FIRST PART OF THE NATIONAL STRATEGY OF ENERGY

Actual Situation and Problems in Albanian Energy Sector

INTRODUCTION

The strategy for the development of the energy sector is a document that analyses and recommends the future changes of the energy sector in the Republic of Albania. This document analyses and includes the necessary changes that should occur in order to increase the security of the energy supply and the optimization of the energy resources in order to meet the demands and achieve a sustainable economic development in the future. As the changes in the energy sector are not spontaneous, the restructuring process of the energy sector needs essential steps. The experience from developed countries indicates the need to establish a right balance between the market mechanisms and government interference as well as among technical/technological aspects, energy management and the importance that should be given to the social aspects. The new strategy for the energy sector development, as an expression of the national demands, provides a sustainable development of the whole national economy and achieves meantime, the environmental protection during the whole cycle of the energy resources. The strategy for the development of the energy sector is part of the general strategy for the economic and social development of Albania. The fundamental issue during the preparation phases of this document was the reliability level of the basic data used for analyses and calculations of the energy scenarios as well as the accuracy to determine the general economic indicators for the future.

There is a very important subject often discussed among policymakers and technicians: does a country under transition phase from a very centralized economy to the establishing of a market economy really need an energy strategy? Although developed countries still discuss on this subject, different countries offer different experiences as regards the relation between the Market and Government interference. The general opinion supports the necessity of preparing and implementing a Strategy to establish a balance between market mechanisms and Government interferences. Obviously, the term “Energy Strategy” has different meanings in centralized and market economies. The achievement of the mission for a sustainable development of the energy sector needs the definition of all the objectives and the necessary fiscal steps within a well-defined strategy as well as respective investments. The Energy Strategy is necessary to fulfill our obligations in the frame of the Regional Electricity Market, and other international obligations regarding the environmental protection as well as the harmonization and converging of the energy sector development according to EU Directives for the association in the European family.

During the period 1994-1996 attempts were made for the first time to prepare an Energy Strategy in cooperation with the European Union and as a result, an Energy Report for Albania was developed. Although a good report, it could not become a base for a reliable Strategy. As a consequence, the European Union provided again a second assistance during the period August 1996 – May 1998 with the objective to further develop the National Strategy of Energy based on the Albania Energy Report. After 20 months of work from the NAE and other energy institutions with the assistance of Ramboll Company, a Draft Document on the National Strategy of Energy was prepared, which provided for the first time the future bases on which the Albanian energy sector should develop. The Draft of the National Strategy of Energy was not approved, but served indeed as a crucial base to prepare several documents and different economical feasibility studies, starting from 1998. At this point, it sounds reasonable to raise a question: **Why is it necessary to prepare a new strategy?**

New important developments have occurred during the period 1990-1992: a number of very important KESH management indicators were achieved through ENEL assistance; the objectives for the reduction of technical and non- technical losses were met and, as a consequence in April 2001 the Donors Group unfrosen the credit line for KESH projects; the Strategic Action Plan (February 2001) was prepared with USAID assistance; the Electricity Regulatory Entity was established and is actually working to approve for the first time a considerable increase of electricity tariffs for the residential sector on a two-block tariff system (already approved on April 1, 2003); the plan for KESH development and monitoring for the period 2002-2005 was prepared; the Power Sector Policy Statement was prepared and approved on April 19, 2002; the law on the Power Sector Reform was prepared and approved; the Albanian Government during the last three years paid more attention to the energy sector by establishing the Inter-Ministerial Committee of Energy in order to manage the situation, etc. Based on the above developments, the Albanian Government, firmly believes, that it is necessary to integrate those steps and many others in a National Strategy of Energy Document.

The energy strategy analyses in details many key issues herein broadly discussed: should we focus more on imports in order to meet the future energy demands (construction of interconnection lines) or on the domestic generation (using the TPP or building new HPP, thus depending on climatic conditions); what should be the necessary steps for energy saving in the household, service and industry sectors; should we still continue to use electricity for space heating in private and public buildings (thus creating a deficit) or should we introduce alternative fuels (especially LPG); should we just import oil by-products, import crude oil and rehabilitate Ballsh refinery to meet the future demands for oil by-products or build a new refinery; which is the best feasible position and capacity for hydrocarbons stocking; which is the best option for the penetration of natural gas in the Albanian energy sector and the necessary investments; etc.

The strategy for the development of the energy sector includes technical, financial, economic, legal, organizational, institutional and environmental aspects as well as the continuous training of the specialists in order to prepare the necessary framework for an easy integration of the Albanian system into the regional and European energy systems. The strategy deals with a number of issues and with the answers of many strategic and important questions, such as:

- What national interests should be protected and how?
- How to distribute those national interests among different energy sub-sectors (oil, hydroenergy, electricity, natural gas, fuel wood, etc)?
- How to increase competition, establish a consumer-oriented market, without impairing the government responsibilities on the energy system functioning, and security of supply?
- What necessary conditions should be established and fulfilled in a defined timetable in order to harmonize the Albanian power system with the EU system?

The technical model for preparation of the alternative scenarios for energy sector development is based in the software LEAP – Long Term Energy Alternative Planning. In order to provide the necessary analysis and realistic recommendations for the energy strategy in the Albanian conditions, this general energy model was adapted. The soft was developed to illustrate the different scenarios till 2015 and the consequences of energy policies and their effects. The scenarios describe two limits within which the Albanian energy system will likely develop. The scenarios describe the medium and long-term possibilities of the Albanian energy sector development based on future technological and economic forecasts for neighbor countries with similar economic development levels and climatic conditions.

Although the scenarios were based on well-known software, the Albanian Energy Strategy remains unique in its concepts due to the country's special conditions that make the job difficult and the fact that no similar solutions can be applied for different countries. Each country of the region, Albania as well, will be included in the EU energy market taking into account its particularities in the energy sector according to the Energy Charter Treaty and the Directive 96/92 on the Electricity. Market long-term economic development strategies are based on clear visions for the future development of the energy sector. Although, it was difficult to accurately predict the characteristics of the future development, guidelines drawn from long historical analysis in different countries, illustrate the future trends:

- The future energy system should be more consumer-oriented,
- The future power system should be very diversified as regards the use of all energy sources and all technologies,
- The future energy system should be more decentralized,
- More attention should be focused on the efficient use of the energy,
- The technologies selected to meet the demands should be based on the least cost planning principle, supply reliability and environmental protection,
- The renewable energy resources (solar, winds, biomass and especially small HPP) should be stimulated for a maximal use of indigenous resources, based meantime on least cost planning and environmental protection principles.

The energy sector strategy is developed as a national strategy based on the country and its citizens/consumers basic interests. No full or partial private priority (for individuals or particular companies) will be allowed over the national interest. This crucial issue was taken in consideration during the preparation of the basic concepts for the development of electricity, oil, by-products and natural gas markets, with a clear division between the public and private functions aiming the improvement of energy markets. As a consequence, the remaining part of the government property in the electricity and natural gas transmission infrastructure according to non-discriminating and impartial principles for subjects buying or selling energy, is based on the Constitution of the Republic of Albania.

I. ENERGY SITUATION IN ALBANIA AND THE OBJECTIVES OF NATIONAL STRATEGY OF ENERGY

The main problems, which have been identified and underlined through the analysis of the historic development and the possible future trends in Albania's energy sector, are:

I.1.1 Situation on the consumption side:

- Increase of the electricity consumption by consumers during the transition period has led to high levels of non-technical losses and reduction of security of supply;
- Lack of electricity price liberalization has led to its massive use for different services in the household and service sectors (space heating and cooking);
- Lack and relatively high prices of other alternative energy sources forced the consumers to focus more on the electricity use;

- Since year 1992 the energy intensity (energy use per economic output, GDP) has improved but this is more related to the growth in GDP due to foreign aid and income from Albanians working abroad, and collapse of heavy industries than to improvements of energy efficiency;
- Growth rate in the consumption of diesel and gasoline especially in transports is much higher than what can be accommodated by the supply of domestic oil by-products affecting so the increase of import.

I.1.2 Situation on the supply and production side:

- Production of oil and gas has declined rapidly due to lack of funds, necessary technical discipline and the natural decline of exploitable sources;
- Efforts to increase oil production in the existing and new sources through production sharing agreements have not yet been successful;
- Generation of electricity is dominated by the hydropower output whereas the thermal based generation has remained stable around 100 GWh per year. During the period 2000-2002 there was a sensitive decline of the electricity production due to drought seasons;
- There are uncertainties about the real cutting rate for fuel woods but it is believed to be at a level equal to 250 000 – 350 000 toe/year;
- Supply structure of primary energy sources is becoming less and less diversified due to the increasing role of oil, hydro and fuel wood energy supplies compared to coal and natural gas.

As a conclusion, the last years situation indicates that the electricity balance is very tight and KESH has become a net importer of considerable electricity quantities and in the coming years will continue to import even more to meet the growing demand until construction of new plants.

I.1.3 Objectives of the National Energy Strategy

Ministry of Industry and Energy through the National Agency of Energy in collaboration with other institutions prepared the National Strategy of Energy. In this Strategy are analyzed in details three main issues: 1) energy demand-supply situation until 2015, 2) restructuring energy sector and 3) preparation of investment package for the implementation of all energy efficiency measures and all master plans based in recommendation of National Strategy of Energy.

The scope of the National Energy Strategy is to develop an effective energy sector that:

- guarantees the security of the energy supply in general and electricity in particular,
- enhances an efficient and economic use of energy, with minimal environmental impacts, in order to support the sustainable development of the whole economic sectors.

Primary Objective of the National Energy Strategy is:

To restructure the energy sector based on market economy principles and develop a modern energy policy.

Specific objectives of the National Energy Strategy are:

1. Establish of an efficient energy sector from the financial and technical aspects;
2. Establish of an effective institutional and regulatory framework;
3. Increase of the security and reliability of the energy supply in general and electricity in particular, in national and regional levels;
4. Increase of the energy efficiency in the generation and use of energy sources aiming a minimal environmental pollution;

5. Optimization of the supply system with energy resources based on the least cost planning principle and minimal environmental pollution;
6. Completion of restructuring process of energy companies;
7. Considerably increase investments in the energy sector through capital enhancement by International Financial Institutions and private capital; and
8. Establishment of a competitive electricity market according to EU requirements for the electricity sector reforms (Directive 96/92 EU) and Albania obligations under the Athens Memorandum (November 15, 2002) to support the energy sector integration into the Southeast Europe Regional Electricity Market and the interconnection with UCTE network.

Immediate objectives of the National Energy Strategy are:

- Fulfillment of the obligations deriving from the Power Sector Policy Statement approved by the Albanian Government on April 19, 2002.
- Fulfillment of the obligations of KESH, two-years Action Plan (2003-2005).
- Reduction of the electricity consumption growth rate by adjusting the electricity tariffs to economic cost levels in parallel with gradual improvements and adjustments of the quality of electricity supply.
- Providing of favorable general conditions to increase electricity import through longer term commercial contracts than what has been the standard so far.
- Promotion of alternative resources such as LPG instead of electricity in the household sector for space heating and cooking.
- Intensification of efforts for rehabilitation of HPPs on the Drin and Mat rivers cascade, as well as rehabilitation of the electricity transmission-distribution network based on the Transmission-Distribution Project financed by the donors group.
- Upgrading with modern technology of the existing thermal power plants of Fier (Czech Unit) and Ballsh by using internal residual fuel oil and heavy fuel oil.
- Acceleration of the procedures to finance the first TPP unit in Vlora.
- Intensification of efforts to increase in cooperation with foreign companies production in the existing oil and gas fields within the economic parameters.
- Reduction of consumption of diesel and kerosene in the transport sector through strict provisions linked to the environmental pollution norms upon EU standards.
- Acceleration of the institutional reform to provide more focus on strategic and demand planning including the support to implement the recommended efficiency provisions in the household, service and industry sectors. The institutional reform is to be supported by other Energy Sectors Specific Laws (Hydrocarbon Law, Mineral Law, Electricity Law (already approved)).
- Reinforcement of the role of the Electricity Regulatory Entity as an independent unit and depoliticizing of energy sector's administration through the enlargement and strengthening the role of the National Agency of Energy.

I.2 ENERGY SECTOR CHALLENGES

The energy sector is currently facing many challenges such as the economic developments in different sectors, the energy intensity and the trend of energy consumption per capita, the self-sufficiency with total indigenous primary energy sources and oil production. Energy sector challenges in every country are inseparably linked to the economic sectors development. Since 1992, Albanian economy has experienced a transforming process from a centralised to a market economy. The economic development reached high rhythms and the GDP increase rates were respectively 9.6% in 1993, 9.4% in 1994, with the highest outcome in 1995 with a rate of 11.3%. GDP growth rate started to decline during the period 1996-1997 due to the collapse of pyramidal schemes. Figure 1 shows the contribution of each economic sector in the total GDP and the GDP growth rates during this period. Figure I.1 clearly indicates that the main contribution in the GDP during the period 1985-1989 was given by the industrial sector that continued to decline till 1994 without significant recuperation after that year, compared to other sectors. The industrial sector contributed with 40% of the GDP in 1985, and 12% in 2001.

The agricultural sector contributed with 20% in 1985 of GDP, and 51% in 2001. The structural change between industry and agriculture in 1985 and 2001 was the main factor that caused the decline of energy consumption. The GDP includes also the values created by the informal economy that may reach a level of 20-25%. Another important factor influencing the energy consumption is the trend of the GDP per capita indicator. The GDP value per capita increased from 213 US$/capita in 1992 to 1120 US$/capita in 2001. The increase was due to a number of factors:

- An ambitious program for the economic development of the country during the last decade,
- Incomes from a large number of Albanian immigrants,
- Important support offered by donors assistance,
- Reduction of the inhabitants number due to the immigration, and
- Revenues using favourable geographical position of the country in transition of goods, serving as a bridge that connects Balkan with Western Europe.

Another important summarizing indicator that shows the level of development of the energy sector especially as regards the efficiency, is the energy intensity, which is equal to the ratio between the energy primary resource supply in a given year, and GDP produced in the same year. Historically, Albania's energy intensity has been very high. The reasons are the same as for the other Central and Eastern European countries: Albanian industry has been orientated towards energy intensive industries such as mining and metallurgy, and where low energy prices have been prevailing. On the other hand, the per capita energy consumption is very low. To a large extent this reveals low levels of economic activity as well as modest levels of comfort in the residential and service sectors.

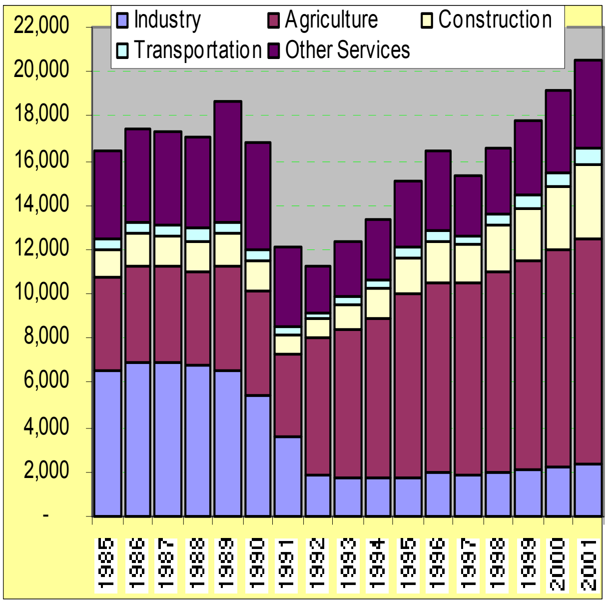


Figure I.1.: Contribution of each economic sector in GDP (realistic terms of 1990, million lek) [1]

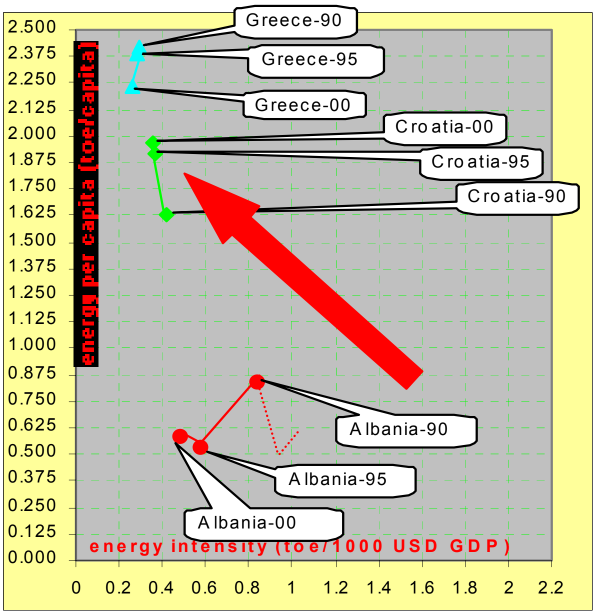


Figure I.2.: Comparison of two most important indicators in 1990, 1995 and 2000[2]

[1] Source: Ministry of Finance and International Monetary Fund (Tirane)
[2] Source: Energy statistics from IAE, EUROSTAT reports and Albanian Energy Balance prepared by the NAE

Thus one of most crucial challenges in relation to the future development of Albania's economy and its energy sector is how the obvious pressure to increase the low per capita energy consumption can be matched with the equally obvious need to reduce the high energy intensity in order to have an efficient economy that will compete in the domestic and foreign market. Figure I.2 illustrates a comparison of the position of Albania and her surrounding countries regarding the energy intensity and the per capita energy consumption indicators. Figure I.2 indicates that the Albanian economy had a very high-energy intensity in 1990 where the energy consumption per economic output was slightly higher than the average for the CEE countries. This level again was almost 5 times higher than the average level of the EU countries (almost twice higher than Greece and Croatia) and the per capita energy consumption in Albania was approximately only 1/3 of the energy consumption per capita in Greece. During following 10 years until 2000, Albania's situation changed radically, as regards these two important indicators. The energy intensity was reduced by some 40% but the energy consumption per capita was reduced to 1/3 of the 1990-level, assuming an analysis of the total GDP. But, in fact the total GDP in Albania derives from the real domestic production in different sectors, foreign assistance, revenues from the immigrants and other items. In rough calculations, if we "undress" the total GDP from other factors and consider only the production, the energy intensity will increase (as shown in the interrupted line in the figure I.2) which means that, in fact, the energy efficiency was not improved. As regards the trend of these indicators, the best direction of movement would be the one signed with the respective arrow in the above graphic.

Two other important indicators are the self-sufficiency of oil demand with endogenous production and the self- sufficiency of the total demands with primary energy sources. As shown in figures I.3 and I.4, both indicators have continuously declined during the period 1990-2001. **The conclusion is obvious: the self-sufficiency with primary energy sources has declined from 97% in 1990 to 47% in 2001. This fact led to the increase of the country's trade deficit from the energy sector alone with approximately 25.6 Million US$ in 1990, while in 2001 the monetary values of energy imports reached to 265 Million US$/year.** Meanwhile, in order to have a clear understanding of these values, it should be reminded that the country's trade deficit in 2001 was approximately 1072 Million US$/year.

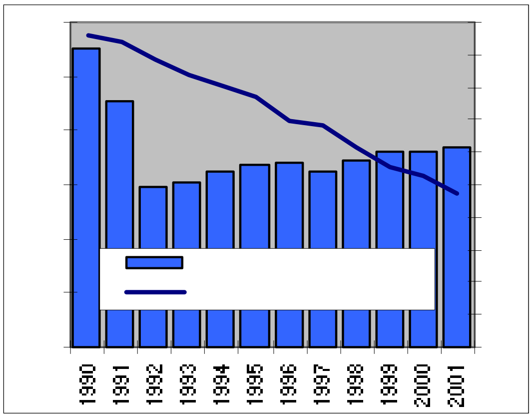


Figure I.3.: Supply with primary energy resources and self-sufficiency with endogenous sources

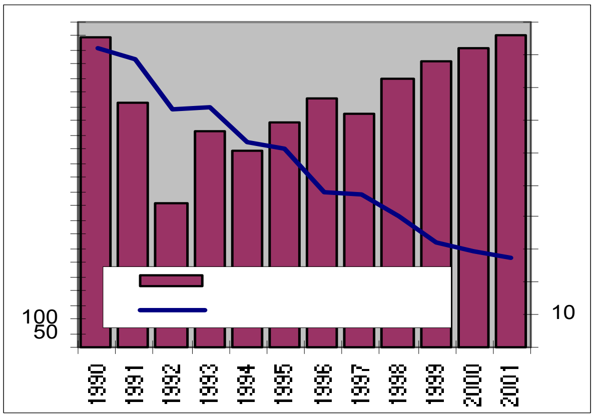


Figure I.4.: Supply with oil and by-products and self-sufficiency with endogenous oil [3]

The economic development in all former socialist countries, including Albania, has proven how difficult it is to forecast the future energy demand. These difficulties are firstly related with big variation of the main energetic and economic indicators, lack of an appropriate and effective

[3] Source: Figures I.3 and I.4 correspond to the National Energy Balances prepared by the NAE.

infrastructure to collect data and selection of an appropriate method to model supply trends of energy resources and consumption of energy sources, especially during the transition period. Difficulties become greater in the existing situation where for different sectors of the Albanian economy there are no clear strategies of development, although the Task Force and the Technical Group did a great job to prepare this Strategy. To get as close as possible to the statistical energy and economic values, the NAE has done a voluminous work in cooperation with all organizations and participating institutions in the technical group for the preparation of the strategy. From the establishing of the Technical Group, the NAE staff has closely cooperated with all members to make possible the creation of necessary data system.

I.3 CONSUMPTION OF ENERGY SOURCES FOR EACH SECTOR

Figure 5 shows the consumption of the energy resources in all economic sectors during the period 1990-2001. As indicated in the respective figures, the consumption has declined from a peak of 2.26 million ton oil equivalent (Mtoe) in 1990 to 1.22 Mtoe in 1992. Since that year the consumption of energy primary resources has increased reaching a value of 1.84 Mtoe in 2001.

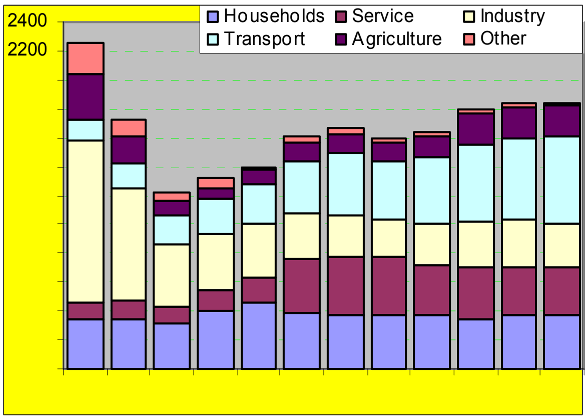


Figure I.5: Contribution of each sector in energy consumption (ktoe)

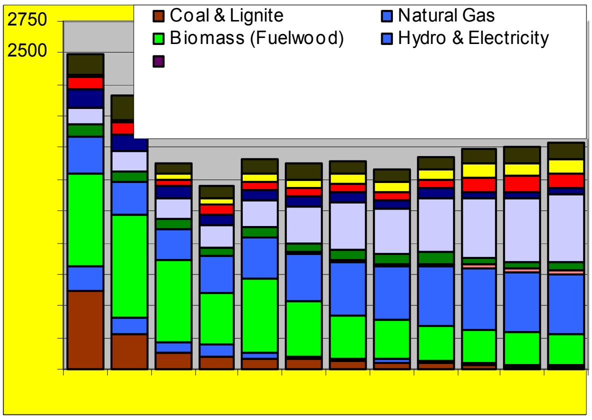


Figure I.6: Contribution of each energy commodities in energy consumption (ktoe)[4]

In 1990, the industry consumed 50% of the total sources, declining to 35% in 1992 and 17% in 2001. Transport was the sector that experienced a continuous increase of the energy sources consumption. In 1990 the transport sector consumed 6% of the total energy consumption, reaching the value of 44% in 2001. Another sector that experienced changes was the residential sector, with a consumption of 14.6% of the total in 1990 reaching a level of 21% in 2001. Service sector also experienced high rates of increase of energy consumption passing from 5.4% in 1990 to 16.5% in 2001. Figure 6 indicates the consumption of energy sources during the period 1990-2001. Analysis indicates that coal, natural gas, electricity, diesel and heavy fuel oil were energy sources that used to play the major role in 1990. One decade later, the situation was quite different with fuel woods, electricity and diesel playing the major role.

Figure I.7 indicates the consumption of electricity according to the economic sectors. During the period 1985-1990 the industry was the largest consumer, followed by service and residential sector and other sectors in a smaller extension. After 1992 the situation changed: as many industrial enterprises were closed down the electricity consumption declined to a minimum, starting to recuperate in the following years due to the reactivation of old enterprises and opening of new ones. This situation remained unchanged till 1999, and then the consumption declined again during 2000-2002 due to the fact that the electric system was unable to supply many small producers rather than the decline of the industrial sector. This fact forced a number

[4] Source: Figures I.5 and I.6 are based on the National Energy Balances prepared by the NAE.

of enterprises to install back-up electricity generators. Electricity consumption in the residential sector has continuously increased during the period 1985-1999. Consumption in the service sector increased during the period 1985-1999 but after that started to decline due to the lack of supply rather than the lack of development.

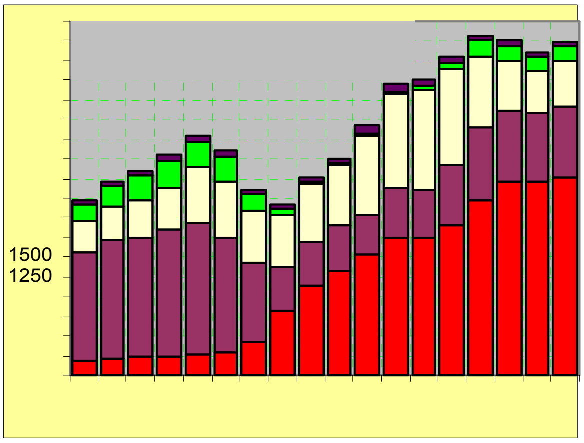


Figure I.7: Electricity consumption according to economic sectors (GWh)

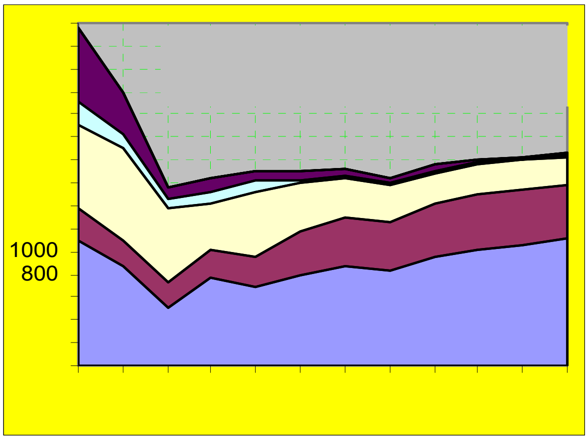


Figure I.8: Supply with primary energy resources (ktoe)[5]

I.4 SUPPLY AND PRODUCTION OF ENERGY SOURCES

Figure I.8 indicates the supply with primary energy sources during the period 1990-2001. As indicated in respective figures, energy supply declined from a peak of 2.75 Mtoe in 1990 to 1.49 Mtoe in 2001. Since that year, the supply with primary energy sources increased to 1.92 Mtoe in 2001. Coal and natural gas were the "big losers" since the economic changes forced many industrial consumers to close down. Supply and use of coal has declined from approximately 644.5 ktoe or 22% of the supply with primary energy sources in 1990 to 20.7 ktoe or 1.11% in 2001. Coal contribution in the Albanian energy market has declined due to the following reasons:

- Coal extraction technology is very old,
- Our domestic coals are of lignite type with low calorific values, high content of sulphur, humidity and ashes,
- The characteristic of indigenous coal sources is that they are extracted from 200 m depth with a lower thickness of layer of 70 –100 cm,
- Extraction and enrichment costs are very high,
- High content of sulphur and ashes would need environmental protection plants that mean a bigger pollution and a higher cost for a generated energy unit.

The same trend was followed by natural gas which production declined from 206 ktoe in 1990 to 7.8 ktoe in 2001. Contribution of natural gas declined to 0.43% in 2001 compared to 10% in 1990, due to a number of factors:

- Existing natural gas fields are in their last production period,
- Researches for new resources have not been successful so far.

Figure I.9 shows the oil production from sand and limestone rocks as well as the respective consumption. Peak production was reached in 1975 followed by a decline till 1982 and the second drastic decline during the period 1980-1992. This drastic decline is linked to the poor work

[5] Source: Figures I.7 and I.8 are based on the National Energy Balances prepared by KESH and the NAE.

discipline for exploitation of existing resources than to the natural decline of generation of these wells. Another fact should also be stressed: during the whole period till 1989 the country was a net exporter of oil by-products. After that year it became a net importer by importing 73% of the needs in 2001. Figure I.10 gives the cumulative total production of crude oil till 2001 that reached a value of 51.6 Mtoe with most part of the cumulative production deriving from sand rocks with a contribute of 65%. Indigenous oil is characterized by a high gravity of the range of 8-35 PAI and high sulphur content 2-6%. It should also be emphasized that the exploitation coefficient of sandy resources was very low 8-12% making most part of reserves to remain in the layers.

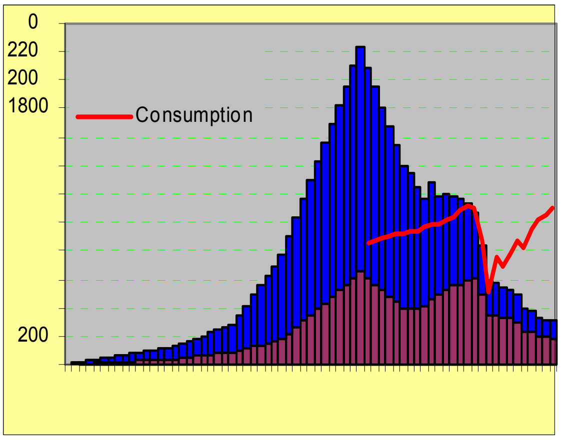


Figure I.9: Oil generation from sand, limestone rocks and respective consumption (ktoe)[6]

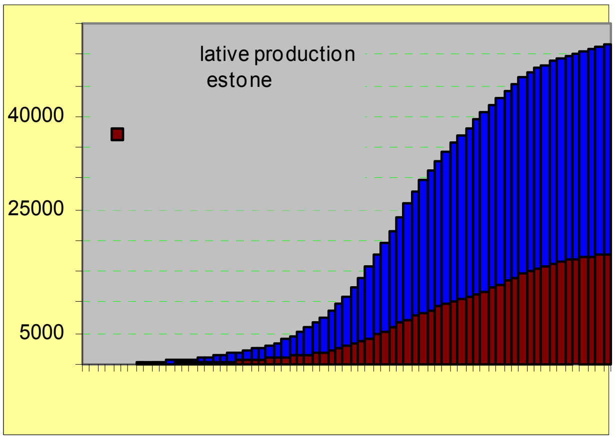


Figure I.10: Oil commutative production from sand and limestone rocks and respective consumption (ktoe)

Despite efforts to reach the factor of oil extraction, oil resources contain considerable quantities of oil that need advanced methods and technologies especially for high viscosity oils and the intensification of the efforts to increase oil extraction. This was the objective of the Premier Oil Company pilot project in Patos-Marinza oil field, expected to achieve first positive outcomes by the end of 2003.

Fuel wood is another important contributor in the Albanian energy balance. In 1990 fuel wood contributed with 727.7 ktoe (or 27% of the total) declining to 256 ktoe in 2001 (13.8% of the total). Decline of fuel wood had a positive effect on the reduction of wood cutting for energy scope but on the other side affected negatively by shifting the load on the electricity, especially in the residential sector, as it is analyzed below.

In addition to the importing financial barriers, the main problem faced today by the Albanian power sector is the limited technical capacity varying averagely 10-12 Million kWh/day for domestic generation and 8-10 Million kWh/day for the import, providing a total average supply of 18-20 Million kWh/day. It should be emphasized that the demand in a normal winter day reaches to 25-27 million kWh. As a consequence, the power system fulfils only 70-80% of the total demand during the peak winter period, causing power supply shortages to customers. Albania has imported 25-40% of the total electricity consumed during last four years. This situation will continue in the future till the construction of new plants. The most urgent problems that the Albanian power sector is facing today are the following:

- ***Current generation capacity*** is insufficient to meet the actual demand of 6.60 TWh/year (for 2003). As a consequence, the electricity supplied to customers is partially interrupted. The most cardinal problem as regards the electricity generation is the fact that almost 99% is produced by HPPs, as indicated in figure I.11. Figure I.11 illustrates the deterioration of the hydropower

[6] Source: Figures I.9 and I.10 are based on Oil and Gas Balances prepared by Albpetrol and processed by the NAE.

situation due to the relatively drought years and the continuous increase of the electricity consumption.

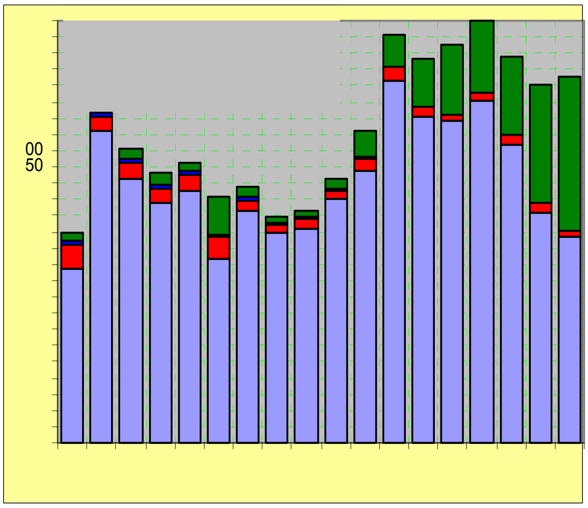


Figure I.11: Electricity generation from HPP and TPP and import (GWh)

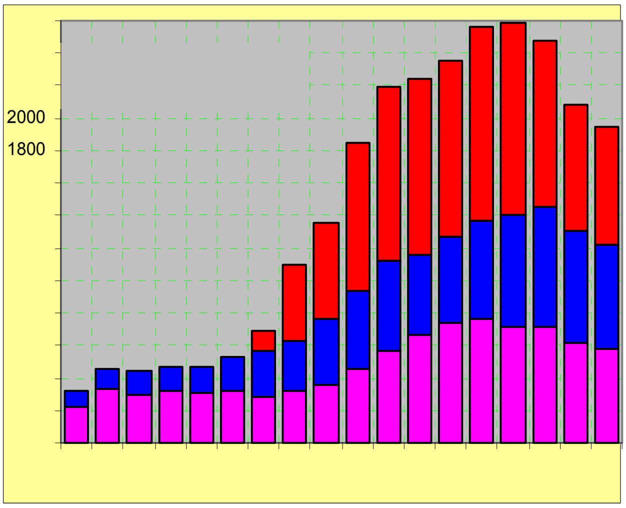


Figure I.12: Transmission and distribution electricity losses and non-technical losses (GWh)[7]

- ***Problem of the so-called "non-technical losses"***: 1,295 GWh of electricity in 1999 were "non-technical" losses that mean either electricity taken from the network through illegal connections or unpaid electricity. In 2000 and 2001, losses were reduced due to very strict measures taken by Ministry of Industry and Energy, Group of Donors in cooperation with KESH and ENEL. Based on KESH action plans since 1999, all the targets were reached and the donors are financing many projects that are analyzed in the respective section.

- ***Technical losses in the transmission-distribution networks*** in 1999 were 1406 GWh (720 GWh for transmission and 685 GWh for distribution) or 22% of the supplied electricity (indicated in figure I.12). KESH, in close cooperation with Group of Donors and ENEL, has prepared an Investment Plan, updated every year, in order to reduce the losses. Necessary investments for this objective are being funded by the financial package approved by the Donors Group. Due to strict measures, the technical losses were reduced to a value of 1277 GWh (622 GWh for transmission and 655 GWh for distribution).

- ***Electric interconnection with neighbor countries:*** Electric interconnections with neighbor countries include three lines: Elbasan-Kardia (400 kV) with a capacity of 1100 MVA, Fierza-Prizren (220 kV-250 MW) and Vau Dejes-Podgorica (220 kV-250 MW). Due to system instability, the effective capacity of lines is reduced to 400 MVA. The capacity was considerably increased in 2001 due to increase of transforming capacities in Elbasan substation and the commissioning of a 220 kV line (4 km) between Elbasan 1 and Elbasan 2 substations, in August 2002. This created for KESH the possibility to import large quantities of electricity and reduce the electricity supply shortages, but due to technical limits of Greek system interconnection lines, the importing capacity is considerably reduced, requiring an extension towards the north part of the country.

- ***High values of electricity consumption for space heating:*** A strong tendency towards the increase of electricity consumption for space heating is becoming evident more and more, although other possibilities to use alternative resources already exist. Figure 13 gives the

[7] Source: Figures I.11 and I.12 are based on the National Electricity Balances prepared by KESH and the NAE.

power system load curve during days with minimal load (summer) and with maximal load (winter). Peak load in summer season reaches to 745 MW, while in winter the peak reaches the value of 1300 MW and the increase (555 MW) is almost dedicated to space heating. This is the main reason why the power system is unable to guarantee a regular supply for other services besides space heating (such as lighting, electric appliances, different industrial operations and service sector). The difficulty that the use of electricity for space heating creates to the system is clearly evidenced in figure I.14, showing the yearly load duration curve with and without space heating. The red zone shows the quantity of electricity consumed for space heating calculated according to related method used in 1999 when the consumption reached to 1375 GWh or 23.8% of the total supplied electricity.

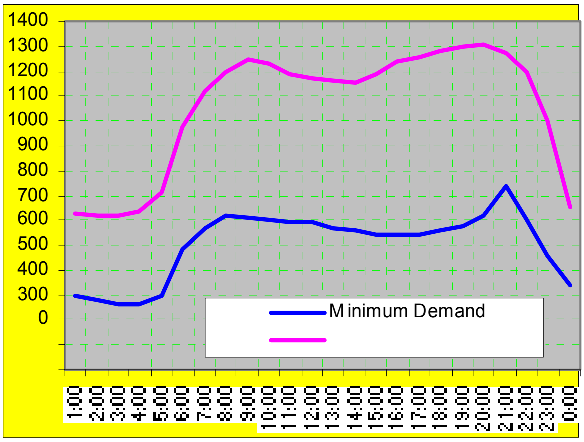


Figure I.13: Electric system load graphic during days of minimal load (summer 1999) and maximal load (winter 1999) in MW[8]

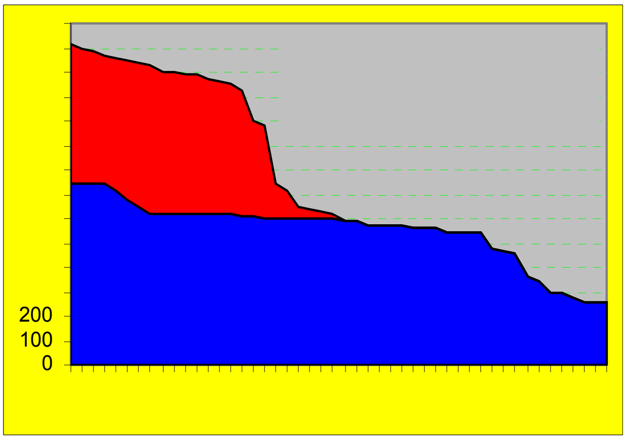


Figure I.14: Annual continuity curve of electric load with and without space heating for 1999 (total supplied electricity 5775 GWh)

Very high demand for space heating may not be avoided without well-defined plans to calculate the energy demand for space heating in household and public building stock and introduction of other alternative energy sources. In the analysis of Scenarios are given a set of recommendations to solve this key problem. In this direction will give their effects the implementation of Law "On the conservation of Heat in Buildings", as well as the Technical Regulation for Private and Public Building in order to ensure Space Heating using fuels instead of electricity, which are already effective.

- ***Unrealistic electricity tariffs:*** Different studies carried out by international and local institutions indicate that the long term marginal cost of electricity generation/transmission/distribution, taking into consideration the new plants/substations/lines that will be constructed to meet the increasing demand, is approximately 8.63 US cents/kWh (Electricity Tariff Evaluation Module prepared by the World Bank in January, 2003). KESH Action Plan approved by the Albanian Government and the Donors recommend tariff increase in order to improve the financial situation of KESH. Electricity tariffs increased considerably on December 1, 2001 (are discussed more in details in the price and tariffs section).

Small HPPs and solar panels used for hot water production are both renewable energy resources that offer a minimal contribution to the national energy balance. Figures I.15 and I.16 give their contribution trend. The generation from small HPP during the period 1990-2001 declined from 50 GWh to 6.7 GWh, due to lack of maintenance and their old technology. Albanian Government has already approved the privatization law for small HPP that will lead to their

[8] Source: Figure I.13 is based on KESH Electric System Load Graphics; Figure I.14 is prepared by NAE.

rehabilitation, the construction of new HPP (many subjects are showing interest in this area) and increase of generation. The energy reserve section will give more details on the potential of the existing and new HPP.

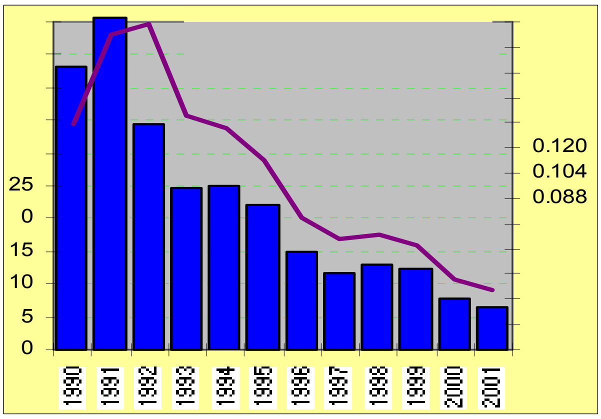


Figure I.15: Generation of electricity from small HPP (GWh) and its contribution in the national energy balance in %[9]

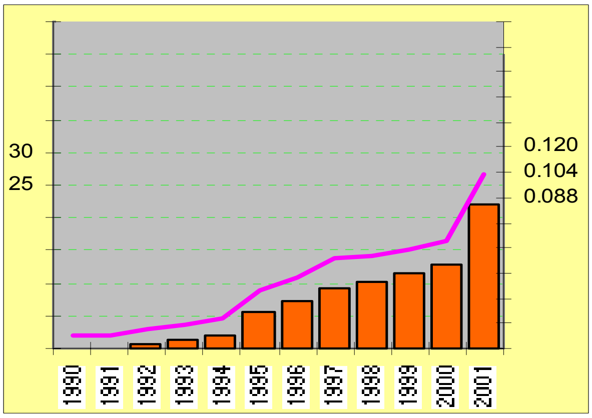


Figure I.16: Generation of hot water production from solar panels (GWh) and its contribution in the national energy balance in %

Totally the contrary occurred during the last decade with the penetration of solar panel systems used for thermal power production, where the generation increased from 0 to 23 GWh in 2001 (figure 16). That happened due to many reasons: spreading of culture of using solar panels due to emigration to neighbor countries, increase of electricity prices and increase of the discipline in electricity payment, etc.. The energy reserve section gives more details on the potential of solar energy and its future penetration.

I.5 PRICES OF ENERGY COMMODITIES

I.5.1 Trend of energy resource prices

Since the beginning of establishment of the market economy in November 1991, the liberalization of prices of energy sources has been the Albanian Government's main objective. The liberalization started first with oil by-products, followed by coal, natural gas and heat. Electricity was the only energy commodity that was not liberalized. Table I.1 shows the actual conditions of the energy price status.

Table I.1: Energy resources price regulation in the Republic of Albania[10]

Energy resource	Wholesale price	Liberalization year	Retail price	Liberalization year
Crude Oil, lek/litter	Liberalized	1993	Liberalized	1993
Oil by-prod. lek/litter	Liberalized	November 1991	Liberalized	November 1991
Natural Gas, lek/m^{3}N	Liberalized	1993	Liberalized	1994
Coal, lek/kg	Liberalized	1994	Liberalized	1994
Heat, lek/kWh $_{thermal}$	Liberalized	1996	Liberalized	1996
	Non-liberalized	-	Non-Liberalized	-

The legal frame of the energy price policy has improved every year during the analyzed period. In 1992, by a decree of the Council of Ministers, the prices of crude oil and oil by-products increased three times, gasoline three times, diesel twice, kerosene 3.3 times and LPG 16 times. It should be emphasized that this was an important step to approach the sale price towards the energy source costs. Figures I.17, I.18, I.19, I.20, I.21 and I.22[11] show the most important trend of energy source prices (primary and secondary) in different economic sectors.

[9] Source: Figures I.15 and I.16 are based on the National Electricity Balances prepared by KESH and NAE.
[10] Source: NAE, General Directorates of Hydrocarbons and Electro-Energy, ERE and KESH
[11] Source: NAE, General Directorates of Hydrocarbons and Electro-Energy

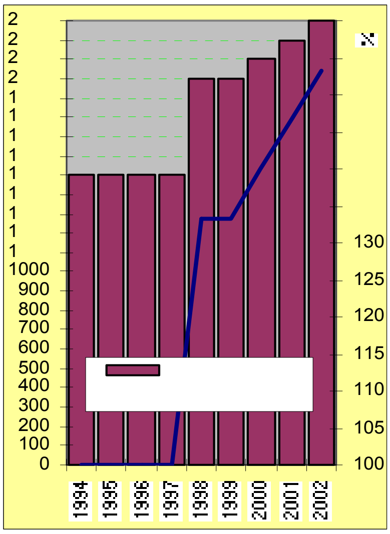


Figure I.17: Fuel wood price trend during period 1994-2002

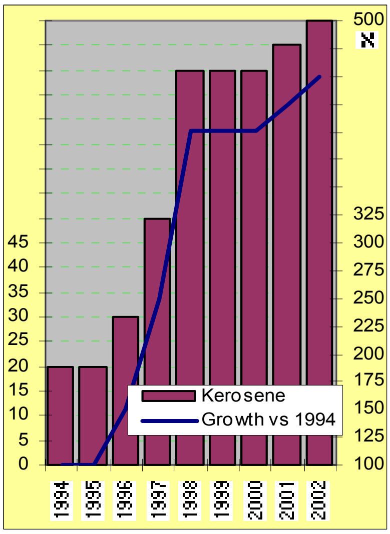


Figure I.18: Kerosene price trend during period 1990-2002

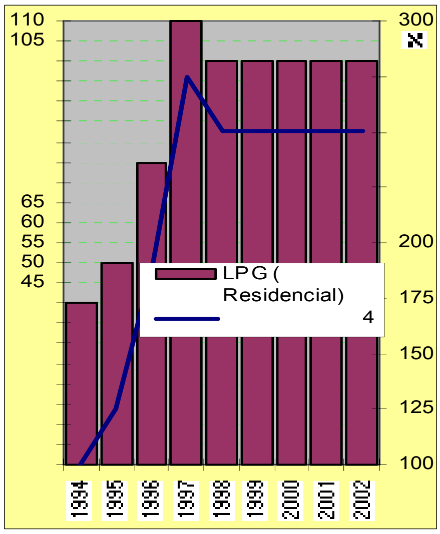


Figure I.19: LPG price trend during period 1990-2002

Coal sources have experienced a drastic decline offering currently a very low contribution in the service and industrial sector (space heating in "Student City"). The WB study for the introduction of new electricity generation plants analyses in details the possible future trend of coal prices in the Albanian energy market. The coal price level will be discussed more in details in the section dealing with power generation.

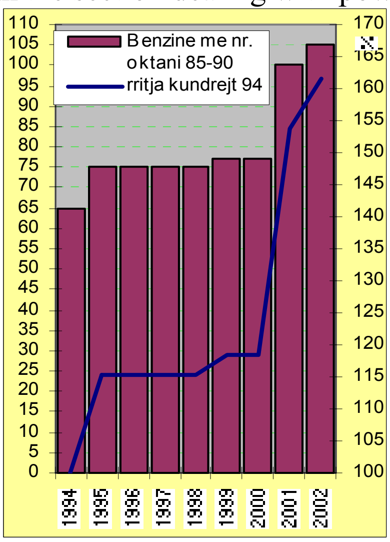


Figure I.20: Gasoline price trend during period 1994-2002

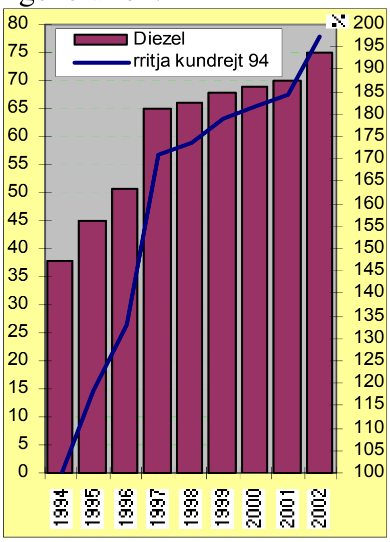


Figure I.21: Diesel price trend during period 1990-2002

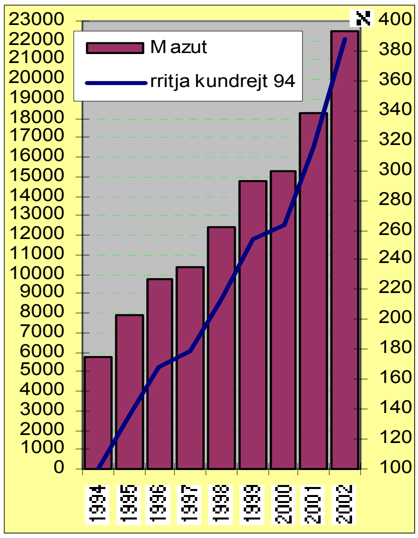


Figure I.22: Heavy fuel oil price trend during period1990-2002

Fuel wood were largely used in the past and less actually, especially in the residential and service sectors. Fuel wood is used in a less extend in the industrial sector. Fuel wood prices have continuously increased as indicated by figure I.16 since reserves have considerably declined.

Figure I.18 shows the kerosene price that increased from 20 to 90 lek/litter during the period 1994-2002. This was the main reason (besides inefficient and polluting equipment used in the past) that this oil by-product is almost out of the energy market either in urban or in rural areas.

As shown in figure I.19, the LPG price increased with 250%, but it should be underlined that during the last years, the price remained constant due to actions taken by the Albanian Government.

The analysis of figures I.20 and I.21 shows a considerable increase of gasoline and diesel prices in 2002 compared to 1994, 162% and 197%, respectively. The indigenous oil production guarantees only 25% of the total needs, making those prices totally dependents of international price volatility and transportation cost. In order to minimize the international price variations, reduce the transportation costs and increase the security of supply, different researching institutions under the guidance of the Ministry of Industry and Energy have carried out feasibility studies to build a coastline hydrocarbon stocking center. Figure I.22 represents the trend of heavy fuel oil price sold by ARMO (Albanian Oil Refining and Marketing Company).

I.5.2 Electricity tariffs trend

Electricity is the only energy commodity that did not gain the price liberalization status. Although big steps were taken in this direction, as briefly described above, the complete liberalization process of electricity prices still remains behind. In figure I.23 is given the electricity price trend for different consumers during the period 1994-2002. The first conclusion of analysis is that prices did not increase considerably during that period as recommended by various studies[12]. The "relax" continuing for years forced the actual rapid increase of electricity average price in order to gain the lost time and equalize the average sale price with the long-term marginal running cost of generation/transmission/distribution of electricity. Limitation of electricity price increase caused big damages because no other energy commodity was used especially for main services in the residential sector. Another conclusion drawn from the analysis of figure I.23 is that, only the electricity price for the first tier of 300 kWh/month for residential customers has not increased except the last increase of April 1, 2003.

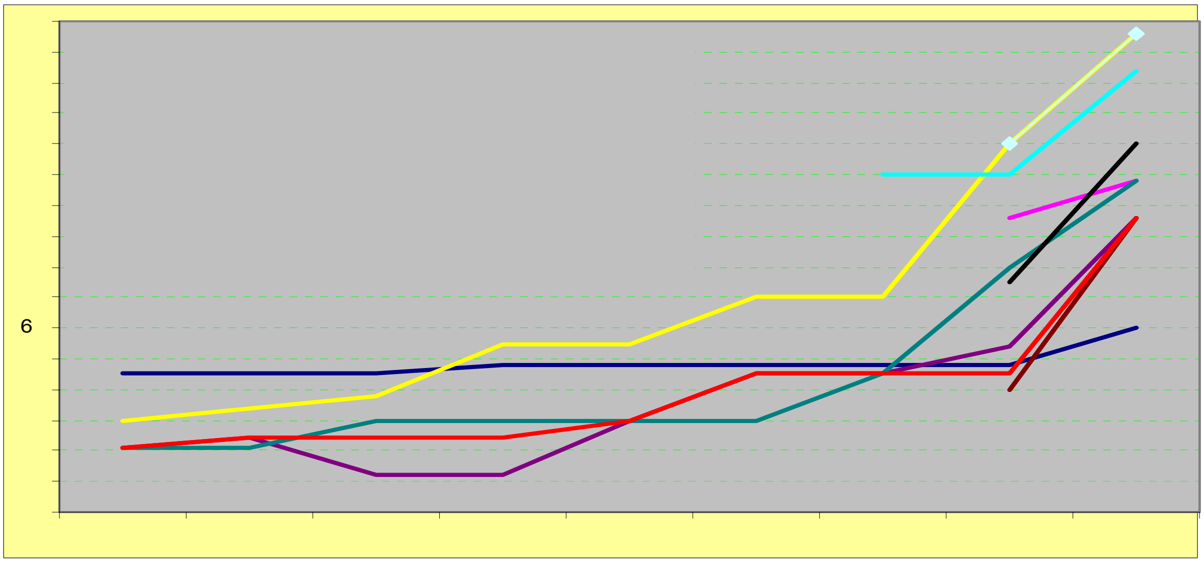


Figure 23: Trend of electricity price for different customers categories[13]

[12] The most important studies are London Economics and Draft National Energy Strategy (1998)
[13] Source: ERE (**E**lectricity **R**egulatory **E**ntity), NAE and DPE (**E**lectro-Energy **G**eneral **D**irectory)

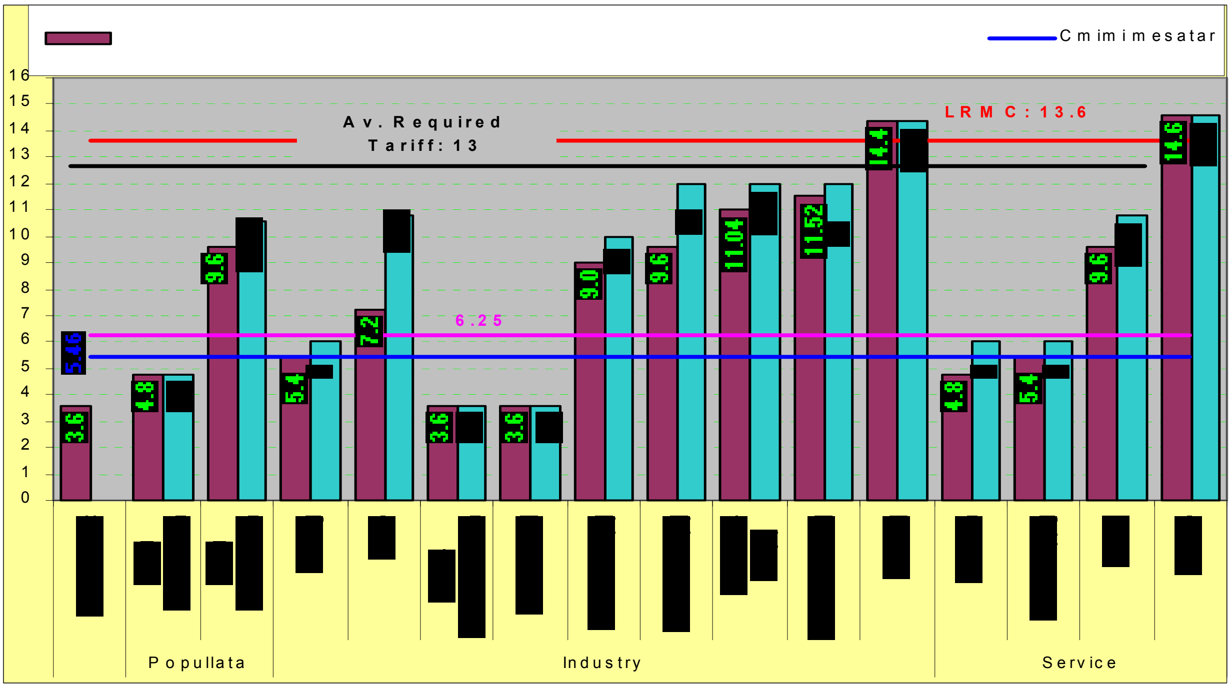


Figure 24: Electricity prices, average price levels and electricity LMRC for different customers categories (lek/kWh)[14].

Figure I.24 indicates the actual and proposed (ceiling price) prices of electricity for different customers categories. The figure shows also the current average price at the level of 5.46 lek/kWh, while the average price is 6.15 lek/kWh based in new tariffs approved by ERE on April1, 2003. This price of electricity, which is, below the long-term marginal running cost of generation/transmission/distribution: 13.6 lek/kWh. The WB study has accurately calculated the level of the long-term marginal cost of generation/transmission/distribution electricity unit, which is around 13.6 lek/kWh. The above analysis shows that electricity prices should be liberalized during a reasonable period of time in order to reflect the actual cost of electricity supply. The study recommends the increase of tariffs to a level of 9.6 lek/kWh in order to have a financially sound power sector. A more detailed analysis is given in the respective sections. The long-term electricity price subsidization strategy resulted non effective, and the Albanian Government with the approval of the Power Sector Policy Statement demonstrated the willingness to avoid subsidization for a period of 3-4 years and increase the electricity prices to the required tariff level in order to reach the positive indicators for power sector. Steps to implement the tariff reform for cost oriented ones within a reasonable period of time while protecting the low-income citizens are critical. Thus, the strategy recommends the establishing of cost based tariffs that correctly distribute the cost burden among customers' categories and eliminate the cross-subsidies, while protecting the low-income citizens.

[14] Figure 24 has the following abbreviations: (1) Industrial consumers supplied by the high voltage, metered in the medium voltage; (2) Industrial consumers supplied by the high voltage, metered in the low voltage; (3) Industrial consumers supplied by the medium voltage, metered in the medium voltage; (4) Industrial consumers supplied by the medium voltage, metered in the low voltage; (5) Industrial consumers supplied by the low voltage, metered in the low voltage; LMRC = Long Marginal Running Cost.

I.5.3 Analysis of different energy resource positions related to provision of main services in the residential sector.

This section analyses the positions occupied by energy resources that may be used in the residential sector. They are given as energy costs linked to the supply of 1 kWh of useful electricity for heating, cooking, hot water production and fixed costs that take into account the first investments for the plants that will guarantee the above-mentioned services. In order to have a coherent analysis in figures I.16-I.23 are shown the prices of energy sources in December 2002. The total cost for these services is calculated based on prices and average efficiency of equipment or plants, energy resource prices and the energy demand for heating, cooking and hot water production. The total costs are given in figures I.25, I.26 and I.27. As shown in figure I.25, fuel wood guarantees space heating with the lowest total cost, while LPG and electricity have higher costs, 9.6 (current price) and 10.8 lek/kWh (approved price after April, 2003) for a higher consumption than 300 kWh/month.

Figure I.26 compares the total costs for providing hot water production. Fuel wood is again the cheapest source while electricity has the highest total cost. The same situation repeats for cooking as shown in figure I.27. This section contains only a short description of the actual situation of the energy source positions for space heating, hot water production and cooking, while a more detailed analysis is done in the section dealing with energy sector development scenarios. As part of the Power Sector WB study, the tariff module calculates the long-term marginal running costs of supply for each customer category (residential sector included), defines the required tariff level for a financially feasible activity of the supplier and recommends the new tariffs implementing program divided in phases. Study will serve to ERE as a base to undertake the necessary steps for a fast tariff transition period.

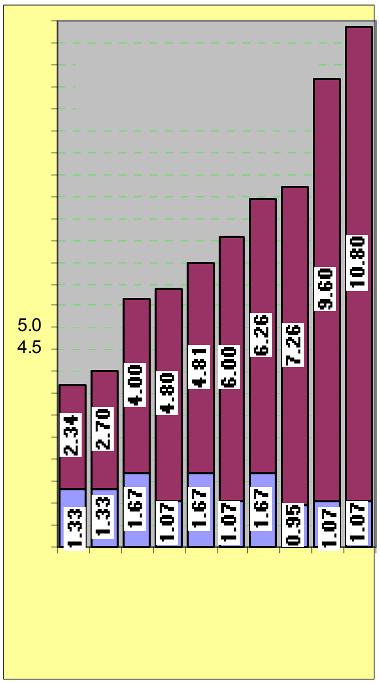


Figure I.25: Comparison of energy commodities related with total investments and energy costs for space heating[15]

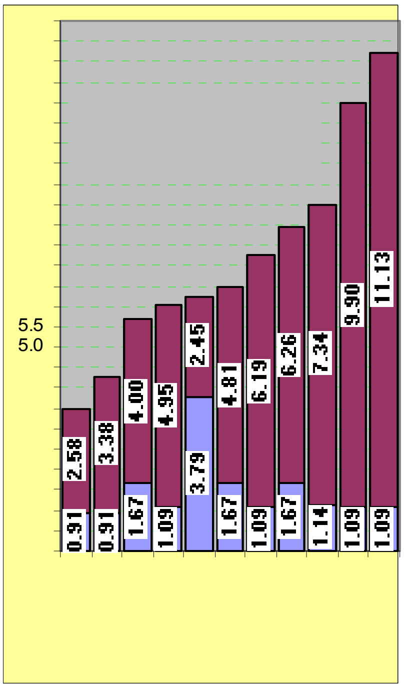


Figure I.26: Comparison of energy commodities related with total investments and energy costs for hot water production

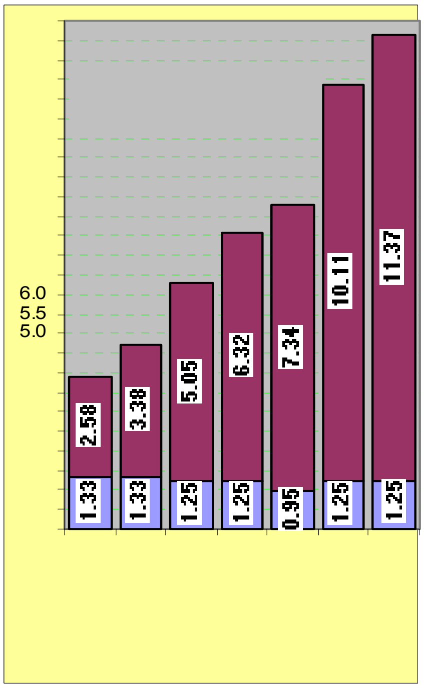


Figure I.27: Comparison of energy commodities related with total investments and energy costs for space heating

[15] Source: National Agency of Energy. Figures I.25, I.26 and I.27 have the following abbreviations:
"Electricity (<a)" = Price of electricity before April 1, 2003 for lower consumption than 300 kWh/month
"Electricity (<p)" = Proposed price after April 1, 2003 of electricity for lower consumption than 300 kWh/month
"Electricity (<a)" = Actual price of electricity before April 1, 2003 for higher consumption than 300 kWh/month

I.6 POWER CAPACITIES OF GENERATION, IMPORTING, TRANSMISSION AND DISTRIBUTION

I.6.1 Capacities of Power Generation, Importing, Transmission and Distribution

I.6.1.1 Power Generation Capacities

The total installed power generation capacity is 1659 MW, including 1446 MW hydro and 213 MW thermal, as indicated in figure I.28. From TPP capacities, only Fier TPP is actually working with a reduced capacity of 12-20 MW from the existing 159 MW. 96% of the total annual power generation comes from HPPs, from which the three HPPs on Drin river cascade generate 86% of the total production. In a normal year, the total generation of electricity is 4160 GWh. As shown in the figure, the generation capacity had a rapid increase after the construction of three HPPs on Drin river cascade: Vau Dejes, Fierza and Koman. On the other hand, the construction of TPPs was more uniform, but as the years passed, after the construction of Koman HPP in 1986, the domination of HPP was evident.

Quite the contrary occurred with the TPP, especially after 1990 when the capacity started to reduce due to the lack of operation in a number of coal-based TPP. After the decommissioning of Korca TPP in 1995, the coal-TPPs stopped the operations. With other TPPs, practically out of work, efforts were concentrated on the rehabilitation of Fier TPP, especially the Czech unit with an installed capacity of 60 MW, constructed in 1980. KESH and the Albanian Government consider the rehabilitation of Fier TPP as a first hand priority. As a result a feasibility study was prepared for the rehabilitation of Fier TPP through US TDA financing[16].

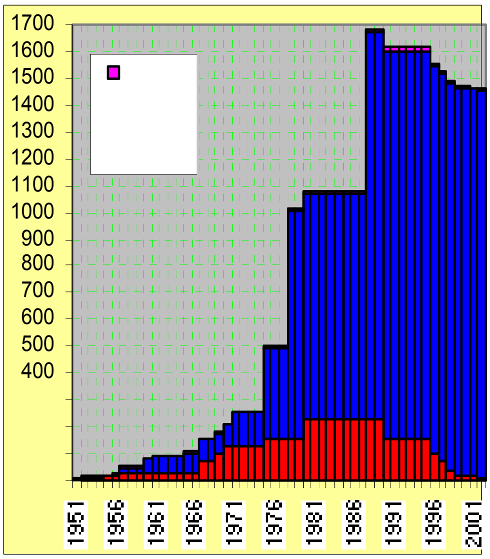


Figure I.28: Installed power generation capacity (MW)

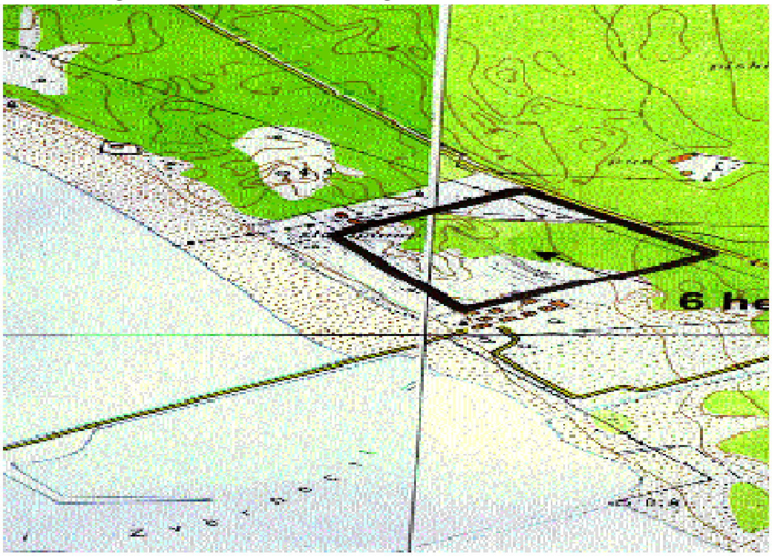


Figure I.29: Location of Vlora B Zone (near to the new port)

The final conclusion of the study carried out by HARZA Company and NAE underlines the urgent need for the rehabilitation of Fier TPP not only for technical and safety reasons but also to reduce the electricity generation unit cost, which is actually very high. The rehabilitation will lead to a higher technical capacity, more security and obviously to a lower electricity generation

"Electricity (<p>)" = Proposed price of electricity after April 1, 2003 for higher consumption than 300 kWh/month

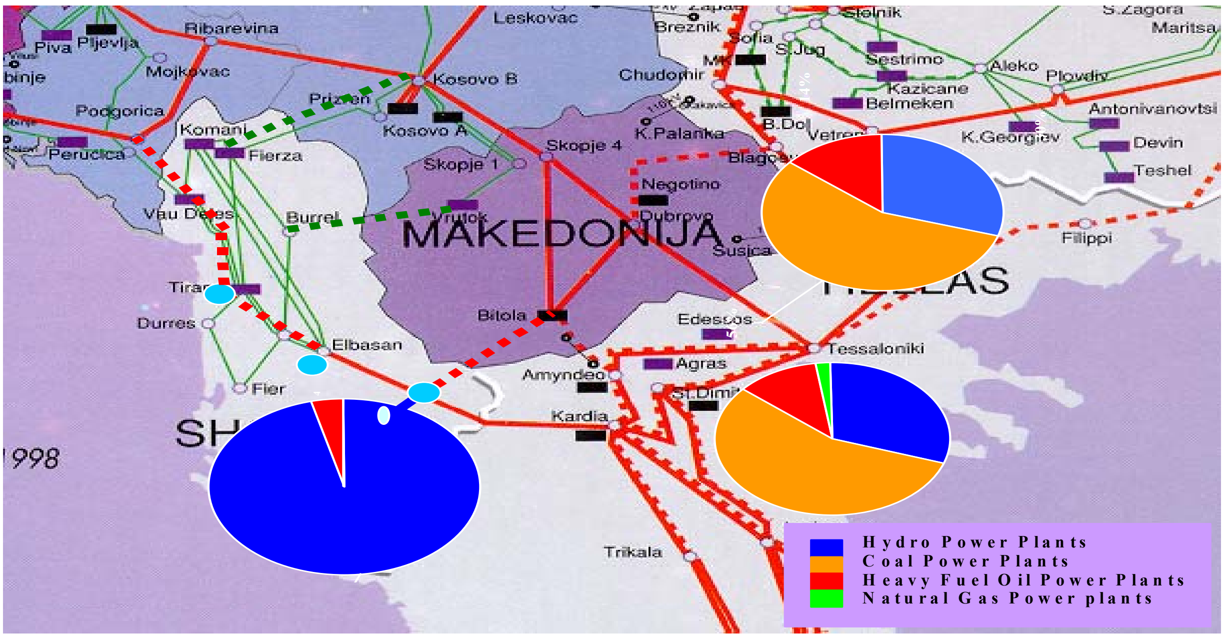
[16] Abbreviations: US TDA = **U**nited **S**tate **T**rade and **D**evelopment **A**gency

unit cost. The first investment for the rehabilitation of the Czech unit (60 MW) is 23 Million USD (15%), and the electricity long-term marginal cost is 4.8 cent/kWh.

World Bank, European Bank of Investments and European Bank for Reconstruction and Development have expressed their support to finance a new TPP with a considerable capacity. The construction of the combined cycle TPP will be divided in three phases. Each phase will have an installed capacity of 135 MW and a first investment of 100 Million USD (first phase). The first phase and the comprehensive feasibility study have already been completed (selection of the location: Vlora B Zone shown in figure I.29). Meantime the Regional Council of Territory Adjustment of Vlora District has approved the construction site and the third phase for the complete assessment of the environmental impact is expected to start soon. The study has been foreseen to conclude in June 2003 followed by negotiations with the banks for the financing of this very important project.

I.6.1.2 Power importing capacities

Power generation in most part of the neighbor countries comes from thermal power plants (shown in figure I.30). Kosova is a typical case with an installed capacity of 1445 MW based almost on coal operating TPP. Based on this situation, the EU Electricity Directive (92/96) and the Athens Memorandum of November 15, 2002 signed by the Energy Ministers of Southeast European countries, was agreed to establish a regional electricity market (REM), that will require the construction of safe interconnection lines and the 400 kV Elbasan-Podgorica line (or Kosova) as a priority one, which will connect Albania, Greece and Macedonia in a short way (the so-called Adriatic root) with UCTE. For this line exist two options, Elbasan-Podgorice and



Elbasan-Kosova B.

Figure I.30: Albania electricity interconnection with neighbor countries.

I.6.1.3 Electricity transmission capacities

Albanian Energy System is facing serious problems due to the insufficient development of the transmission system and the actually lack of rehabilitation and upgrading of the equipment during the last 15 years, as shown in figure I.31. This has considerably reduced the reliability of system operation and the quality of electricity supplied, and has limited the exchange capacity with neighbor countries. The main existing problems are the followings:

- Overloading of several 220 kV transmission lines causes losses, a lower voltage level than standards and load shedding,
- Lack of system flexibility and the operation not in accordance with n-1 criteria, reduces the reliability and capacity of the transmission system,
- Lack of possibility to operate in an optimal way and non-balancing of the reactive power,
- Many assets of the 220/110 kV substations are old and during the last years the maintenance operations barely existed,
- Limitation of electricity exchange capacity with neighbor countries,
- The old and inefficient controlling system communication means.

Actually, the Albanian transmission system is composed of a combined network and three levels: 400 kV, 220 kV and 110 kV. Figure I.31 shows the trend of the electricity transmission network installation. The 220 kV transmission network connects three big hydro power plants on the Drin River cascade (Vau Dejes, Koman and Fierza) and Fier TPP with high load centers such as Tirana, Durres, Elbasan, Burrel and Fier. In general, the 220 kV transmission lines are heavily loaded when the system works under normal conditions. Based on the need for upgrading and development of the main transmission equipment, to support the network increasing capacity for electricity import and the development of the transmission and distribution system, the World Bank, in cooperation with other donors, has approved a package for the Transmission and Distribution System Rehabilitation Project. The project objectives are as follows:

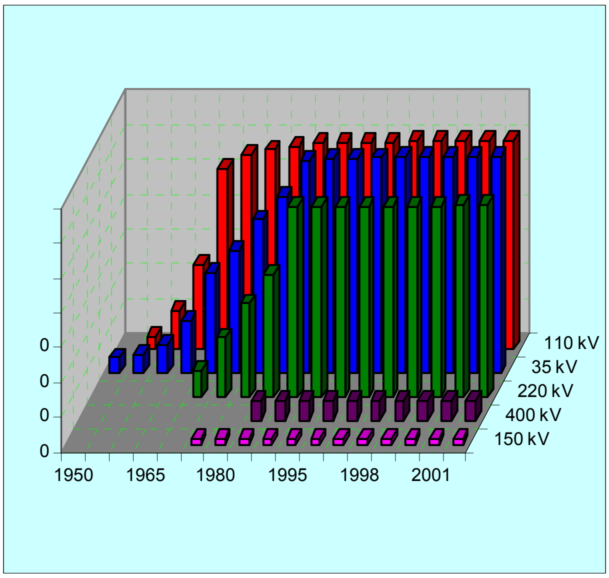


Figure I.31.: Transmission network structure[17] (km)

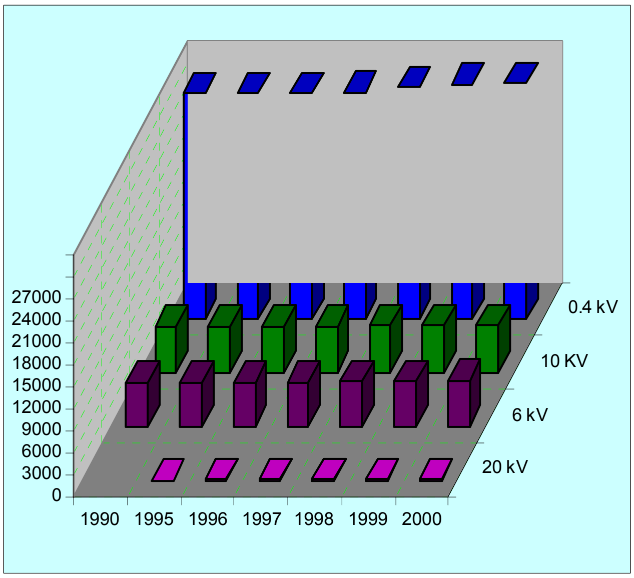


Figure I.32.: Distribution network structure (km)

- Improvement of all standards, quality and efficiency of the transmission system,
- Optimal operation, the reduction of technical losses and the improvement of voltage profile,
- Support and development of intermediate transmission and distribution equipment,
- Upgrading and extension of exchange capacities with neighbor countries especially in times when the increased demand for electricity in Albania has to be met from import.

I.6.1.4 Electricity distribution capacities

The average number of customers per km^2 and the inhabitants' number per km^2 in Albania are approximately one third of the same figure in developed countries. The low number of

[17] Source: Figures I.31 and I.32 are based on KESH data

customers and the low density of the population require big unit investments per customers. The main cables and the main distribution system feeders are 6 kV, 10 kV and 220 kV, as shown in figure I.32. The actual distribution equipment is in a very bad condition due to the long working period. Extreme overload conditions are reached during the winter with the high consumption of electricity for space heating continuously damaging the distribution system. Since 1999, the Ministry of Industry and Energy, and KESH have started a number of rehabilitation projects for the distribution system. The plans are part of the rehabilitation project of the transmission and distribution system financed by the donors group, consisting on:

a) the rehabilitation of distribution system equipment in 10 main cities: Tirana, Durres, Shkodra, Vlora, Elbasan, Fier, Lushnje, Kavaja, Lezha, Berati as well as in the urban area in both sides of Tirana-Durres road. As regards the demand side, the substitution of the distribution system is a necessity, taking into consideration the introduction of the 110/20 kV network as a substitute for the existing voltage levels of 35/10 and 35/6 kV,
b) the rehabilitation of distribution equipment for the second group of smaller cities to reach covering of demand through the change of the voltage level from 6 to 10 kV and the total substitution of the existing equipment, and
c) rehabilitation of the distribution system in rural areas by changing the voltage level from 6 to 10 kV.

I.6.1.4 Rehabilitation Action Plan for the Transmission/Distribution System

In the framework of the Power Sector Action Plan, submitted to the donors on December 2000, KESH, assisted by ENEL, has developed an investment plan with projects for the upgrading, rehabilitation and enforcement of the transmission and distribution system. The most important investments of the plan are:

1. BISABU Project financed by the German Government. The project will rehabilitate Bistrica 1&2 HPPs, reconstruct Saranda, Permet and Tepelena distribution networks and improve Gjirokastra substation. The investments needed are with a value of DM 40 million.
2. Transmission and Distribution Rehabilitation Project: World Bank and Donors, as described in the energy scenario analysis, will finance an investment package (following list) of approximately 230 million USD.
3. Construction of a new 220/110 kV substation in Rashbull (Durres), with an approximate cost of US$ 8 million. The project is under construction.
4. Construction of a new Dispatching Center that will drastically improve the transmission network operation, prevent the emergency conditions and implement the electricity shortage procedures.
5. "March 2000" Package: KESH has received a fund of Italian Lt. 17 milliard from the Italian Government for the reconstruction of 5 new substations of 110/20 kV and the development of the 20 kV distribution network for Tirana, Shkodra, Durres and Kashar. Most part of the package has been fulfilled.
6. Projects financed by the Albanian Government: The state budget has provided a considerable fund for different projects in the distribution system.

I.6.2 Production, Transmission, Refining, Stocking, Distribution and Importing Capacities of Crude Oil and Oil By-Products

I.6.2.1 Oil Production Capacities

The domestic oil fields have good potential capacities since their recovery coefficients compared with oil fields in analogue conditions are very low due to the lack of modern extraction technologies and sometimes due to exploitation in bad manner of these oil fields.

There are actually 12 oil fields administrated by oil and gas company Albetrol, which are located in Saranda, Vlora, Mallakaster, Fier, Lushnja and Kucova. The total number of wells in oil field is 4666, from which 3123 are operating wells and 981 are out of work. The oil well inflow in our oil fields are very low, varying to a range of 0.2-1.5 m^3/day in sand stone and 2-12 m^3/day in limestone oil fields. Recovery coefficients range respectively 38.5-17% in limestone and 12.6-6.5% in sand stone oil fields as showed in figures 33 and 34[18].

The main reasons causing the significant reduction of oil recovery for the period 1990-2002 are:

- Significant reduction of the number of operating wells.
- Significant reduction of the number of new wells.
- Not utilization of recovery oil methods.
- Significant reduction of oil production from the use of working methods in the layers.
- Limited investments for production in oil sector.

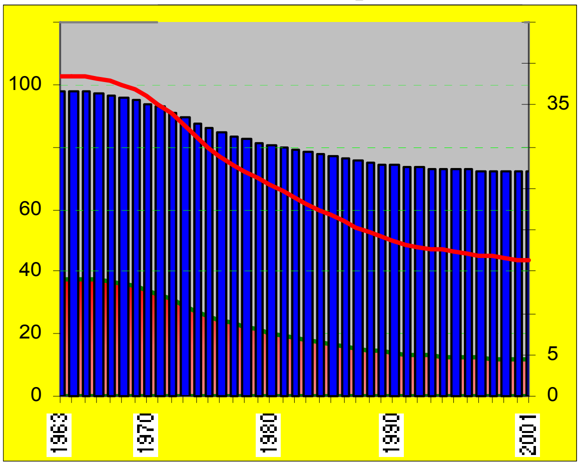


Figure I.33.: Trend of exploitation capacities in limestone oil fields.

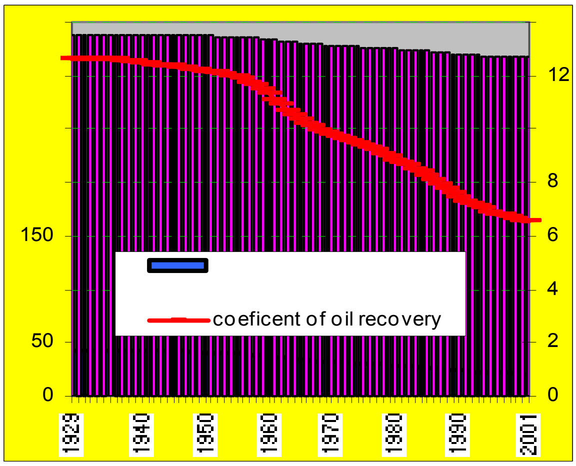


Figure I.34.: Trend of exploitation capacities in sand stone.

Taking into account the potencial capacities of the sand stone field forenhanced of production, on September 1994, Albpetrol and a group foreign companies signed the agreement "On Patos-Marinza and Dumrea area". After fulfilling the license obligations, according to the respective phases, the partners interrupted the research operations in Dumrea, thus the license remained valid only for Patos-Marinza oil fields. The development plan for Patos-Marinza oil fields represents in details the rehabilitation and development of the oil fields through drilling of 400 new wells, increasing of the recovery through use of a new technology and the necessary investments to guarantee the expected profits.

I.6.2.2 Oil transporting capacities

Albpetrol is responsible for crude oil transport from oil fields to gathering station and refineries and ARMO refining and marketing company is responsible for transport of oil by-products. The transport network infrastructure is equipped with pipelines, tankers, pumping stations, control equipment, etc. The crude oil transport system has been conceived and developed as a unique network that connects each oil field with gathering station and refineries. The system was projected to provide normal working conditions for the refineries when they are working with full capacity with a flow of 7000 ton/day or 2.5 million per year. The branch system for crude oil export through Vlora with a 5000 ton/day capacity is actually out of operation. It should be underlined that the local transport network for crude oil and oil by-products needs to be

[18] Source: Figures I.31 and I.32 are based on Albpetrol data.

rehabilitated due to the old technology and the gradual erosion that acted during the whole life. Pipeline network for crude oil transport has a length of 200 km and is mainly concentrated in oil fields areas. Oil by-products network has a length of 180 km, including:

⇒ Pipeline and the respective pumping station system for the transportation of half-processed oil by-products (gasoline, diesel) from Fier, Cerrik, Kucova (the last two have not been working since 1995) to Ballsh refinery,

⇒ Pipeline system for the transmission of LFO in Visoka, Marinza and Sheqishte (80% diesel and 20% gasoline) used for reducing the oil viscosity through mixing the heavy and viscous crude oil into production wells with some additional LFH.

I.6.2.3 Oil refining capacities

Ballsh and Fier are the only operating refineries, but due to the decline of crude oil production and their physical depreciation, they use only 30% of their capacity. Ballsh refinery commissioned in 1978 as the only complex refinery of the country composed of modern plants for the production of a large range of oil by-products. Although built in 1978, the refinery technology belongs to ’60. It should be underlined that the parameters of many technological processes such as oil desalination or water cleaning do not comply with the environmental requirements. Ballsh refinery needs to be rehabilitated due to the heavy depreciation. Fier refinery produces heavy products such as heavy fuel oil, bitumen and heavy fuel oil. Booth refinery needs a feasibility study to assess the economic justification of continued operation.

Both refineries have mainly used the initial oil for technology with small changes of equipments dictated by the situation. The economic effect as regards energy expenses has deteriorated in these refineries. As a consequence, under the new conditions created in the oil-refining sector, which is currently faced by many problems, such as cost of refinery production compare with the Mediterranean rafineries and the oil by-products quality, remain first-hand priorities. Alternative scenarios include detailed economic analyses regarding the rehabilitation of oil refineries or construction of the new ones.

I.6.2.4 Oil and oil by-products storage capacities

The crude oil and by-products stocking system is divided as follows:

⇒ Storage capacities of ARMO and Albpetrol companies,

⇒ Storage capacities of wholesale private companies, and

⇒ Storage capacities of retailing stations.

Albpetrol storage capacities is a quantity of 100 000 m^3 for crude oil while ARMO facilities are in Ballsh including: 45 000 m^3 diesel, 46 000 m^3 gasoline, 25 000 m^3 heavy fuel oil, 22 000 m^3 after and 61 000 m^3 crude oil. As semi products may be stored: 20 000 m^3 diesel, 25 000 m^3 gasoline, 6 000 m^3 kerosene, 25 000 m^3 heavy fuel oil and 2 000 m^3 crude oil. Fier refinery stores 700 m^3 diesel, 500 m^3 gasoline, 5000 m^3 heavy fuel oil and 800 m^3 bitumen.

The oil by-product storage park in Vlora include 7 X 5000 m^3 storage tanks, 4 for diesel and 3 for gasoline. The installed reservoirs in other 21 branches in different districts have a total fuel storage capacity of approximately 30 000 m^3, from which: 10 000 m^3 diesel, 9 000 m^3 gasoline, 7 000 m^3 kerosene and 4 000 m^3 heavy fuel oil. The storage capacity of the wholesale private companies is approximately 50 000 m^3. It is important to mention that their location in some districts, particularly in the tourist area create many problems from environmental point of view. The third storage category is composed of retail pumping stations. There are approx. 700 retail pumping stations in the whole country with a total stocking capacity of 20 000 m^3.

Based on the law no.8450, date 24.2.1999 "On the processing, transporting and trading of oil, gas and their by-products", each subject is obliged to guarantee a security reserve equal to 30 days sale of the previous year activity. In order to apply the above law, many companies have provided to improve the storage structure starting with the construction of seashore deposits. The study "On the definition of appropriate spaces for the construction of seashore deposits of oil, gas and their by-products" has defined two appropriate zones for seashore deposits: Vlora Bay and Bishti Palles (Durres). Actually, the permission for the construction of LPG deposits in the area of the former Caustic Soda factory in Vlora Bay was approved and discussions are going on for the construction of new oil by-product deposits. In Bishti Palles region, the permission procedures for the construction of LPG and oil by-product terminals have already started.

I.6.2.5 Oil by-products distribution capacities

Oil-by-products trade in our country is generally covered in the whole territory by 700 retailing stations, from which 33 belongs to ARMO Company. The number of the retailing stations has increased 3 times compared to 1994.

I.6.2.6 Oil by-products import/export capacities

Oil by-products are mainly imported from Greece and in lower quantities from Italy, Russia and some other countries. The transport sector is the main oil by-product consumer reaching representing of 46% of the energy primary sources. Import of oil by-products that lately has considerably increased, is mainly done through ports of Vlora, Durres, Shengjin and Saranda. Domestic stocking capacities are capable to face the by-product import, taking into account that during the last decade 100-800 thousand ton oil by-products have been imported every year. The export of by-products started after 1980 mainly consisting in semi-processed products.

I.6.3 Natural Gas Production, Importing, Transmission and Distribution Capacities

I.6.3.1 Natural Gas Production Capacities

The domestic gas production capacities are in their minimal limits, due to drying up of the reserves and decline of the initial pressure in oil resources. So far, approx. 500 wells have been drilled in natural gas fields, from which only 255 of them contained gas. Due to gas reserve decline, 25 wells have a debit production varying from 1000-8000 m^3N/day. The existing natural gas fields are in their final development phase. The only concrete possibility to increase gas production is forcasing to drill of a new well in Delvina, which requires an investment of about US$ 8 million.

I.6.3.2 Natural Gas Transmission Capacities

The endogenous gas network infrastructure has had a larger extension than the oil infrastructure. Due to the fact that gas fields have a larger extension starting from Durres to Delvina, which creates the possibility for the close-by consumers to connect with the network. The pipeline network has a length of 498 km and connects all gas fields (Povelce, Divjaka, Frakulla, Panaja and Delvina) with consumers located in Fier, Vlora, Elbasan, Lushnja, Ballsh and Durres. Currently, gas infrastructure in many places is out of operating and needs rehabilitation and parts of the network need to be totally substituted. Due to the low level of gas production, some of the pipelines are unable to transport gas due to their continuous corrosion and destruction.
Studies done so far in the gas field aimed the identification of different alternatives to connect Albania with the European gas network and the market evaluation for the next 15 years. In these conditions, after 1992 NAE undertook a number of initiatives inh cooperation with foreign companies for the interconnection of Albania with the European natural gas network. There are

three possible interconnection alternatives for Albania: north, east and west, as shown in figure I.36.

I.6.4 Coal Production and Importing Capacities

Actually, the capacities of coal mines are, at their minimum, producing around 9000 tons from 2 million tons produced in years 90', and this production comes mainly from Memaliaj mine and other three small mines in Korca. Memaliaj basin has been exploited in three different sectors detached amongst them and acting as separated mines. In Korca district, actually, operate 3 mines, 2 of them in Gore and a third one in Mborje Drenove. All three mines are given to private investors through leasing, which production is of limited capacities. Our country imports coal for needs of service and industry sectors mainly from Greece.

I.7 ENERGY RESOURCES

Primary energy resources are classified in different ways. The most appropriate, in the view of their use by mankind, is the following classification:

1. **Non-renewable energy sources** are those that are exhaustible such as organic fuels: *coal, oil , natural gas, wood, energy produced by burning solid urban wastes and nuclear energy generated from radioactive disintegration*. The non-renewable energy sources have given and are giving the greater contribution for meeting the energy needs of each country.
2. **Almost inexhaustible energy sources** are those energy sources, which despite being used by mankind for its needs, at the level of historical perspective, result almost inexhaustible. Here are included: geothermal energy and the energy from the reaction of thermonuclear synthesis.
3. **Renewable energy sources** are all those reaching to the land's surface from the universe. In the renewable resources are included: hydro, solar, wind, biomass, and ocean wave energy.
4. **"Virtual" energy sources** where the energy conservation is classified.

Following is made a brief description of the energy resources of our country, which are exploitable from technical and economic pointview and cause minimum adverse impact on the environment.

I.7.1 Reserves of non-renewable energy resources

Based on their economic value, fuels reserves are classified as following:
-proven resources are those that are evaluated of future economic benefit using the existing technology, by modern geology, drilling and exploitation engineering.
-forecasted resources are either those that geologically are explored but still with no economic benefits or those not precisely confirmed geologically. In this group is included the energy generated from the radioactive disintegration of radioactive elements (uranium, radium, plutonium etc.), but they will not be considered as a possible option while developing the scenarios of the National Strategy of Energy till 2015.

I.7.1.1 Oil Reserves

Oil reserves in our country, despite predomination of normal technologies of oil exploitation, still conserve relatively high oil resources, which may be extracted applying the enhanced oil recovery. In the existing oil fields, the total reserves are about 450 Mtoe from which 340 Mtoe from sandstone deposits and some 110 Mtoe from limestone deposits. Greater share of the rezerves are situated in Driza deposit estimated in a value of 200 Mtoe and in Kucova in a value of 68 Mtoe, representing both 60% of the total geological oil reserves. Oil fields are of high gravity of 12-25 API rank and with 4-8 % sulfur content.

I.7.1.2 Natural Gas Resources

Gas resources in our country have incurred drastic decline since 1985 year reaching the minimum after '90 as a consequence lack of investments in the existing gas fields and non-discovering of new reserves. Below is shown an estimation of gas reserves in the natural gas resources, gas condensate (in Delvina well) and associated gas. Recent years, the works for exploration of new gas fields, are limited in a small number of gas fields and are concentrated mainly on Divjaka region and less on that of Frakulla. Reduction of exploration activities is caused due to high cost of well drillings and increase of difficulties to discover new commercial gas rezerves, which means economically valuable.

In Divjaka structures are planned and projected to drill a number of wells in both gas-content zones. In the Pliocene zone will be drilled 8 wells with deepness of 1220-1600 m with an initial debit of 6000-8000 m^3N/day and a monthly decreasing coefficient of 4-6%. In Mesiniani-Tortoniani deposits will be drilled 4 new wells with a deepness of 2950 to 3650 m, and based on the up to date experience it is expected to be extracted some 147 million m^3N. Frakulla structure is a gas field under exploitation where gas contents are proven to be in all part of the structure. From 88 wells drilled in this area, up to date, 30 of them have given positive results and deposited reserves result to be around 260 million m^3N. Panaja source is still undeveloped with exception of the stratum of well Pa-10 with reserves of 50 million m^3N. Particular of geological problems of this gas fields obliged to do gas exploration and production with foreign partners in this area using the most updating technologies. In Povelca structure are drilled totally 36 wells. Results of last wells in northern part of the structure, where the reserves for each well are below the average of all wells, influenced the suspension of drilling of new wells. In Delvina structure, an associated gas source is proven with estimated resources of 1.3-1.9 billion m^3N.

Summarizing, the total proven reserves of natural gas in the country are some 57 million m^3N. Drilling in the Mesiniani-Tortoniani deposits guaranties the needs of Ballsh refinery and Albpetrol self-consumption. Delvina is another very effective gas field to continue drillings and to produce associated gas.

I.7.1.2 Exploration Results of Hydrocarbon Agreements

Activity of foreign companies for exploration and production of oil in Albania is completing 12^{th} year, and during this period 10 wells (6 off shore and 4 on shore) are drilled and 13000 km of new seismic profiles are completed. The map of division of the exploration areas for oil and gas reserves is given in the figure I.37. New wells of this exploration activity have proven that in certain area of our country the oil reserves have been almost negligible. Even there wasn't discovered any new proven source, these exploration activities have helped in the progress of concept on geological structure of our country. Actually, from five Hydrocarbon Agreements signed for exploration in Albania offshore area, only in the "RODONI-1" block the Hydrocarbon Operations are continuing, while on shore area exploration activities are going on in four blocks of first round and in five blocks of second round.

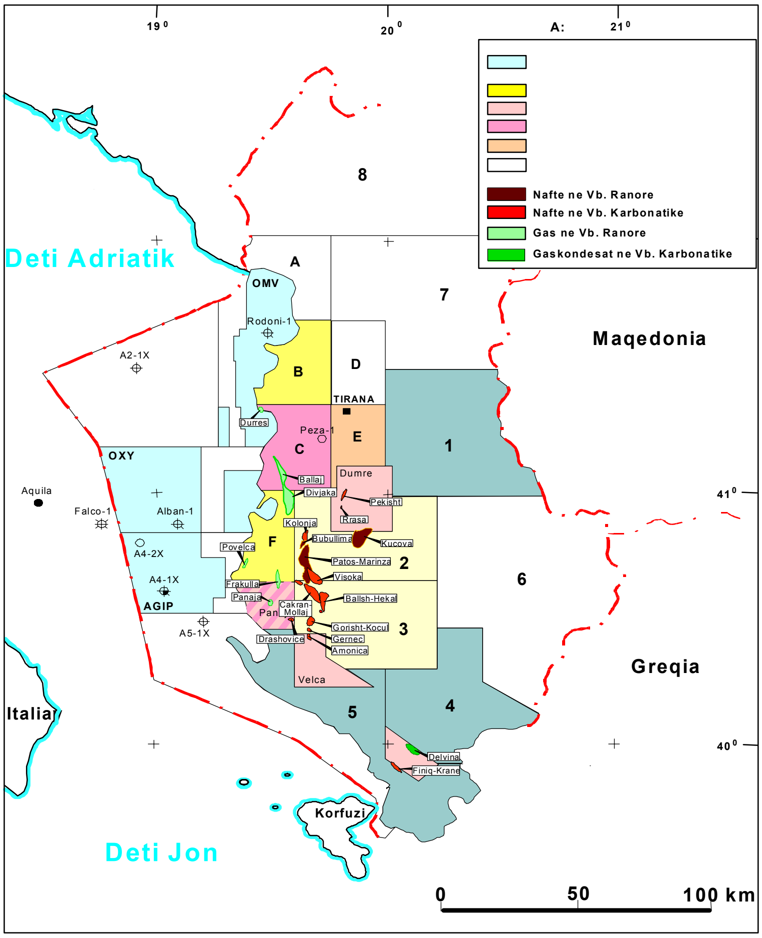


Figure I.37.: Map of Oil and Gas Resources and of Exploration Blocks

I.7.7.1.3 Coal Resources

Coal is one of largest energy source of Albania and is spread in four main basins that are given in the table I.2. As it shown in the table, the forecasted coal reserves are around 226.49 Mtoe. Coal production in our country was provided by 17 enterprises, which used to run 21 mines, six of which (Memaliaj, Mborje-Drenove, Valias, Verdove, Krrabe and Mushqeta) during years '80-'90 gave 90% of the total coal output. Currently, the coal industry is facing with various problems relating to lack of financial means for updating the already old technology, mineral transportation and competition from the imported coal, etc. In general, our coal basins have coal with low net calorific value and thin mineral layer that cause a higher cost for energy unit compare to imported coal. These problems led closing down of many coal mines in Tirane-Durres, Pogradec and Korca basins except Bezhani mine, which is almost an open one. The Bezhani mine reserves are around of 2.77 Mtoe and it is the only mine in Korca basin with an efficient coal extraction cost. Proven reserves are approximately 14.7 Mtoe.

Table I.2: Coal Resources in Albania

	Forecasted reserves				Proven reserves
No.	Resource	Amount [thousand ton]	Calorific Value [kJ/kg]	Energetic value [MTEP]	Energetic value [MTEP]
1	Tirane-Durres	613000	12100	1991.6	114.96
2	Memalia	30000	20510	14.7	14.7

3	Pogradecit	33400	12980	10.35	-
4	Korce-Eeseke	32400	11600	8.97	2.77
5	Other resources	3500	10465	0.875	-
6	Total	712000		226.49	132.43

In Tirana-Durres basin, 70% of total reserves are proven reserves. Maximal thickness of layer goes up to 2 m. From analysis done above it results that the proven reserves in this coal basin are around 114.96 Mtoe. Our coal is characterized by low quality, high sulfur content (3-5%), high ash content, which is 30-60%, and moisture content up to 60%. Our coal has a low calorific value of range 8400-16400 kJ/kg and is extracted from the deepness, which goes up to 300 m. Together with the coal, a considerable amount of peat is discovered in Korca area (Maliq source with 156 million m^3) and Saranda area (1.3 million m^3) with a thickness of the layer varying from some centimeters to three meters. Peat is combustible and with a calorific value of 12180 [kJ/kg]. Peat reserves are not economically feasible to be exploited due to high cost and their exploitation would impoverish the arable land.

I.7.1.4 Energy reserves from urban wastes

Problem of municipal solid wastes is an important problem either for developed countries or developing ones as they amount grows with welfare growth of the people. Conservation of raw material through restoring and recycling as much as possible of municipal solid wastes is of vital importance in nowadays. In table I.3 are given the net calorific values of some typical components of solid wastes. As it is shown from the table, the forecasted energy resources from solid urban wastes in our country by 2010 will be around 9.517 toe. Potential of municipal solid wastes as fuel is given primarily through their ingredients, calorific value, moisture content and non-combustible quantity municipal. Solid wastes are composed from components by many elements given in table I.3 (the net calorific values are given for comparison purposes as well). Table I.4 gives the urban waste reserves for some main areas of the country.

Table I.3: Calorific value for some typical components of solid wastes.

Ingredients of solid wastes.	Net calorific Value [MJ/kg]
Paper	14.6
Plastic	37
Cautchouc	34.7
Old rags	16.3
Food wastes	6.7
Vegetable and animal wastes.	18
Wood wastes.	19.5
Coal	(20-35)
Oil	44
Natural gas	52.4

Table I.4: Energetic content of urban wastes in some areas of country.

	Energetic contents in year	Energetic content in year 2010 in
Durres	191	1071
Elbasan	155	861
Fier.	110	524
Korce	112	584
Shkoder	131	724
Tirane	399	2938
Vlore	130	704
Albania	1783	9517

Solid wastes may be used for energy production, but it should be emphasized that their cost is much higher than other traditional fuels. There are four well-known ways of solid waste treatment with a goal of energy production: direct combustion, production of combustible briquettes, production of gaseous or liquefied fuels and production of biogas from their bio-degradation. Since these schemes require big capital investment it is typical that they require collection of large quantity of solid wastes and their products have a large selling market. When the selling market is difficult to be found, these products may be combusted for producing steam (to generate electricity) or hot water.

I.7.2 Reserves of almost inexhaustible energy resources

I.7.2.1 Geothermal Energy Reserves

There are a variety of geothermal sources, which may be classified in: hydrothermal sources, hot drought and melted rocks. From these three groups, up to date, only hydrothermal sources have found practical utilization in Albania. Hydrothermal sources are divided in: sources where drought steam is produced from, sources where saturated steam is produced from temperatures of these two sources are higher than 150 C^o and sources where hot water is produced, from which in some countries is used for space heating. A new technique of using the geothermal energy, which is spreading out, is that of injection of cold water in deep wells of oil and natural gas where it gets warmed. Water is injected with a temperature of (7-8)^{o}C and comes out on the surface with a temperature of (22-25)^{o}C. In our country there are still not discovered geothermal sources, producing steam, as the geological studies show there is a little hope for these sources, but there are some hydrothermal sources with lower temperature. These sources are given in the table I.5.

Table I.5.: Geothermal resources in Albania				
No.	Location of hydrothermal source	Temperature, C^0	Title of Well	Temperature of water on surface, C^0
1	Karme-Sarande	34	Ishmi-1/b	60
2	Langarice-Permet	26-31	Kozan-8	54
3	Sarandapori-Leskovik	26-27	Galigati-2	45
4	Tervoll-Gramsh	24	Bubullima-5	48-50
5	Llixha-Elbasan	58	Seman-1	35
6	Kozan-Elbasan	57	Ardenica-12	32
7	Shupal-Elbasan	29-30		
8	Mamurras-Kruje	21		
9	Peshkopi	35-43		

Most important geothermal resources in Albania are:

- Geothermal area of Kruja is the zone with the largest geothermal resources in Albania, with a size of 18 km length and 4.5 km width, containing reserves of a range of $5.9x10^8$-$5.1x10^9$ GJ.
- Geothermal area of Ardenice where the water springs from deepness with a temperature of 32-38 ^{o}C and a water flow of 15-18 l/s.
- Geothermal area of Peshkopi where there are some geothermal sources located next to each other. Water flow is about 14-17 l/s and the temperature is 43.5 ^{o}C.

I.7.3 Reserves of renewable energy sources

All over the world the interest over renewable energy sources is increasing day by day for these reasons: oil, natural gas and coal reserves are limited, fuel reserves (oil reserves particularly) are concentrated (around 75% of them) in area of Middle-east, an area with high instability. Another reason, which is getting more weight nowadays, is the increase of the environment pollution.

I.7.3.1 Reserves of Hydropower Resources

Albania has a major hydropower potential of which only 35% so far is being exploited. Hydropower capacity installed up to 2002 is 1446 MW. Average output from hydropower is 4162 GWh (as shown in table I.6). Power produced by hydro power plants result with no gases emissions, as it happen when it is produced by combustion of fuels. Profitability of hydropower exploitation is conditioned by the geological and topographic conditions for construction of dams and particularly by topographic conditions in view of avoiding as much as possible the land flooding. Their construction depends on big capital investment for unit as well as the possibility to adjust the flow in high level creating cumulative reservoir. HPP-s already are a far electricity generation in almost all countries around the world. However, exploitation of hydro-energy for producing electricity brings too many economic, social and environment problems. Theoretical hydropower potential considerably declines if we take into account all problems that are related to their construction. Construction of a HPP causes flooding of large areas of land and in most cases accompanied with displacement of population living in those areas. Construction of new dams creates big problems to the rural population living closed to the river, energetic, tourist and water supply companies because each of them tries to protect their interests, which in most cases are almost in opposed. Along with new HPPs that will be built (their list is shown below), two most valuable strategies for increase of power produced by HPPs are: increase of the existing HPPs capacity through installation of new turbines there where they are economically viable, and installation of turbines in dams already built for controlling of flow streams in reservoirs for irrigation and supply of potable water. In our country, actually, are exploited three rivers with a cascade scheme. HPPs built in each cascade have following parameters:

- Drin river cascade with three main hydropower plants with a total installed capacity of 1350 MW, representing 90% of country's power generation;
- Mat river cascade with two hydropower plants with a total installed capacity of 52 MW;
- Bistrica river cascade with a total installed capacity of 28.5 MW.

It should also be emphasized that a number of small HPPs (Selita/Lanabregas, Bogove, Smokthine, and Gjançi) with a total capacity of 20 MW are still in operating.

Table I.6.: Technical Characteristics of existing HPPs

Name of HPP and River		Characteristics of Reservoir			Characteritics of HPP				
HPP	River	Max height of work (m)	height of	storage	units	Nominal head (m)	discharge	capacity	generation (GWh)
Fierzë	Drin	295	237	2200	4	118	472	500	1167
Koman	Drin	170	-	200	4	96	736	600	1704
Vau i Dejës	Drin	60.5	-	250	5	52	565	250	874
Ulza	Mati	128.5	117	124	4	46	64	27	99
Shkopeti	Mati	76.5	74	10	2	36	80	25	81
Bistrica 1	Bistrica	151.8	148.5	0.29	3	91	30	23	150
Bistrica 2	Bistrica	58.5	57.3	-	1	26	27	5.5	
Selita/Lanabregas, Bogovë, Smokthinë, Gjanci		-	-	-	6	-	-	20	87
								1450	**4162**

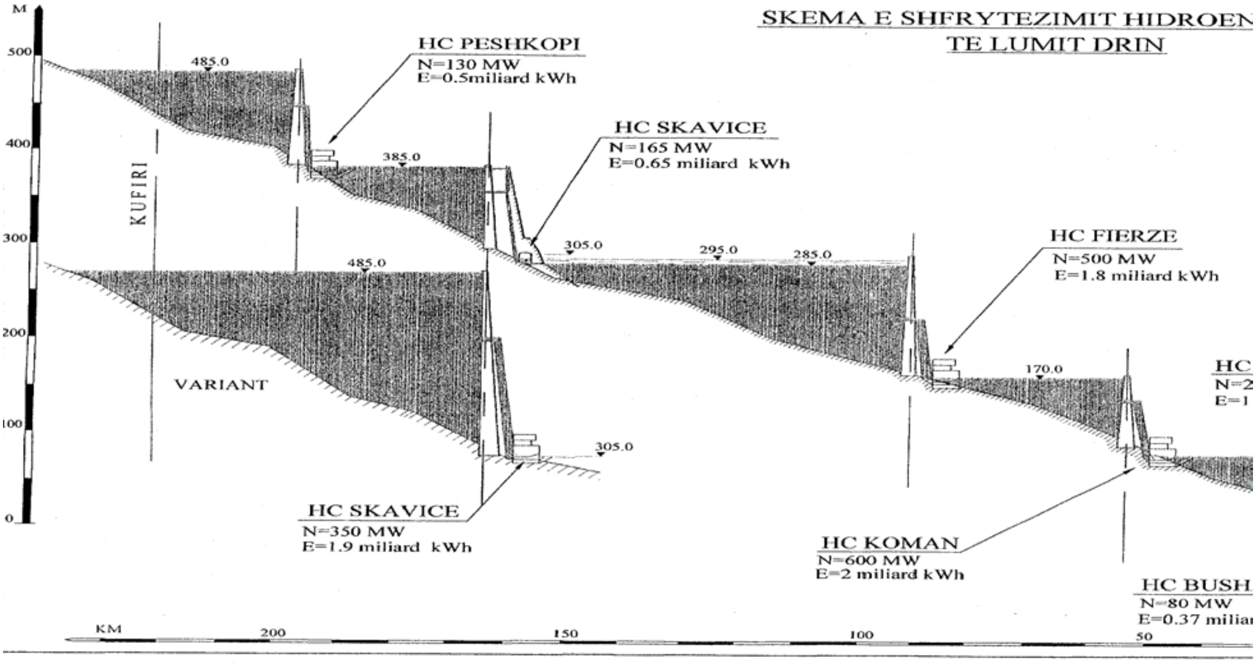


Figure I.38.: Hydro energy exploitation scheme of Drin river in cascade manner

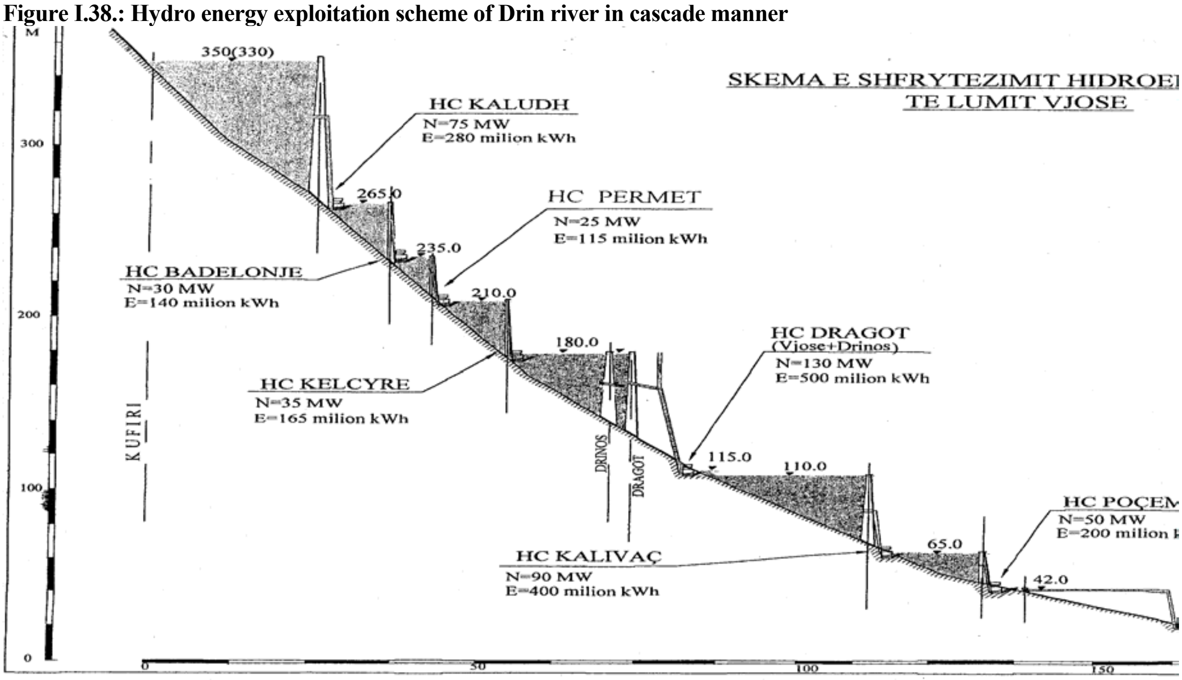


Figure I.39.: Hydro energy exploitation scheme of Vjosa river in cascade manner

Table I.6 gives the main technical characteristics of existing HPP schemes. Actually, a group of donors are funding the rehabilitation of the existing HPPs, mainly in Drin and Mat rivers cascades. These rehabilitation investments, which initial value is US$ 40 million, will increase the reliability of these HPPs. The rehabilitation program will be discussed in details in the chapter of the analysis of scenarios. The total hydropower reserves are estimated around 3000 MW and the potential of annual generation may reach 10 TWh..

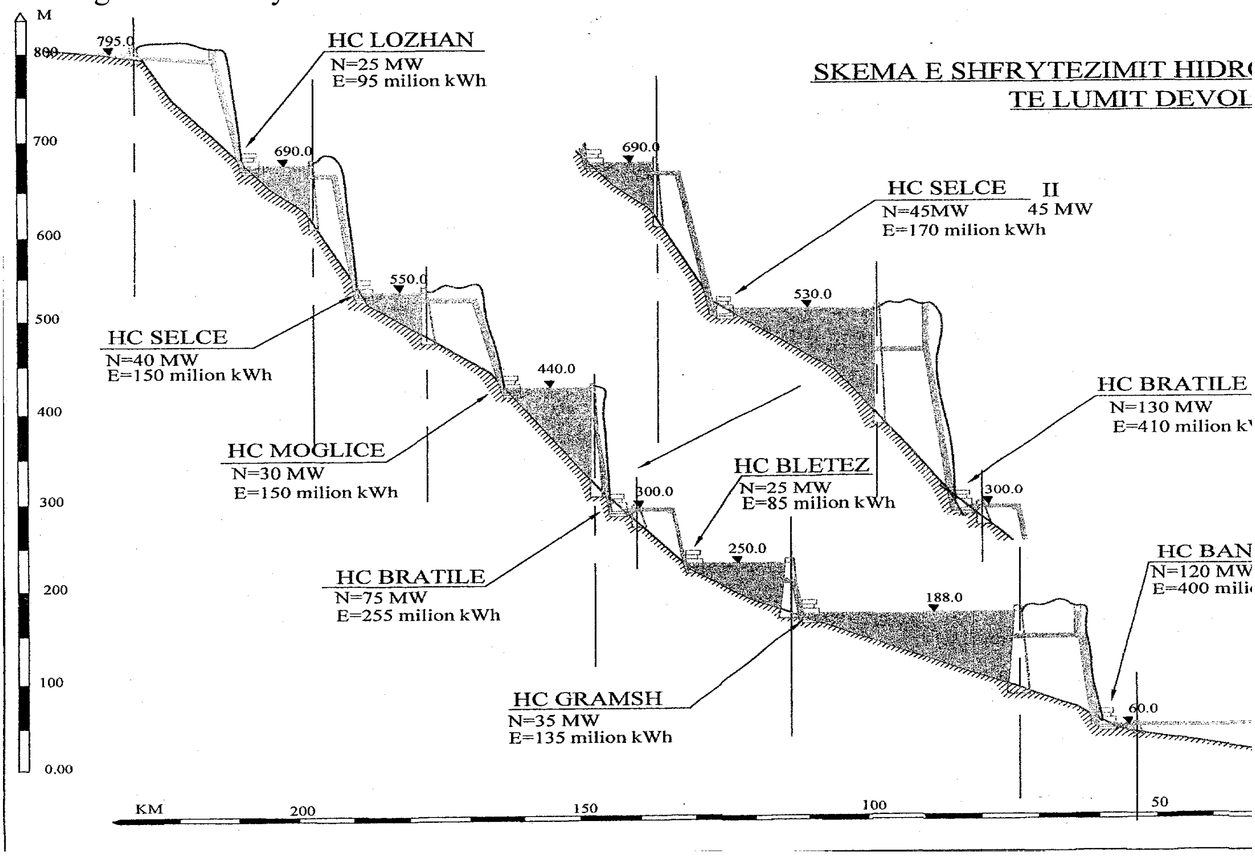


Figure I.39.: Hydro energy exploitation scheme of Devoll river in cascade manner

Based on the actual state of our system, new generation plants are preferred in south part of the country (Vjosa and Devoll rivers) in order to achieve geographical balance of generation and demand. Based on the studies of Institute of Hydrotechnic Studies and Designing the exploitation schemes of Drin, Devoll and Vjosa rivers are given in figures I.38, I.39 and I.40. After discussions held between experts of KESH, the Institute of Hydrotechnic Studies and Designing and the experts of DECON (WB contractor who carried out the Albania Power Study) on the proposed options for construction of new HPP in the future, the following candidates are proposed to be considered:

- On Drin river:

Bushati HPP (84 MW): Situation of this project is as following: In February 2001, KESH signed a turn-key contract with the Chinese Power and Water Corporation (CEW) for construction of Bushati HPP. In parallel, a loan agreement for financing of project was signed with the Chinese counterpart. Both agreements were suspended till an independent evaluator confirmed the financial evaluation of the project. The evaluation was completed by Lahmeyer Company in October 2001. The environment assessment remains to be completed.

- On Vjosa river:

Kaludha HPP (75 MW), Dragot-Tepelena HPP (130 MW) and Kalivaci HPP (100 MW).

- On Devoll river:

Bratila HPP (115 MW) and Banja HPP (80 MW).

Main characteristics of these projects are given in table I.7. Discussions between Decon and Albanian experts have concluded that the other projects such as Skavica (two options) are evaluated as less attractive, particularly from economic point of view, and are not selected as possible candidates to cover the demand for 2005-2015 period. However, their financial profitability will be discussed more in details in the future development scenarios of power sector. Implementation of Banja project is referred to completion of the remaining investments. Initial investment includes civil works for irrigation of an area of 120 000 ha. The original investment cost allocated for the hydropower plant and irrigation component is 40:60. It should be underlined that project completion is almost exclusively in the interest of power generation component because the Ministry of Agriculture has no big interest in this plant due to high cost of irrigation and decline of irrigation demand. Therefore, investment completion will be charged only for power component making it less attractive.

Table I.7.: Main characteristics of possible HPP that may be built till 2015

Name of river and HPP		Characteristics of Reservoir			Characteristics of HPP			
HPP	River	Max height of work (m)	Minimum height of work (m)	Active storage (hm³)	Nominal head (m)	Nominal discharge (m³/s)	Installed capacity (MW)	Annual production (GWh)
Bushati	Drin	23	23	0	18	540	84	350
Kaludh	Vjosa	350	323	300	85	120	75	280
Dragot-Tepelena	Vjosa	180	165	145	65	240	130	500
Kalivaçi	Vjosa	110	96	200	45	260	90	400
Bratila	Devoll	530	510	100	230	62	115	410
Banja	Devoll	180	155	320	120	80	80	325
Total:							**379**	**1530**

Exploitation of hydro energy through small hydropower plant schemes is of interest, too. Until 1988, in Albania were built 83 small HPPs, which capacity varies from 5 to 1200 kW, with a total capacity of 14 MW. The purpose of construction of these HPPs, at the beginning, was to supply with electricity isolated mountainous areas. These HPPs are mostly of *derivation* type and exploit the water springs and streams closed to these areas. The average life of these HPPs is 25 years. A development program of these HPPs has been part of GoA energy policies, and the law on privatization of small HPPs has created some possibilities to bring them back in effective operation. Taking into account their average life, damages they suffered during the transition period after 90', qualification of the employees that have worked in these HPPs, and their maintenance cost, considerable investments, particularly on their mechanic and electric equipment, are required. In the completed studies are included HPPs, which are in stage of their evidencing or project-idea or project-application. 83 existing small HPPs may be classified according to zones as given in table I.8.

Table I.8.: Small HPPs classification according to zones

HPP classification according to zones	Installed capacity (kW)	Annual Generation Capacity (000/kW/h)
Zone 1 (Bulqize, Diber)	3374.5	15370
Zone 2 (Elbasan, Gramsh, Librazhd)	2040	11490
Zone 3 (Kolonje, Korce, Pogradec, Devoll)	2893	17140
Zone 4 (M. Madhe, Tropoje)	1120	8190
Zone 5 (Gjirokaster, Permet, Sarande, Tepelene)	1366	4760

Zone 6 (Mat, Mirdite, Lac, Shkoder)	1320	1030
Zone 7 (Skrapar)	420	1200
Zone 8 (Vlore)	144.7	420
Zone 9 (Has, Puke, Kukes)	599	2420
Total	**14.00**	**62020**

I.7.3.2 Reserves of biomass energy (fuel wood inclusive)

Biomasses can be classified in four major categories: woods or wood residues from various wood processing industries; vegetation residues (stems, seeds etc.) after completion of their production cycle, which are not used in other economic sectors; energetic plants (woods) cultivated to be burned as biomass, and animal residues (bones, skins, manure), which are not used in other economic sectors. Estimations of agriculture residues are based on average ratio between residues and output for unit for each of main agriculture crops. These ratios differ from one zone to another, and are indirectly related to the agriculture output and other conditions. According to some approximate estimations, the agriculture residues in Albania in the year 1980 have been around 800 [toe/year], while in 2001 were around 130 [toe/year].

Data on forest resources are based on inventories done every 10 years from the Forestry Directorate subordinated to the Ministry of Agriculture. Total forecasted resources reach some 125 million m^3 (14.3 Toe). Forests are classified in these major categories: high forests which represent 47-50% of the total wood resources, cropses which are 29-30% of total resources and bushes which are 24-25% of total wood resources. From three aforementioned categories, only 10% of high forests and 50% of copses and 100 of bushes are used as fuel woods. From these data, proven resources of fuel wood are respectively 5.87, 18.25 and 30 million m^3. Total proven reserves of fuel wood are considering about 6 Mtoe.

I.7.3.3 Reserves of Solar Energy

Some of the advantages of exploiting solar energy are:

- is a huge energy source;
- it is free;
- its exploitation provides a high flexibility.

These systems provide energy for very sensitive seasons (drought) and for particular remote areas where the energy supply has a high cost.

The exploitation of solar energy has some disadvantages, too. Initial investment required for exploitation of solar energy for all applicable technologies are very high. This can be explained with the fact that economic benefits of its exploitation depend on the availability of solar energy (which is not continuous), the solar radiation which is variable during the day as well as the large surfaces needed to collect this type of energy. Major limit of renewable energies (solar energy inclusive) is that they are not continuous; therefore all their production systems require energy accumulation. The energy can be accumulated in thermal or electrical accumulator.

Active exploitation of solar energy is achieved in systems that absorb this energy through flat collectors. Hot water can be used for space heating, when its temperature is high, but it is used largely for Domestic Hot Water (DHW) needs. Now days, this technology has resulted as the most viable for exploitation of solar energy, and various countries such as Israel, Turkey, and Greece provide hot water for residential and service sectors using systems of solar panels. There exists also the possibility of transforming solar energy directly into electrical energy without going through intermediate stages, using photovoltaic systems, but the cost of one energy unit produced by them is around 27-32 US cents/kWh. The Energy Efficiency Center Albania-EU

(EEC) is carrying out a pilot project on exploitation of photovoltaic systems for pumping of irrigation and potable water. In tables 9 and 10 are given the average solar radiation for some of main counties of Albania.

Table I.9.: Daily average solar radiation in (kJ/m^2)

County	*Jan.*	*Feb*	*March*	*April*	*May*	*June*	*July*	*August*	*Sept*	*Oct*	*Nov*	*Dec*
Peshkopia	9813	11584	13952	15127	17192	19225	20704	19815	18838	14189	12161	11566
Shkodra	10857	12316	14119	15771	17425	19253	20836	20069	18855	14450	12977	12235
Durres	13205	13523	14347	17604	18637	20228	22277	23199	20305	17750	15347	14677
Tirana	12066	13292	14243	16007	18555	20538	21598	21896	19854	16564	13604	13250
Vlora	14239	13894	13733	17726	19207	21376	22926	24093	23217	19791	17799	15347
Saranda	12868	15445	16633	18511	20405	22758	23443	24101	23237	17390	16857	14820

Table I.10.: Sunshine hours according to measuring stations

Meteorological Station	**Hours with sun (h/year)**				
	1951-1960	1961-1970	1971-1980	1981-1990	**Average, 1951-1990**
Vlore	2 734	2 718	2 765	2 524	**2 685**
Durres	2 666	2 684	2 717	2 310	**2 595**
Kucove	2 532	2 674	2 648	2 441	**2 574**
Shkoder	2 533	2 489	2 370	2 232	**2 406**

NAE and EEC have carried out a number of studies for installing solar panels in both residential and service sector. Based on these studies, the EEC has achieved providing small grants from various donors, and has installed 15 solar panel systems. Albanian citizens have started installing solar panels for hot water promoted repeatedly by the EEC through various awareness campaigns. If the solar panel systems in Albania would be developed similarly with that in Greece, the potential production of hot water shall be equal with the energy amount of 360 GWh_{th} (or 75 MW_{th} of installed capacity). These figures correspond to a total surface of solar panels of 300 000 m^2 (or 0.3 m^2/family), while the solar panel penetration in countries such as Israel and Greece is actually greater than 0.45 m^2/family.

I.7.3.4 Reserves of Wind Energy

Wind energy is used for water pumping, windmills and last decades the attention is concentrated on the power generation. Aggregates operating with wind energy have an installed capacity from few [kW] to 2 [MW], and are being used successfully in isolated areas. Wind energy is a considerable potential as energy source, uniformly widespread in every corner of the earth. Windmills can be installed quickly and they need a small area of land. In most of the countries, installment of windmills have a common concern, that of not having continuous measurement of the wind speed and long-lasting along several years. For this reason, various companies that are willing to invest in this sector it is difficult to take a decision whether it is feasible to invest in a certain area without these necessary data. Data received from the meteorological stations, given in the in table 11, are approximate and not very reliable data..

Tabla I.11.: Average speed of wind (m/s)

Month	Durres	Kryrvidh	Tepelene	Sarande
January	4.10	5.00	5.80	4.90
February	4.50	5.10	5.70	4.90
March	4.20	4.60	4.90	4.80
April	4.10	4.50	4.30	4.60
May	3.60	3.70	3.60	4.30
June	3.40	4.10	3.40	4.50
July	3.30	4.30	3.50	4.60
August	3.20	4.00	3.50	4.40
September	3.30	4.30	4.10	4.10
October	3.50	4.70	5.30	4.50
November	4.10	4.90	4.70	4.70
December	4.40	5.10	5.60	5.00
Mesatare	**3.80**	**4.52**	**4.53**	**4.60**
Density W/m^2	75 150	100 230	100 230	110 250

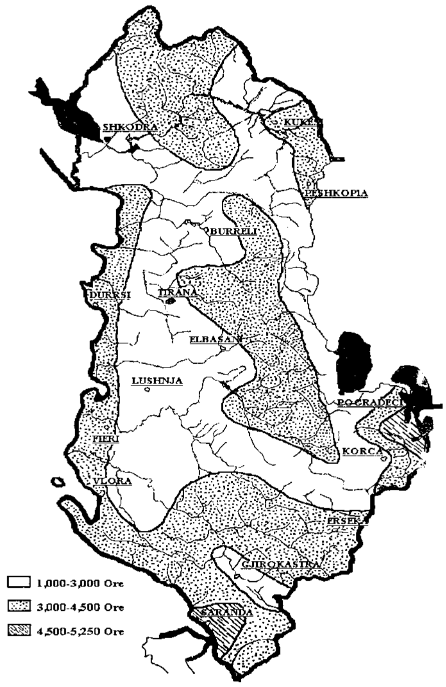


Figure I. 40: Zoning according to annual time of wind with a speed greater than 5 m/s^2.

They are not available for all regions of our country except of areas of Durres, Kryevidh, Xarre, Bulqize and Milot (as it's shown in table I.11). The EU objectives for next 20 years are to secure 20% of the electricity supply from wind. In Albania conditions, it is estimated that by 2020, only 4% of the generated power can come from wind energy (some 400 GWh/year). This implies to give priority to the construction of 20 windmills nearby 20 pumping stations that are situated along the Adriatic cost safeguarding the land from floods. Based on some studies carried out by the NAE, in the costal lowland nearby pumping stations (which demand from the power system around 30 GWh/year or 0.7% of the actual domestic power generation), interesting zones from the viewpoint of wind potential are identified. In these zones average speed of wind, throughout the year, is around 4-6 m/s (10 m height), and the average annual energy density of 150 W/m^2. Predicting that a concession project with 20 windmills with total investments of US $150 million crediting limits within a period of 20 years (it means building nearby each pumping station a windmill of 9 MW capacity with wind turbines of installed capacity WT1500; WT1000; WT600) will be applied, than it is expected to get by year 2015 an additional power energy of 400 GWh/year in the energy balance. In the analyzed scenarios, a way of penetration of windmills in the Albanian energy sector is described.

I.8 ENVIRONMENT POLLUTION FROM ENERGY RESOURCES

I.8.1 Environment Pollution from Production and Exploitation of Energy Resources

Fuel production has been the major contributor of environmental pollution in the country. Solid polluters coming from coal and oil extraction, when these industries use to work with full capacity, were estimated to be more than 1.5 million tons in year 1989, and they are reduced approximately by 0.2 million tons/year in 2001. However, the main concern remains spills of crude oil and refinery residues in rivers, lakes and oilfield land. In all area of hundreds km^2 surrounding Ballsh and Fier refineries prevails an unpleasant smell, while the water of rivers and torrents of this area has a high concentration of hydrocarbon residues. Losses in gas pipelines are big and it is estimated that 15-20% of the natural gas production is emitted in atmosphere as fugitive emissions. Time by time, around 2-3 thousands tons of hydrocarbons and acid mud are deposited in different places, particularly in Gjanica riverbed. Based on the aforementioned analyses, the areas of Ballsh refinery and Patos-Marinza oilfield are declared by UNEP as "hot spots". Problems of environment pollution are caused also by power generation activities. Construction of HPPs, repetitively, has caused adverse environment impacts relating to construction of big reservoirs, floods of arable land, and general exacerbation of water quality as well as changing of micro-clime in the area where these reservoirs are located.

I.8.2 Emission of CO, SO_2 and NO_x Gases from Energy Sector

From fuel combustion, a considerable emission of CO, CO_2, $NMVO_x$, SO_2 and NO_x occurs, which are released in the atmosphere. One of the major problems of environment pollution, at local level, is the acid accumulation. Acid accumulation is created as a result of two main gases (SO_2 and NO_x) emitted from fuel combustion in energy sector, which mix up with water drops (vapor) creating, respectively, sulfuric and nitric acids. In many countries worldwide (including our country), lakes, rivers and water reservoirs are on the way to be acidified in very alarming levels where living being is merely disappearing. Acidification of surface waters has caused loss of huge revenues from fishing activities, corrosion of metallic surfaces of ships and fishing boats, corrosion of concrete structures, damage of forests and desiccation of plants. In our country, a monitoring system of gases emitted from fuel combustion is established by the Ministry of Environment. To reduce the air pollution, already are adopted the Law No.8897, dated 16.05.2002 "On protection of air from pollution" and the Government Decree No.435, dated 12.09.2002 "On approval of norms of emissions in the atmosphere in the Republic of Albania". In figures I.41 and I.42 are given the emissions of SO_2 and NO_x gases from fuel combustion. These emissions are calculated based on LEAP software and attested by IPCC software.

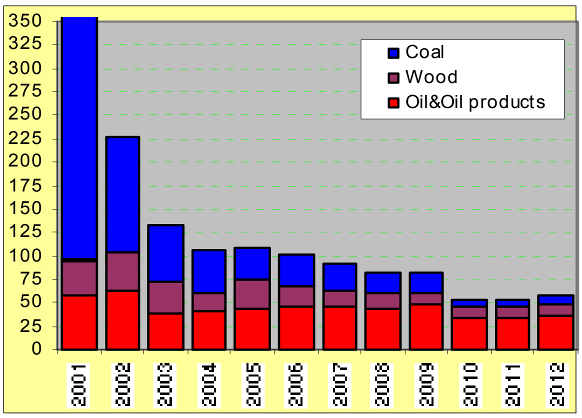


Figure I.41: SO_2 emissions from combustion of 1000 tons of fuel for period 1990-2001

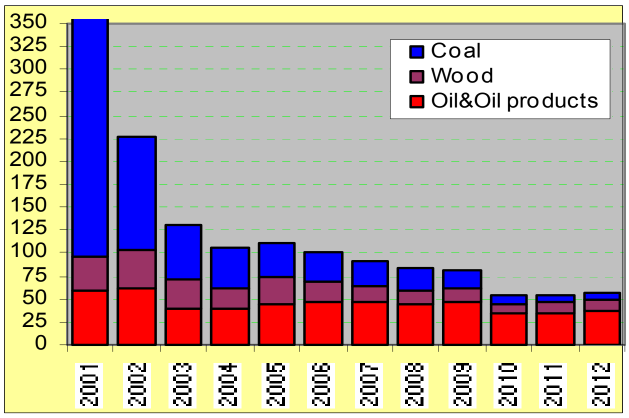


Figure II.42: NO_x emissions from combustion of 1000 tons of fuel fro period 1990-2001

From figure I.41, is evident that main emissions during last years of centralized economy derived from coal combustion, years in which, as it is stated above, coal used to play a significant role in our energy balance. As years went by, coal contribution declined drastically, and along with it, declined SO_2 emissions as well, which consist a positive fact from environment point of view, but a negative one from energy balance point of view. As figure I.42 shows, the same tendency is verified for NO_x emissions due to coal combustion.

I.8.3 Emission of Greenhouse Gases from Energy Sector

Article 4 of the UN Framework Agreement on Climate Change, which Albania has signed, states: "All parties, under their responsibility and national according to their and regional specific priorities, have to develop, periodically improve, publish and make ready for the Conference of the Parties, in accordance with Article 12, the national inventory of anthropogenic emissions from sources and absorptions of all greenhouse gases".

First part of the Document of First National Communication on Climate Change calculates emissions and absorptions of greenhouse gases in all economic sectors of the country for the year 1994. Inventory of the greenhouse gases is the first in Albania completed under the project financed by GEF "Enabling Albania to prepare the First National Communication in anticipation of membership in UNFCCC". Pursuant to the IPCC Methodology, Albania inventory is calculated for major sectors: Energy & Transport, Industrial Processing, Solvents, Agriculture, Changes due to Land and Forest Use, and Urban & Industrial Wastes. Albania inventory of GHG contains data for three gases, which have a direct impact in the greenhouse effect, CO_2, CH_4 and N_2O. Figures I.43 & I.44 show total emissions of main greenhouse gas CO_2 (considering the firewood part of the forest sector for the first case (figure I.43) and part of the energy sector for the second case (figure I.44)).

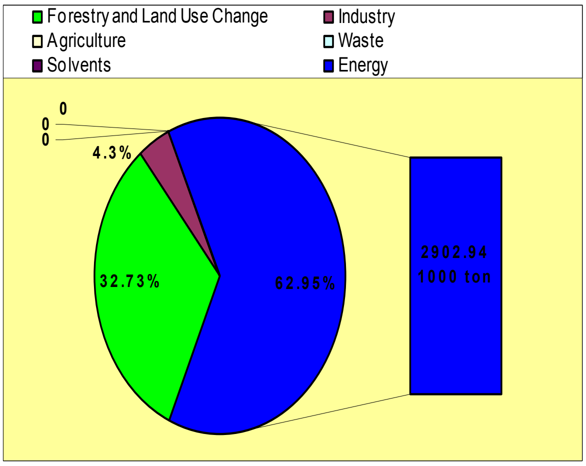


Figure I.43: CO_2 emissions considering firewood as part of forest sector [4611.33Gg], 1994

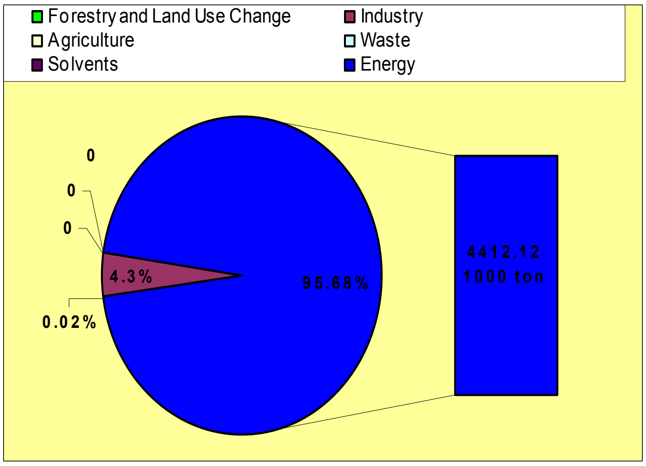


Figure I.44: Figure 43: CO_2 emissions considering firewood as part of energy sector [4611.33 Gg], 1994

As it can be seen in figure, main contributor of CO_2 is the energy sector (62.95%) due to fuel combustion. Second contributor is Land and Forest Use, which contribute with more than 32.73%. CO_2 emissions coming from firewood are included in the Land and Forest Use, but firewood is still an important energy source in Albania. In addition of that, the woodcutting has been done improperly, and actually in Albania there are more wood cutting than planting.

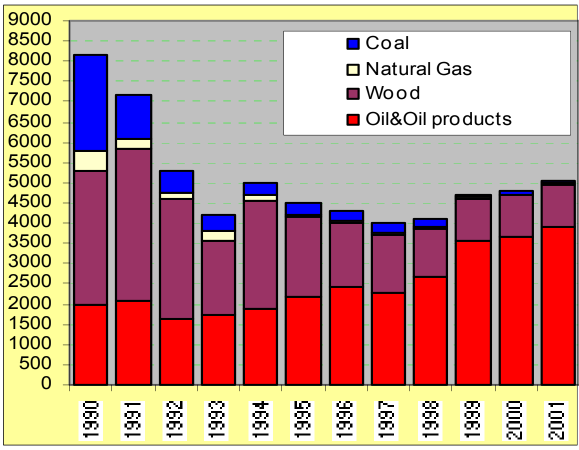


Figure I.45: CO_2 emissions from combustion of 1000 tons of fuel during 1990-2001.

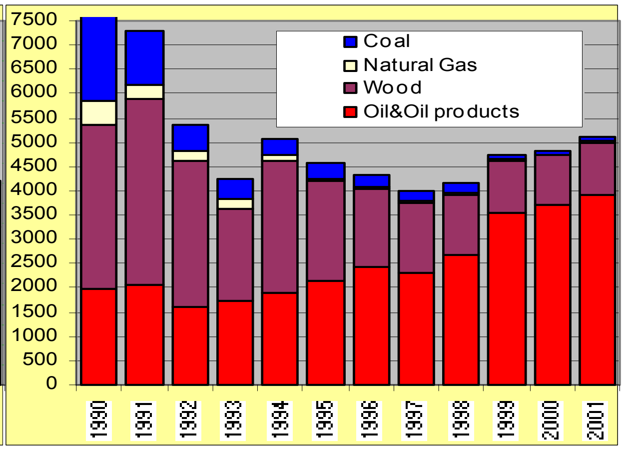


Figure I.46: Equivalent CO_2 emissions from combustion of 1000 tons of fuel for 1990-2001.

In figure I.44, is evident that emissions from firewood are added to the energy sector. The final conclusion of the document of the First National Communication of Climate Change is that as in other countries the energy sector is the main contributor of greenhouse gases. This conclusion, and particularly the recommendations of the chapter of the First National Communication of Climate Change on reduction of greenhouse gases have been taken into account as the energy scenarios were elaborated. In figures I.45 & I.46 are shown the emissions of CO_2 and $CO_{2\ \text{equivalent}}$ gases in the atmosphere released from fuel combustion. Analyzing the figure I.45, it is evident that the CO_2 emissions from energy sector has declined considerably during 1990-1992 due to economic collapse and decrease of consumption of energy resources during this period. Main contributions have been provided by consumption of oil by-products and firewood.

I.8.4 Comparison of gas emissions with other countries

In figures I.47 & I.48 the levels SO_2 and NO_x emissions from the energy sector in our country and in some of EU members for year 1998 are compared. SO_2 emissions per capita in 1990 have been closely two times higher than the EU average, while for period 1994-2001 it was below that average. Figure I.48 shows that NO_x emissions per capita in our country are 10-15 times lower than those of EU, and this mainly because of low industrialization level of our country.

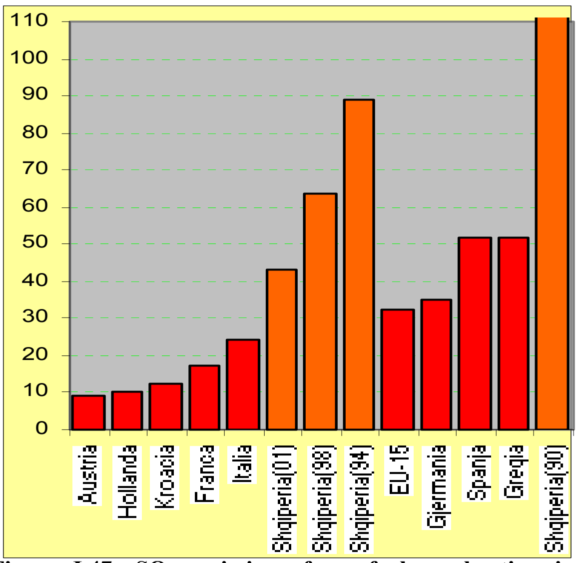


Figure I.47: SO_2 emissions from fuel combustion in kg/capita for 1998 (Albania for years ’90, ’94, ’98, ’01)

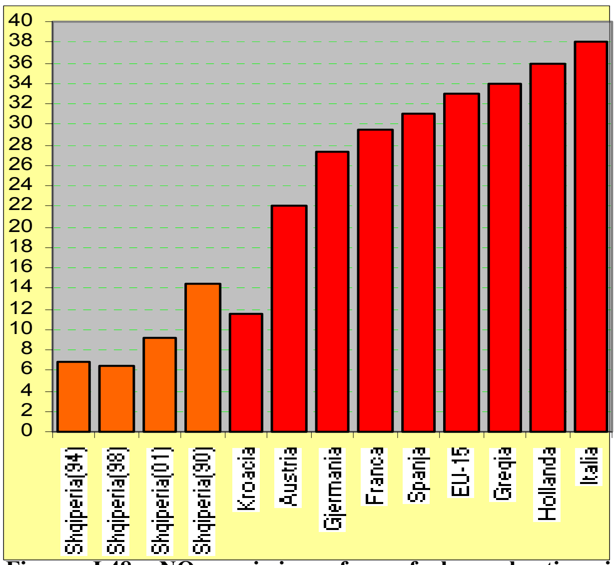


Figure I.48: NO_x emissions from fuel combustion in kg/capita for 1998 (Albania for years ’90, ’94, ’98, ’01)

In figures I.49 & I.50 a comparison of CO_2 emission per capita and per US $1 million of GDP is given. As figure I. 49 shows, during '90-'01 period, Albania has had the lowest rate of CO_2 emission per capita, and this is related to the following reasons:

- Energy consumption per capita in our country is lower compare to the other countries;
- Power generation is almost based on hydropower;
- Various energy services in residential sector such as space heating, hot water and cooking are covered, in high percentage by electricity;
- Energy consumption in industry sector has declined during 1990 –1994, with a slight increase after this year;

As figures 50 shows, the rate of CO_2 emission per US $1 million of GDP for Albania is 8-14 times higher than the developed countries average, and this because of these main reasons:

- Technologies used in Albania are inefficient and consume much energy;
- Productivity of Albanian economy is low compare to industrialized countries;
- A great share of all energy resources is consumed in residential and service sectors for their comfort and not for producing material goods in industry sector to grow the GDP.

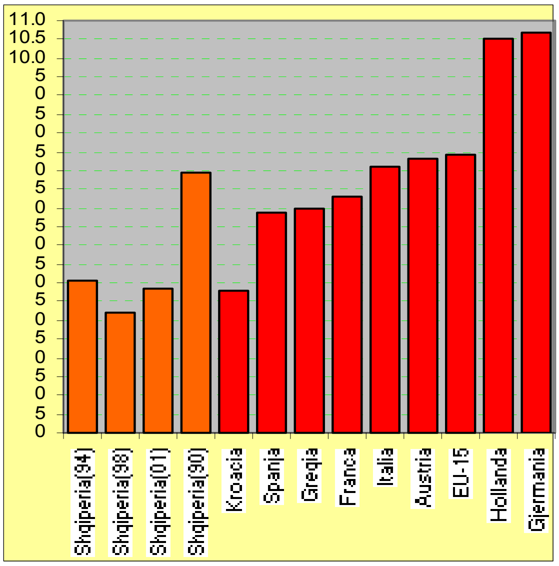


Figure 49: CO_2 emissions from fuel combustion in tons/capita for 1998 (Albania for years '90, '94, '98, '01)

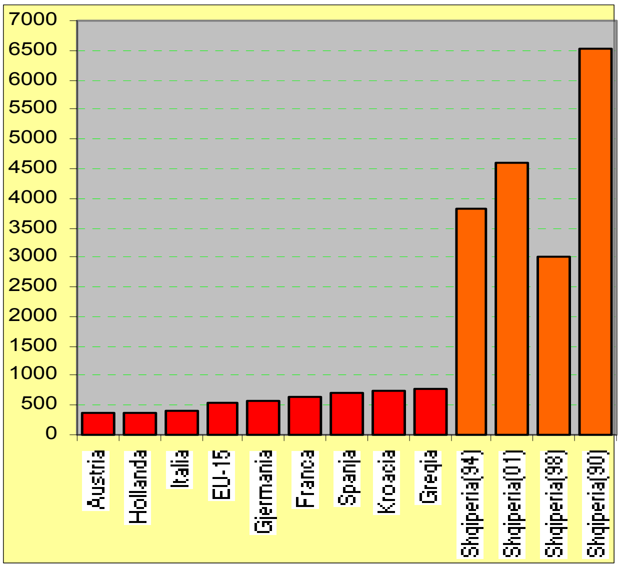


Figure 50: CO_2 emissions from fuel combustion in tons/US $million GDP for 1998 (Albania for years '90, '94, '98, '01)

I.8.5 International obligations relating to environment protection

Two international conventions on environment are of importance for the energy sector:

- Long-term convention on trans-boundary air pollution (LRTAP) under which are signed a number of protocols pending soon ratification by the Albanian Government, and;
- UN Framework Convention on Climate Change, including Kyoto Protocol.

It should be emphasized that our country has not yet ratified Kyoto Protocol, nevertheless this protocol impose no obligation for Albania since it makes part of group of countries not included in first Annex. During the First National Communication regarding to Climate Change it is underlined that there are possibilities to reduce greenhouse gases in a range of 25-28% as a result of using the energy resources in a more efficient manner and increasing the use of renewable energy sources.