Production of electrical energy from renewable sources of energy in Albania

Prof. Dr. Angjelin SHTJEFNI
European University of Tirana
E-mail: angjelin.shtjefni@uet.edu.al

MSc. Hasimin KEÇI
European University of Tirana
E-mail: hasimin.keci@uet.edu.al

Abstract

Nowadays the issue of energy is becoming more and more discussed in the public. In the academical system this topic is getting more and attention than before. And this the right thing. In the Republic of Albania, we are passing through an energetical crisis. We produce the electrical energy using water resources. This indicates that we depend on a lot of form weather conditions. During the end of fall and during the winter we produce electrical energy more than we need and we sell it with lower prices, from the other side during the spring and summer, due to the drought, we cannot produce the necessary electrical energy that we need. As a result, to fulfill the needs of the country, we are obliged to buy the electrical energy that we need with a higher price than we sell it. And we are now talking about the best case: the case that we have a good situation of rainfalls. But do we have other opportunities to produce electrical energy form other sources? Of course, we have. Due to its geographical position and climate, Albania has a lot of opportunities to produce the energy that it needs using other renewable energy sources as: sun, wind, and geothermal sources. In this study I am going to give a panorama of our needs for energy. In this study I am going to present where can we produce energy from these sources. I am also going to present also other opportunities of building new plants to produce energy using water,

and how can we produce more energy combining two sources like for example water and sun. Generally to heat buildings we use conventional sources of energy (coal, gas or diesel). Instead of these sources, we can use renewable sources of energy. I am going to compare the costs for the heating of different buildings using diesel from one side and solar panels and geothermal sources from the other side.

1. General concepts on energetics

Energy in general and electricity in particular are the basis of a country's development and civilization.

The first attempts to generate electricity in Albania were made by an Austrian engineer in the city of Korça, around 1921, who proposed the installation of a diesel power plant to produce direct electricity.

The power system has been developed in several stages of growth:

- The first stage, until 1950, was to repair all the damage and destruction caused by the war.
- The second stage, during the 50s to 60s when the construction of the first small and medium works began, such as the hydropower plants of Selita, Ulza, Bistrica, Shkopet, the first power plants in Tirana, Vlora, Maliq, Kuçova , Cërrik, near important industrial works, of the time, when needed, not only electricity, but also technological steam.
- In the third period after the 70s, the construction of large hydropower and thermal power plants began, to respond to the demands of large electricity consumers, which were built in this period, such as those built on the Drin River.
- The fourth period, after the 80s, began to study the qualitative problems for the use of the power system to increase the safety of its work, the 400 kw line was built for the parallel connection of the system of our country with that of Greece, was conducts studies to optimize the operation of lakes, hydropower plants, especially that of Fierza.

In all these stages of development the following criteria were taken into account:

a. First to use the reserves of the country's energy resources
b. Second, that the rates of electricity development be higher than those of other sectors of the economy
c. Third, that the use of electricity be introduced as wide and deep as possible in all sectors of life and the economy.

There are various energy sources in nature which we classify:
a) In non-renewable energy sources
- Organic fuels
- Nuclear energy

b) In renewable energy sources
- Hydropower
- Helioenergy
- Wind energy
- Geothermal energy

The development of renewable energy sources is important for any country because it helps the country meet at least two of its strategic objectives:

1. security of supply and
2. sustainability

However, Albania is a special case, because most of the electricity generation is provided by large and medium hydropower plants. There are 5 sectors that help us better understand the distribution of energy consumption.

1) Industry sector
2) Transport sector
3) Housing sector
4) Services sector
5) Agriculture sector

The distribution of the contribution for all sectors is given in the following table:

Sector	Consume	Consume %
Industry	413.4 ktoe	20.25
Transport	828 ktoe	40.53
Buildings	484 ktoe	23.69
Services	204.5 ktoe	10.01
Agriculture	112.56 ktoe	5.52

Total energy consumption has a value of 2042.46 ktoe.

Energy intensity in Albania is the highest in the region, after Bulgaria. Consequently, the energy sector in Albania will continue to face two important challenges:

1) maintaining this intensity at medium levels and
2) increase energy consumption per capita

In recent years, energy strategies and policies have been used in Albania as well. The objective of these strategies is based on several advantages:

a. security of supply through a better use and utilization of energy resources
b. energy diversification
c. increasing competition and protecting the environment.

Given the growing energy need, the depletion of fossil fuel resources and the impact they have on the environment and human health, a global change in energy production and consumption is becoming increasingly necessary. For these reasons, it would be important to intervene with policies that aim not only to reduce energy consumption and curb the demand for energy resources, but also to enable a wider use of less polluting energy resources, such as also accelerate technological change. In this context, renewable sources represent a solution both to achieve the objective of reducing the price of greenhouse gases, as well as to reduce economic dependence on oil-producing countries.

Albania is a small country on the continent of Europe, and quite rich in renewable resources. Our country has one of the highest percentages of energy produced from renewable energy sources - 95% of the energy produced is produced from renewable sources. According to various sources and statistics, Albania has not had a defined policy in support of renewable resources. In 2013, energy legislation was enriched with facilitation provisions for renewable energy sources. A support tariff was set for electricity produced from renewable energy sources by hydropower plants with an installed capacity of more than 15 MW. These facilities also include priority network access. However this law was never put into practice due to the lack of supporting provisions. The only expectation relates to low-power hydropower plants installed, so there is no support scheme implemented in Albania for other renewable energy sources such as solar and wind. Some positive changes were made in 2017 opening up a positive outlook.

2. Hydropower in Albania

Based on the considerable water resources, Albania ranks among the richest countries in Europe. In an area of 28,748 km2 Albania has a hydrographic distribution with a water area of approximately 44,000 km2 or 57% more than the official territorial area. The topography of our country is characterized by a

difficult relief and a large hydropower reserve. More than 95% of electricity and approximately 20-23% of primary sources in Albania are based on hydropower. This makes the country's economy vulnerable to changes in hydrological conditions.

For 2025, an increase of 2.31 MWh is expected according to IEA estimates, which is the lowest growth in the region. The presence of the largest and most important lakes in the Balkans (lake systems of Prespa, Ohrid and Shkodra), with an area of 270 and 425 km2, respectively, as well as the intensive melting of snow, etc., creates a stable water wealth. of energetic importance as well. Albania's hydrographic network includes 11 rivers which have a large number of tributaries, with a total catchment area of 20,000 km2. There are another 125 rivers with a small total catchment area. Buna is one of the largest and most important rivers of the Mediterranean Sea. Albania's hydrographic network has over 110 important water sources, such as: Syri i Kaltër, Shën Naumi, etc.

In the rational use of hydropower, a significant impact has the introduction of new technologies with more effective production of aggregates and equipment of hydropower plants, especially small ones, where the problems have been very large. Some of the observed problems are: low production efficiencies, low equipment service life, etc.

In order to determine the competitive energy values that can be produced in the hydropower cascade, for every 1 m3 of water taken from the reservoir at the top, the water levels in the other cascades of HPPs must be taken into account.

There are four defining cases:

- The reservoirs of all HPPs are full, so the water brought by the river can not be stored in any of the reservoirs, which means that: if the energy production capacity of this water is not used by the cascade, then due to lack of capacity productive, this water will be wasted. For this, the value of water that can not be stored in the reservoir can be considered equal to "zero". The energy produced with this water is accepted at "zero cost" of water.
- The reservoir at the top is full, while the reservoirs of other HPPs are not full. In this case, the energy "value" of water taken from the reservoir at the top of the cascade is determined by the value of water in the following reservoirs (in the sense that: in these reservoirs, it is possible to store for later use an amount of water that brings the river). Energy value C2 + C3
- HPP on top with unsaturated aggregates. Other HPPs saturated by side streams and HPPs at the top. Energy value C1
- The reservoirs of all three hydropower plants are not full. In this case the values of water in operation, is defined as the value of water in all hydropower plants. Energy value C1 + C2 + C3

Skavica Project

An initiative to optimize electricity production in Albania, in order to improve the supply of electricity to consumers is the construction of a hydropower plant in Skavica, in the northeast of the country on the border with northern Macedonia. The construction of this hydropower plant has been planned since 1960.

The feasibility study for this hydropower plant has been done with the help of the European Union and the European Bank for Reconstruction and Development. The Skavica hydropower plant is designed for an energy production of 915 GWh, but studies have found that production from the Koman and Fierza hydropower plants downstream will increase by 80 GWh. They have a capacity of 600 MW and 500 MW respectively. The last in line is Vau i Dejës with a capacity of 260 MW.

According to the feasibility study this project will have the following benefits:

a. capacity from renewable energy sources will be increased by 119MW
b. 915 GWh / year energy produced by this hydropower plant and additional production in Koman
c. 70,000 households benefiting from electricity generation
d. a population of 100,000 inhabitants benefit from flood protection measures
e. 10,000 ha of rural / agricultural land are protected from floods
f. the total beneficiary population is 2,100,000 inhabitants

The construction of this hydropower plant will start next year and will last 4 (four) years. The construction of this work will cost 500 million euros, 350 million euros will be invested directly in the work and 150 million euros in the infrastructure of the surrounding areas. This work will be built with direct financing of the Albanian government in the amount of 16.2%, with loans in the amount of 83.2% and with grants in the amount of 0.6%.

3. Wind energy in Albania

Wind energy is another alternative that can help alleviate energy shortages in Albania. However studies show that challenges have been encountered in the use of wind energy due to the lack of data on models that would facilitate the assessment of its potential.

Italian companies are interested in investing in wind energy in Albania because of the favorable policies that our country has used. Italy's "Marsgelia" group has expressed interest in developing wind collectors in northern Albania, which will have the capacity to produce up to 410 megawatts of energy.

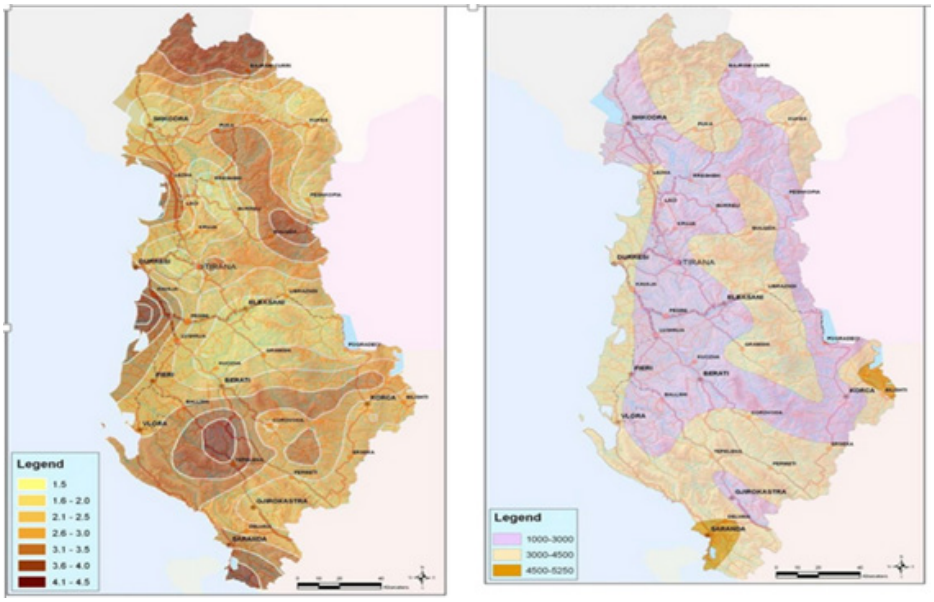
Wind farms can meet the hydroelectric power in Albania with lower initial investment costs compared to that of hydroelectric and solar energy. The high demand for wind energy from Italy shows that wind energy can really give us a positive outlook.

In an analysis of energy production are studied about 11 wind cultivators that are licensed in Albania. Wind cultivators were located at altitudes of 60, 55, 50 and 45 meters, so they could measure the change in wind speed at different altitudes. Many areas have been discovered in Albania, such as Shkodra (Velipoja), Kukës, Lezhë (Shengjin Island, Tale, Balldre), Durrës (Ishëm, P. Romano), Kavaja (Kryevidh), Fier (Seman), Karavasta (Hoxhara, Hoxhara 2), Vlora (Akerni), Saranda, Korça and Tepelena. The main wind directions are northwest-southeast and southwest-northeast, with a dominant direction towards the earth. Albania has a coastline from north to south for about 345 km where part is a coastal lowland while the rest is located very close to the mountains.

In order to assess the usability of Albania's fields, the following constraints (positive and negative) must be taken into account:

1. Altitude above sea level (area lower than 1800 m);
2. Natural or protected areas;
3. Road network (keeping gravel roads less than 5 km);
4. Power supply system (distance from the power supply system less than 10 km)

FIG. 1 - Average wind speed and the amount of annual hours in the territory of Albania



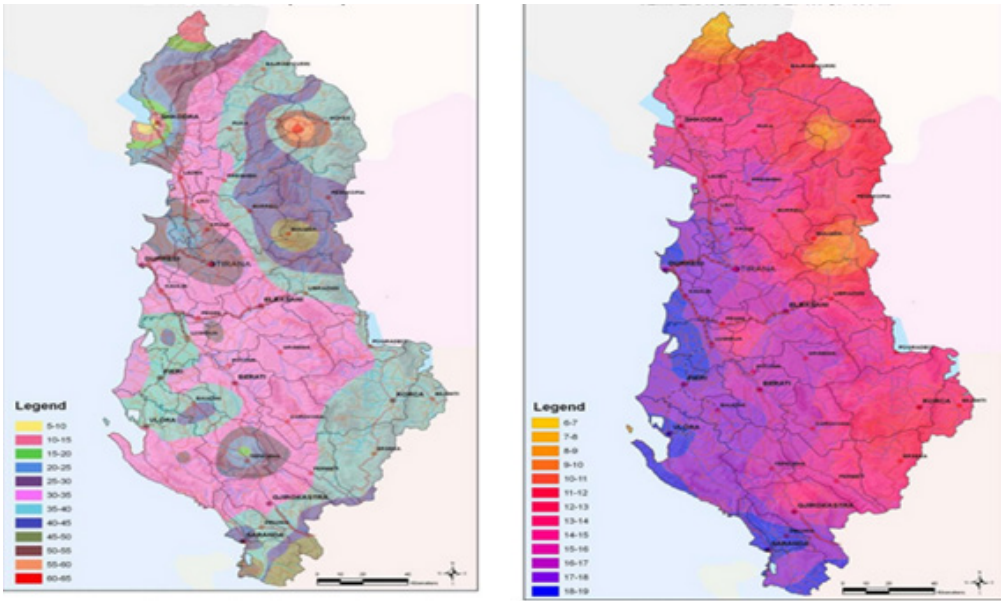
4 .Geothermal energy in Albania

Albania represents a country with real low enthalpy geothermal energy potential, which can be used for economic purposes. The use of thermal springs or wells is facilitated by the fact that they are generally located in urban areas.

There are several geothermal areas in Albania:

- Kruja geothermal area.
- Ardenica geothermal area.
- Peshkopi geothermal area.

FIG.2 - Heat and temperature flow at a depth of 100 m



Geothermal heating / cooling systems have high economic efficiency and are environmentally friendly. For these reasons, geothermal systems are being used more and more in advanced countries, but they are also found in the countries of the region, in Greece, Montenegro, Serbia, Slovenia, etc. Their energy-economic contribution lies in several directions:

a. In improving the country's energy balance. It is for this reason that many countries support funding for the installation of these geothermal systems.
b. In saving fuel and electricity, realizing heating and cooling of buildings at a lower cost.

The environmentally friendly nature of geothermal heating / cooling systems stands in two directions:

1. To reduce to a minimum the release of carbon dioxide
2. In not polluting the environment with the ashes of coal, hydrocarbons, etc.

5. Solar energy in Albania

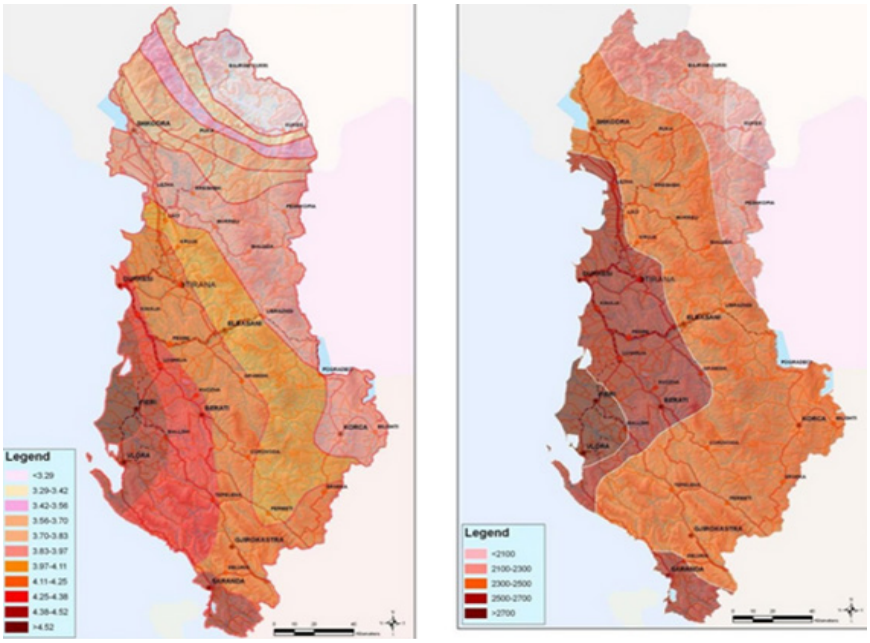
Solar energy is a suitable alternative to conventional energy sources. Despite the fact that the provision (benefit) of solar energy requires large capital investments, it offers cheap energy with minimal risk to the environment.

In 2005 a group conducted a solar "test" in Albania with the help of the Austrian government. The group's objective was to develop a specification scheme for small-scale sales of solar panels and solar collectors.

The specific objectives of the group were:

- to set up a quality control scheme.
- to perform test systems on solar collectors.
- to produce consulting services to the general public.
- to raise awareness among the government, business and public of Albania.

FIG.3 - Average daily solar radiation and average hours of sunshine in Albania



The development of technologies for the use of solar energy is not mentioned at all in the strategies, nor in other government documents, therefore the PV system for the same reason will not be an important resource in the near future. Indeed, in relation to photovoltaic installations there are only a few small installations at some railway stations, with power less than 1 kw.

The Energy Regulatory Entity has granted the company Statkraft Renewables Albania a license with a term of 25 years, for the activity of electricity generation from the floating photovoltaic plant on the reservoir of HEC Banja. In a decision a few days ago, the ERE underlined that the documentation submitted by the company was completed, but the application for a 30-year license could not be met in conditions when according to the feasibility study, the lifespan of the panels is 25 years. From the feasibility study designed for the floating photovoltaic plant of the Company "Statkraft Renewables Albania" sh.p.k. it turns out that the lifespan of a panel does not exceed 25 years "is stated in the decision, arguing the duration of the license.

The photovoltaic plant above the Banja HPP will have an installed capacity of 2MW and will be built at a cost of about 2.5 million euros. Statkraft has signed a contract with another Norwegian company such as Ocean Sun, to apply their innovative technology related to the construction of the floating park.

Another project that is expected to take place is the construction of a photovoltaic plant in Vaun e Dejës. The plant will be built on the reservoir of the Vau i Dejës hydropower plant which is owned by KESH and represents an important development in the innovation of green technology using the rich solar resources of Albania and avoiding the use of limited land terrains.

The EBRD loan of 9.1 million euros will be provided to a specialized KESH tool that will be used for the construction of the project. It is the first financing of this kind from an international financial institution and will contribute to the commercialization of KESH, one of the largest state-owned companies in Albania.

The project reveals Albania's ambition to develop its solar capabilities following two successful EBRD-supported tenders that have resulted in highly competitive tariffs; 140 MV in Karavasta and 100 MV of the Hospital project.

The EBRD has also mobilized € 315,830 to assist in the preparation of the green project and implementation scheme with the support of the Austrian Government (DRIVE Fund) and the Taiwan-EBRD Technical Cooperation Fund.

6. An economic analysis

For comparison, the same buildings have been treated which can be heated by different heating systems. The comparison will be made between the boiler

heating system and the geothermal systems. The geothermal systems analyzed are schematic; vertical heat exchanger - water-water geothermal heat pump. Water-water heat pumps with a heating capacity of 73.84 kw were selected, which have an electric power of 27.3 kw, having a performance coefficient of 2.70. The vertical exchangers are placed in well batteries with a depth of 100 m, the exchangers are calculated with a length of 100 w / m. Water with a flow of 3.05 l / sec for each pump circulates through the vertical U-shaped exchanger. The water circulation pumps in the exchanger have an electric motor with a power of 7.5 kw and a water lifting height of 120 m.

TABLE 1 – Annual consume of electrical energy

			Heat pumps			Circulation pumps		
Name	Work hours	Instaled power [in kw]	Quantity of heat pumps	Electrical power of pumps [in kw]	Annual consume of electrical energy [in kw]	Nr of pumps	Electrical power [in kw]	Annual consume of electrical energy [in kw]
MINISTRY OF EDUCATION								
CITY OF THE STUDENTS	3,624	5,526	75	2,049	7,425,576	75	7.5	2,038,500
Building of PUT	2,114	1,190	16	437	923,818	16	7.5	253,680
Faculty of Civil Engineering	2,114	637	9	246	520,044	9	7.5	142,695
Total for Ministry of Education		7,353	100	2,732	8,869,438	100	7.5	2,434,875
MINISTRY OF HEALTH								
Hospital QSU	3,624	7,858	108	2,948	10,683,552	108	7.5	2,935,440
Sanatorium of Tirana	3,624	1,600	22	601	2,178,024	22	7.5	597,960
Hospital of Shkodra	3,624	2,556	35	956	3,464,544	35	7.5	951,300
Sanatorium of Shkodra	3,624	151	2	55	199,320	2	7.5	54,360
Hospital of Durrës	3,624	1,510	21	574	2,080,176	21	7.5	570,780
Hospital of Korça	3,624	3,600	49	1,339	4,852,536	49	7.5	1,331,820
Hospital of Berat	3,624	1,628	22	601	2,178,024	22	7.5	597,960
Hospital of Lezha	3,624	800	11	301	1,090,824	11	7.5	298,980
Polyclinic of Durrës	2,718	250	4	109	296,262	4	7.5	81,540

Polyclinic of Berat	2,718	407	6	164	445,752	6	7.5	122,310
Total for Ministry of Health	34,428	20,360	280	7,648	27,453,065	280		7,542,450
TOTAL		27,360	380	9,481	36,321,446	380		9,977,325

TABLE 2 – Annual cost

			Annual cost	
Name	Annual consume of electrical energy [in kwh]	Price without VAT [in lekë/kwh]	[In lekë]	[In euro]
Ministry of Education	11,303,256	14.4	162,766,880	1,323,308
Ministry of Health	34,995,515	14.4	503,935,416	4,130,618
TOTAL	46,298,771		666,702,296	5,453,926

TABLE 3 – Annual consume and costs using burning materials

Annual consumption of electrical energy (in kWh)	Annual cost of electrical energy		Consume and annual costs of burning materials			
	[in lekë]	[in euro]	Burning material	Quantity [in ton]	Annual cost [in lekë]	[in euro]
46,298,771	666,702,296	5,453,926	Coal Solar Fuel	3,334 5,134 4,257.75	16,003,200 308,807,000 668,466,750	130,092 2,504,637 5,434,676
			Total		992,545,950	8,069,405

TABLE 4 – Balance

SYSTEM OF HEATING	Annual Cost	
	Lekë	Euro
With furnace	992,545,950	8,069,405
Geothermal	666,702,296	5,453,926
Savings by using geothermal system	325,843,654	2,384,521

These data not only argue the high energy and economic efficiency of the use of geothermal heating / cooling systems, which has made them today at the top of the systems applied in advanced countries, but also allow two recommendations to be made for the implementation of in Albania:

- First, they must be primary systems in new public and private construction, in conditions where technically feasible

- Second, to have priority during the reconstruction of existing systems in public buildings such as schools, dormitories, hospitals and offices

Bibliography

1. Llazar Papajorgji : Zhvillimi i elektro-energjetikës ne Shqipërim, SHBLU, Tiranë 2004.
2. Niqifor Dino ,Hysen Agolli : Kaldajat dhe gjeneratorët e avullit, GA, Tiranë 2015.
3. Alfred Paloka : Burimet e ripërteritshme të energjisë, SHBLU, Tiranë 2011.
4. Alfred Paloka : Shfrytëzimet e energjisë ujore, SHBLU, Tiranë 2005.
5. Spiro Thadhonjani, Bashkim Cela, etj: Burimet e energjsë, Botimet Toena, Tiranë 2008.
6. Petraq Vasili : Prodhimi i energjisë elektrike me anë të energjsë së erës, Botimet Uegen, Tiranë 2004.
7. Petraq Vasili : Centralet termike diellore për prodhimin e energjisë elektrike, Botimet Uegen, Tiranë 2003.
8. AKBN :Të dhëna të ndryshme
9. ERE(www.ere.gov.al) Raportet vjetore
10. Dr.Armir Rauber :Renewable Energy. etj
11. Xhevat Berisha : Burimet e Energjise, SHBLU, Tiranë 2017.
12. Fejzullah Krasniqi : Termofikimi dhe Rrjetet Termike, Botime Universitare Prishtinë, Prishtinë 2019.