

1.1. Uzbekistan's energy policy

Since the beginning of independence, the Government of Uzbekistan has implemented its energy policy as part of its socio-economic policy, focusing it largely on maintaining Uzbekistan's energy security and using energy resources to further the social aims of the society of Uzbekistan.

Despite difficulties that arise when new economic relationships are being created and financial resources are limited, the Government has been highly supportive of the country's core industrial sectors, particularly enterprises in the fuel-energy market where Government policy has focused on achieving its main energy strategy priorities, namely, to:

- achieve fuel independence by increasing petroleum and natural gas condensate output;
- create a reliable raw materials base for the energy sector;
- maximize the public's access to natural and liquefied gas, electricity and the latest types of fuels;
- promote the financial stability of and attract more investments in the energy sector;
- develop the energy sector's legal framework and improve its financial-taxation system, taking into account the peculiarities of price formation and how the energy sector interacts with closely allied sectors;
- use energy resources more efficiently; and
- promote competition in the energy sector by consistently establishing entities that are genuine market entities and consistently building an economic infrastructure that is a genuine market economy infrastructure.

To achieve the above-mentioned priorities, a number of major energy projects have been com-

pleted: the Kokdumalak petroleum condensate field has been brought online; the Bukhara Oil Refinery has been built; sulphur scrubbers have been installed at the Mubarek Natural Gas Refinery; and a power-generating unit has been completed at the Novoangren Thermal Power Plant. New petroleum pipelines, long-distance natural gas pipelines and electric power transmission lines have gone into operation along with other energy sector production and public services facilities. Rural settlements are obtaining access to natural gas on an expedited basis.

By the mid-1990s, as a result of Government measures, energy policy strategic goals adopted by the Government during the early years of independence had been achieved: energy independence and reorientation of the fuel-energy market to achieve society's priority social goals.

At the same time, the following administrative measures were taken to improve the management and efficiency of the economy's energy sector:

- all enterprises and organizations in the electricity sector were brought under the jurisdiction of the Ministry of Energy and Electrification of Uzbekistan;
- The national oil and gas company Uzbekneftegaz, made up of petroleum, petroleum refining and natural gas enterprises, was founded and was subsequently reorganized as a national corporation;
- The Central Asian Coal Association Sredazugol was reorganized as the Joint Stock Coal Association Ugol; and
- A Cabinet of Ministers of Uzbekistan Special Committee was created to deal with economic matters concerning fuel and energy resources.

In the years that followed, a strategy for meeting the

country's energy needs was formulated to coordinate mining and production of all basic energy resources with priority emphasis on making the natural gas industry economically the most efficient and environmentally the cleanest source of energy in Uzbekistan over the next twenty years (the Export Potential Development Program, 1998).

In addition, recognition was given to the special role the fuel-energy market plays as the foundation for the country's sustainable economic development and for expansion of its export potential needed for the economy to function efficiently and to meet economic development priorities (Cabinet of Ministers of the Republic of Uzbekistan Program of Measures for Managing the Performance of the General Economic Complex, 2000).

For these purposes as well as for purposes of improving the quality and reliability of energy consumers are provided and to continue progress towards a market economy while stepping up measures to attract foreign investments, the following reorganization measures were taken in the administrative-management structure of the sector:

- The National Corporation Uzbekneftegaz was reorganized into the National Holding Company Uzbekneftegaz while state operated and state stock companies and enterprises of corporations were reorganized into stock companies (1998). These stock companies incurred responsibility for the efficient management of government property and government shareholdings in the petroleum-gas sector; and
- The state stock power company Uzbekenergo, created within the hierarchy of the Ministry of Energy and Electrification, absorbed the stock company Ugol (2001). Uzbekenergo's main objectives were defined as promoting a sustainable economy, providing the country with electricity and developing and promoting the adoption of renewable energy sources.

A number of other national and sector projects and programs have been devised and are being implemented to develop the power, petroleum, natural gas and coal industries, e.g., major projects such

as the Program to Develop and Reconstruct Power Generating Capacity in Uzbekistan's Energy Sector, 2001-2010, and the Program to Develop the Coal Industry of Uzbekistan, 2002-2010.

In view of the fact that over 60% of Uzbekistan's population lives in rural areas [4], a great deal of attention is paid to matters regarding supplying rural areas with energy. Since independence was gained, major efforts have been devoted to gasification of rural settlements and as a result by 2003, 86.3% of the rural population had natural gas [5]. Efforts have been made in recent years to implement the Program to Supply Rural Settlements with Natural Gas for the period 2003-2005, and the Program to Supply Liquefied Gas and Other Forms of Fuel to Remote Hard to Reach Sparsely Populated Rural Settlements for the Period 2003-2005. The goal of the first program was to supply all rural settlements, where construction of a gas system is economically feasible, with natural gas by 2006. The second program is to provide 1,191 remote hard to reach sparsely populated rural settlements with a steady supply of liquefied gas, coal and other types of fuel.

As a result of consistently pursuing an energy policy based on the concept of implementing reforms step-by-step, Uzbekistan has been able in a relatively short time to make its fuel-energy market function in a sustainable fashion and to develop in a stable manner.

Nonetheless, for the country to be able to maintain its energy independence and its export potential, it is imperative that problems concerned with using energy resources more efficiently and creating the conditions for the adoption of renewable energy sources be solved.

The urgency of these issues was underlined in the Government of the Republic of Uzbekistan's Resolution on the Results of Socio-economic Development in 2005 and on the Most Important Priorities for Adding Impetus to the Economic Reforms in 2006. The Resolution calls for the drafting and adoption of a Program of Specific Measures for the Economical Use of Energy Resources for the Period 2006-2010, including widespread application of non-traditional and alternative energy sources.

1.2. Energy resources

Renewable energy sources should be adopted as an integral part of the overall energy sector development strategy which delineates the role and place of renewable energy sources in the country's current and future energy balance taking into account the technological potential of renewable energy.

Modern Uzbekistan's energy sector is well developed. In terms of the amount of natural gas production, Uzbekistan ranks among the world's top 10 producers. [6, 7] As much as 50% of the power gen-

erating capacity in the united power grid of Central Asia and Southern Kazakhstan [8] is concentrated in Uzbekistan and the amount of primary fuel-energy resources produced exceeds 55 million t.o.e. (Table 1.1, calculation based on data in [9]).

As the data on primary energy resources production in Table 1.1 and Figure 1.1 show, natural gas is the Republic of Uzbekistan's main source of primary energy, constituting nearly 85% of the total amount of energy it produces.

Table 1.1

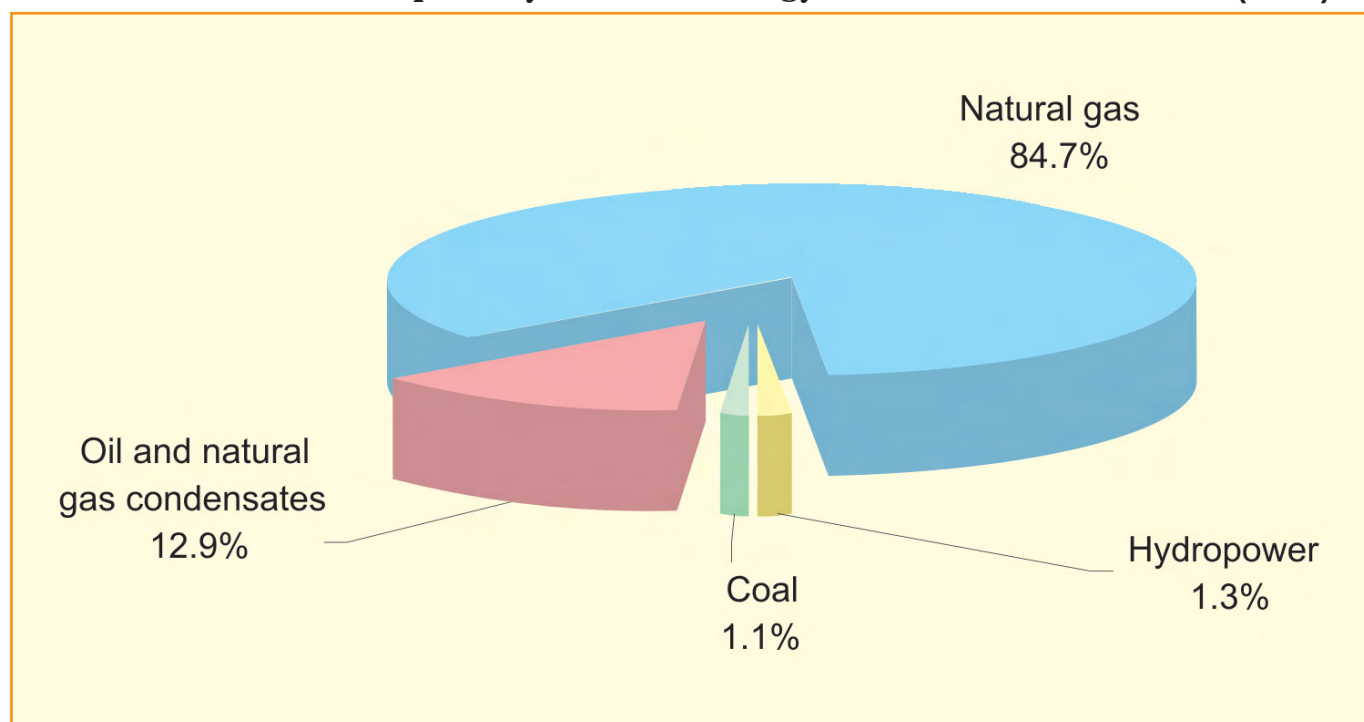
Production of primary fuel-energy resources

(in millions of t.o.e.)

Primary fuel-energy resources	2001	2002	2003
Breakdown:			
Oil, including natural gas condensate	7.2	7.3	7.2
Natural gas	46.6	48.4	47.1
Coal	0.8	0.8	0.6
Hydropower	0.5	0.6	0.7
Total production	55.1	57.2	55.6

Figure 1.1

Production structure of primary fuel and energy resources in Uzbekistan (2003)



Oil and natural gas condensate make up about 13% of the country's primary energy production. The rest is made up of electricity, produced at hydro power plants, and coal. The latter, used mainly at the Angren and Novoangren thermal power plants, is also used by a number of boiler plants as well as the public.

The measures Uzbekistan took during its first years of political independence to ensure its fuel independence made it possible to significantly increase the country's output of natural gas, oil and natural gas condensate. As a result, in 2003 Uzbekistan produced 58.1 billion cubic meters of natural gas and 7.2 million tons of oil (including natural gas condensate), compared with 42.8 billion cubic meters of gas and 3.3 million tons of oil (including natural gas condensate) in 1992 [9].

By 1996 Uzbekistan was no longer an importer of fuel resources of any kind. Despite a significant reduction in coal production, an increase in liquid and gaseous hydrocarbon supplies has made it possible to provide the economy and people of Uzbekistan with a sustainable energy supply.

According to the National Holding Company Uzbekneftegaz data, 85% of the natural gas produced in Uzbekistan goes to domestic consumers, and the

rest is exported [10]. In 2003 natural gas exports totaled over 7.4 billion cubic meters [11].

Using these data, one can calculate Uzbekistan's total domestic energy consumption as being 49 to 50 million t.o.e (Box 1.1).

At present, hydropower is the only renewable energy source with a significant share in Uzbekistan's energy balance. The other kinds of renewable energy – solar, wind and biomass – are used so little that they are omitted from official statistics.

Box 1.1

Coefficients for converting quantitative indicators of energy resources into oil equivalent (for Uzbekistan)

Energy Resource	Unit	t.o.e.
Oil	1 ton	1.0050
Natural gas	1000 m ³	0.8112
Lignite	1 ton	0.3007
Bituminous coal	1 ton	0.5940
Electricity	1 MWh	0.0860

1.3. Energy infrastructure overview

Uzbekistan's fuel-energy market includes the National Holding Company Uzbekneftegas's and State Stock Company Uzbekenergo's enterprises and organizations which produce (extract) and supply consumers with oil, natural gas, coal and products made from them, in addition to hydropower. Enterprises under the jurisdiction of local authorities supply tenant-clients with heat.

The fuel industry's raw material base consists of over 190 oil fields, natural gas condensate fields, natural gas fields, lignite and coal fields. The total reserves of these fields are estimated to be between 2.2 and 5.1 billion t.o.e., including: 82 - 245 million

t.o.e. of oil, 1,476 – 1,979 million t.o.e. of natural gas, and 639 – 2,851 million t.o.e. of coal. [6, 10, 12, 13, 14]

By conservative estimates, the current rate of oil production is expected to last for another 10 to 12 years, while natural gas production is expected to last for the next 28 to 30 years. Coal reserves can last for a longer period of time but increasing the share of coal in the energy balance will require significant investments and may cause further environmental degradation in places where coal is burned and increase greenhouse gas emissions.

Meeting consumer fuel demands

The National Holding Company “Uzbekneftegaz” provides consumers with petroleum products, natural gas and liquefied gas while the Joint stock Company “Ugol” provides lignite and coal.

Raising hydrocarbon output in 2003 to 54.3 million t.o.e. (calculation based on data in [9]) was possible as a result of the reorganizations that took place within the oil and natural gas sector. Natural gas made up 86.7% (Figure 1.2) of total hydrocarbon production, giving natural gas the largest share of primary energy used in Uzbekistan: over 80% of Uzbekistan’s total energy demand is for natural gas.

Natural gas is used not only as an energy source but also as a raw material for Uzbekistan’s petrochemical manufacturing plants: e.g., the Mubarek Gas Refinery (which began production in 1972), the Shurtan Gas Plant equipped with sulfur scrubbers (1980) and the Shurtan Petrochemical Plant (2001) which is Central Asia’s largest manufacturer of polyethylene.

Uzbekistan’s three oil refineries with a combined refining capacity is 11.2 million tons of oil and natural gas condensate per year [10] manufacture a variety of petroleum products. These refineries use Uzbekistan’s oil and natural gas condensate output as raw materials.

Uzbekistan boasts a well developed and sizeable system of long-distance natural gas pipelines and

pipeline bleeders as well as a distribution network for transporting natural gas from gas fields and refineries to consumers in Uzbekistan and abroad, (Annex 1). The length of its long-distance natural gas pipelines totals over 13 thousand km. Compressor stations run by about 250 units with electric and gas turbine drives operate the natural gas pipeline system [10]. A distinctive feature of the natural gas transport system is that it plays an important role between states by transporting natural gas from Uzbekistan and Turkmenistan to the neighboring states of Kazakhstan, Kyrgyzstan and Tajikistan as well as to Russia and Ukraine.

To accommodate seasonal variations in natural gas use, there is a network of underground natural gas storage facilities.

The Joint Stock Company “Ugol”, comprised of five coal mining enterprises, engages in coal mining. Three coal mining technologies are used at the Angren coal field (Tashkent oblast): open pit mining at the Angren strip mine, underground mining at Mine #9, and underground coal gasification at the Podzemgaz installation. Two other coal mining enterprises, located in Surkhandarya oblast, use the underground mining method.

As Figure 1.3 shows, since the time independence was gained, coal production and consumption have decreased significantly in Uzbekistan [18].

The State Stock Company Uzbekenergo’s power plants are Uzbekistan’s biggest coal consumers, consuming 80% of the country’s coal output [19].

As a result of the reforms underway to modernize, reconstruct and retool the coal sector’s enterprises, coal production is to increase gradually, reaching 9.4 million tons by 2010 [19].

Figure 1.2

Structure of hydrocarbon production in Uzbekistan (2003)

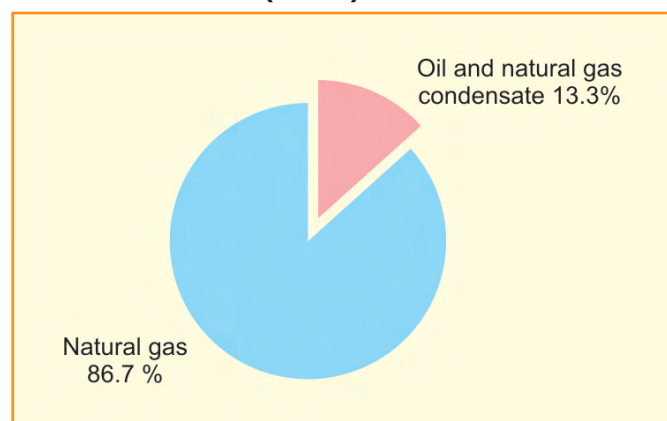
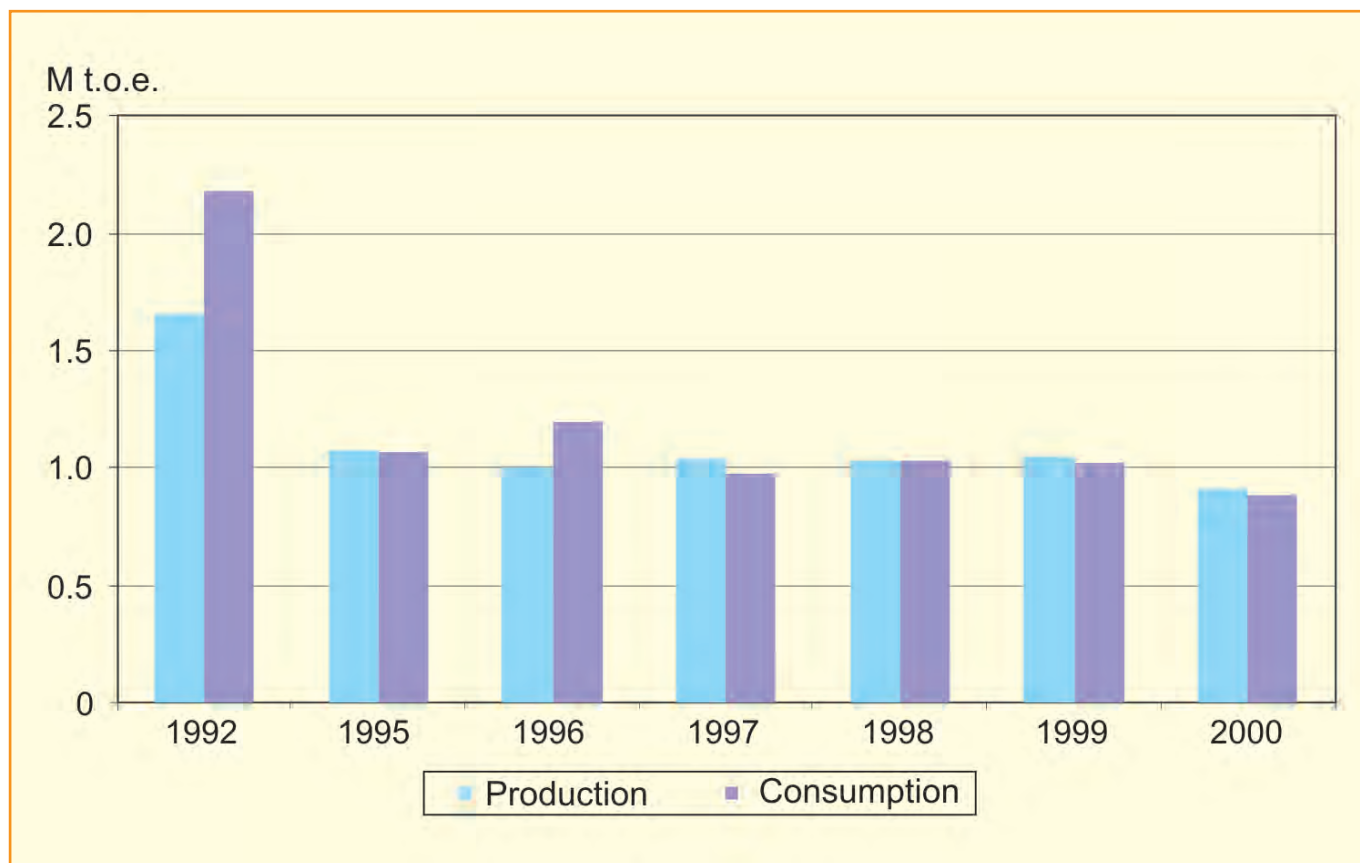


Figure 1.3

Coal production and consumption in Uzbekistan



Power sector

Power sector is one of Uzbekistan's key economic sectors. Total installed capacity of Uzbekistan's power plants exceeds 12.4 GW. Twelve thermal power plants, with a combined capacity of over 10.7 GW, and 31 hydro power plants, with a combined capacity of 1.7 GW, belonging to the State Stock Company "Uzbekenergo", the Ministry of Agriculture and Water Resources, the Mining and Metallurgical Company "Almalyk" and the Uzkhimprom Association, constitute the backbone of the electricity sector [8, 9].

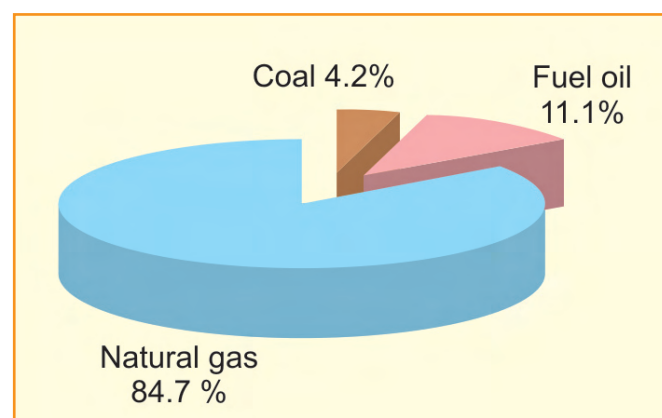
The thermal power plants, whose efficiency does not exceed 35%, account for between 84 and 92% (depending on hydro power plant output) of the country's total electricity capacity. Natural gas is the main fuel used by Uzbekistan's thermal power plants. In 2002, 84.7% of all fuel consumed by thermal power plants was natural gas, 11.1% was liquid fuel oil, and 4.2% was coal (Figure 1.4) [16].

Today practically the entire populated territory of Uzbekistan, except for certain (less than 1,500) re-

mote hard to reach agricultural settlements, is provided with the centralized power supply [16]. The electricity is transmitted and distributed using power transmission lines whose voltage ranges between 0.4 and 500 kV and whose total length exceeds 230,000 km [9], (Annex 2, [10]). To further increase

Figure 1.4

Structure of thermal power plant fuel consumption in Uzbekistan (2002)



the country's electricity capacity, construction is continuing of Central Asia's largest thermal power plant, the Talimardzhan thermal power plant, whose total capacity is 3.2 GW. Six hydro power plants with a total capacity of 298.2 MW are under construction as part of the Program to Develop Small Hydropower in the Republic of Uzbekistan, approved by the Government in 1995.

Since the time independence was gained, electricity production and consumption in Uzbekistan have declined somewhat, stabilizing at the level of 48 - 50 TWh (Table 1.2) [9].

Industrial and farm enterprises are the primary consumers of electricity (Figure 1.5).

In recent years electric losses in general grids have been rising steadily, reaching 17.7% (calculation based on data in [9]) of total consumption.

The centralized management system for the power sector that existed until 2001 did not allow for the resolution of issues the system faced regarding increasing the efficiency of electricity production and sales. To tackle these issues while pressing forward with market reforms in the country's energy sector and improving its management system and thereby ensuring its sustainable operation, the President of the Republic of Uzbekistan enacted Presidential Decree #2812 On Adding Impetus to the Reforms in the Electricity Sector of Uzbekistan, 22 February 2001.

The state stock company Uzbekenergo, of which the stock company Ugol is a part, was created on the basis of the Ministry of Energy and Electrification.

Within Uzbekenergo were established:

- Uzelektroset - daughter companies of electrical trunk grids specializing in electricity transmission; and
- regional stock companies for the distribution and sale of electricity.

In addition, Uzgosenergonadzor, a state agency for oversight of the power sector, was established as a regulatory body for the electricity, thermal power and coal sectors, which in turn was subsequently reorganized into the State Inspectorate Uzgosenergonadzor under the Cabinet of Ministers of the Republic of Uzbekistan.

Energy sector reforms entered a new stage in 2004. Building upon the trunk electrical grids of unitary enterprise Uzelektroset of state stock company Uzbekenergo, five regional electricity transmission affiliates were created, while distribution networks with up to 110 kV voltage were transferred to regional power distribution and sales enterprises. As market reforms proceed in the power sector, monopolistic and competitive activities are being made separate from each another.

Ongoing reforms must attract both local as well as foreign investments in the electricity sector to modernize and re-equip its existing infrastructure as well as to stimulate the development of a competitive environment in energy production by providing equal access to transmission grids that are independent of energy producers.

Table 1.2

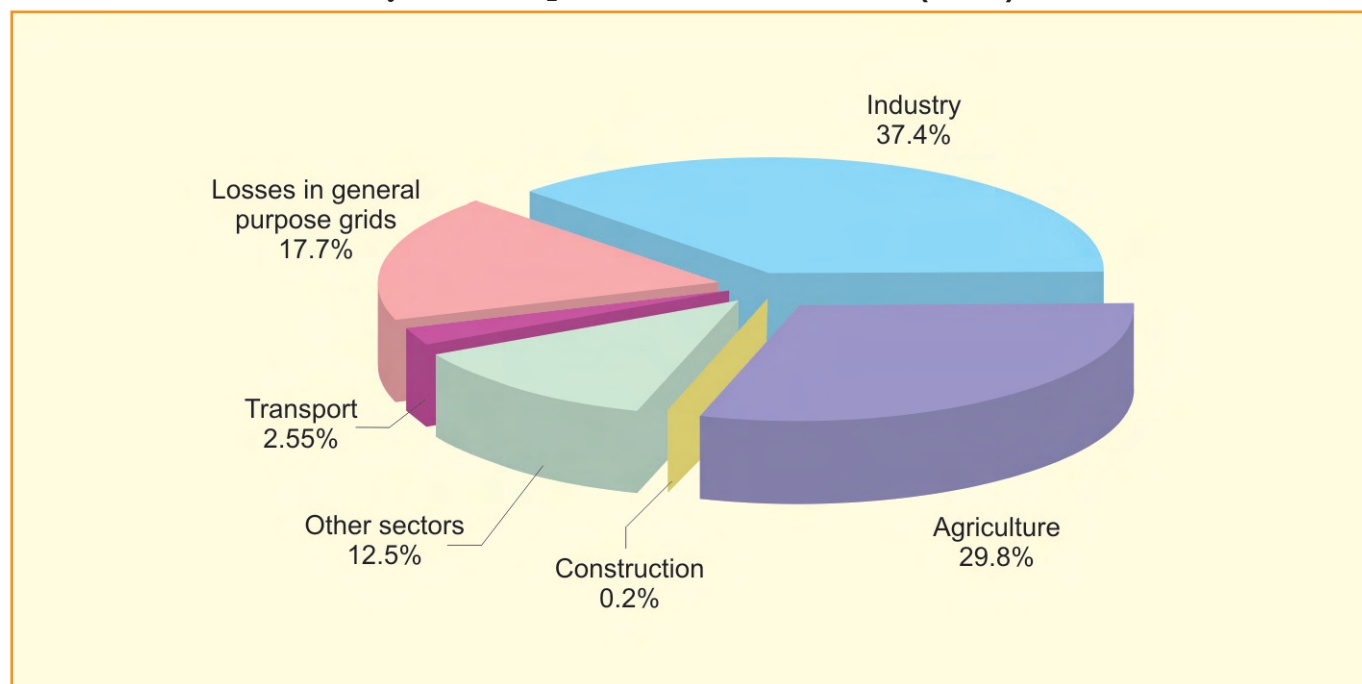
Electric power balance for Uzbekistan

(TWh)

Electric power balance	2001	2002	2003
Total production	48.0	49.4	48.7
including hydropower	5.3	7.3	7.6
Imported by Uzbekistan	13.5	11.4	12.4
Exported by Uzbekistan	13.0	11.5	12.4
Consumed within Uzbekistan – total	48.5	49.3	48.7

Figure 1.5

Structure of electricity consumption for Uzbekistan (2003)



Meeting consumer thermal energy demands

Centralized sources (general purpose electric power plants, district boiler houses), autonomous sources, i.e., thermal and power generating plants of industrial enterprises, local (group and building) boiler houses, and individual sources of heat installed directly in a building being heated all serve as suppliers of hot water and steam to manufacturers, public services facilities and the public of Uzbekistan.

Part of the demand for thermal energy from manufacturers and public services facilities covers non-fuel sources: waste treatment facilities and electrical heaters.

Uzbekistan's thermal energy sources produced 34.2 million Gcal of thermal energy in 2003. Boiler houses are the main supplier of thermal energy, providing two-thirds of all thermal energy produced. More than 7.5 thousand boiler houses of various capacities operate in Uzbekistan with nearly 25,000 boilers of various types and design. As of the end of 2000, just boiler houses with a capacity between 3 and 100 Gcal per hour alone totaled 1,186 [9, 20].

Each year around 5 million t.o.e. of fuel are expended on heat production in Uzbekistan, constituting nearly 10% of the country's total fuel demand. Natural gas is the main type of fuel used to produce heat, although a small number of coal fired boiler

houses produce heat too and firewood is used in remote agricultural regions as well.

District heating has been developed in some of the country's cities, including Tashkent, Fergana, Bukhara, Navoi, Urgench, Angren, Kokand, Takhi-atash, Shirin, Katta-Kurgan and a number of others. In all of these cities the system is built on virtually the same principle: heat released to consumers is regulated by varying the temperature of the hot water being released, but hot water is drawn directly from hot water mains with no regulation.

Research done in Tashkent found that the district heating system there is inefficient.

In a district heating system the water at the heat source must be maintained at a prescribed level even when ambient temperatures are high enough that apartment buildings do not require heating. A disadvantage of having to maintain a prescribed water temperature at a hot water plant when relatively warm temperatures occur during the winter is that it results in the overheating of high-rise apartment buildings whose residents become accustomed to the higher temperature.

The existing district heat supply system usually operates with elevated expenditures of make-up water

because a prescribed temperature of 18°C for the interior of an apartment seems uncomfortable to its residents who start resorting to unauthorized intervention in the regulation of the building's heating system. An elevated amount of make-up water in one building unavoidably lowers the flow of hot water into nearby buildings whose residents in turn intervene and disrupt the heating system in their buildings. When water temperature drops during cool weather, such intervention accelerates disruption of the heating system's calibration. When expenditures of make-up water reach a point exceeding the capacity of the heat sources, it becomes necessary to lower pre-set pressure parameters at outlets further limiting the amount of heat apartment residents receive.

The thermal energy supply problems a city such as Tashkent experiences are made even worse by the fact that nearly 30% of its housing has antiquated internal heating systems in need of replacement.

Considering the inefficiency of its district heating system, the city of Tashkent is studying the possibility of connecting buildings to closed loops via heat exchangers, with the expectation that that would

double the service life of indoor heating systems.

At present, heating utilities are administered by local authorities. That, plus the limited means of many consumers to pay for services rendered, requires that the government subsidize measures to improve the situation in the district heating sector. Subsidies will make it possible to upgrade the district heating system without placing a financial burden on local authorities or household utilities consumers.

The question of decentralizing the heating sector by introducing small and individual stand-alone heating plants is also under study. Presumably, decentralization would lower the risk of heat supply malfunctions and would increase the efficiency of small boiler houses using highly efficient boilers and would also reduce heat loss during transmission [21].

Meanwhile, the issue of district heating systems for large cities and for energy intensive consumers (heat and power) must be studied in tandem with studies of introducing heat and power cogeneration to vastly increase the energy efficiency of the fuel resources uses in Uzbekistan.

Energy's environmental impact

Air, water, and soil pollution caused by energy sector activities have in some areas reached levels high enough to disturb the ecological balance to the detriment of people's health and biodiversity.

In Uzbekistan over 80% of all harmful substances emitted into the atmosphere are byproducts of fuel combustion [14]. Fuel combustion produces toxic oxides of nitrogen, sulfur carbon, sulfur, and hydrocarbons as well as various carcinogenic substances. Nitrogen and sulfur oxides washed out of the atmosphere by precipitation produce acid rain harmful to the environment, agricultural crops, buildings and facilities.

In 2002 fuel-energy sector enterprises alone emitted about 452 thousand tons of pollutants into the atmosphere amounting to 62% of all industrial atmospheric pollution [16].

In addition, the processes of mining, producing, refining, transmitting and transporting various kinds

of fuel and energy are invasive of regions beneath the earth's surface while hydro power plants, power transmission lines, gas and oil pipelines, gas and fuel oil storage facilities, and fuel ash dumps occupy large areas of land.

The energy sector negatively impacts the environment globally as well. The energy sector is responsible for the bulk of carbon dioxide and methane gas emissions creating a worldwide greenhouse effect.

Of the 160.5 million tons of greenhouse gases (in CO₂ equivalent) produced on the territory of Uzbekistan in 1999, the energy sector produced 137.3 million tons, i.e., 85.5% of all greenhouse gas emissions [17].

Expanding the scale on which renewable energy sources are used in Uzbekistan can not only optimize the country's energy balance but also reduce the energy sector's negative environmental impact.