants, boiler houses			-5	-149	-561			616	42	-57
8	Oil refinery		-20	18							-2
9	Other conversions and losses			-18	-50				-91		-159
10	Energy supply 10=6±7±8±9	8	0	699	632	0	9	321	589	42	2 300
11	Industrial Sector 11=12+13+14+15	2	0	89	105	0	0	0	97	14	307
12	Metallurgy			1	4				42	1	48
13	Chemistry, oil chemistry			18	22				23	2	65
14	Nonmetal materials	1		15	11				13	3	43
15	Other enterprises	1		55	68				19	8	151
16	Transport sector 16=17+18+19	1	0	404	15	0	0	0	46	0	466
17	Aviation, sea			14	1				4		19
18	Railway and motor transport	1		361	9				36		407
19	Others			29	5				6		40
20	Other sectors 20=21+22+23+24	5	0	202	323	0	9	321	446	28	1 334
21	Agriculture			59	61			14	24		158
22	Public/household services	2		16	52			18	17	18	123
23	Population	2		92	176		5	279	396	6	956
24	Others	1		35	34		4	10	9	4	97
25	Non energy consumption			4	189						193
26	Power generation (supplied) GWH			178	457	6 528					7 163
27	Heat energy generation TJ										1 730

Table 27
Fuel and Energy Balance of Georgia in 2004 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production	7	98		8	507	9	342			971
2	Import	2		731	943				104		1 780
3	Export	-1	-80	-3							-84
4	Bin		-2	2	-2						-2
5	Changes in reserves										0
6	Primary production 6=1+2-3±4±5	8	16	730	949	507	9	342	104	0	2 665
7	Power plants, boiler houses			-6	-191	-507			576	35	-93
8	Oil refinery			15							15
9	Other conversions and losses		-16	-17	-56				-79		-168
10	Energy supply 10=6±7±8±9	8	0	722	702	0	9	342	601	35	2 419
11	Industrial Sector 11=12+13+14+15	2	0	92	128	0	0	0	99	16	337
12	Metallurgy	1		1	5				41	2	50
13	Chemistry, oil chemistry			19	24				27	3	73
14	Nonmetal materials			16	13				10	3	42
15	Other enterprises	1		56	86				21	8	172
16	Transport sector 16=17+18+19	1	0	418	23	0	0	0	49	0	491
17	Aviation, sea			15	3				3		21
18	Railway and motor transport			372	11				39		422
19	Others	1		31	9				7		48
20	Other sectors 20=21+22+23+24	5	0	208	359	0	9	342	453	19	1 395
21	Agriculture			60	64			15	25		164
22	Public/household services	2		17	58			20	19	7	123
23	Population	3		95	201		5	296	399	8	1 007
24	Others			36	36		4	11	10	4	101
25	Non energy consumption			4	192						196
26	Power generation (supplied) GWH			215	598	5 893					6 706
27	Heat energy generation TJ										1 465

Table 28
Fuel and Energy Balance of Georgia in 2005 (thousand tones of conditional fuel, coal equivalent)

	Energy Supply	Coal	Crude Oil	Oil Products	Gas	Hydro Energy	Non-traditional	Wood, Wastes	Electricity	Heat Energy	Total
1	Production		67		12	522	10	361			972
2	Import	3		746	1 161				120		2 030
3	Export		-61	-3					-10		-74
4	Bin		-1	-2	1						-2
5	Changes in reserves										0
6	Primary production 6=1+2-3±4±5	3	5	741	1 174	522	10	361	110	0	2 926
7	Power plants, boiler houses			-8	-161	-522			611	38	-42
8	Oil refinery		-5	4							-1
9	Other conversions and losses			-16	-339				-84		-439
10	Energy supply 10=6±7±8±9	3	0	721	674	0	10	361	637	38	2 444
11	Industrial Sector 11=12+13+14+15	0	0	94	143	0	0	0	105	10	352
12	Metallurgy			2	6				40	2	50
13	Chemistry, oil chemistry			18	25				34	3	80
14	Nonmetal materials			16	14				9	1	40
15	Other enterprises			58	98				22	4	182
16	Transport sector 16=17+18+19	1	0	420	21	0	0	0	51	0	493
17	Aviation, sea			16	3				4		23
18	Railway and motor transport			371	12				38		421
19	Others	1		33	6				9		49
20	Other sectors 20=21+22+23+24	2	0	202	314	0	10	361	481	28	1 398
21	Agriculture			62	56			21	28		167
22	Public/household services	1		18	52			23	20	18	132
23	Population	1		98	196		6	305	421	8	1 035
24	Others			24	10		4	12	12	2	64
25	Non energy consumption			5	196						201
26	Power generation (supplied) GWH			285	746	6 070					7 101
27	Heat energy generation TJ										1 590

Table 29
Data on Formation of Fuel and Energy Resource During the Years 2001-2005

Local Production of Energy Resources						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thous. tones	10,6	12,7	17,0	14,9	0,0
Oil	thous. tones	98,7	74,3	139,8	97,6	67,3
Natural gas	million cub.m	39,7	16,1	18,6	9,9	14,9
Wood	thous. cub.m	2 236,5	2 264,9	2 279,1	2 428,2	2 563,1
Nontraditional	thous. cub.m	63,9	59,7	62,5	66,4	69,1
Hydro energy	million kWh	5 571,5	6 742,5	6 527,9	5 892,8	6 070,0

Import						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thous. tones	4,3	6,4	6,4	4,3	6,4
Oil products	thous. tones	680,4	694,1	708,9	731,2	745,8
Natural gas	million cub.m	832,2	699,3	1 009,4	1 169,3	1 439,6
Electricity	million kWh	877,6	713,2	844,3	1 210,0	1 399,0

Energy Conversion						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thous. tones	31,2	24,1	19,8	16,2	5,1
Oil products	thous. tones	9,9	6,2	22,9	23,1	23,9
Natural gas	million cub.m	429,1	197,2	215,8	270,3	229,4
Electricity	million kWh	651,1	569,7	534,8	295,3	418,6

Energy Export						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thous. tones	-	6,2	4,2	2,1	-
Oil products	thous. tones	70,1	51,8	117,9	80,2	61,1
Natural gas	thous. tones	2,1	1,1	1,9	3,1	2,9
Electricity	million kWh	523,3	244,5	109,3	-	120,0

Structure of Primary Energy Resources						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
1. Coal	thous. tones	14,9	15,1	17,0	17,1	6,4
2. Oil Products	thous. tones	673,1	690,3	702,0	727,8	729,8
Including:	thous. tones					
2.1. Gasoline	thous. tones	282,8	289,9	294,9	305,8	310,5
2.2. Diesel Fuel	thous. tones	221,6	227,2	231,1	239,6	234,2
2.3. Kerosene	thous. tones	82,7	84,8	86,3	89,4	90,8
2.4. Liquid Gas	thous. tones	26,7	27,4	27,8	28,9	29,3
2.5. Naphtha	thous. tones	3,4	3,5	3,5	3,6	3,7
2.6. Aviation Fuel	thous. tones	12,8	13,2	13,4	13,9	14,1
2.7. Mazut	thous. tones	17,3	17,8	18,1	18,7	19,0
2.8. Lubricants	thous. tones	2,4	2,5	2,5	2,6	2,6
2.9. Bitumen	thous. tones	23,4	24,0	24,4	25,3	25,6
3. Natural Gas	million cub.m	886,6	713,0	1 030,4	1 168,1	1 455,7
4. Nontraditional (Thermal energy) Energy	thous. cub.m	63,9	59,7	62,5	66,4	69,1
5. Wood	thous. cub.m	2 236,5	2 264,9	2 279,1	2 428,2	2 563,1
6. Electricity	million kWh	7 302,3	7 837,2	7 906,9	7 906,9	8 395,3
7. Heat energy	t. joule	1 717,9	1 592,2	1 759,8	1 466,5	1 592,2

Energy Resources after Conversion						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thous. tones	14,9	15,1	17,0	17,1	6,4
Oil Products	thous. tones	694,1	708,9	699,1	721,8	720,9
Natural Gas	million cub.m	457,5	515,8	814,6	906,4	1 226,4
Nontraditional	thous. cub.m	63,9	59,7	62,5	66,4	69,1
Wood	thous. cub.m	2 236,5	2 264,9	2 279,1	2 428,2	2 563,1
Electricity	million kWh	6 651,1	7 267,4	7 372,1	7 511,6	7 965,1
Heat Energy	t. joule	1 590,0	1 590,0	1 730,0	1 465,0	1 590,0

Reserves of Fuel and Evener Resources						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thous. tones	-	2,2	-2.2	-	-
Oil	thous. tones	2,1	1,9	-2.2	-2,0	-1.1
Oil Products	thous. tones	-2.9	-1.1	1,9	3,1	2,9
Natural Gas	million cub.m	8,7	-3.0	3,0	-3.0	1,2

Total Energy Losses						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Natural Gas	million cub.m	26,6	21,4	30,9	35,1	43,7
Electricity	million kWh	465,6	508,7	516,0	525,8	557,5
Heat Energy	t. joule	171,8	159,2	176,0	146,6	159,2
Energy for End Consumption						
Name	Unit of Measure	Years				
		2001	2002	2003	2004	2005
Coal	thous. tones	14,9	15,1	17,0	17,1	6,4
Oil Products	thous. tones	694,1	692,1	704,3	730,0	741,2
Natural Gas	million cub.m	430,9	500,3	790,2	879,2	1 189,2
Nontraditional	thous. cub.m	63,9	59,7	62,5	66,4	69,1
Electricity	million kWh	6 185,5	6 758,7	6 856,0	6 985,8	7 407,6
Heat Energy	t. joule	1 546,1	1 433,0	1 583,8	1 319,9	1 433,0
Wood	thous. cub.m	2 236,5	2 264,9	2 279,1	2 428,2	2 563,1

Table 30
Electricity Consumption by Sectors for the Years 2001-2005

2001			
	Name	**Natural Units, million kWhs**	**Conditional Units, thous. tones of cond. fuel**
1	**2**	**3**	**4**
I	**Industry, total**	1 023,2	88,0
1	Metallurgy	476,7	41,0
2	Chemistry, Oil Chemistry	232,5	20,0
3	Nonmetal Production	127,9	11,0
4	Other Enterprises	186,1	16,0
II	**Transport, total**	499,8	43,0
1	Aviation	23,2	2,0
2	Automobile and Railway	360,4	31,0
3	Others	116,2	10,0
III	**Other Sectors**	4 662,7	401,0
1	Agriculture	244,2	21,0
2	Services and Small Commercial Companies	162,8	14,0
3	Household Sector	4 186,0	360,0
4	Others	69,7	6,0

2002			
	Name	**Natural Units, million kWhs**	**Conditional Units, thous. tones of cond. fuel**
1	**2**	**3**	**4**
I	**Industry, total**	1 104,3	95,0
1	Metallurgy	499,7	43,0
2	Chemistry, Oil Chemistry	244,2	21,0
3	Nonmetal Production	162,8	14,0
4	Other Enterprises	197,6	17,0
II	**Transport, total**	546,4	47,0
1	Aviation	34,9	3,0
2	Automobile and Railway	441,8	38,0
3	Others	69,7	6,0
III	**Other Sectors**	5 104,6	439,0
1	Agriculture	255,8	22,0
2	Services and Small Commercial Companies	186,1	16,0
3	Household Sector	4 569,7	393,0
4	Others	93,0	8,0

2003			
	Name	**Natural Units, million kWhs**	**Conditional Units, thous. tones of cond. fuel**
1	**2**	**3**	**4**
I	**Industry, total**	1 127,9	97,0
1	Metallurgy	488,4	42,0
2	Chemistry, Oil Chemistry	267,4	23,0
3	Nonmetal Production	151,2	13,0
4	Other Enterprises	220,9	19,0
II	**Transport, total**	534,8	46,0
1	Aviation	46,5	4,0
2	Automobile and Railway	418,6	36,0
3	Others	69,7	6,0
III	**Other Sectors**	5 186,0	446,0
1	Agriculture	279,1	24,0
2	Services and Small Commercial Companies	197,7	17,0
3	Household Sector	4 604,6	396,0
4	Others	104,6	9,0

2004			
	Name	**Natural Units, million kWhs**	**Conditional Units, thous. tones of cond. fuel**
1	**2**	**3**	**4**
I	**Industry, total**	1 151,0	99,0
1	Metallurgy	476,7	41,0
2	Chemistry, Oil Chemistry	313,9	27,0
3	Nonmetal Production	116,2	10,0
4	Other Enterprises	244,2	21,0
II	**Transport, total**	569,8	49,0
1	Aviation	34,9	3,0
2	Automobile and Railway	453,5	39,0
3	Others	81,4	7,0
III	**Other Sectors**	5 266,7	453,0
1	Agriculture	290,1	25,0
2	Services and Small Commercial Companies	220,9	19,0
3	Household Sector	4 639,5	399,0
4	Others	116,2	10,0

2005			
	Name	**Natural Units, million kWhs**	**Conditional Units, thous. tones of cond. fuel**
1	**2**	**3**	**4**
I	**Industry, total**	1 220,8	105,0
1	Metallurgy	465,1	40,0
2	Chemistry, Oil Chemistry	395,3	34,0
3	Nonmetal Production	104,6	9,0
4	Other Enterprises	255,8	22,0
II	**Transport, total**	592,9	51,0
1	Aviation	46,5	4,0
2	Automobile and Railway	441,8	38,0
3	Others	104,6	9,0
III	**Other Sectors**	5 592,9	481,0
1	Agriculture	325,6	28,0
2	Services and Small Commercial Companies	232,5	20,0
3	Household Sector	4 895,3	421,0
4	Others	139,5	12,0

Table 31
Natural Gas Consumption by Sectors for the Years 2001-2005

2001			
	Name	**Natural Units, thous. cub.m**	**Conditional Units, thous. tones**
1	**2**	**3**	**4**
I	**Industry, total**	93 000	75
1	Metallurgy	3 720	3
2	Chemistry, Oil Chemistry	19 840	16
3	Nonmetal Production	21 080	17
4	Other Enterprises	48 360	39
II	**Transport, total**	234 160	11
1	Aviation	-	-
2	Automobile and Railway	7 240	6
3	Others	6 200	5
III	**Other Sectors**	220 720	178
1	Agriculture	12 400	10
2	Services and Small	38 440	31
3	Household Sector	148 800	120
4	Others	21 080	17
IV	**Non-energy Sectors**	104 160	84

2002			
	Name	**Natural Units, thous. cub.m**	**Conditional Units, thous. tones**
1	**2**	**3**	**4**
I	**Industry, total**	150 040	85
1	Metallurgy	26 040	3
2	Chemistry, Oil Chemistry	12 400	21
3	Nonmetal Production	63 240	10
4	Other Enterprises	48 360	51
II	**Transport, total**	16 120	13
1	Aviation	-	-
2	Automobile and Railway	9 920	8
3	Others	6 200	5
III	**Other Sectors**	249 240	201
1	Agriculture	17 360	14
2	Services and Small	39 680	32
3	Household Sector	172 360	139
4	Others	19 840	16
IV	**Non-energy Sectors**	122 760	99

2003			
	Name	**Natural Units, thous. cub.m**	**Conditional Units, thous. tones**
1	**2**	**3**	**4**
I	**Industry, total**	130 200	105
1	Metallurgy	4 960	4
2	Chemistry, Oil Chemistry	27 280	22
3	Nonmetal Production	13 640	11
4	Other Enterprises	84 320	68
II	**Transport, total**	18 600	15
1	Aviation	1 240	1
2	Automobile and Railway	11 160	9
3	Others	6 200	5
III	**Other Sectors**	400 520	323
1	Agriculture	75 640	61
2	Services and Small	64 480	52
3	Household Sector	218 240	176
4	Others	42 160	34
IV	**Non-energy Sectors**	234 360	189

2004			
	Name	**Natural Units, thous. cub.m**	**Conditional Units, thous. tones**
1	**2**	**3**	**4**
I	**Industry, total**	158 720	128
1	Metallurgy	6 200	5
2	Chemistry, Oil Chemistry	29 760	24
3	Nonmetal Production	16 120	13
4	Other Enterprises	106 640	86
II	**Transport, total**	28 520	23
1	Aviation	3 720	3
2	Automobile and Railway	13 640	11
3	Others	11 160	9
III	**Other Sectors**	445 160	359
1	Agriculture	79 360	64
2	Services and Small	71 920	58
3	Household Sector	249 240	201
4	Others	44 640	36
IV	**Non-energy Sectors**	238 080	192

2005			
	Name	**Natural Units, thous. cub.m**	**Conditional Units, thous. tones**
1	**2**	**3**	**4**
I	**Industry, total**	177 320	143
1	Metallurgy	7 440	6
2	Chemistry, Oil Chemistry	31 000	25
3	Nonmetal Production	17 360	14
4	Other Enterprises	121 520	98
II	**Transport, total**	26 040	21
1	Aviation	3 720	3
2	Automobile and Railway	14 880	12
3	Others	7 440	6
III	**Other Sectors**	389 360	314
1	Agriculture	69 440	56
2	Services and Small	64 480	52
3	Household Sector	243 040	196
4	Others	12 400	10
IV	**Non-energy Sectors**	243 040	196

Table 32
Consumption of Oil Products by Sectors for the Years 2001-2005

2001			
	Name	**Natural Units**	**Conditional Units**
1	**2**	**3**	**4**
I	**Industry, total**	91,1	91,0
1	Metallurgy	2,2	2,0
2	Chemistry, Oil Chemistry	19,8	20,0
3	Nonmetal Production	15,2	15,0
4	Other Enterprises	53,9	54,0
II	**Transport, total**	401,8	402,0
1	Aviation	15,8	16,0
2	Automobile and Railway	360,1	360,0
3	Others	25,9	26,0
III	**Other Sectors**	198,1	198,0
1	Agriculture	64,2	64,0
2	Services and Small Commercial Companies	11,9	12,0
3	Household Sector	85,8	86,0
4	Others	36,2	36,0
IV	**Non-energy Sectors**	2,9	3,0

2002			
	Name	**Natural Units**	**Conditional Units**
1	**2**	**3**	**4**
I	**Industry, total**	89,9	90,0
1	Metallurgy	1,9	2,0
2	Chemistry, Oil Chemistry	18,9	19,0
3	Nonmetal Production	16,2	16,0
4	Other Enterprises	52,9	53,0
II	**Transport, total**	409,7	410,0
1	Aviation	15,1	15,0
2	Automobile and Railway	364,8	365,0
3	Others	29,8	30,0
III	**Other Sectors**	202,9	131,0
1	Agriculture	62,1	62,0
2	Services and Small Commercial Companies	15,9	16,0
3	Household Sector	90,8	19,0
4	Others	34,1	34,0
IV	**Non-energy Sectors**	6,2	6,0

2003			
	Name	**Natural Units**	**Conditional Units**
1	**2**	**3**	**4**
I	**Industry, total**	89,1	89,0
1	Metallurgy	1,1	1,0
2	Chemistry, Oil Chemistry	18,1	18,0
3	Nonmetal Production	15,2	15,0
4	Other Enterprises	54,7	55,0
II	**Transport, total**	403,9	404,0
1	Aviation	14,2	14,0
2	Automobile and Railway	360,9	361,0
3	Others	28,8	29,0
III	**Other Sectors**	202,1	202,0
1	Agriculture	59,3	59,0
2	Services and Small Commercial Companies	15,8	16,0
3	Household Sector	91,9	92,0
4	Others	35,1	35,0
IV	**Non-energy Sectors**	3,7	4,0

2004			
	Name	**Natural Units**	**Conditional Units**
1	**2**	**3**	**4**
I	**Industry, total**	92,1	92,0
1	Metallurgy	1,2	1,0
2	Chemistry, Oil Chemistry	18,9	19,0
3	Nonmetal Production	15,8	16,0
4	Other Enterprises	56,2	56,0
II	**Transport, total**	417,8	418,0
1	Aviation	14,8	15,0
2	Automobile and Railway	371,7	372,0
3	Others	31,3	31,0
III	**Other Sectors**	208,0	208,0
1	Agriculture	60,2	60,0
2	Services and Small Commercial Companies	16,8	17,0
3	Household Sector	94,9	95,0
4	Others	36,1	36,0
IV	**Non-energy Sectors**	4,0	4,0

2005			
	Name	**Natural Units**	**Conditional Units**
1	**2**	**3**	**4**
I	**Industry, total**	93,9	94,0
1	Metallurgy	1,9	2,0
2	Chemistry, Oil Chemistry	18,1	18,0
3	Nonmetal Production	16,2	16,0
4	Other Enterprises	57,7	58,0
II	**Transport, total**	420,2	420,0
1	Aviation	16,1	16,0
2	Automobile and Railway	370,8	371,0
3	Others	33,3	33,0
III	**Other Sectors**	202,2	202,0
1	Agriculture	62,1	62,0
2	Services and Small Commercial Companies	18,3	18,0
3	Household Sector	97,8	98,0
4	Others	24,0	24,0
IV	**Non-energy Sectors**	4,9	5,0

Table 33
Electricity Consumption by Region for the Years 2001-2005, million kWhs

2001	Quarter				
Name	**I**	**II**	**III**	**IV**	**Year**
Tbilisi	731,9	542,2	427,0	667,9	2 369,0
Achara	59,2	82,6	88,8	102,7	333,3
Samgrelo-Zemo Svaneti	61,4	78,5	78,1	80,3	298,2
Guria	9,6	25,8	29,7	19,3	84,3
Imereti	130,6	169,0	194,6	178,7	672,9
Racha-Kvemo Svaneti	11,5	15,3	15,1	18,0	59,9
Meskhet0Javakheti	19,2	18,2	21,2	23,3	81,9
Shida Kartli	17,1	34,6	41,9	38,2	131,8
Mtskheta-Mtianeti	55,2	30,3	33,0	39,4	157,9
Kvemo Kartli	65,0	44,0	56,3	66,9	232,2
Rustavi Relasi	23,4	22,4	22,6	27,4	95,8
Kakheti	20,7	29,3	26,0	15,9	91,9
Other Enterprises	97,4	196,2	189,1	132,5	615,1
Abkhazia	298,3	203,5	146,6	264,1	912,6
Samachablo	12,7	12,6	12,4	11,7	49,4
Total Consumption	1 613,1	1 504,4	1 382,3	1 686,3	6 186,0

2002	Quarter				
Name	**I**	**II**	**III**	**IV**	**Year**
Tbilisi	685,3	507,7	425,4	623,3	2 241,8
Achara	111,5	101,1	101,4	95,0	408,9
Samgrelo-Zemo Svaneti	89,1	91,9	93,0	79,3	353,3
Guria	8,1	11,6	16,8	13,8	50,2
Imereti	204,4	193,5	201,6	209,0	808,5
Racha-Kvemo Svaneti	13,9	9,7	5,6	4,3	33,5
Meskhet0Javakheti	32,1	27,5	26,1	29,1	114,7
Shida Kartli	44,5	48,9	62,7	56,0	212,1
Mtskheta-Mtianeti	31,1	32,5	28,2	34,1	125,9
Kvemo Kartli	59,6	57,3	63,7	70,6	251,1
Rustavi Relasi	24,6	25,9	23,3	26,6	100,3
Kakheti	24,0	26,9	35,2	21,9	108,0
Other Enterprises	223,6	221,0	236,6	219,9	901,1
Abkhazia	335,1	218,0	159,0	270,6	982,7
Samachablo	19,4	14,0	11,0	19,4	63,8
Total Consumption	1 906,3	1 587,4	1 489,5	1 772,8	6 756,0
Losses	267,5	249,8	257,8	229,4	1 004,5
Total	2 173,8	1 837,2	1 747,3	2 002,2	7 760,4

2003	Quarter				
Name	**I**	**II**	**III**	**IV**	**Year**
Tbilisi	683,8	479,9	393,3	657,6	2 214,6
Achara	92,1	97,4	92,2	104,6	386,3
Samgrelo-Zemo Svaneti	86,6	84,6	60,8	95,0	327,0
Guria	11,1	27,8	23,3	23,7	85,9
Imereti	225,9	235,2	192,5	236,1	889,6
Racha-Kvemo Svaneti	4,0	5,1	7,5	10,7	27,3
Meskhet0Javakheti	31,0	27,5	23,0	29,6	111,2
Shida Kartli	48,2	53,3	61,8	49,7	213,1
Mtskheta-Mtianeti	34,6	34,1	31,0	41,6	141,3
Kvemo Kartli	70,9	73,4	81,4	84,3	309,9
Rustavi Relasi	22,9	22,2	29,5	22,4	97,0
Kakheti	18,7	21,3	19,4	25,2	84,5
Other Enterprises	162,8	209,6	224,6	234,8	831,8
Abkhazia	369,3	221,4	165,4	303,6	1 059,6
Samachablo	29,2	13,3	9,2	17,4	68,9
Total Consumption	1 891,0	1 606,0	1 414,8	1 936,2	6 848,0

2004	Quarter				
Name	**I**	**II**	**III**	**IV**	**Year**
Tbilisi	729,6	500,6	414,3	672,7	2 317,2
Achara	89,1	117,8	100,9	103,5	411,3
Samgrelo-Zemo Svaneti	92,9	87,1	86,2	79,7	346,0
Guria	17,6	29,2	27,9	19,4	94,1
Imereti	229,8	204,5	189,4	182,3	806,0
Racha-Kvemo Svaneti	12,7	11,6	10,1	10,1	44,5
Meskhet0Javakheti	29,1	30,3	25,3	34,8	119,5
Shida Kartli	53,4	59,3	69,6	64,5	246,9
Mtskheta-Mtianeti	41,4	32,3	33,1	37,1	143,9
Kvemo Kartli	91,2	80,3	87,2	105,9	364,6
Rustavi Relasi	27,5	24,1	24,4	14,0	89,9
Kakheti	21,5	31,1	41,7	45,3	139,5
Other Enterprises	144,2	186,7	177,3	214,9	723,1
Abkhazia	366,3	224,5	176,5	307,3	1 074,6
Samachablo	16,8	14,0	11,9	24,4	67,1
Total Consumption	1 963,1	1 633,3	1 475,9	1 915,8	6 988,0

2005	Quarter				
Name	**I**	**II**	**III**	**IV**	**Year**
Tbilisi	760,2	492,1	399,6	626,5	2 278,4
Achara	95,7	97,8	100,4	124,9	418,8
Samgrelo-Zemo Svaneti	77,3	85,3	78,5	107,0	348,1
Guria	18,5	29,6	26,7	30,6	105,4
Imereti	182,6	194,2	170,9	212,8	760,5
Racha-Kvemo Svaneti	10,6	9,4	11,1	14,7	45,9
Meskhet0Javakheti	39,6	36,2	30,5	40,5	146,8
Shida Kartli	57,7	52,6	67,0	70,5	247,8
Mtskheta-Mtianeti	38,9	41,6	38,8	47,0	166,4
Kvemo Kartli	113,6	117,9	103,5	127,9	462,8
Rustavi Relasi	41,5	38,7	29,1	37,9	147,2
Kakheti	41,0	42,1	46,6	54,8	184,5
Other Enterprises	164,7	230,4	243,3	252,6	891,0
Abkhazia	398,4	221,8	179,5	334,0	1 133,7
Samachablo	21,8	13,0	11,9	23,3	69,9
Total Consumption	2 062,1	1 702,4	1 537,5	2 105,0	7 407,0

Table 34
Consumption of Oil Products by Regions for the Years 2001-2005 in Natural Units, thousand tones

2001								
	Name	**Petrol**	**Diesel Fuel**	**Kerosene incl. Aviation**	**Mazut, Stove Fuel**	**Liquid Gas**	**Oils, Bitumen etc.**	**Total**
1	Tbilisi	60,2	44,4	18,1	2,5	3,1	5,8	134,1
2	Imereti	41,1	33,2	13,3	2,6	4,2	4,3	98,7
3	Guria	15,2	13,5	5,7	0,4	1,9	1,8	38,5
4	Samegrelo-Zemo Svaneti	31,1	24,3	10,5	1,9	2,1	3,4	73,3
5	Racha-Kvemo Svaneti	10,7	11,9	4,8	0,6	2,3	1,5	31,8
6	Shida Kartli	19,8	15,5	6,7	1,5	1,6	2,2	47,3
7	Kvemo Kartli	33,5	26,5	11,4	2,1	3,7	3,7	80,9
8	Kakheti	24,2	22,2	9,5	1,7	2,7	3,1	63,4
9	Samtskhe-Javakheti	14,6	16,1	4,7	1,2	2,3	1,5	40,4
10	Mtskheta-Mtianeti	12,2	6,6	3,8	1,6	2,5	1,2	27,9
11	Achara	20,2	7,4	7,0	1,2	0,3	2,4	38,5
12	Total	282,8	221,6	95,5	17,3	26,7	30,9	674,8

2002								
	Name	Petrol	Diesel Fuel	Kerosene incl. Aviation	Mazut, Stove Fuel	Liquid Gas	Oils, Bitumen etc.	Total
1	Tbilisi	58,0	43,1	18,6	1,3	2,3	6,0	129,3
2	Imereti	40,6	31,8	13,7	2,1	4,3	4,4	96,9
3	Guria	17,4	13,6	5,8	1,5	2,5	1,9	42,7
4	Samegrelo-Zemo Svaneti	31,9	29,9	10,7	2,1	2,2	3,5	80,3
5	Racha-Kvemo Svaneti	14,5	11,3	4,9	2,2	2,2	1,6	36,7
6	Shida Kartli	20,3	15,9	6,8	2,0	2,3	2,2	49,5
7	Kvemo Kartli	34,8	27,2	11,7	3,1	3,9	3,8	84,5
8	Kakheti	30,0	22,7	9,8	_	2,7	3,2	68,4
9	Samtskhe-Javakheti	14,9	11,4	4,9	1,8	1,5	1,6	36,1
10	Mtskheta-Mtianeti	11,6	9,1	3,9	_	2,0	1,3	27,9
11	Achara	15,9	11,2	7,2	1,7	1,5	2,3	39,8
12	Total	289,9	227,2	98,0	17,8	27,4	31,8	692,1

2003								
	Name	**Petrol**	**Diesel Fuel**	**Kerosene incl. Aviation**	**Mazut, Stove Fuel**	**Liquid Gas**	**Oils, Bitumen etc.**	**Total**
1	Tbilisi	56,1	43,9	18,8	3,4	5,2	6,2	133,6
2	Imereti	41,3	32,3	13,9	2,5	3,8	4,5	98,3
3	Guria	17,7	13,8	5,9	1,1	1,7	1,9	42,1
4	Samegrelo-Zemo Svaneti	32,4	25,4	10,9	1,9	3,0	3,6	77,2
5	Racha-Kvemo Svaneti	14,7	11,5	4,9	0,9	1,4	1,6	35,0
6	Shida Kartli	20,6	16,2	6,9	1,2	1,9	2,3	49,1
7	Kvemo Kartli	35,4	27,7	11,9	2,2	3,3	3,9	84,4
8	Kakheti	29,5	32,1	9,9	1,8	2,8	3,3	79,4
9	Samtskhe-Javakheti	14,7	11,5	4,9	0,9	1,4	1,7	35,1
10	Mtskheta-Mtianeti	11,8	9,2	4,0	0,7	1,1	1,3	28,1
11	Achara	20,7	7,5	7,7	1,5	2,2	2,4	42,0
12	Total	294,9	231,1	99,7	18,1	27,8	32,7	704,3

2004								
	Name	**Petrol**	**Diesel Fuel**	**Kerosene incl. Aviation**	**Mazut, Stove Fuel**	**Liquid Gas**	**Oils, Bitumen etc.**	**Total**
1	Tbilisi	58,1	45,5	19,5	3,6	5,5	6,4	138,6
2	Imereti	42,8	33,5	14,4	2,6	4,0	4,7	102,0
3	Guria	18,3	14,4	6,2	1,1	1,7	2,0	43,7
4	Samegrelo-Zemo Svaneti	33,6	26,3	11,4	2,0	3,2	3,7	80,2
5	Racha-Kvemo Svaneti	15,3	12,0	5,2	0,9	1,4	1,7	36,5
6	Shida Kartli	21,4	16,7	7,2	1,3	2,0	2,3	50,9
7	Kvemo Kartli	36,7	28,7	12,4	2,2	3,4	4,0	87,4
8	Kakheti	30,6	23,9	10,3	1,9	2,9	3,4	73,0
9	Samtskhe-Javakheti	15,3	11,9	5,1	1,0	1,5	1,7	36,5
10	Mtskheta-Mtianeti	12,2	9,6	4,1	0,7	1,1	1,3	29,0
11	Achara	21,5	17,1	7,5	1,4	2,2	2,5	52,2
12	Total	305,8	239,6	103,3	18,7	28,9	33,7	730,0

2005								
	Name	**Petrol**	**Diesel Fuel**	**Kerosene incl. Aviation**	**Mazut, Stove Fuel**	**Liquid Gas**	**Oils, Bitumen etc.**	**Total**
1	Tbilisi	59,0	44,5	19,9	3,6	5,6	8,2	140,8
2	Imereti	43,5	32,7	14,7	2,6	4,1	6,1	103,7
3	Guria	18,6	14,0	6,3	1,1	1,7	2,6	44,3
4	Samegrelo-Zemo Svaneti	34,1	25,7	11,5	2,1	3,2	4,7	81,3
5	Racha-Kvemo Svaneti	15,5	11,7	5,2	0,9	1,5	2,2	37,0
6	Shida Kartli	21,7	16,4	7,3	1,3	2,0	3,0	51,7
7	Kvemo Kartli	37,2	28,1	12,6	2,3	3,5	5,2	88,9
8	Kakheti	31,0	11,7	10,5	1,9	2,9	4,3	62,3
9	Samtskhe-Javakheti	15,5	5,8	5,2	0,9	1,5	2,1	31,0
10	Mtskheta-Mtianeti	12,4	9,3	4,2	0,7	1,2	1,7	29,5
11	Achara	22,0	34,3	7,5	1,6	2,1	3,2	70,7
12	Total	310,5	234,2	104,9	19,0	29,3	43,3	741,2

Table 35
Natural Gas Consumption by Regions for the Years 2001-2005, thousand cub.m

	Name	2001	2002	2003	2004	2005
1	Tbilisi	180 420	218 592	301 154	367 644	422 303
2	Kvemo Kartli	564 068	391 904	427 682	537 446	647 253
3	Mtskheta Mtianeti	39 191	38 512	59 432	79 776	61 148
4	Meskhet-Javakheti	3 012	3 676	3 659	4 549	5 725
5	Shida Kartli	29 594	26 713	39 715	73 970	140 665
6	Kakheti	3 788	5 128	5 120	8 702	10 714
7	Imereti	17 416	9 344	15 884	24 765	31 651
8	Guria	_	_	132	128	2 152
9	Achara	_	_	122	343	1 519
10	South Osetia	1 930	2 971	3 909	5 162	8 440
11	Samegrelo	223	_	_	_	_
12	**Total for Georgia**	839 642	696 840	856 809	1 102 485	1 331 570

Quarterly Distribution of Natural Gas in 2005					
	Quarter				
	1	2	3	4	Year
Natural Gas Consumption, thousand cub.m	592 548	170 442	182 425	386 155	1 331 570
Same in %	44,5	12,8	13,7	29,0	100,0

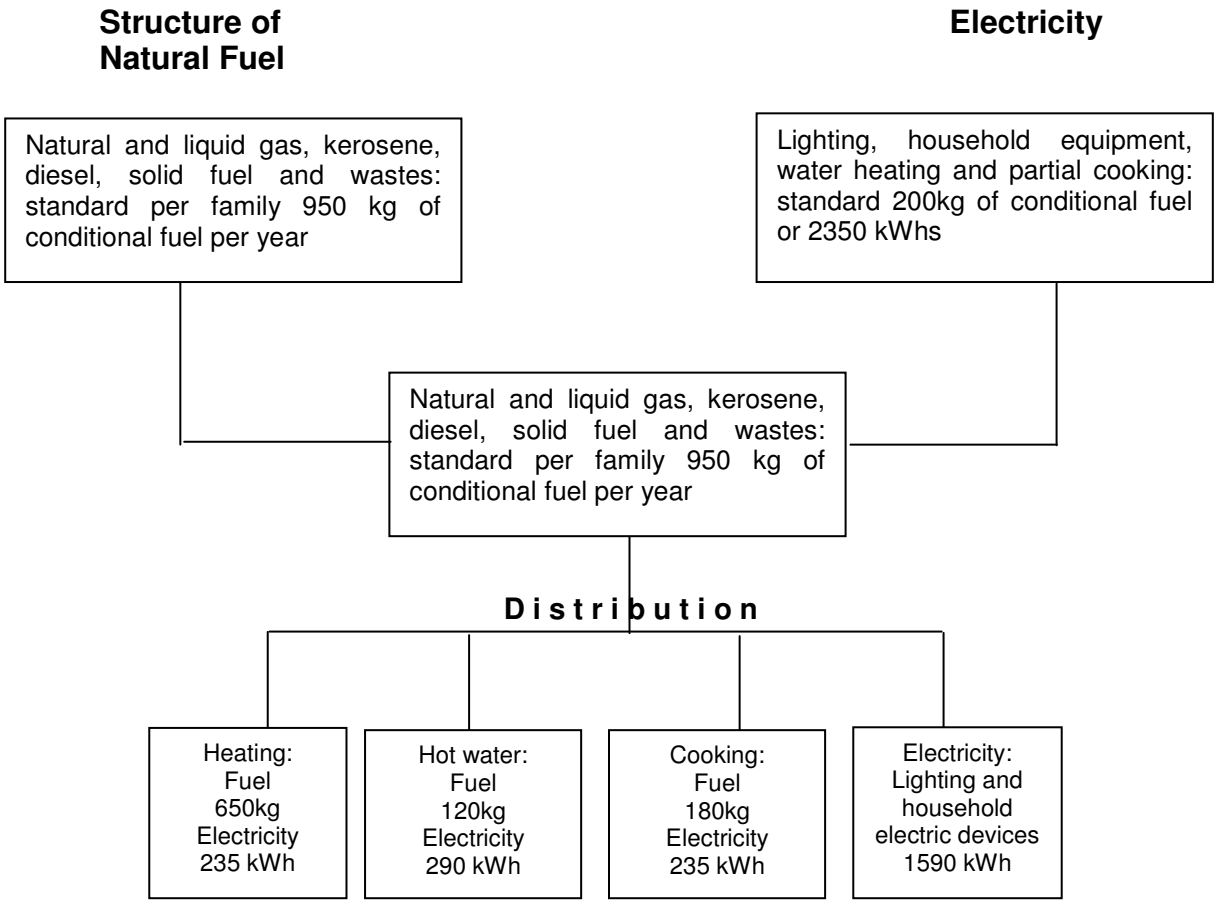
Table 36
Development Parameters for Economy of Georgia for 2001-2005

	Name	Years				
		2001	2002	2003	2004	2005
1	Nominal GDP, million GEL	6 674,0	7 456,0	8 564,1	9 969,8	10 800,0
	GDP per Head, GEL	1 445,0	1 625,9	1 880,0	2 198,3	2 391,0
2	Increase Rate of GDP, %	100,0	111,7	114,8	116,4	108,8
3	Industry Production, million GEL	1 154,8	1 308,4	1 549,9	1 754,2	2 045,1
4	Agriculture	2 101,8	2 156,4	2 483,4	2 437,0	2 496,0
5	Consumer Price Index, %	103,4	105,4	107,0	107,5	106,2
6	Unemployment, %	11,1	12,3	11,5	12,6	13,8
7	Employed Persons, thousand	1 877,7	1 839,5	1 814,5	1 783,0	1 737,7
8	Monthly Cash Income of Population, million GEL	162,2	210,2	218,6	236,9	259,5
9	Nominal Average Monthly Salary, GEL	94,4	114,0	125,9	156,8	167,4
10	Cost of living for men able to work, GEL	118,0	127,9	136,0	150,5	156,2
11	Average Cost of Living, GEL	103,5	112,2	119,4	132,0	137,0

Table 37
Several Macro Economic Parameters of the Energy Sector of Georgia - Years 2001-2005

Year	Population, persons	GDP, mln. GEL	Energy Consumption, thous. tones of cond. fuel	Including				Energy-intensivity of GDP, kg/GEL	Consumption per Head, kg of cond. fuel					Share of Energy in GDP, tetri/GEL	Total Cost of Energy for End Consumer, million GEL
				Oil Products	Natural Gas	Electricity	Other Resources		Oil Products	Natural Gas	Electricity	Other Resources	Energy, total		
2001	4 401,4	6 638,0	2 259,0	675,0	715,0	531,0	338,0	0,3	153,0	162,0	121,0	77,0	513,0	15,9	1 055,0
2002	4 371,5	7 448,0	2 255,0	692,0	575,0	581,0	407,0	0,3	158,0	132,0	133,0	93,0	516,0	15,6	1 162,0
2003	4 342,6	8 565,0	2 518,0	704,0	831,0	589,0	394,0	0,3	162,0	191,0	136,0	91,0	580,0	16,2	1 387,0
2004	4 315,2	9 758,0	2 665,0	730,0	949,0	601,0	389,0	0,3	169,0	220,0	139,0	90,0	618,0	17,9	1 747,0
2005	4 289,1	10 809,0	2 926,0	741,0	1 174,0	637,0	374,0	0,3	173,0	273,0	148,0	87,0	681,0	20,1	2 162,0

Table 38
Structure of Household Energy Basket
for Medium Size Family (4 persons)
in 2005



Household (Family) Energy Consumption Scenario in Georgia

	Resources	Heating		Hot water		Cooking		Lighting, household electric devices	Total Annual Payment, GEL
		Qty.	Qty.	Qty.	Qty.	Qty.	Qty.		
1.	Natural gas, m^3 Electricity, kWh	806 235	290 33	149 290	54 41	223 235	80 33	223	754
2.	Liquid fuel, kg Electricity, kWh	650 235	845 33	120 290	156 41	180 235	234 33	223	1565
3.	Liquid gas, kg Electricity, kWh	575 235	920 33	106 290	170 41	159 235	254 33	223	1674
4.	Coal, kg Electricity, kWh	1300 235	130 33	240 290	24 41	360 235	36 33	223	520
5.	Wood, m^3 Electricity, kWh	7 235	175 33	1.3 290	33 41	1.9 235	48 33	223	586

Note:
Accounting prices: Natural gas - 0.36 tetri/m^3
Liquid fuel average - 1.3 GEL/l
Liquid gas - 1.6 GEL/kg
Coal - 25 GEL/m^3
Electricity – 0.14 GEL/kWh.

7.3 Charts

7.3.1 Soviet Period (Years 1960-1990)

Production and Consumption of Fuel and Energy Resources in Georgia
thousand tones of conditional fuel (coal equivalent)

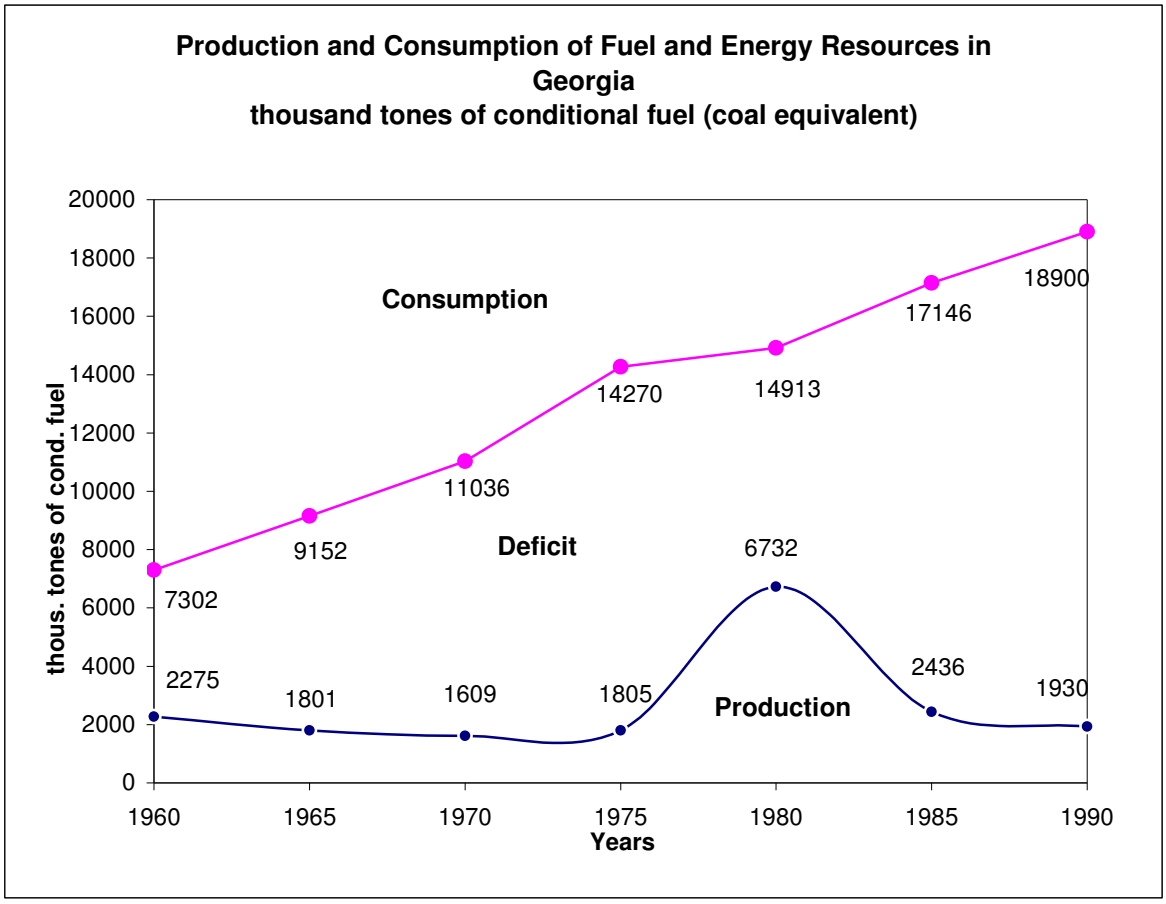
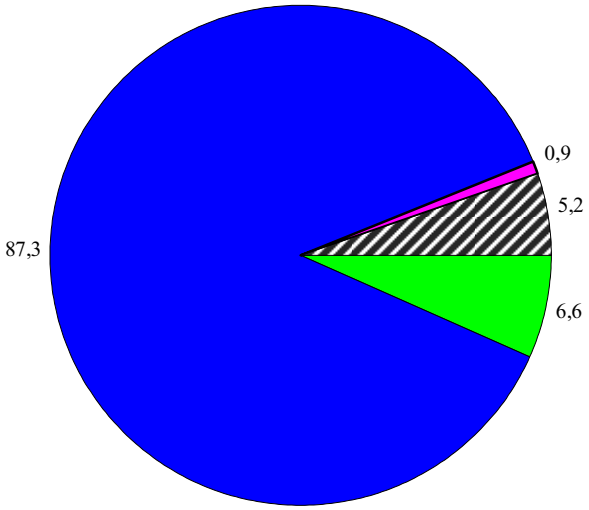


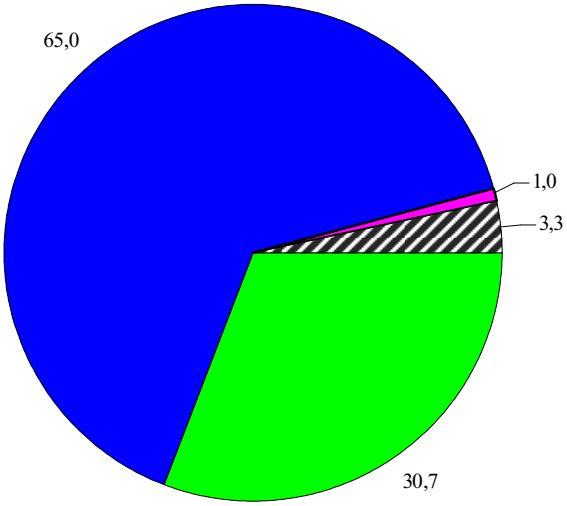
Fig. 1

Sources of Formation of Fuel and Energy Resources (%)

1975



1980

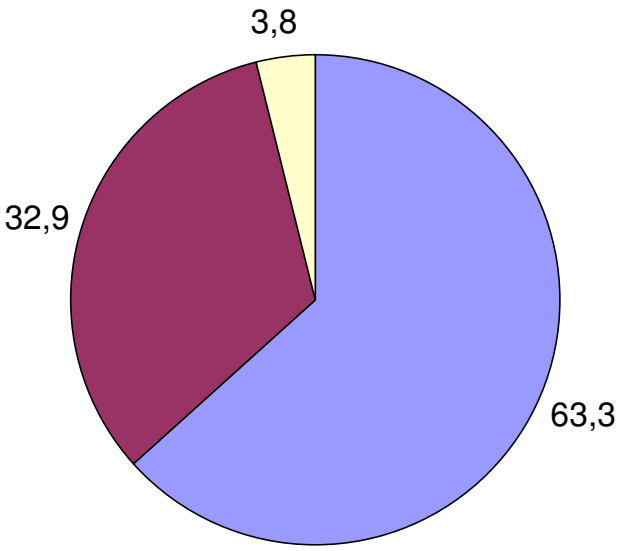


- Fuel and Hydro Energy Production (Exploration)
- Import from other Republics
- Other Sources
- Balance at the Beginning of the Year

Fig. 2

Distribution Of Fuel And Energy Balance (%)

1975



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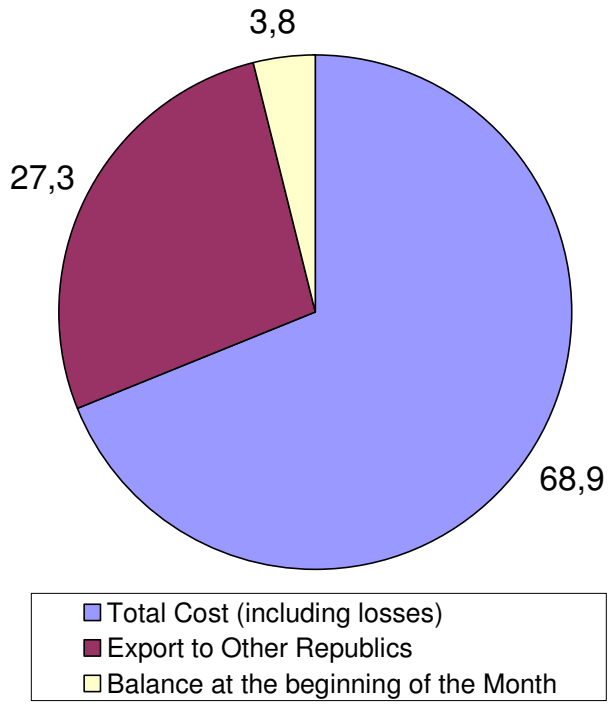
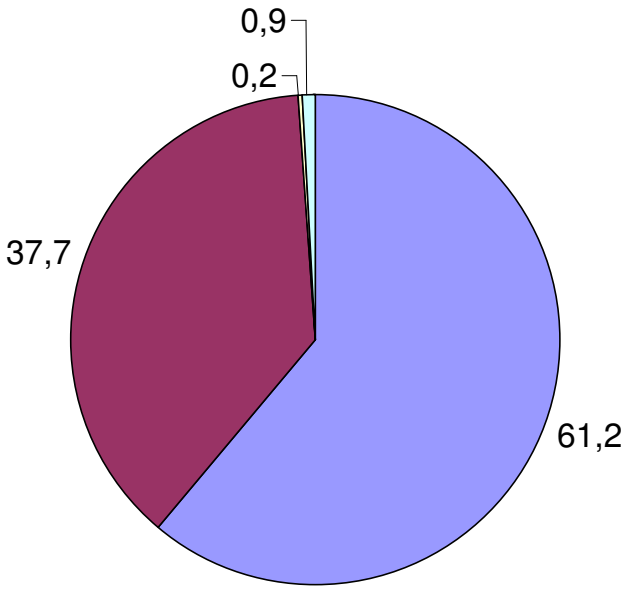


Fig. 3

The Structure of Fuel and Energy Resources (%)

1975



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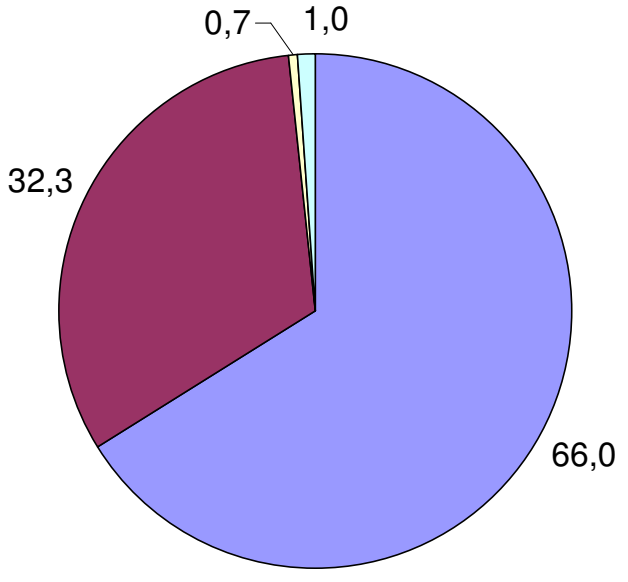


Fig. 4

Changes in the Production Structure for Natural Fuel Resources Years 1970-1080, %

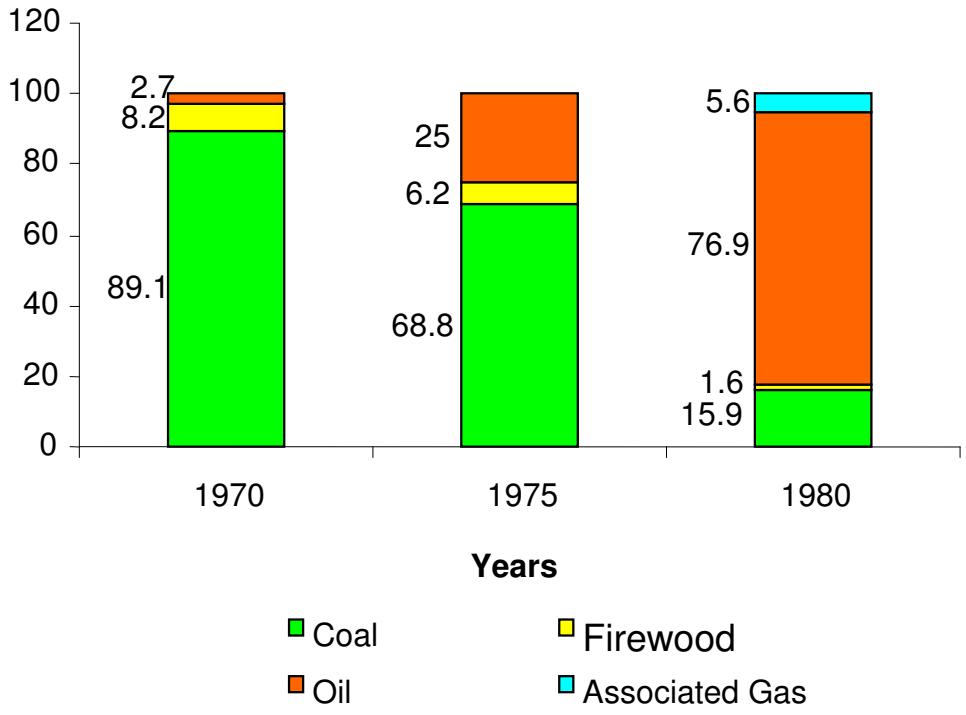
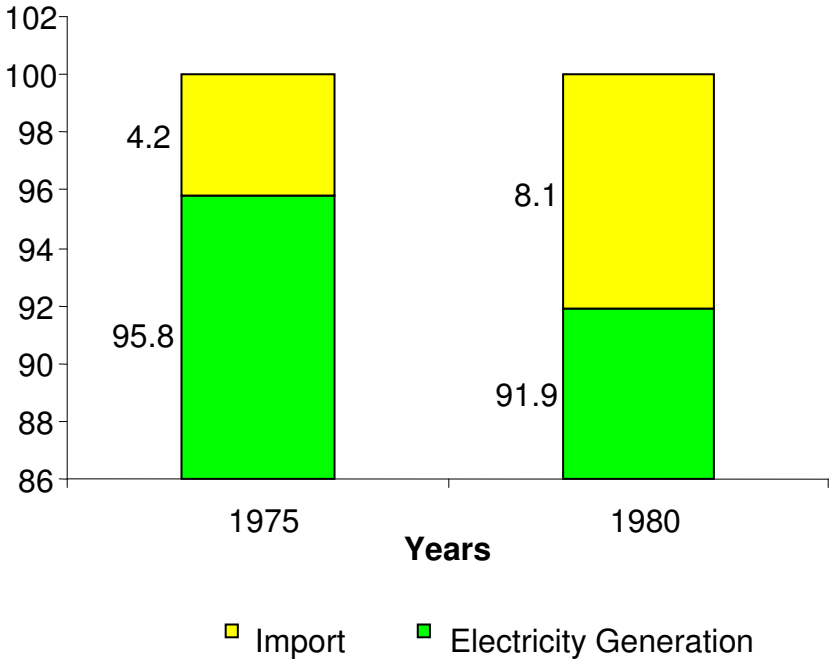


Fig. 5

Electricity Balance of Georgia, %
1. Resources



Electricity Balance of Georgia, %
2. Distribution

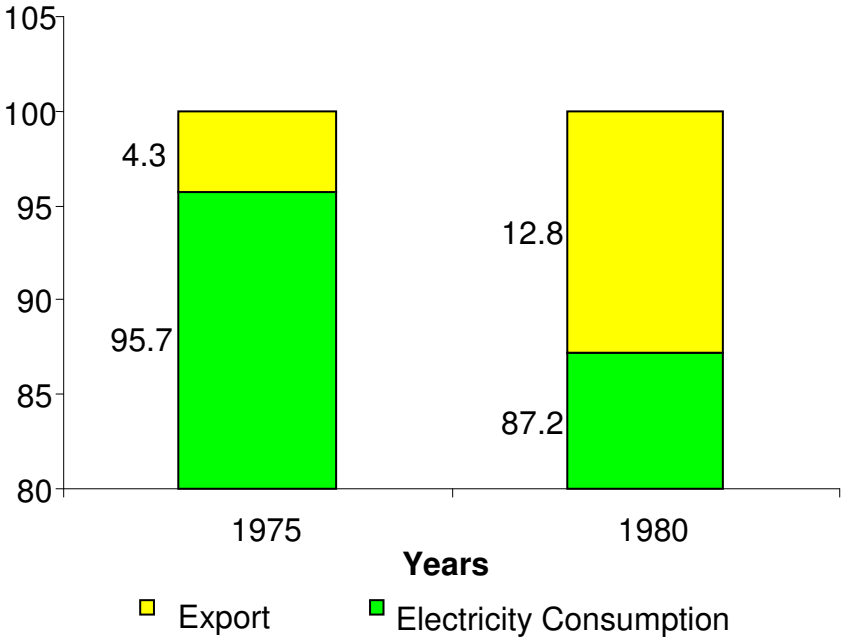
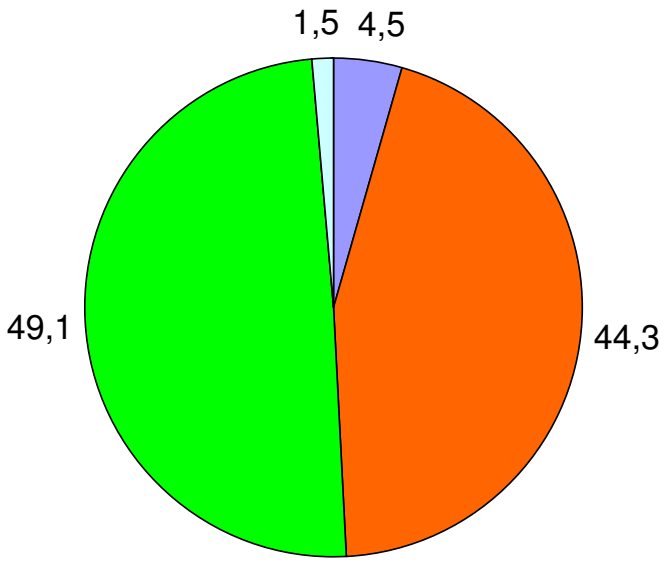


Fig. 6
Share of Different Types of Fuel Resources in the Total Consumption, %

1975



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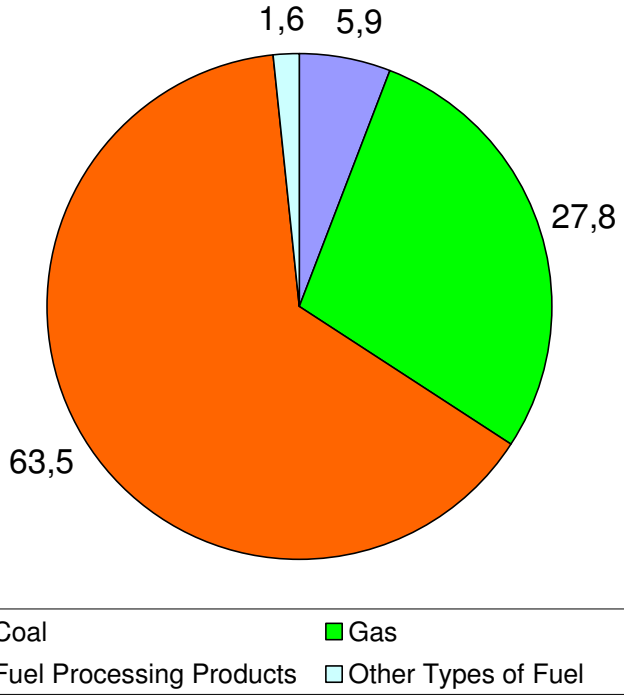
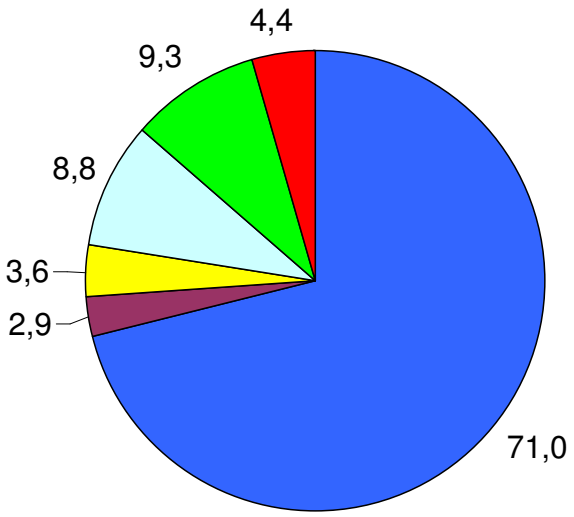


Fig. 7

Fuel Consumption in Georgia by Setors, %
1975



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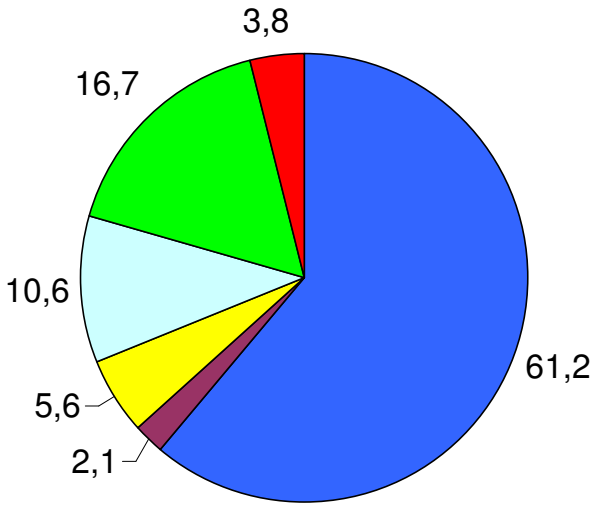


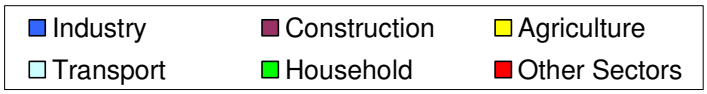
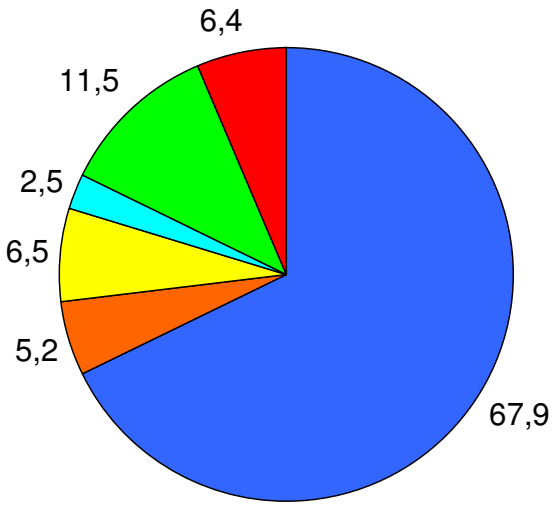


Fig. 8

Electricity Consumption in Georgia by Setors, %
1975



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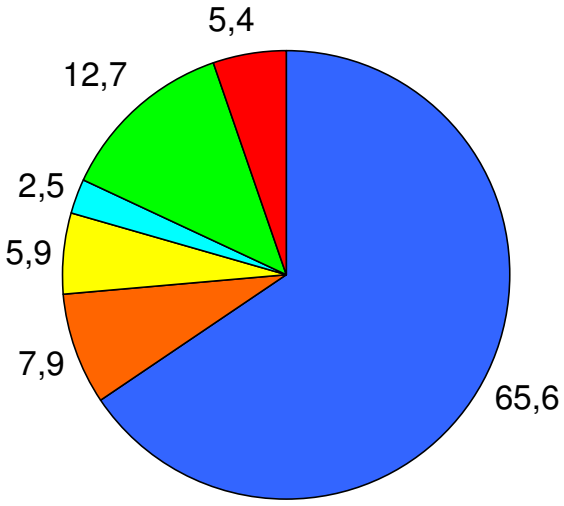


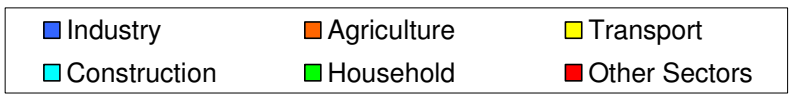
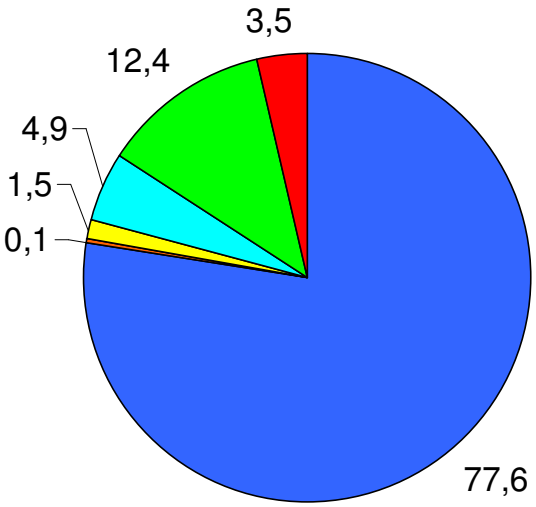


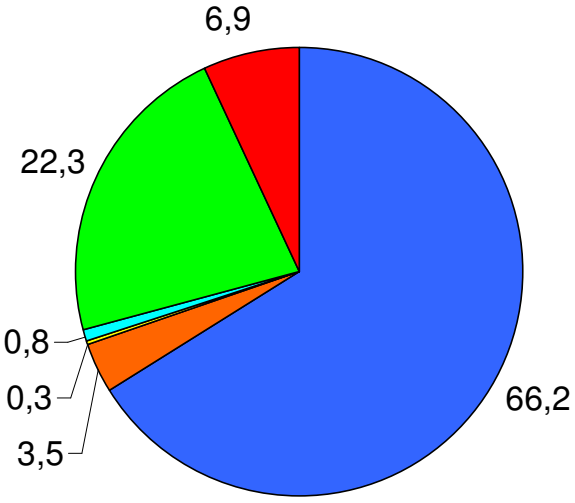
Fig. 9

Heat Energy Consumption in Georgia by Sectors, %

1975



1980



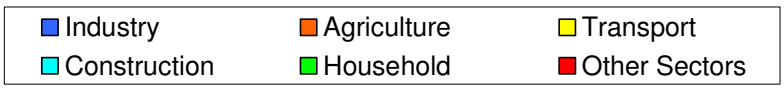
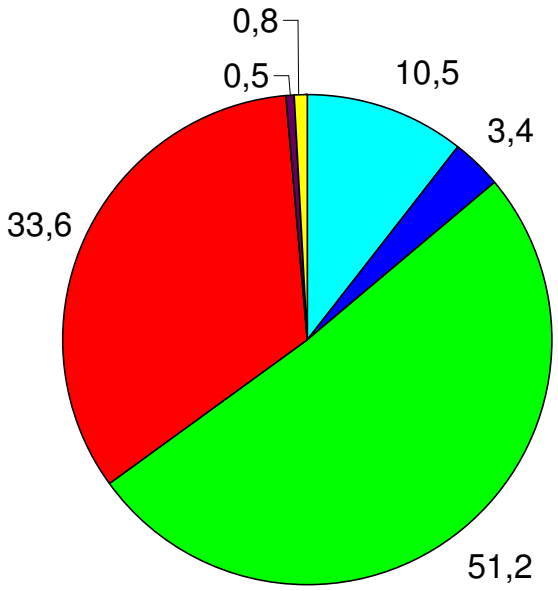


Fig. 10

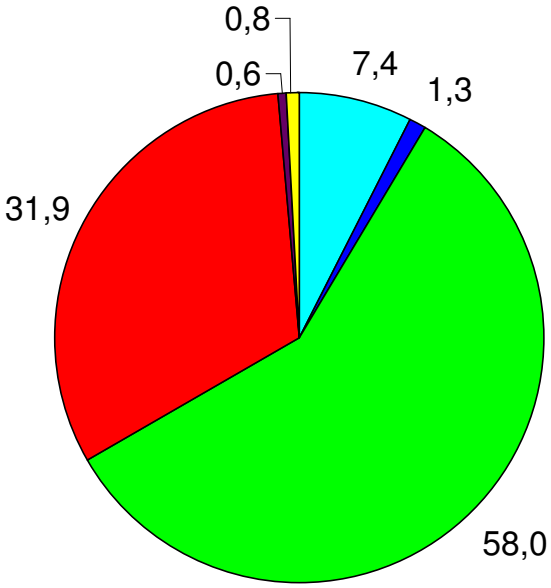
7.3.2 Years of Independency (1991-2005)

Structure of Local Production of Energy Resources (%)

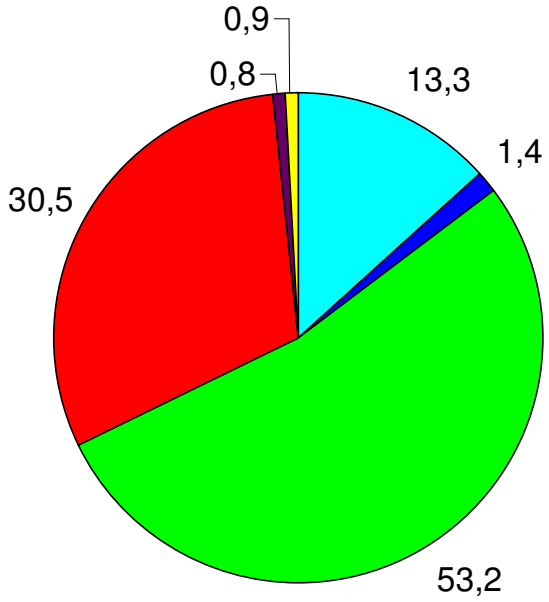
Year 2001 – 936 Thousand Tones of Conditional Fuel



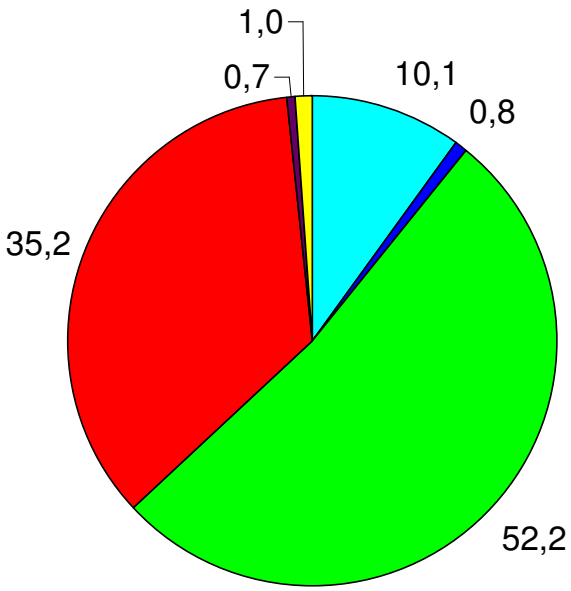
Year 2002 – 1000 Thousand Tones of Conditional Fuel



Year 2003 – 1054 Thousand Tones of Conditional Fuel



Year 2004 – 971 Thousand Tones of Conditional Fuel



Year 2005 – 972 Thousand Tones of Conditional Fuel

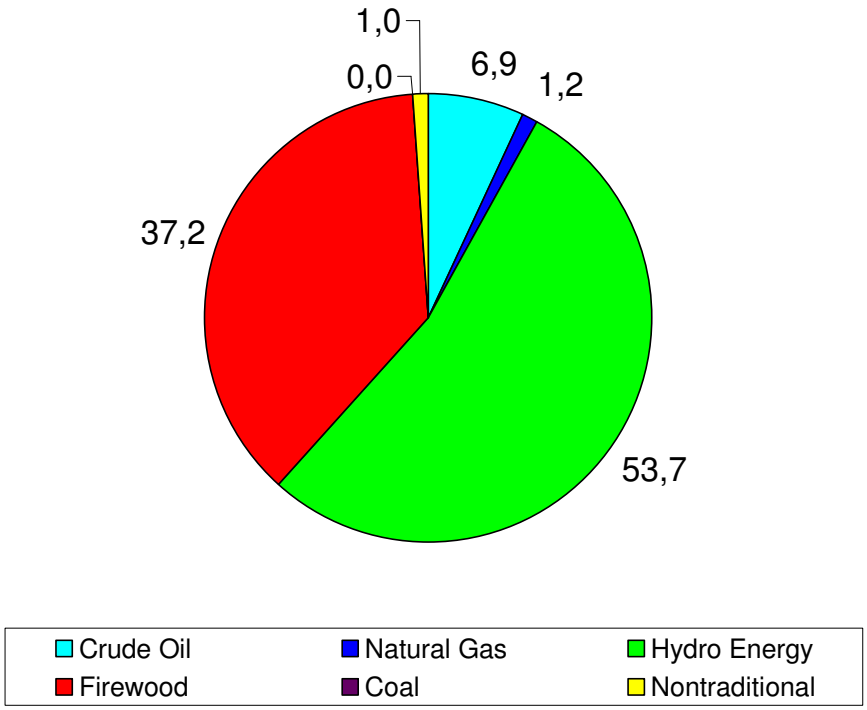
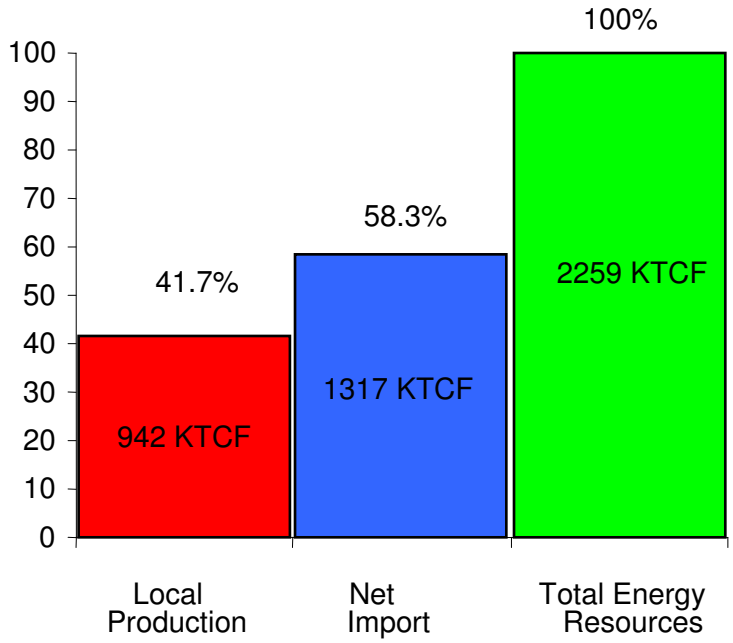


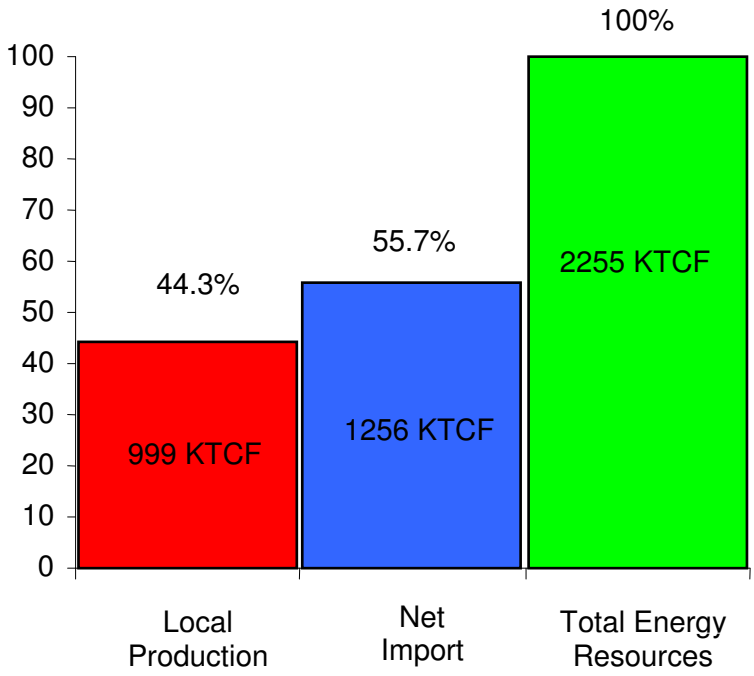
Fig. 11

Structure of Primary Energy Resources

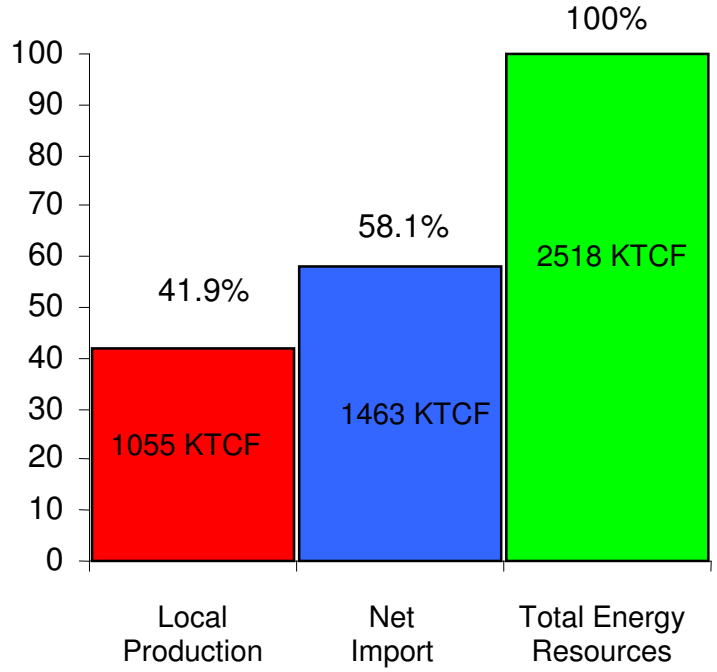
2001



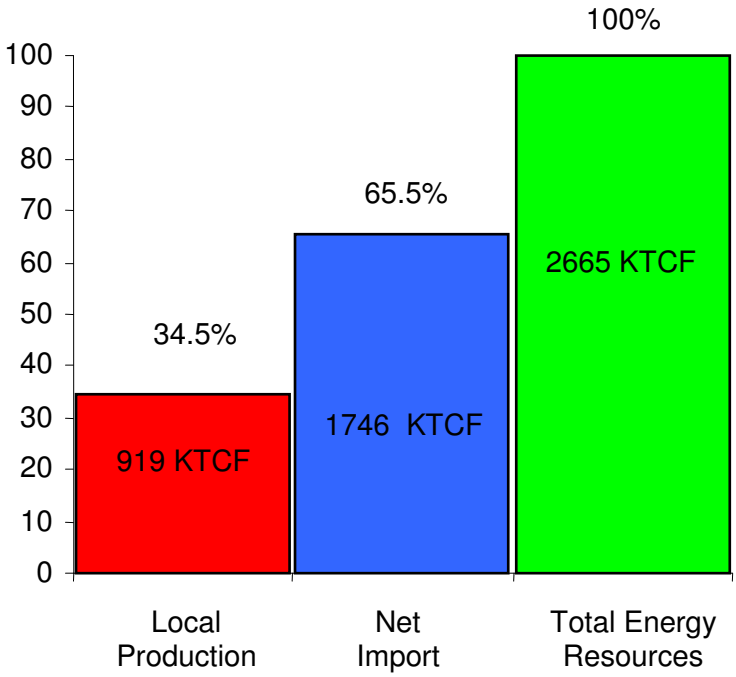
2002



2003


100%
100
90
80
70
60
50
40
30
20
10
0
58.1%
41.9%
2518 KTCF
1463 KTCF
1055 KTCF
Local Production
Net Import
Total Energy Resources

2004


100%
100
90
80
70
60
50
40
30
20
10
0
65.5%
34.5%
2665 KTCF
1746 KTCF
919 KTCF
Local Production
Net Import
Total Energy Resources

2005

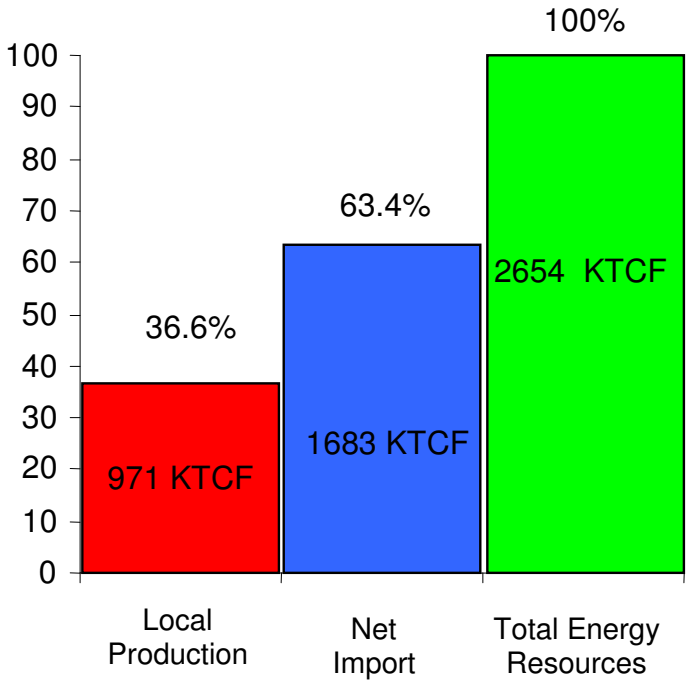

100%
100
90
80
70
60
50
40
30
20
10
0
63.4%
36.6%
2654 KTCF
1683 KTCF
971 KTCF
Local Production
Net Import
Total Energy Resources

Fig. 12

Demand on Oil Products
(Thousand Tones of Conditional Fuel)

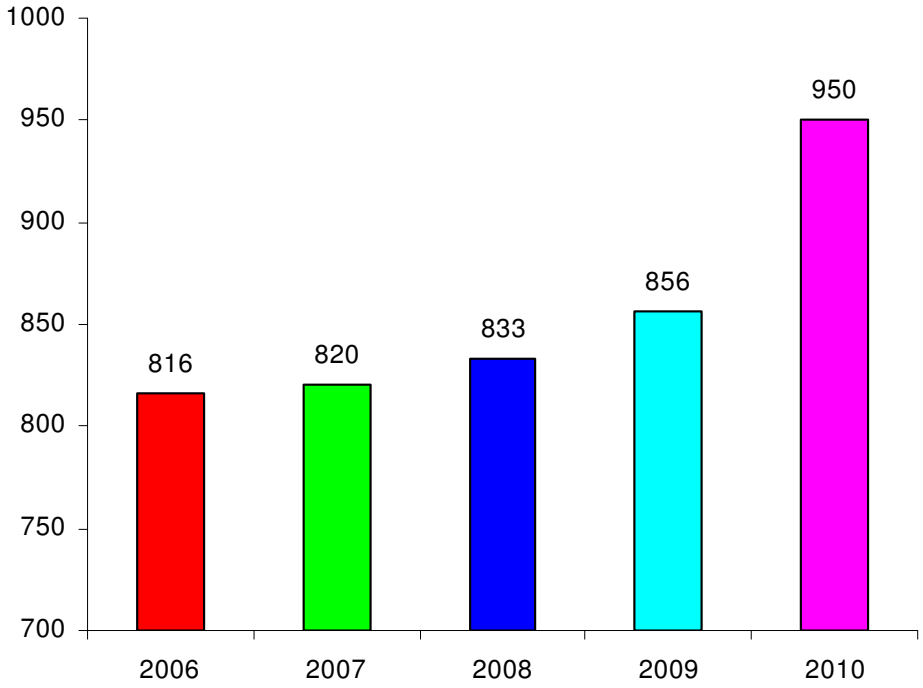


Fig. 13

Demand on Natural Gas
(Thousand Tones of Conditional Fuel)

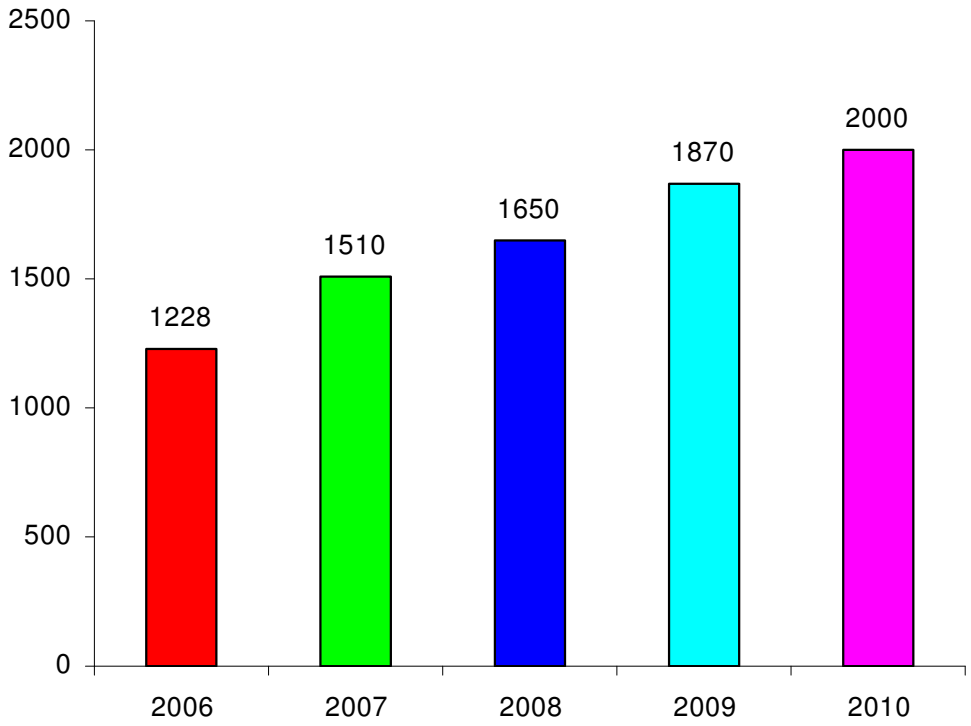


Fig. 14

Demand on Electricity
(Million kWhs)

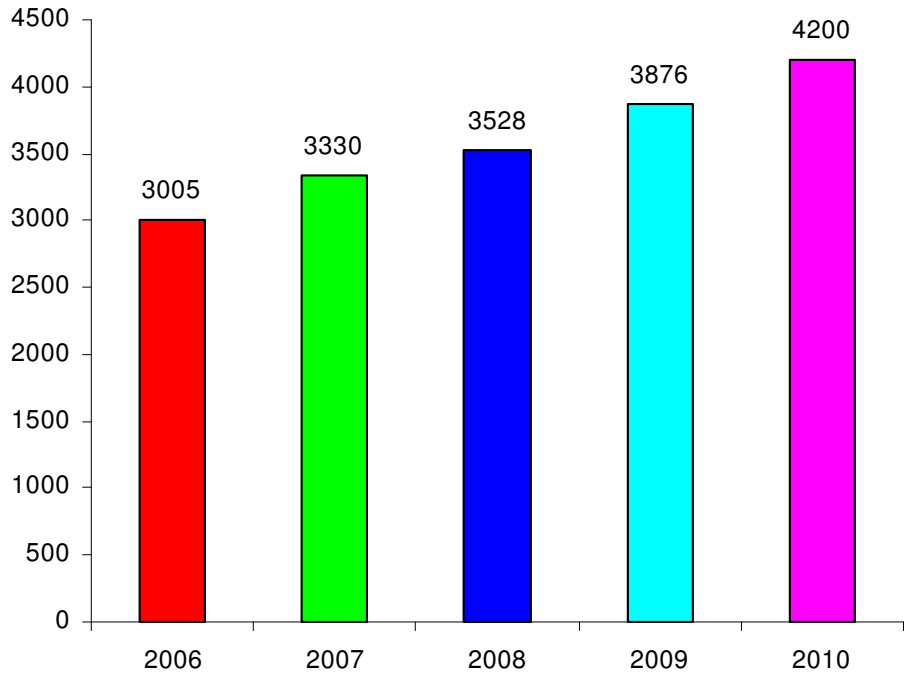


Fig. 15

Information Channels of The Energy Balance

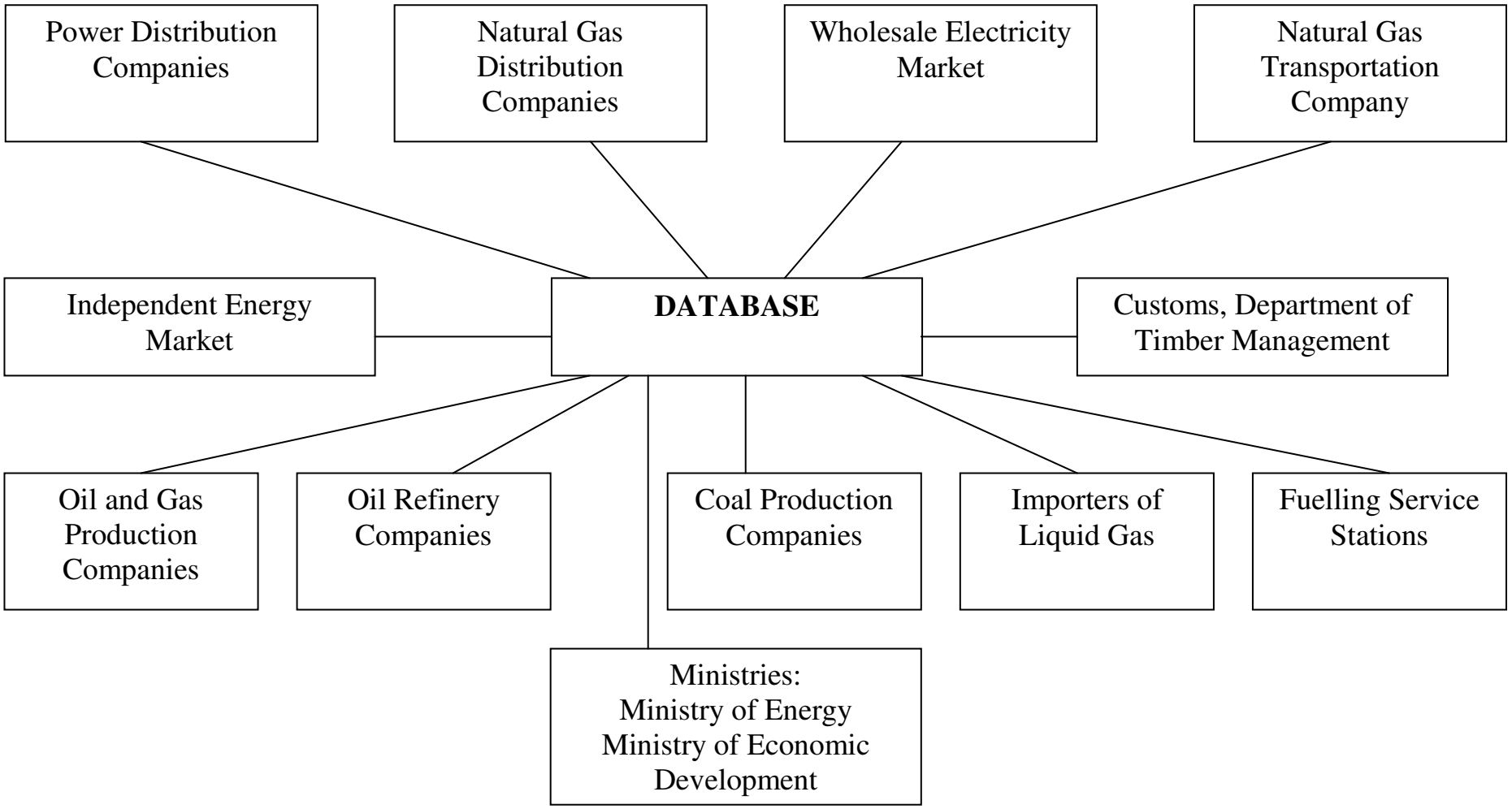


Fig. 16

Calories and Price Proportions in Case of Substitution of Energy Resources (based on the data of July, 2006)

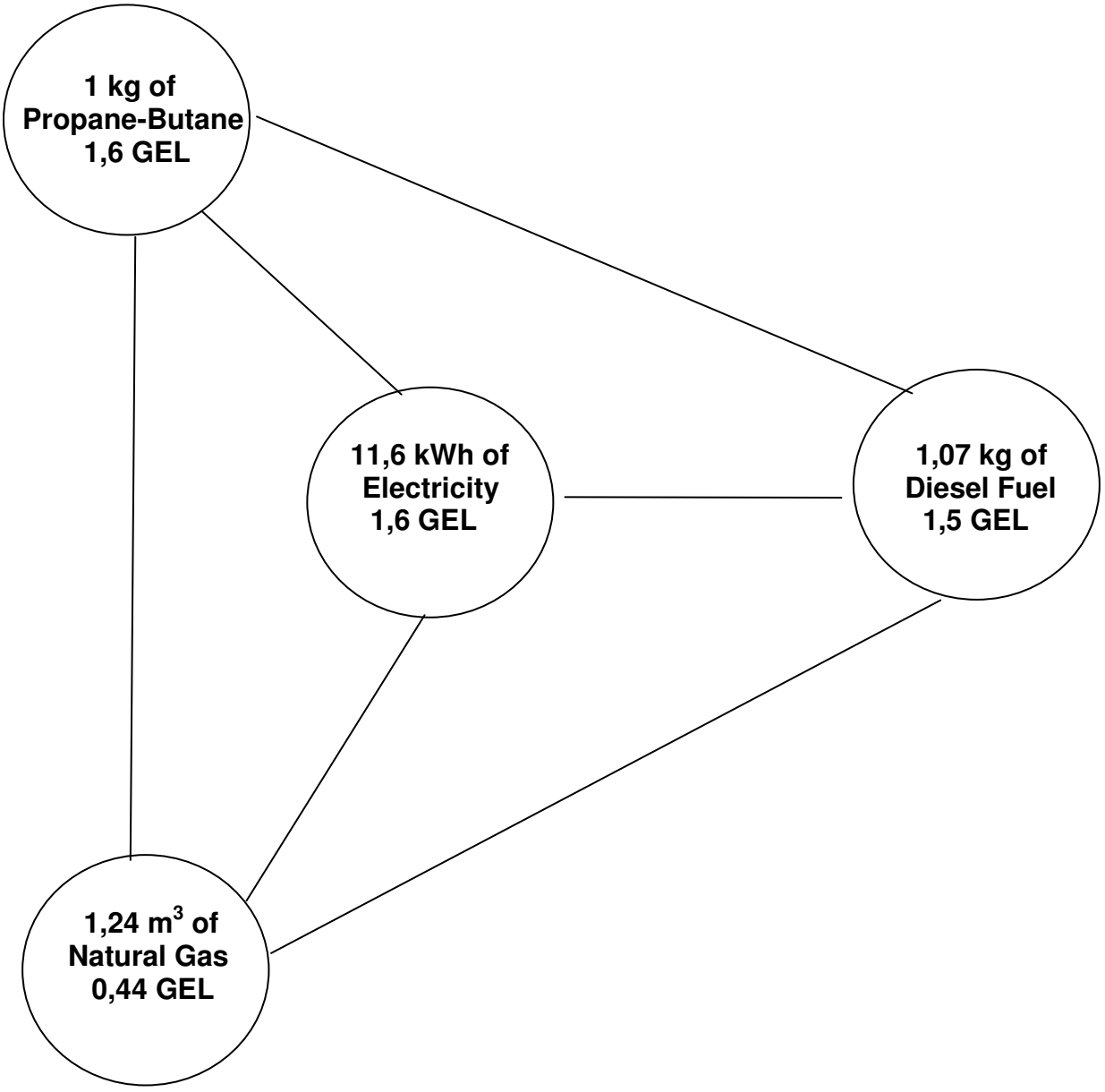


Fig. 17