

“OUTLOOK ON PRINCIPLES FOR PROJECTING OF INTEGRATED AND CASCADE USE OF GEOTHERMAL ENERGY OF LOW ENTHALPY IN ALBANIA”.

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INTRODUCTION

In the countries of Western Europe, USA and Japan, the technologies of a new generation evolved to exploit high and low enthalpy geothermal sources and mineral waters. There are great experiences for modern complex exploitation of these resources, which increase natural wealth values, in European Community Countries.

In Albania, rich in geothermal resources of low enthalpy and mineral waters, similar new technologies have been either partly developed or remain still untouched. Modern complex exploitation is very rare phenomena.

Large numbers of geothermal energy of high and low enthalpy resources, a lot of mineral water sources and some CO₂ gas reservoirs represent the base for successfully application of modern technologies in Albania, to achieve economic effectively and success of complex exploitation.

Actuality, there are many geothermal, hydrogeological, hydrochemical, biological and medical investigations and studies of thermal and mineral water resources carried out in Albania. Generally, these investigations and studies are separated each from the other. Their information and data will serve for studies and evaluations in Albania regional scale. These studies and evaluations are necessary to well know in regional plane the thermal and mineral water resources potential and geothermal market of the Albania. According to results of these new studies, the evaluation for the perspective level of the best areas in country will be necessary. After the evaluation is possible to start investments in these areas. These investments will be profitable in a short period of time.

Integrated and cascade use of geothermal energy of low enthalpy it is important condition for profitable investment.

1. OVERLOOK ON NATURAL ENERGETIC RESOURCES IN ALBANIA

Albania is a mountainous Mediterranean country with numerous natural energetic resources. Albania has a total surface 28 748 km², where 70-75% of the territory is composed of mountains, hills, lakes and rivers. There are many rivers flowing from the mountains. The total hydrographic chatchment area surface of Albania is about 40 000 km². The average level of the hydrographic network is 700 m. Albania is a country with relatively high precipitation. In its hydrographic area fall in average 1 400 mm rain per year. Its snows in the levels over 1 000 m in mountain areas. 70% of the river water flows observed during the winter and spring. During a year from all Albanian Rivers flows in sea about 39 billion m³ water. The average perennial total inflow of Albanian Rivers is about 1 245 m³/sec. of One of main Albanian rivers, Drini River in Northern Albania, has an average inflow about 340 m³/sec.

According to Preliminary Feasibility Studies result that the hydro-energetic potential of Albania for the exploitation reach about 16 000 GWh per year.

Hydroenergetic resources represent most important energetic resources of Albania. Seven hydro-power plants have been built, with an installed power of 1446 MW. Fierza, Komani and Vau Dejes Hydroelectro power plants have been constructed in Drini River, with an installed power, 500 MW, 600 MW and 250 MW, respectively. Electric energy production is 5 000 GWh in 1999. From 58 small hydroelectric power plants were produced only 0.23% of the

energy of hydroelectric energetic system of Albania.

Until now it is utilized about 30% of the hydro-energetic potential of Albania.

There are about 20 oil and gas reservoirs under exploitation in Albania, producing about 2.4 Mt oil in 1974, but within the last years the production is decreased and in 1999 only about 340 Kt of oil were extracted.

There are tens of coalmines in Albania, with an output of over 2.2 Mt coal in 1989 and 420 Kt of coal in 1995. In 1999 the production is under 50 Kt of coal.

Thermoelectric power plants have an installed power about 213 MW, and production has been 182 million kWh during 1999. Fieri Thermoelectric Power Plant is most important, with an installed power 160 MW.

The Albanian energetic system is mainly based on electricity produced by hydropower plants. The climate of Albania is a typical Mediterranean one, with a hot and dry summer. This climate makes the electrical system (based on the water resources of Albania) very capricious.

In the present conditions of a new Albanian market economy, together with the transformations in the management of existing energetic system, the study of other energetic sources has begun. There are great possibilities to use renewable energies.

Solar energy is most important of renewable energies in Albania. Albania is a country with great sunshine period during the year, from 2731 o'clock/year in the Southern Albania, 2 560 o'clock/year in the Tirana region and 2046 o'clock/year in Northern Albanian regions (Climate of Albania, 1978).

Solar heat in Albania has an average value about $129.3 \text{ Kcal}\cdot\text{cm}^{-1}\cdot\text{year}^{-1}$. The use of the solar panels for the direct solar energy exploitation will have a great importance in Albania.

Wind energy exploitation in Albania is important, too. In the coastal areas the average wind speed is about $2.8\text{-}3.8 \text{ m}\cdot\text{sec}^{-1}$ (Climate of Albania, 1978). There are many regions where the wind speed is several times greater than that

in the above-mentioned regions, 35-45 m/sec in coastal areas and 20-35 m/sec in the other regions. This is another important source of renewable energy.

In Albania there are also many thermal water springs and wells of low enthalpy, with a temperature of up to 65.5°C , which indicates that it is possible direct use of the geothermal energy.

2. GEOTHERMAL ENERGY IN ALBANIA

2.1 Geological Features

The Albanides form an integral part of the southern branch of the Mediterranean Alpine orogen. They are subdivided in two zones: the Internal and the External Albanides. The geology of Albanides creates the premises for the research and exploitation of natural geothermal energetic resources.

The results of the geothermal studies carried out in Albania are presented in maps and geothermal sections. Temperature maps have been drawn for different levels of up to 5000m depth. Geothermal gradient, heat flow density and geothermal resources maps have also been drawn. The natural springs with thermal waters and the geological structures with high water temperature have also been mapped. The water basins with higher average temperature than that of yearly average in one of the regions has been studied as well. The study of the possibility of exploitation of abandoned deep oil wells as "Vertical Earth Heat Probes" has already begun.

The greatest heat flow density with a value of $42 \text{ mW}\cdot\text{m}^{-2}$ is found in the center of the Preadriatic Depression (Fig. 1). In the east of the ophiolitic belt heat flow density reaches values of up to $60 \text{ mW}\cdot\text{m}^{-2}$.

The temperature varies from a minimum of 12°C at a depth of 100m up to 105.8°C at a depth of 6000m. In the central part of the Preadriatic Depression, there are many deep oil wells where the temperature reaches up to 68°C at a depth of 3000m. The isotherm runs in a direction that fits that of the strike of the Albanides. The configuration of the isotherm is the same down to a depth of 6000m. Going deeper and deeper the zones of highest temperature move in a direction southeast to northwest, towards the center of the Preadriatic Depression and even further towards the northwestern coast.

The geothermal gradient has the highest value about $18.7 \text{ mK}\cdot\text{m}^{-1}$ in the center of the Preadriatic Depression. Elsewhere the gradient is mostly $15 \text{ mK}\cdot\text{m}^{-1}$ (Fig. 2). In the south of the country the geothermal gradient has low values $11.5\text{-}13 \text{ mK}\cdot\text{m}^{-1}$. The lowest gradient value of $7\text{-}11 \text{ mK}\cdot\text{m}^{-1}$ is found in the deep synclinal belts. Towards the northeastern and southeastern regions of Albania, over the ophiolitic belt, the geothermal gradient increases, reaching the value of $23.5 \text{ mK}\cdot\text{m}^{-1}$.

2.2. Geothermal Areas and Reservoirs

In Albania there are many thermal springs and wells of low enthalpy. Their water has temperatures that reach values of up to 60°C (Fig. 3).

Table 1 presents some data on the water temperature for such springs.

Table 1
THE THERMAL WATER SPRINGS IN ALBANIA

N° of Springs	Location	Temperature in °C	Salt in mg/l	Artesian Spring yield in l-s-1
1	Llixha Elbasan	60	0.3	0
2	Peshkopi	5-43	9	10
3	Krane-Sarande	34		<10
4	Langareci-Permet	6-31		>10
5	Shupal-Tirana	29.5		10
6	Sarandoporo-Leskovik	26.7		>10
7	Tervoll-Gramsh	24		>10
8	Mamurras-Tirane	21	26	>10

These thermal water springs are mainly near zones of regional tectonic fractures. Generally the water circulates through carbonatic rocks of the structures and evaporitic beds at some kilometers of depth. The water of these springs

contains salt, absorbed gas and organic matter. They are sulfide: methane, iodine-bromium and sulfate types.

In many deep oil and gas wells there are thermal water fountain outputs with a temperature that varies from 32 to 65.5°C (table 2)

Table 2
THE OIL AND GAS WELLS THAT HAVE SELF-DISCHARGE OF THE THERMAL WATER

N°	Well Name	Temperature in °C	Salt in $\text{mg}\cdot\text{l}^{-1}$	Self-discharge, in $\text{l}\cdot\text{sec}^{-1}$
1	Kozani-8	65.5	4.6	10.4
2	Ishmi 1/b	64	19.3	4.4
3	Galigati 2	45-50	5.7	0.9
4	Bubullima 5	48-50	35	
5	Ardenica 3	38		15-18
6	Ardenica 12	32		
7	Semani 1	35		5
8	Verbasi 2	29.3		1-3

These waters comes from different depth levels (800-3000 m) of limestone reservoirs (wells 1, 2, 3, 4) and sandstone reservoirs (wells 5, 6, 7 and 8).

Until now the thermal waters of the springs 1, 2, 4, and 6 and wells 1, 2, 3 in Albania are used only for health purposes. These waters may be used for heating purposes, green houses,

aquaculture, and thermal pool for tourists, extraction of the microelements and natural salts as well.

In conclusion, reservoir is a heterogeneous collector and its thermo-hydrodynamic regime is stable in Kruja geothermal area. We could find other springs with greater geothermal resources, higher yield and water temperature we may expect in this geothermal area. For that, it is necessary that hydrogeological and geophysical investigations to be carried out and new wells be drilled in order to capture the water deeper where the temperature is higher.

2.3. Directions for the exploitation of geothermal energy of low enthalpy in Albania

The geothermal situation of low enthalpy in Albania offers two directions for the exploitation of geothermal energy, which is unused until now.

- First, thermal sources of low enthalpy and of maximal temperature up to 80°C. These are natural sources or wells in a wide territory of Albania, from the South near Albanian-Greek boundary to North-east districts in Diber Region.

Thermal waters of springs and wells in Albania may be used in several ways:

1. For SPA clinics for treatment of different diseases and hotels for development of Eco-tourism.

Such centers may attract a lot of clients not only from Albania, because not only the good curative properties of these waters but also because they are situated in nice places near sea side, mountains or Ohrid lake.

2. The hot water of SPA may be used also for heating of hotels, SPA and tourist centers, as well as for the preparation of hot water used there.

Near these SPA it is possible to build :

- greenhouses for flowers and vegetables
- aqua-culture installations.

3. From thermal waters it is possible to extract very useful chemical microelements as iodine, bromine, chlorine etc. and other natural salts, so necessary for preparation of pomades for the

treatment of many skin diseases as well as for beauty treatments. From these waters it is possible to extract sulphidric and carbonic gas, the former is well known for special treatments of breathing ways, the later for treatment of food. It is possible to build installations for processing of thermal waters. Such developments are useful also for the creation of new working places and improvement of the level of life for local communities near thermal sources.

The sources of low enthalpy geothermal energy in Albania, which are at the same time the sources of multi-element mineral waters, they represent the basis for a successful use of modern technologies for a complex and cascade exploitation of this energy, achieving an economical effectiveness.

- **Second**, the use of deep doublet abandoned oil and gas wells and single wells for geothermal energy, in the form of a "Vertical Earth Heat Probe". The geothermal gradient of the Albanian Sedimentary Basin has average values of about 18.7 mK·m⁻¹. At 2 000 m depth the temperature reaches a value of about 48°C. In these single abandoned wells a closed circuit water system can be installed. This "Vertical Earth Heat Probe", by means of water conversion, is coupled with the heat transfer from the surrounding rocks downwards, to be finally recovered in the tubes.

Actually in Albania the study of the possibilities of exploitation of the geothermal energy has begun.

3. ALBANIAN GEOTHERMAL ENERGY MARKET

Objectives of market study:

- Evaluation of present status of geothermal development in Europe, regarding promotion activities, results, application, barriers for market penetration, legal and financial framework, etc.
- Comparison of present status between the countries involved
- Identification of the attitude and feelings (awareness, knowledge, preference, etc.) for the target groups towards geothermal energy.
- Identification of the attitude and feelings of the target groups towards environmental aspects of geothermal energy.

- Evaluation of the outcome of promotion methods adopted by EU and national institutions
- Formulation of proposals for effective promotion strategies for geothermal energy in Albania.

Amend above proposals in order to transform them to effective promotion strategies for geothermal technologies in Albania.

3.1. Consumers for geothermal energy & thermal water (heat, spa, cooling, power production, drinking water, aqua-culture, agriculture)

In the present some SPA, with a primitive technology, worked in geothermal springs and wells in Albania: Lixha Elbasani, Bilaj Balneological Center (Ishmi 1/b well), Peshkopia (Diber district) SPA, Langarica (Leskovik District) SPA, Langarica-Ura Kadiut (Permeti District) SPA.

The oldest and important is **Elbasani Llixha SPA**, which located about 10 km south of Elbasani city and 61 km in south-east of Tirana, in the Central part of Albania. By national road communication, Llixha area is connected with Elbasani and Tirana. Only 10 km will be from the highway Duresi- Skopje- Sofia- Istanbul, which is projected for construction in the future and nominated as No. 8 European Corridor. The proximity with highways create great possibilities for **Elbasani Lixha SPA to be a nice place. This area may be frequented by a large number of people from different Balkan countries, Italy, UK, Germany, Ostrich, France, Low Countries**, and by Albanians from Albania, Macedonia and Kosovo as well. these thermal springs From about 2000 are know years ago. According to historic data, in Elbasani Llixha thermal springs there has been an inn, near of the old road "Via Egnatia" that has passed from Duresi to Constantinople.

There are seven spring groups that extends like a belt with 320° azimuth. Surface water temperature is about 60°C and yield in total 15 l/sec. Springs have constant hot water yield and temperature for a long period of time. These data are evidence of a stable thermo-hydrodynamic reservoir regime.

Before the Second World War, in one from the springs ("Nosi spring") has been constructed "PARK-NOSI" SPA (***), with 166 beds, for medical treatment of various diseases, generally

rheumatic. The "NOSI" SPA functioned during a period of time more than 60 years and for the present is private property. Land with surface of 20 000 m², hotel and restaurant are owned by PARK NOSI Sh.p.k.. Particularly reconstructed hotel after the privatization actually is in work. Near this property there is located a public hotel, with 180 beds, almost in destruction state, but which may be reconstruct.

Albanian patients treated for rheumatism and various illnesses in Elbasani Lixha SPA are:

in 1990	7899 persons
1992	4659 persons (Transition Period)
1993	4908 persons
1994	3603 persons (after the privatization, only in Park NOSI Hotel)
1995	3800 persons (after the privatization, only in Park NOSI Hotel)

The events in the first half of 1997 year in Albania, have caused a decrease of the numbers of patients in PARK-Nosi SPA (**). After the stabilization of the situation in Albania started the increase of SPA frequenting

The price in PARK-Nosi SPA, for day's treatment (hotel, meal and treatment) in SPA, for Albanian patient, in actual economical situation, has been:

in 1990	1.84 USD
in 1996	680 lek = 7.16 USD (1 USD = 95 lek)
in 1997	680 lek = 4.68 USD (1 USD = 145 lek) (inflation result)
in 1999	1000 lek = 7.4 USD (1 USD = 135 lek)

VAT 20% is included in the price.

This is a more chipper price compared with hotels in Elbasani city, regarding accommodation and breakfast only. **From 30 to 240 USD per day is the price in Tirana hotels.**

About this price, it is necessary to expose the following:

In the future, the increase of price for daily treatment of the patient in SPA. will increase also the profit, according to:

Firstly, amelioration of the medical treatment, the accommodation and food conditions in the SPA.

Secondly, from foreign and Albanian patients the SPA frequenting demand will increase, according to new situation of the supply and demand.

Thirdly, the life level of Albanian people will increase

Fourthly, SPA frequenting by Albanians from Macedonia and Kosovo, which have more high economic level.

Fifthly, European patients and tourists will start to frequent the New SPA, by creating the best condition for medical treatment and tourism for them.

Land price in Elbasani region, in 1996, has been 5-7 USD/m².

Actually, there is not a law for thermal waters in Albania. The PARK NOSI Sh.p.k. Llixha Elbasani, is using thermal spring as ex-owner of SPA before the Second World War. SPA in Ishmi well area has privates in 1993.

All seven groups of the springs in Llixha Elbasani and Kozani-8 well geothermal area will have the possibilities for modern complex exploitation. The beautiful landscape of Elbasani Llixha area will be not only for medical treatment but also as tourist place. This area located near of the very know Ohrid Lake pearl or mountains Gjinari, with their fantastic forests and nice climate.

Ishmi 1/b geothermal well is located in beautiful Tirana field, near of Rinasi (Tirana) Airport, near of the Adriatic coastline and Kruja - Skendergeg Mountain. There are all the possibilities for the echo-tourism development: thermal water, Ishmi beach at the Adreatic Sea , and mountain's area.

3.2. Geological risk, financial possibilities to cover geological risk

No geological risk for the exploitation of thermal water of geothermal springs and wells in Albania.

3.3. Traffic connections: roads, railways, navigation, and possibilities for transport of heavy goods

The **Ishmi-1/b well** is located in Ishmi area and represents the northernmost geothermal well of the Kruja geothermal area. It is located in 20 kilometers NW of Tirana (near of Rinasi-Tirana Airport). By national road communication, Ishmi 1/b well is connected with Tirana, Tirana Airport, Durresi and Shkodra cities.

Kozani-8 well is located 35 kilometers southeast of Tirana, on hill's area. Well connected by 1.7 km road with Tirana-Elbasani national road, and hightway "Corridor 8" Durresi-Elbasan-Scopje. One km from Kozani 8 well located Saint George Vladimir Monastery.

Elbasani Llixha SPA is located about 12 km south of Elbasani city and 61 km in south-east of Tirana, in the Central part of Albania. By national road communication, Llixha area is connected with Elbasani and Tirana. Only 10 km will be from the highway Durresi- Skopje- Sofia-Istanbul, which is projected for construction in the future and nominated as No. 8 European Corridor. These thermal springs from about 2000 are known years ago. According to historic data, in Elbasani Llixha thermal springs there has been an inn, near of the old road "Via Egnatia" that has passed from Durresi to Constantinople.

4. THE AIMS AND OBJECTIVES OF THE PROJECT

4.1. The aims of the project

To examine, demonstrate and disseminate the positive technical and financial aspects of transfer and utilization of innovative geothermal energy technologies in Albania, which will have a direct impact in the development of the regions by increasing their per capita income and at the same time ameliorating the standard of living of the people.

This development will be achieve in parallel with the reduction of any negative environmental effect, which would have followed this type of development if older geothermal energy technology or even conventional sources of energy were to be utilized. Significant financial, social and technical benefits will arise from the promotion and final application of the results of this project.

4.2. Objectives:

Integrated exploitation and cascade direct use of the geothermal energy has projected.

The objectives of the project:

4.1. Geothermal energy and mineral water resources evaluation of country

4.2. In-situ detailed investigation of the pre-selected zones with high energy potential & consumers geothermal source, where will installed demonstrative unit.

Among others this task will be concerned with:

- Intentions of users-thermal load inspections
- Initial energy balance analyses
- Thermal characteristics of individual users
- Technical geothermal data collection
- Examination of existing technology

It is necessary to select the thermal applications, which correspond to the local needs. The following will be defined:

a) In situ consideration of geothermal physical-chemical parameters and potential

b) Thermal load demands for space heating for each end-user of geothermal sources:

- Dwellings,
- Geothermal SPA,
- Greenhouses,
- Geothermal pools, etc.,
- Aquaculture,
- Mineral waters production
- Extraction of the micro-elements and natural salts

b) Energy balance between different end-users,

c) Technologies to be applied

d) Preliminary design of the geothermal energy exploitation system

e) Definition of thermal demands

i) Energy conservation, and

k) Economic evaluation of thermal energy (space heating and hot water production installation cost, life cycle, energy product cost, pay back period). This evaluation will be based on actual market prices for equipment, construction etc.

Based on the above analysis, for the best area selected, a Feasibility Study will be performed to analyze three components: energy supply, environmental impact and financial aspects, and to suggest the best solution of the innovative geothermal energy utilization technology applications in that area.

4.3. Environmental protection and preserving level will be improved, to well assist the ecosystem protection of thermal and mineral water source areas.

Among other subjects this phase will focus mainly on:

-Examination of the nature of the geothermal fluid

-Environmental impact of the geothermal fluids during their utilization and disposition

- Selection of the most acceptable environmentally methods for the disposal of the geothermal fluids

4.4. The concrete detailed design for the implementation phase of the Project will be prepared.

Task 1. Demonstrative units (pilot plants) will be constructed, monitored and finally demonstrated. These demonstrative units will assist in the promotion of the new innovative technology application facilitating in parallel the transfer of this innovative technology to end users as well as industrial production.

The proposed schemes represent an integrated scheme and cascade scheme for exploitation of geothermal energy. This exploitation will realized by integrated scheme of geothermal energy, heat pumps and solar energy to fulfil. This scheme has an environmental benefit by using renewable energies (geothermal energy, solar energy), new technologies (heat pumps) and energy savings (cascade scheme).

Cascade scheme should be used to fulfil the thermal energy demand for the selected area in order to get the maximum benefit from geothermal energy and the minimum energy supply from heat pumps: the promotion of energy savings will be in place.

These demonstrative units will make researcher and scientists aware, on-site, of specific plant operational problems, new technology implementation problems and finally assist to their in situ solution.

These pilot demonstrative units will help potential users overcome psychological barriers towards the utilization of new innovative technologies for direct application.

Task 2: A promotion and tourist agency will be organized. This agency will prepare the reclaims and booking of the rooms for Albanian and foreign patients.

5. APPLICATION AND TRANSFER TECHNOLOGY FOR A COMPLEX AND CASCADE EXPLOITATION OF GEOTHERMAL ENERGY

5.1. Construction of thermal supply installations:

1. Installation of pipe – distribution system
2. Heat exchanger
2. Distributors
3. Control Room-Monitoring.

5.2. Construction of the experimental units for exploitation of the geothermal energy:

1. Building of SPA, with 30-40 beds, for the medical treatment (gynecological and rheumatic diseases),
2. Construction of heating installation in the buildings
3. Construction of the greenhouse for the flower.
4. Construction of the greenhouse for the legumes.
5. Construction of thermal pool for tourists, wardrobe and bar.
6. Installation of equipment for extraction microelements and natural salts.

5.2. Feasibility Study

Technical and financial feasibility study for innovative geothermal energy utilization technology applications. Market penetration of geothermal energy.

Economic evaluation should include:

- First investments for the proposed schemes (integrated scheme, cascade scheme);

- Evaluation of thermal energy (space heating and hot water production) unit cost produced by integrated scheme: geothermal energy, heat pumps and solar energy;

- Evaluation of benefits (in financial terms) through comparison with the classical scheme of the proposed integrated and cascades scheme;

- Other benefits will be assessed for example the environmental benefit by using renewable energies (geothermal energy, solar energy), new technologies (heat pumps) and energy savings (cascade scheme).

Among others and for one of the two application cases this phase will be examine:

- Preliminary consideration for each case
- Definition of the main parameters affecting each system
- Analysis of the effect of the different parameters
- Selection of the "basic" application cases/techniques
- Design of the system
- Selection of alternative cases
- Final technical conclusions

Based on the above analysis, for the best area selected, a Feasibility Study will be performed to analyze three components: energy supply, environmental impact and financial aspects, and to suggest the best solution of the innovative geothermal energy utilization technology applications in that area.

6. PRELIMINARY COST FOR THE INVESTMENT

Cost estimation is carried out only for the first phases, to realize investment step by step:

No	Object	Cost, in USD
1	Reconstruction of heating and thermal baths	50 000
2	Construction of two thermal water unit equipment's	80 000
	Construction of green houses, 2 * surface 3 000 m ²	240 000
4	Construction of new SPA Clinic and for new hotel building), (****)	2 200 000
5	Feasibility study and project idea	53 000
9	Other Expenditures	20 000
10	Overhead rate	15 000
	TOTAL exc. VAT	2 418 000

7. ECONOMICAL-FINANCIAL EVALUATIONS

HOTEL-SPA, First Phase: 25 bed rooms, 40 beds.

Currency: USD

Inflation rate: 3.5%

Table 1

Economic bases	Years				
	1st	2nd	3rd	4th	5th
1. Number of rooms (1)	25	25	25	25	25
2. Number of beds	40	40	40	40	40
3. Days of operation	280	280	280	290	290
4. Food&beverages-facilities	280	280	280	290	290
5. Guest structure and room price					
6. Average room occupancy	100%	100%	100%	100%	100%
7. Average room price	72	74	75	75	75
	50	50	55	55	60

- 1) Hotel has 15 doubles rooms and 10 single rooms
Rata: Single room 50 USD; Double room 70 USD (Include VAT) (Present room's rate in *** Hotels in Tirana)

Supplementary facilities:

1. Outdoor-indoor thermal & swimming pool
2. Ball sports (tennis, volleyball, basketball)
3. Recreation (sauna, Turkish bath, solarium)
4. Fitness Center with aerobic
5. Restaurant, bar
6. Meeting room
7. Others (rent a car, coiffeur, boutiques)

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7. Building of SPA, with 30-40 beds, for the medical treatment (gynecological and rheumatic diseases),
8. Construction of heating installation in the buildings
9. Construction of the greenhouse for the flower.
10. Construction of the greenhouse for the legumes.
11. Construction of thermal pool for tourists, wardrobe and bar.
12. Installation of equipment for extraction microelements and natural salts.

5.2. Feasibility Study

Technical and financial feasibility study for innovative geothermal energy utilization

technology applications. Market penetration of geothermal energy.

Economic evaluation should include:

- First investments for the proposed schemes (integrated scheme, cascade scheme);
- Evaluation of thermal energy (space heating and hot water production) unit cost produced by integrated scheme: geothermal energy, heat pumps and solar energy;
- Evaluation of benefits (in financial terms) through comparison with the classical scheme of the proposed integrated and cascades scheme;
- Other benefits will be assessed for example the environmental benefit by using renewable energies (geothermal energy, solar energy), new technologies (heat pumps) and energy savings (cascade scheme).

Among others and for one of the two application cases this phase will be examine:

- Preliminary consideration for each case
- Definition of the main parameters affecting each system
- Analysis of the effect of the different parameters
- Selection of the "basic" application cases/techniques
- Design of the system
- Selection of alternative cases
- Final technical conclusions

Based on the above analysis, for the best area selected, a Feasibility Study will be performed to analyze three components: energy supply, environmental impact and financial aspects, and to suggest the best solution of the innovative geothermal energy utilization technology applications in that area.

6. PRELIMINARY COST FOR THE INVESTMENT

Cost estimation is carried out only for the first phases, to realize investment step by step:

No	Object	Cost, in USD
1	Reconstruction of heating and thermal baths	50 000
2	Construction of two thermal water unit equipment's	80 000
	Construction of green houses, 2 * surface 3 000 m ²	240 000
4	Construction of new SPA Clinic and for new hotel building), (****)	2 200 000
5	Feasibility study and project idea	53 000
9	Other Expenditures	20 000
10	Overhead rate	15 000
	TOTAL exc. VAT	2 418 000

7. ECONOMICAL-FINANCIAL EVALUATIONS

HOTEL-SPA, First Phase: 25 bed rooms, 40 beds.

Currency: USD

Inflation rate: 3.5%

Table 1

Economic bases	Years				
	1st	2nd	3rd	4th	5th
8. Number of rooms (1)	25	25	25	25	25
9. Number of beds	40	40	40	40	40
10. Days of operation	280	280	280	290	290
11. Food&beverages-facilities	280	280	280	290	290
12. Guest structure and room price					
13. Average room occupancy	100%	100%	100%	100%	100%
14. Average room price	72	74	75	75	75
	50	50	55	55	60

- 2) Hotel has 15 doubles rooms and 10 single rooms
 Rata: Single room 50 USD; Double room 70 USD (Include VAT) (Present room's rate in *** Hotels in Tirana)

Supplementary facilities:

8. Outdoor-indoor thermal & swimming pool

9. Ball sports (tennis, volleyball, basketball)
 10. Recreation (sauna, Turkish bath, solarium)
 11. Fitness Center with aerobic
 12. Restaurant, bar
 13. Meeting room
 14. Others (rent a car, coiffeur, boutiques)

Table 2
FINANCIAL BASES

Proceeds	%	Years				
		1st	2nd	3rd	4th	5th
1. Room Rental (without breakfast)	71					
number of rooms		25	25	25	25	25
*day of operation		280	280	280	290	290
=max. room overnight		7 000	7 000	7 000	7 250	7 250
*average room occupancy		72%	74%	75%	75%	75%
=number of room overnight		5 040	5 180	5 250	5 438	5438
*average room price		50	50	55	55	60
= arrangement (without f&b)		252 000	259 000	288 750	299 090	326 280
2. Food&beverage	26					
a) Full Pension		100%	100%	100%	100%	100%
Number of consumptions		7 056	7 252	7 350	7 612	7 612
*Proceeds/guest		10	10	11	11	12
=full pension		70 560	72 520	80 850	80 850	80 850
b) Beverages		21 168	21 756	22 050	22 836	22 836
-full pension (full pens. * 3)						
Total revenues F&B		91 728	94 276	102 900	106 568	114 180
2. Food&beverage	26					
b) Full Pension		100%	100%	100%	100%	100%
Number of consumptions		7 056	7 252	7 350	7 612	7 612
*Proceeds/guest		10	10	11	11	12
=full pension		70 560	72 520	80 850	80 850	80 850
b) Beverages		21 168	21 756	22 050	22 836	22 836
-full pension (full pens. * 3)						
Total revenues F&B		91 728	94 276	102 900	106 568	114 180
3. Telephone revenues	3	10 311	10 560	11 750	12 170	13 214
4. Shopping revenues						
5. Other revenues for rental						
TOTAL REVENUES		354 040	363 874	403 399	417 828	458 674
OPERATING EXPENSES						
1. Personnel Expenses	28.	37	37	37	37	37
number of employed	1					
Year's salary per employed		1 440	1 4040	1 560	1 560	1 620
Personnel Salary		36 000	36 000	39 000	39 000	40 500
Insurance		13 500	13 500	14 625	14 625	15 187
Personnel Expenses		67 500	67 500	72 345	72 345	75 127
2. Cost of goods sold	19.	45 864	47 138	51 450	53 284	57 090
	1					
3. F&B for the personnel (3 USD/day)	13	31 500	31 500	32 625	32 625	32 625
4. Direct expenses Phone+fax; laundry+cleaning	3	7 080	7 277	8 068	8 356	9 073
5. Indirect Expenses - energy, water	11.					
	9					

- Maintenance						
- Small wares						
- Travel expenses						
- Insurance						
- Advertising						
- Marketing+Management						
- Office material						
- Bensol						
- Transport						
TOTAL		28 677	29 474	32 675	33 844	37 152
VAT, 20%		59 511	61 164	67 969	70 402	77 565
TOTAL OPERATING EXPENSES		240 132	244 053	265 132	270 856	288 632
GROSS OPERATING PROFIT		113 908	119 821	138 267	146 972	170 042

**Table 3
REPAYMENT OF THE CREDIT**

Moderate credit 1 300 000 USD

Interest: 3%

Repayment period 15 years

Financial bases	Years				
	1st	2nd	3rd	4th	5th
GROSS OPERATING PROFIT	113 908	119 821	138 267	146 972	170 042
Interest			39 000	39 000	39 000
Credit repayment	101 908	104 821	83 095	89 972	112 042
Cumulating credit repayment	101 908	206 729	289 824	379 796	491 838
Cash flow	12 000	15 000	17 300	18 000	19 000

Financial bases	Years				
	6th	7th	8th	9th	10th
GROSS OPERATING PROFIT	170 042	170 042	170 042	170 042	170 042
Interest	39 000	39 000	39 000	39 000	39 000
Credit repayment	112 042	112 042	112 042	112 042	112 042
Cumulating credit repayment	603 880	715 922	827 964	940 006	1 052 048
Cash flow	19 000	19 000	19 000	19 000	19 000

Financial bases	Years				
	11th	12th	13th	14th	15th
GROSS OPERATING PROFIT	170 042	170 042	170 042	170 042	170 042
Interest	39 000	39 000	39 000		
Credit repayment	112 042	112 042	23 868		
Cumulating credit repayment	1 164 090	1 276 132	1 300 000		
Cash flow	19 000	19 000	19 000	170 042	170 042

payback is 13 years for one hotel-SPA for first their phase, 40 beds (25 rooms), for one moderate credit of 1 300 000 US.

**8. GATHERING INFORMATION
MATERIAL AND KNOWLEDGE
DISSEMINATION IT IS VERY
IMPORTANT ELEMENT OF
UTILIZATION OF GEOTHERMAL
ENERGY**

Task 1

Information material concerning the general principles of geothermal application and new technologies will be gathered and created. An information booklet and posters will be published and distributed to possible users.

Task 2. Establishment of communication channels with local users

Communication with local authorities will take place in order to find the end users, especially those capable of installing geothermal applications. Direct personal contacts with end users will also take place.

The investigators will implement this study by answering and focusing on the solution of the following questions:

The selection of the most suitable utilization plan according to the actual applications of the new technologies in question, the energy conservation, the desired transfer of the innovative technology to country, the probable users intentions and the existing heating consumption needs of the planned innovative applications.

The investigation of any probable environmental impact and the selection of the most suitable method for the disposal of the geothermal fluids to avoid possible environmental problems.

The selection of the best possible network for the geothermal fluid transport to ensure the viability of the utilization carrier, a single disposition price and the disposition of considerable quantities of energy (converted in TOE-s).

Task 3.

-To create ready for use permanent educational and informative structures.

-To provide a useful tool for the education and information of geothermal energy end users

- For further dissemination of the results of this projects will organize days of open conferences. Workshops, seminars, TV and radio-emissions, pamphlets, posters, and summer school will organize. In parallel, the strategies presented for the geothermal energy exploitation will be announced and criticized during these activities. The participant will originate from the public sector, users, associations, Technical Chambers, higher educational institutes etc. Finally, material from Phase C will be also forwarded to the public authorities that are responsible for the awareness of users and therefore in close contact with them.

-To introduce, via an attractive method, the concepts of geothermal energy utilization and new technology transfer in the third level education

**9. SIGNIFICANCE OF THE PROJECT
PROPOSAL AND ITS EXPECTED
ACHIEVEMENTS**

The project proposal has great importance for Albania:

Firstly, it creates the scientific knowledge base for evaluation of natural wealth of geothermal energy and mineral waters in Albania. These data will be used to evaluate and select the rich areas in country. In these areas it is possible to start the investment for complex exploitation of geothermal energy and mineral water resources

Secondly, transfer of new methods for R&D and evaluation of geothermal water resources, modern technologies and unit equipment for thermal waters exploitation in Albania.

Thirdly, a technical and organizing base for modern hotel SPA construction will be created.

Thermal and mineral water springs, usually, are located in coastal or very beautiful mountainous regions of the Albania. The tourism will be developed. Thermal waters of low enthalpy will be used for the heating of green houses and SPA hotels and tourist villages near the springs. Extraction of chemical micro- elements as Iodine, Bromine, Borax, various natural salts from thermal and mineral waters, CO₂ and H₂S gas, will be achieved by installing the necessary equipment. Drinking-mineral water installations will be constructed. This development will create

new working posts and will ameliorate the life conditions and level for habitants in thermal and mineral water spring areas.

Fourthly, new modern studying technologies will be disseminated in scientific and business community of country.

Fifthly, Environmental protection and preserving level will be improved, to well assist the echo-system protection of thermal and mineral water source areas.

10 .WORK PROGRAMME

Methodology

This project must be implemented during the 3 years period, by the integration of the following phases:

FIRST PHASE .

The project must be realized using a complex of modern methods according to the objectives:

1. Complex and integrated study of all geothermal data on resources of geothermal energy in Albania:

- Integrated geothermal, hydrogeological, hydrochemical surveys in the sources and wells of geothermal energy.

- Mathematical modeling for calculation of potential of geothermal energy in Albania, as well as for the study of reservoirs.

- Geothermal and mineral water resources detailed feasibility study will be carried out in geothermal area. Project idea will be compiled, too.

- Technical projects will be compiled for investments in more perspective areas.

6 months

SECOND PHASE. 1. Construction of thermal water unit equipment in geothermal springs and wells.

2. Heating system, the thermal water unit equipment and baths must be reconstructed in existing Hotels SPA. After second phase, all year SPA

frequenting will realize. During the winter there are more demands for the medical treatment.

Good conditions in the SPA will help to have patient numbers increasing.

2. Green house, up to 3000 m² surface, must be constructed in the territory of thermal springs and wells

THIRTY PHASE: New Hotels-Clinic SPA hotel construction of (****) in geothermal areas. For the first time, the SPA Clinic and the hotel will have two or three floors, with the possibilities to build and 2 or three other floors in the future. In the ground floor will be located the restaurant, bar, medical clinic and thermal baths. Bedrooms will be located in the first and second floors. Thermal swimming pool will construct in the ground floor or in the yard.

24 months

FOUR PHASE: 1. Unit equipment for the extraction of chemical microelements and salts, CO₂ and H₂S gas will be designed and installed.

2. Unit equipment and collector for treatment and clearing the thermal water before their outflow will be designed and installed, to protect echo-system of the area.

3. Promotion and tourist agency will be organized. Put in full efficiency of all complex of the SPA will be completed.

10 months

11. CONCLUSIONS

In Albania, there are several geothermal energy sources that can be used.

Such geothermal energy sources are natural thermal water springs and deep wells with a temperature of up to 65.5°C. Deep abandoned oil wells can be used as “Vertical Earth Heat Probe”.

The integrated and cascade use of geothermal energy in the Albania must start as soon as

possible, in the framework of a joint or separate project.

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