Renewable Energies Resources and Future of Their Use. Albania Case Study

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Abstract:

Albania is among the countries with the highest potential for renewable energy production in Europe. Physical and geographical conditions in Albania offer a very diverse climate and rich in term of renewable energies. For this reason, our country has very favorable conditions for solar energy development, including: a. average solar radiation 4.1kWh/m ², b. average sunny hours per year are 2400 hours. Similarly, water resources are among the most important natural resources in Albania. Eight large rivers, fed by hundreds of rivers and small streams flowing through the country from the mountains to the east toward the Adriatic and the Ionian Sea in the west. Albania has an untapped potential of wind power, particularly along the Adriatic coast with defined space with high potential for wind power development where the annual average wind speed ranges from 6m - 8m/s. Few countries in European continent have a weaving of water resources in the same room where the observed sources and solar energy, wind or biomass without skipping and sea, which we really refer to technical indicators, which constitute a potential first stop should seriously and carefully, our country has the opportunity to make radical changes in the development policies so far not only in the energy sector but also in separate directions of social economic development. Material and methods used individually are based on data obtained from the relevant ministry which will serve to show us the way these renewable energy can be applicable not only in the industrial sector but also the family that showing the advantages and difficulties in successfully implementing their implementation. This paper aims to show the opportunities that our country offers in terms of sources of renewable energy that it possesses and the capacity to be free from dependence on the use of fuel by positioning the renewable energy sector as one of the priority sectors.

Keywords:

Renewable Energies, Opportunity, Healthy Environment, Natural Resource

1. Introduction

Albania is located in south-western part of Balkans peninsula, Southeast Europe. Albania is very rich in renewable energy sources, which, along with the relatively low construction prices and labor force salaries, makes it very attractive to investors. Historically, most of the country's electricity needs has been generated from hydropower plants, although the increased demand has led to regular power shortages. Water resources are Albania's most important natural resources. Albania is working for a reliable and sustainable energy sector, development of which shall be based on using all energy options in order to meet own energy demand and to create added value for Albania citizens, in alignment with principles of environmental, economic and social responsibility.

The actual energy system in Albania is currently based completely at the hydro energy. There are enormous doubts on its sustainability, as there are limited generation capacities towards the growing demand. On the other side it is limited with a considerable number of technical and non-technical problems related to the network loss and leading to a multi-year energy crisis. One of the main challenges of the Albanian energy sector is the diversification of the energy sources and the fulfillment of the needs by own country resources, decreasing the import dependence. The utilization of renewable resources is an important factor for diversification of the energy sources and reduction of emissions of CO_2 gasses (Orion Zavalani etc al. Polytechnic University of Tirana)

2. Materials and Methods

This paper presents an approach to build and to evaluate different renewable energies source using by our government. The materials are used to estimate like the monthly average daily total solar radiation, monthly average daily total wind energy on a horizontal surface, based on measured data. Measured data include monthly-average daily total solar radiation on a horizontal surface and monthly-average daily sunshine duration, the wind energy, biomass energy which are used for this paper. One of the lacks of this paper is that for many cities missing the date so we are trying to give the date for the main cities. The country has significant potentials for renewable resources in the form of biomass, geothermal, wind, and solar.

2.1. Solar energy

As this geographical position, Albania belongs to Mediterranean climate belt with hot dry summer, with long days of sunshine and mild winter with abundant rainfall, possessing in this way a considerable solar potential energy: most areas of Albania are exposed to more than 1500 kWh/m ²per year varying from 1185 to 1690 kWh/m ², per year.

The average of daily solar radiation is near 4.1kWh/m ²changing from a minimum of 3.2kWh/m ²in the Northeast up to a maximum of 4.6kWh/m ²in the South-Western. This is show in the table nr ¹ and table nr ². 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.

***Table 1**. Daily average solar radiation in (kj/m ²).*

City	January	February	March	April	May	June	July	August	September	October	November	December
Durres	13205	13523	14347	17604	18637	20228	22227	23199	20305	17750	15347	14677
Tirane	12066	13292	14243	16007	18555	20538	21598	21896	19854	16564	13604	13250
Saranda	12868	15445	16633	18511	20405	22758	23443	24101	23237	17390	16857	14820

***Table 2.** Sunshine hours according to measuring stations.*

Cities	Hours with sun	Period	Period	Period	
	1951- 1960	1961-1970	1971-1980	1981-1990	Average 1951-2016
Durres	2666	2684	2717	2310	**2695**
Tirane	2595	2670	2700	2200	**2640**
Sarande	2734	2718	2765	2524	**2778**

Based on these studies, has achieved providing small grants from various donors, and has installed the solar panel systems. Albanian citizens have started installing solar panels for hot water promoted repeatedly by the NANR 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 360GWh (or 75 MWh of installed capacity).

***Graphic 1**. The history of domestic production from 1985-2012 (MWh), source by Institute of Hydro-Meteorology 2012*

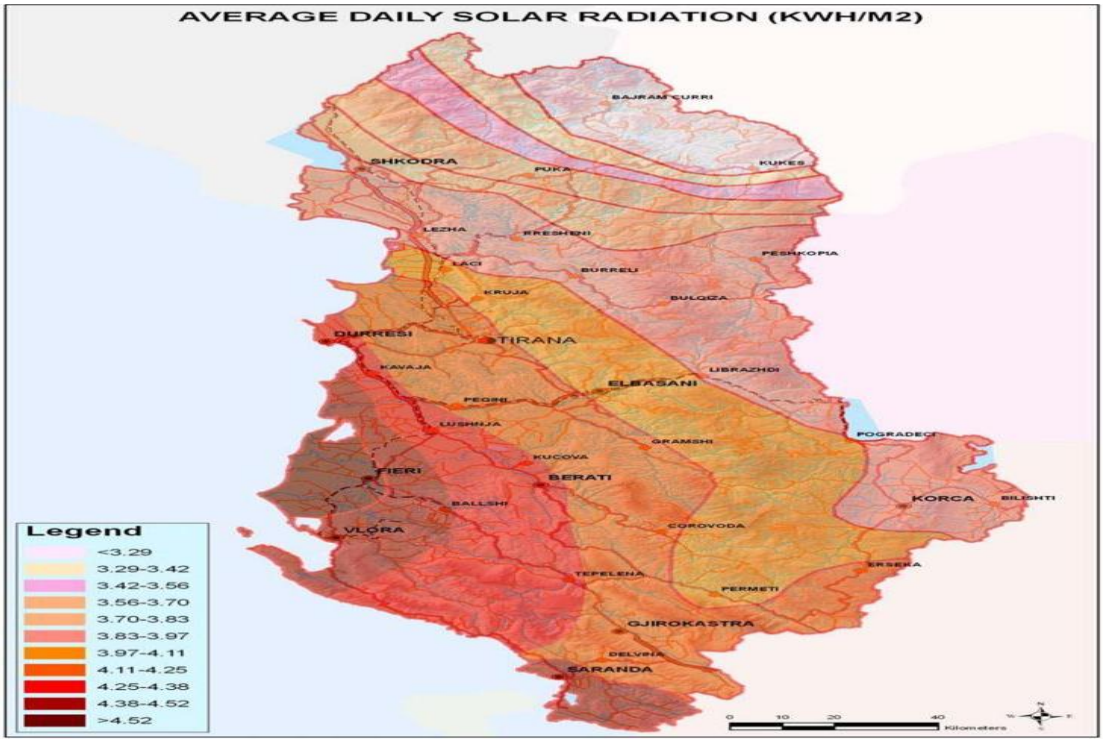

Figure 1. *Average daily solar radiation (kWh/m²) source by Institute of Hydro-Meteorology 2012.*

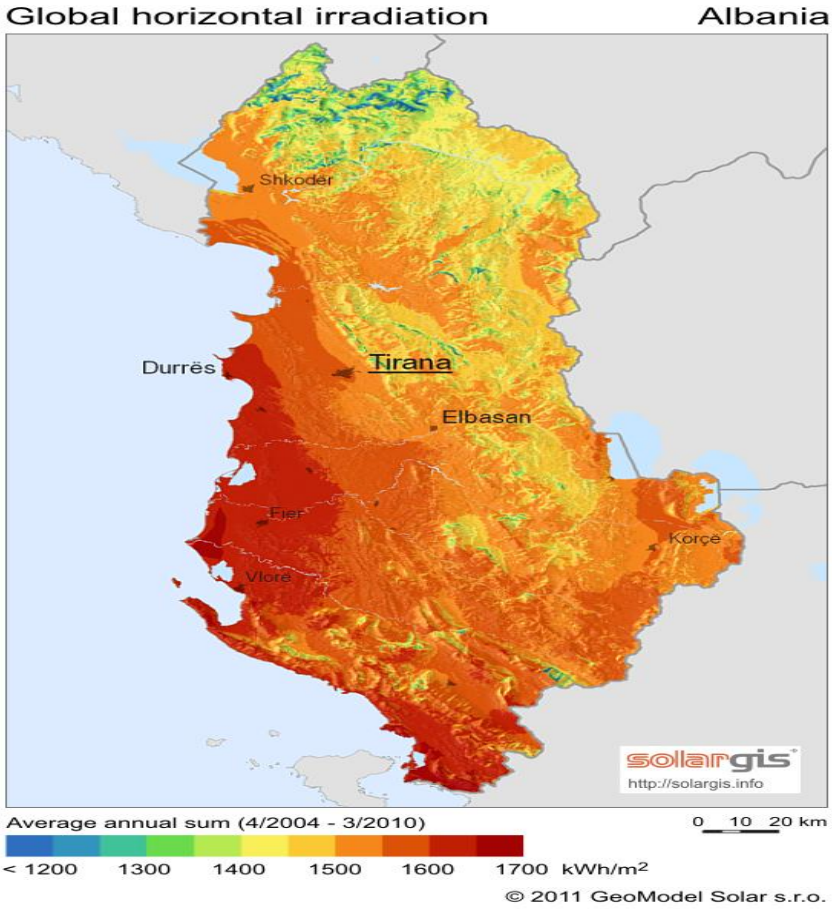

Figure 2. *Average annual sum in the main cities.*

Map shows average quantity of sunshine in the territory of Albania (3 zones) Map 1 and 2 shows the average daily solar radiation in the territory of Albania. Solar water heaters are proven technologies to supply domestic hot water to the service sector (e.g. hospitals, hotels), industry and households. However, low electricity prices and non-payments are obstacles. Nevertheless, solar panels have already been available on the market and significant volumes have been installed.

National Agency of Natural Resources (NANR) and donors has carried out a number of studies for installing solar panels in both residential and service sector. Based on these studies, has achieved providing small grants from various donors, and has installed the solar panel systems. Albanian citizens have started installing solar panels for hot water promoted repeatedly by the NANR 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 (or 75 MWh of installed capacity). These figures correspond to a total surface of solar panels of 300 000 m kWh/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.

In 2010, a total of 10,700 m ^{2}were installed (60% by services, 40% by households), bringing total installations to 52,000 m ^{2}(equivalent to around 70 GWh/year or 1% of electricity consumed by households in 2009). UNDP is supporting a program (2011-2015) to install 50 thousand m ^{2}of solar panels based on grants and fiscal incentives.

The Global Environment Facility has provided a grant to develop the country program of Albania, as part of the (UNDP), United Nations Environment Program UNEP/Global Environment Facility GEF/ICA Global Solar Water Heating Market Transformation and Strengthening Initiative. The objectives of the Project is to facilitate the installation of 75,000 m ^{2}of new installed collector area over the duration of the project, reach an annual sale of 20,000 m ^{2}by the end of the project and with expected continuing growth to reach the set target of 520,000 m ^{2}of total installed SWh capacity by 2020. We hope that in the near future Albania will use solar energy as the main source not only in the industry but also in agriculture and consumer needs.

2.2. Wind Energy

Methods of evaluation

The climatic analysis conducted for the evaluation of the natural potential of the wind in Albanian territory, has taken into account observations in some meteorological stations spread all over the country.

The assessments have analyzed the following parameters:

a. Distribution of average velocity by direction;

b. Daily and annual wind speeds;

c. Speed distribution for different thresholds.

According the study wind speed of is around 6 meters per second (m/s). The good areas in Albania for wind farm locations are especially in the coastal lowlands, in the hills of Northern Albania and mountains of Southern and Eastern Albania. The main directions of wind in our country are northwest-southeast and southwest-northeast, with dominant direction towards land. Our country's coastline is 345 km north-south

direction, where a part is the coastal lowlands and the other coast very close to the south seaside mountain. Inside the territory, the direction and intensity of wind from area to area varies in time.

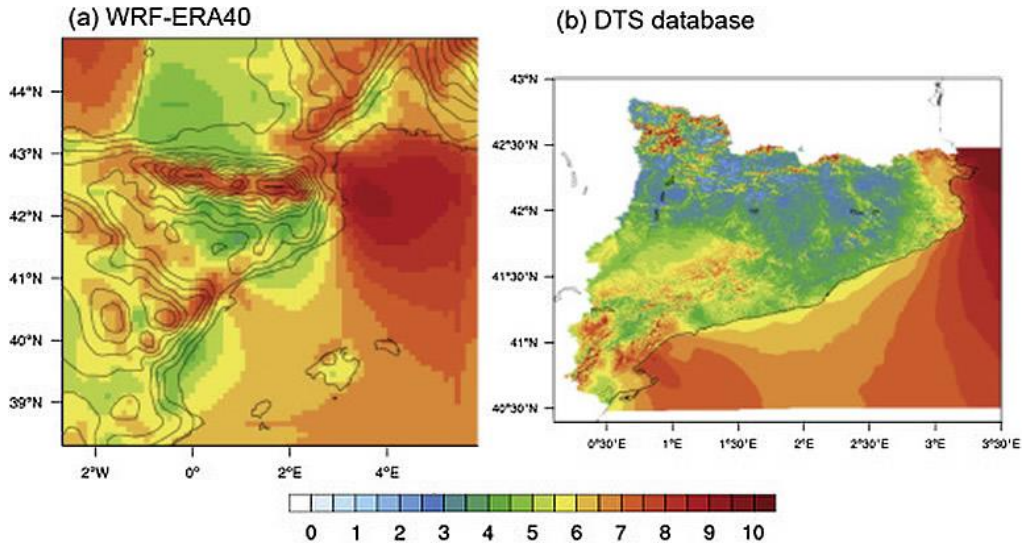

Figure 3. *Average Wind Speed at 50 m/g/l. over the Albanian territory.*

The map obtained applying the simulation code, subsequently corrected with ground measured data; clearly show the windiest areas, unfortunately not entirely suitable to wind power exploitation due to natural, economic or financial constraints. In order to estimate the actually exploitable areas of Albania, the following (positive and negative) constraints were taken into account:

·height above sea level (areas lower than 1800 m);

·natural or protected areas;

·road network (distance from national or well-kept gravel roads less than 5 km);

·electric power supply system (distance from the electric power supply system less than 10 km).

Observed as can expected in advance of theoretical knowledge on the characteristics of circulation and movement of air measures on the territory of our country that potential areas with the highest potential for wind energy production are the height and inside the country, and somehow they near the coastline . The problems are that indicators referred to above average speed 6 m/s annual average that is generally the minimum for using of wind energy.

Albania is limited in space. Secondly even if it is limited in space and distance from the nearest point of connection with the national energy network that indirectly reflects a higher degree of loss and consequently lowers effectiveness of plaint.

In Albania so far (ERE - Energy Regulatory Authority) have submitted Seven enterprise applications for the construction of wind energy parks and the same are licensed. Some of these projects will be presented below.

a. Captain project:

This project includes an area of 4.125 hectares in which this park will be built Wind Powered Generators. Through a conducted study it was found that the noise level

reaches the level of 40 db. The total capacity of wind energy park will contain 150 MW. This corresponds to an annual energy output of 383.000 MW/h (Project Kappa)

b. Vlora Project:

This project will reach a total capacity of 500 MW, which corresponds to a production annually of 1.250 GW/h (for the assumed value of 2.500 Hours full load for Year).

c. Kryevidh Project :

The Kryevidh project will reach a total capacity of 150 MWh, corresponding to an annual output of 375 GWh (for the estimated value of 2.500 hours of full load per year). 75 Power Generators will be installed at this location.

Table 3. *Source: Ministry of Energy (License File by June 2012).*

NR	**Project**	**Enterprise**	**Capacity in MV**
1	Kappet	Hera shpk	150
2	Grykderdhja e Shkumbinit,Terpan	Alb Wind Energy shpk	225
3	Kavaje, Kryevidh	ERS-08 shpk	40
4	BPGE 1, BPGE 2 Lezhe	Biopower Green Energyshpk	230
5	Kryevidh, Kavaje	Union Eolica Albania shpk	150
6	Butrint, Markat	E-Vento srl Albania shpk	72
7	Vlore	Enpower Albania shpk	500
	Total		1.367

2.3. Geothermal Energy

Nowadays, increasing attention has been given in most countries of EU to the development of geothermal resources for utilization in district heating and in direct end users in services and agriculture sectors. Geothermal energy resources in Albania are estimated as warm water sources of the underground soil, which have a sufficient temperature to be used as energy source. This is show on map number 4.

Our country is rich in geothermal water sources. The country's thermal springs ours and some data on them are also given in the table number 4.

Geothermal energy resources in Albania are estimated as warm water sources of the underground soil, which have a sufficient temperature to be used as energy source. Geothermic situation of Albanide offers two ways to use energy geothermic, separated as follows:

- thermal sources with low entalpi and maximum temperature up to 80 ℃. These are natural resources or wells that are located in a vast territory of Albania, from the south, near to the border with Greece northeastern area;

- deep vertical wells for geothermal energy, where is included a large number of oil and abandoned gas wells, that can be used for heating purposes.

In our country there are some more appropriate areas for its use like the three geothermic space: Ardenices geothermical Space that is concentrated in the coastal region, where water has a temperature of 32-38 ℃, and flow 5- 8 l/sec. Geothermic space of Kruja where are located the biggest geothermic sources in Albania evaluated

5.9 x 08 5. x 09 GJ and the geothermic space of Peshkopi in the northeast of Albania, where some sources of thermal location near each other have a water temperature of 43.5 ℃ and inflows of 47 l/s. Actually, evaluation of this energy is under study process.

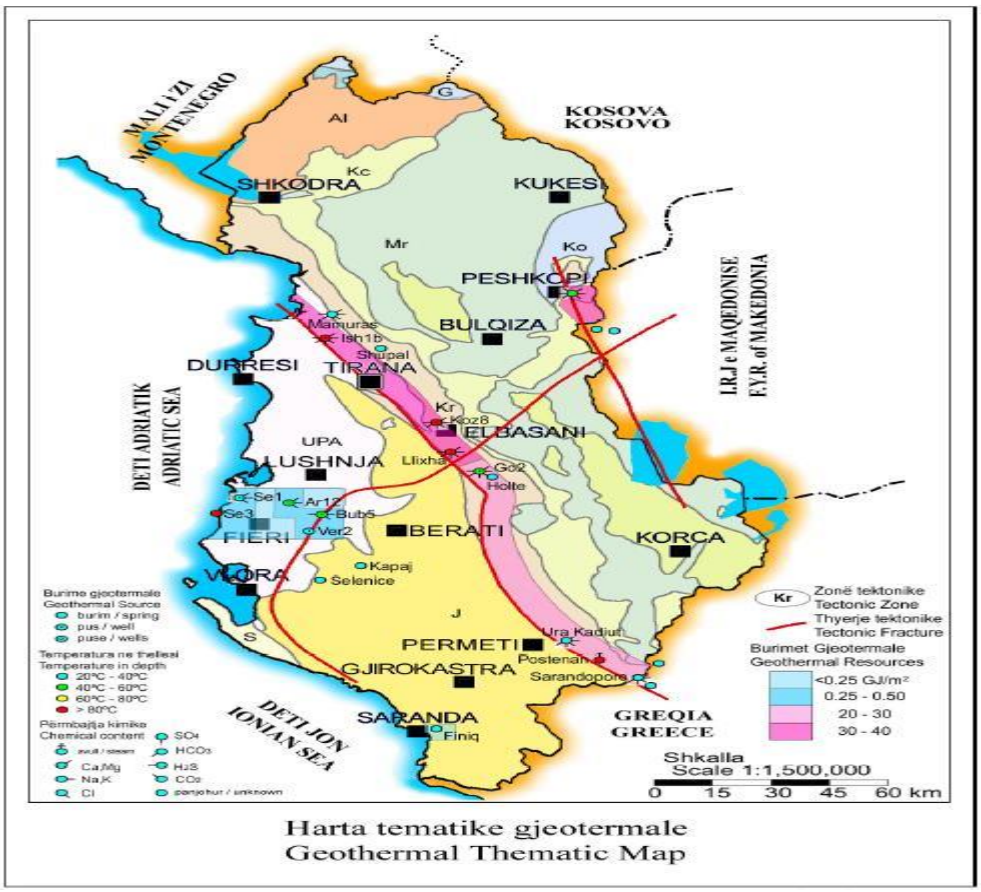

Figure 4. *Gjeothermal Thematic map in Albania, by Source Institute of Energy.*

Table 4. *Thermal source Data by Institute 2017.*

Nr	Name of source	Temperature	Latitude	The debit (l/s)
1	Mamurras 1 dhe 2	21-22	41˚ 42’ 24” 19˚ 42’ 48”	11. 7
2	Shupal	29. 5 4	41˚ 26’ 9 ” 19˚ 55’ 24”	<10
3	Llixha, Elbasan	60	41˚ 02’ 2˚04’ 20”	15
4	Peshkopi	43. 5	41˚ 42’ 10” 20˚ 27’ 15	14
5	Ura e Katiut, Langaric ë, P ërmet	30	41˚ 42’ 10” 20˚ 27’ 15”	>160

2.4. Biomass Energy

The data of the last national Forest Inventory carried out during years 2002-2009, the sustainable annual harvesting possibility is 1.152.000 m ³. The annual potential of biomass for bio-energy production includes firewood, branches, foliage and residues of timber processing. Firewood consumption is estimated to be around 2 million m ³, much higher than the official statistics record. The difference is considered to be the result of illegal cutting. The potential for bio-energy production will be higher if we take also into account the timber provided from thinning (35000 m^3/y) and timber provided from artificial plantations with species of short cycle of production, like

willow, eucalyptus, poplar, acacia, tamaris. According to the Ministry of Agriculture's statistics, Albania possesses about 403.651 ha bare land that could be used for short rotation plantations for energy production. The potential of energy derived from our forest resources is estimated as follows:

Table 5. *Potential annual sustainable wood and biomass production from forests (2006) according to the last NFI.*

Type of forest	**Unit**	**Stem volume (m3/y3)**	**Fuel wood (m3/y3)**	**Total residues (m3/y)**	**Thinning Residues**	**Total amount of biomass for energy**
High forests	m^3	426.383	231.557	581.174	32.900	845.631
Coppice	m^3	52.699	81.444	64.575	2.100	148.119
Shrubs	m^3	-	6.387	-	-	6.387
Total potential production	m^3	479.082	319.388	645.749	35.000	1.000.137
Potential energy production from forests resources	-	-	63.878	129.150	7.000	200.028

The table nr 5 show that the forests constitute about 36 percent of the total land area, pastures 16 percent, agricultural land 24 percent and other lands 24 percent. Almost 50 percent of the country's population is living in rural settlements. This has created very strong relations between the community and forests. For several years, forests have been the main source of their employment and income. But at the same time, this has put a very high pressure on forests that in many cases have suffered unlimited use and degradation. Also, the difficult socioeconomic conditions of populations in these areas are another factor that has contributed to such degradation.

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Sources of biomass, geothermal power and sea waves are also kept in consideration when we will seek a combined use of these energies and that also has reviews of studies and an unquestionable potential.

3. Results and Discussion

In Albania, the greatest benefit from renewable resources is from hydro power and more specifically from large hydropower plants. It is worth mentioning that quite effective policies followed by the Albanian Government in the promotion and development of small hydropower stations, where due to the improvement of the legal framework and procedures for energy investments in these works have an issue, we always booth. In 1988, the number of small hydropower plants in Albania was 83 with an installed power of 50 kWh to 1200. The total capacity of 14 MWh is their design, but their potential is estimated at 25 MWh, it's because for most of them there is the possibility of capacity increase.

Interest in our country is the use of solar energy where it is worth emphasizing the use of solar energy in the areas of Fier, Vlora, Durres Sarande etc as the regions with the highest annual radiation.

Identification of favorable conditions for the use of wind for energy purposes, related to the recognition of some very important parameters such as average speed, amount of hours of wind per year over a threshold of data, the probability of occurrence that winds for different thresholds maximum wind speeds etc. These parameters will be used in the future for an in-depth study in this area. However, several attractive areas have been identified as: Shkodra (Velipoja, Cas), Lezha (Shengjin Island, Tale, Balldre), Durres (Ishem, P.Romano), Fier (Karavasta, Hoxhara 1, Hoxhara 2), Vlore (Akerni) Tepelene, Sarande.

Geothermal energy is not taken into account in our country, although there are some areas more suitable for its use. Thus, three geothermal areas are defined: Ardenice's geothermal space, which is concentrated in the coastal region, where the water has a temperature of 32-38 ℃, with a flow of 15-18 l/s. Geothermal area of Kruje where geothermal resources are the biggest in Albania, with a reserve of 5.9x108 - 5.1x109 GJ and geothermal area of Peshkopi in Northeast Albania, where some of the localized thermal sources close to each other have a water temperature 43.5 ℃ and a flow of 14-17 l/s.

Biomass is another renewable energy source that has an extension almost throughout the country. In addition to the firewood that continues to be used in a non-sustainable manner, a great deal of interest is represented by the enormous wealth of shrubs and solid urban waste. Regarding the biomass of plants, it can be considered such as agricultural waste used for food or bedding for the animals during the winter. While biomass produced by farming can be considered due to the non considerable number of pets and the fact that they do not are grouped in livestock farms. For this reason, the remains are scarce and currently they are used as organic fertilizer.

4. Conclusions

A potential still untapped energy that we used to achieve the whole so in combination with each other to different types of renewable enough to reach satisfactory levels of production of electricity in our country especially in space lowland west exactly where the number of population is high. Almost 97% of the electricity produced in the country is generated by hydropower plants. Anyway the share of use of solar energy collectors mainly for water heating in the national energy balance is very small.

Energy sources are consumed in different economic sectors like Residential, Service in Public and Private ones, Industry, Transport and Agriculture. The relation between the economic development of a country and its energy demand is considered a key issue, and it is represented by a closed cycle. Currently, energy intensity in Albania is at a relatively high level. This means that the macroeconomic production, generally reported by the Gross Domestic Product (GDP), has been low compared to total energy consumption. Reasons for this are related to low industrial development of Albania, old technologies and big share of energy consumption goes for Residential Sector, etc.

Albania will have implemented innovative energy research programs. The main reasons to support innovative energy research are of three (non-exclusive) types:

• *The support to national energy and/or to technology endowment on the one hand and the support to national industrial sectors on the other hand*

• *The search for energy independence for security issues as well as the result of the increase of oil prices*

• *The contribution of energy research and technological development to sustainable development policies.*

An important item is creating a draft law will be the establishment of the renewable energy fund. The Fund shall be used for financing projects and studies for identification of the renewable energy potentials in the country; for financing projects that support the use of renewable energy sources, for providing incentives for them; for testing and monitoring the new technologies utilizing energy from renewable sources; for financing awareness campaigns for the use of renewable energy sources, etc.

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