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Scenarios For Integrated and Cascade Use of Geothermal Energy of Low Enthalpy in Albania

Alfred FRASHERI
Faculty of Geology and Mining, Polytechnic University of Tirana, ALBANIA
E-mail: alfi@inima.al

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ABSTRACT
Large numbers of geothermal energy of low enthalpy resources are located in different areas of Albania. Thermal waters are sulfate, sulfide, methane, and iodinate-bromide types. Thermal sources are located in three geothermal zones:

Kruja geothermal zone represents a zone with bigness geothermal resources. Kruja zone has a length of 180 km. Identified resources in carbonate reservoirs are $5.9x10^8$-$5.1x10^9$ GJ,
Ardenica geothermal zone is located in the coastal area of Albania, in sandstone reservoirs.
Peshkopia geothermal zone in northeastern area of Albania. Several springs are conected with disjunctive tectonics of the gypsum diapir.

The geothermal situation in Albania offers three directions for the exploitation of geothermal energy:
- **Firstly,** the uses of the heat flow of shallow geological section for space heating and cooling. Integrated exploitation and cascade direct use of the geothermal energy must be realized by integrated scheme of geothermal energy, heat pumps and solar energy to fulfill.
- **Secondly**, thermal sources of low enthalpy are natural sources or wells in a wide territory of Albania. They represent the basis for a successful use of modern technologies for a *complex and cascade exploitation* of this energy, achieving an economical effectiveness:
1. SPA clinics for treatment of different diseases and hotels for ecotourism.
2. The hot water for heating and sanitary waters of the SPA and hotels, greenhouses and aquaculture installations.
3. From thermal waters it is possible to extract chemical microelements.
- **Thirdly**, the use of deep abandoned oil and gas wells as "Vertical Earth Heat Probe".

Actually in Albania the study of the possibilities of exploitation of the geothermal energy has begun. The aims of the project are to examine, demonstrate and disseminate the positive technical and financial aspects of transfer and utilization of innovative geothermal energy technologies in Albania.

1. INTRODUCTION

In Albania, rich in geothermal resources of low enthalpy and mineral waters, new technologies of direct use of geothermal energy are still undeveloped. Large numbers of geothermal energy of low enthalpy resources, a lot of mineral water sources and some CO_2 gas reservoirs represent the base for a successful application of modern technologies in Albania, to achieve economic effectiveness and success of complex direct use.

At the present, many geothermal, hydrogeological, hydrochemical, biological and medical investigations and studies on thermal and mineral water resources are ongoing in Albania. 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 up to 3000m 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. Generally, these investigations and studies are separated each from the other. These studies and evaluations are necessary to well know at a regional scale the thermal and mineral water resources potential and geothermal market of the Albania.

According to the results of these new studies, the evaluation of the perspective level of the best areas in country will be necessary. After such evaluation is possible to start investments in these areas. Integrated exploitation and cascade direct use of the geothermal energy will be realized by an integrated scheme of geothermal energy, heat pumps and solar energy. This scheme gives an environmental benefit by using renewable energies (geothermal and solar energy), new technologies (heat pumps) and energy savings (cascade scheme). Cascade scheme should be used to fulfill 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.

Direct use of geothermal energy will have a direct impact on the development of the districts, by increasing the per capita income and at improving

the same time the standard of living of people. These investments will be profitable in a short period of time, more than century.

2. GEOTHERMAL ENERGY RESOURCES IN ALBANIA

2.1. Methodic

Platform for direct use of geothermal energy in Albania that is presented in the paper is based on the result of geothermal studies carried out in Albania (Frashëri et al. 2004, 2005). The results of these geothermal studies carried out in Albania are presented in maps and geothermal sections. Temperature maps have been drawn for different levels of up to 3000m depths. 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 studies for the possibility of direct use of geothermal energy in Albania have been presented in different scientific conferences (Frashëri et al 1997, 2003, Frashëri 2001, 2004 etc.).

2.2 Geothermal Features

The geological setting of the Albanides creates the premises for the research and exploitation of natural geothermal energetic resources.

The greatest heat flow density with a value of 42 $mW \cdot m^{-2}$ 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 $mW \cdot m^{-2}$ (Frashëri et al. 2004). The geothermal gradient has the highest value about 18.7 $mK \cdot m^{-1}$ in the center of the Peri Adriatic Depression. Elsewhere the gradient is mostly 15 $mK \cdot m^{-1}$ (Fig. 2). In the south of the country the geothermal gradient has low values 11.5-13 $mK \cdot m^{-1}$. Towards the northeastern and southeastern regions of Albania, over the ophiolitic belt, the geothermal gradient increases, reaching the value of 23.5 $mK \cdot m^{-1}$. The temperature at a depth of 100m ranges 6.7 to 18.8°C, in average 16.4°C (Fig. 3) and at a depth of 500m from 21 to 27.7°C.The temperature ranges 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 (Fig. 4,5).

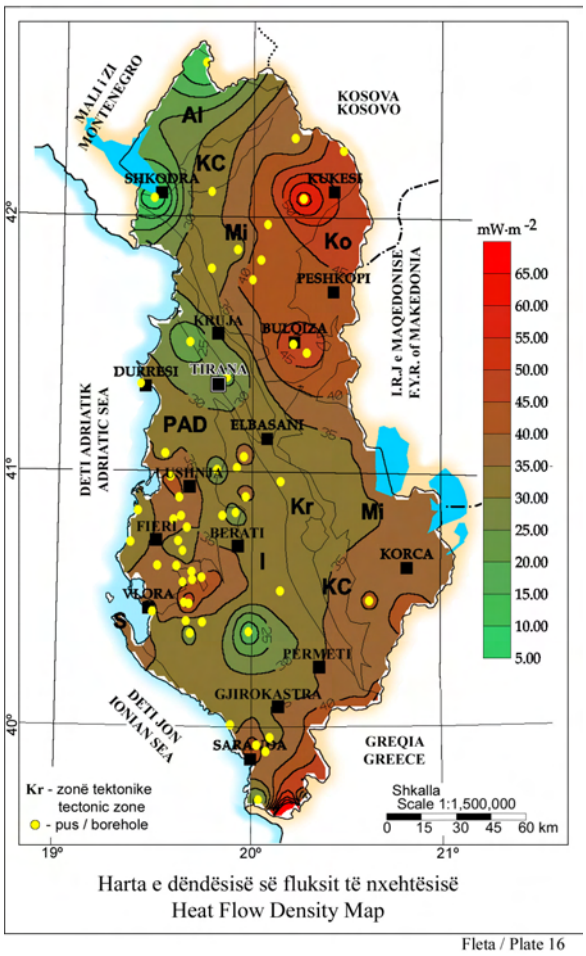


Fig. 1. Heat Flow Density Map of Albania.

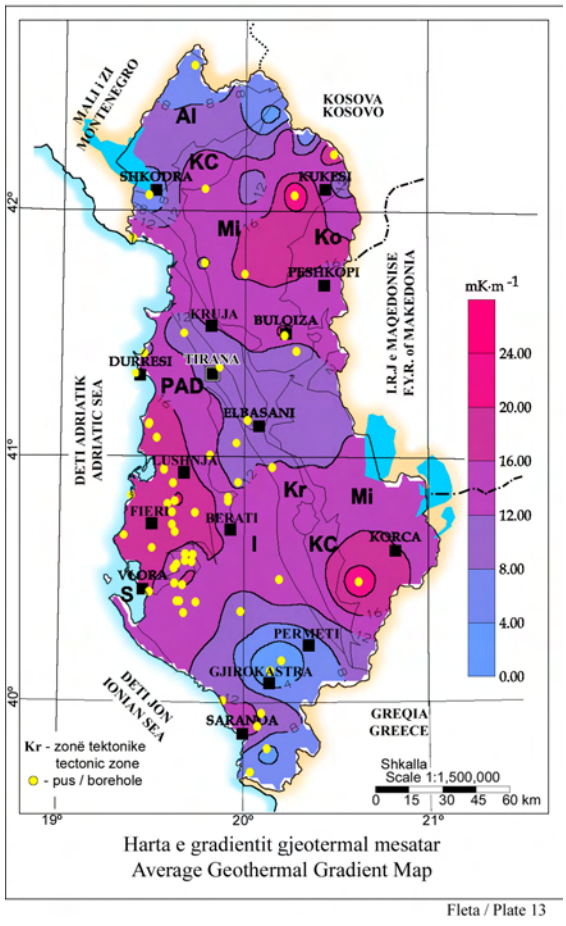


Fig. 2 Geothermal Gradient Map of Albania

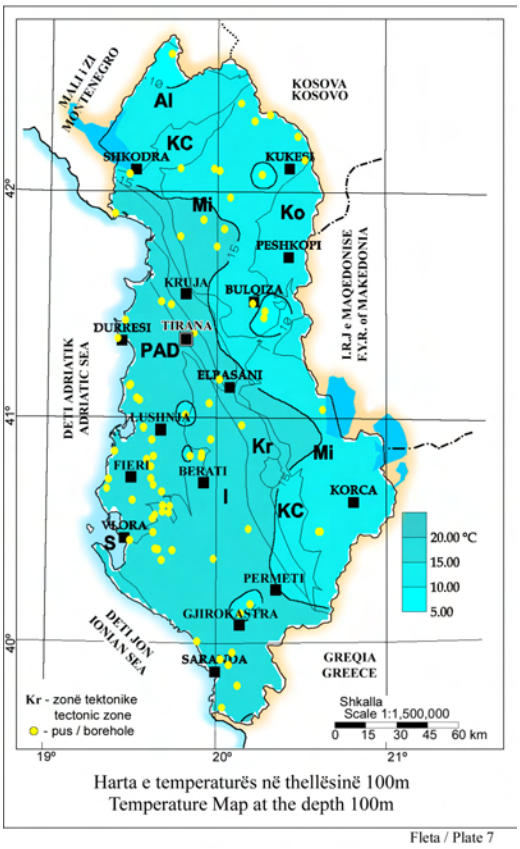


Fig. 3. Temperature Map of Albania, at the depth 100 m.

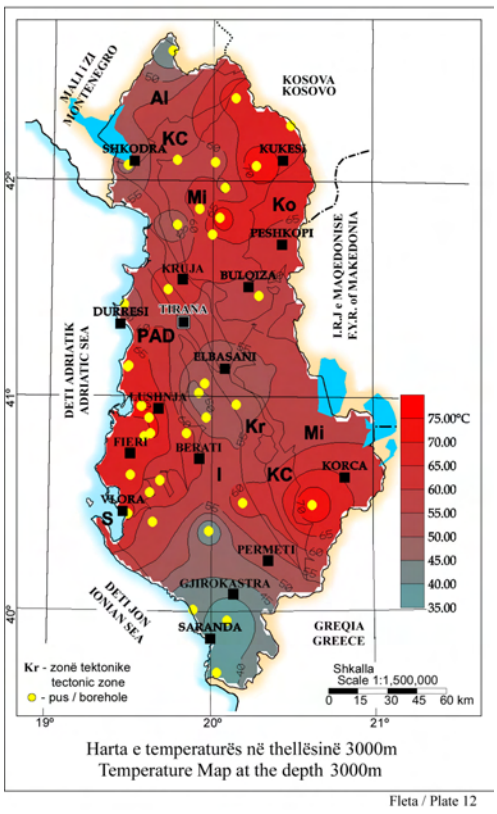


Fig. 4. Temperature Map of Albania, at the depth 3000 m.

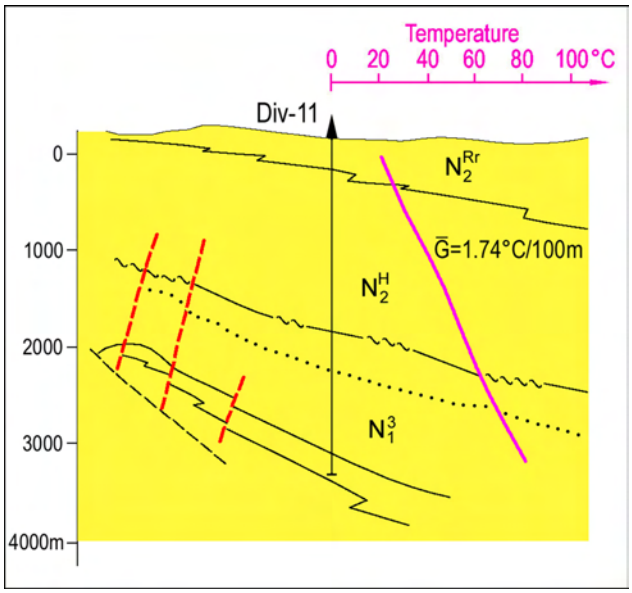


Fig. 5. Geothermal profile in the Peri Adriatic Depression.

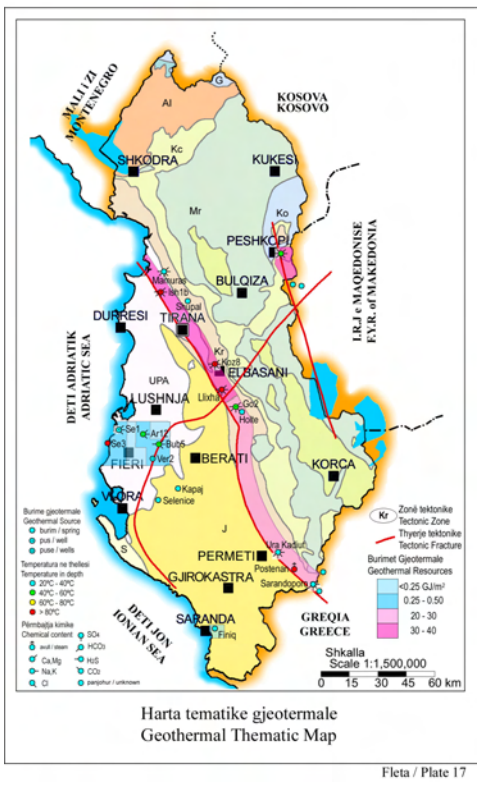


Fig. 6. Geothermal Zones in Albania.

2.3. Geothermal Areas and Reservoirs

In Albania there are many thermal springs and wells of low enthalpy (Fig. 5, Tab. 1) (Avxhiu et al. 1999, Eftimi et al.1989, Frashëri et al. 2004, 2005, Hydrogeological Map of Albania, at scale 1:200,000, 1985).

Thermal water sources and wells in Albania Tab. 1

Type of the source	Location	Temperature, (°C)	TDS, (mg/l)	Yield, l/sec
Natural Spring	Llixha Elbasan, Peshkopi, Krane (Sarande), Langaric (Permet), Shupal (Tiranë), Sarandoporo (Leskovik), Postenan (Leskovik) Tërvoll (Gramsh), Mamurras (Tiranë).	21-60	0.3-26	10-40
Deep wells	Peri Adriatic Depression and in the Kruja tectonic zone	29.3-65.5	1-19.3	0.9-18

These thermal water springs and wells 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 the Tirana-Elbasani area, thermal waters are of Mg-Cl type. They contain the cations Ca, Mg, Na and K, the anions Cl, SO_4 and HCO_3, as well as H_2S and free CO_2, with pH to 6,7-8, mineralization 1,65-19,3 g/l, and density of 1,001-1,006 g/cm^3. The waters come from different depth levels (800-3000 m) from limestone and sandstone reservoirs. Thermal sources are located in three geothermal zones (Fig. 5):

- **Kruja geothermal zone** represents a zone with large geothermal resources. Kruja zone has a length of 180 km. Identified resources in carbonate reservoirs are $5.9x10^8$-$5.1x10^9$ GJ,
- **Ardenica geothermal zone** is located in the coastal area of Albania, in sandstone reservoirs.
- **Peshkopia geothermal** zone is located at northeastern area of Albania. Several springs are conected with disjunctive tectonics of the gypsum diapir.

3. SCENARIOS FOR THE DIRECT USE OF GEOTHERMAL ENERGY OF LOW ENTHALPY IN ALBANIA

The geothermal situation of low enthalpy in Albania offers following directions for the exploitation of geothermal energy, which is unused until now. Direct use will be realized by an integrated scheme of geothermal energy, heat pumps and solar energy, and cascade use of this energy (Frashëri et al. 1997, 2003, 2005, Frashëri 2001, 2003, 2004).

Firstly, space heating and cooling using ground heat by the Borehole Heat Exchanger (BHE), in shallow boreholes (about 100 m depth).

Secondly, thermal waters of low enthalpy with a maximal temperature up to 80°C. These are natural sources or wells in a wide territory of Albania. These thermal waters may be used in several ways:

1. Modern SPA clinics for treatment of different diseases and hotels, with thermal pools, for development of eco-tourism. At present only SPA, with a primitive technology, worked in some geothermal springs and wells in Albania.
2. Preparation of sanitary hot water and heating of clinics, hotels, and tourist centers. Near these centers it is possible to build the greenhouses, and aquaculture installations.
3. Extraction of very useful chemical microelements and natural salts. From these waters it is possible to extract sulphidric and carbonic gas. It is possible to build installations for processing of mineral waters.

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

Thirdly, 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. Near of these wells, the greenhouses can be building.

In Albania the study of the possibilities for direct use of the geothermal energy is currently ongoing.

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 direct use of geothermal energy in that area.

4. ALBANIAN GEOTHERMAL ENERGY MARKET

Objectives of market study are as follows:

- Evaluation of the present status of geothermal development in Europe, particularly in Balkan countries, regarding promotion activities, results, application, barriers for market penetration, legal and financial framework, etc.
- Comparison of the present status between the different Albanian regions.
- Identification of the attitude and feelings (awareness, knowledge, preference, etc.) for the industrial groups, municipalities and local communities towards geothermal energy.
- Identification of the attitude and feelings of the public environmental offices, local communities and owners of geothermal installations groups towards environmental aspects of direct use 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.

4.1. Space heating and cooling

At the present the electric energy consummation for heating is 1 375 GWh/year, or 23.8 % of the total electric energy production in Albania (National Agency of Energy, Tirana, 2003). The situation becomes more problematic because the use of natural gas for heating emits large quantities of CO_2 in the atmosphere.

Direct use of the ground heat by Borehole heat Exchanger-Geothermal Heat Pump represents a modern system for space heating and cooling (Lund 2005, Rybach and Sanner 2005, Sanner 2004). Two types of shallow heat sources exist: ground heat and underground waters heat. Consequently, two kinds of technologies may be applied:

1. Borehole heat Exchanger-Geothermal Heat Pump or ground-couplet (closed loop) for ground-source, and
2. Underground water system – Geothermal Heat Pump (open loop).

To contribute for solving of the problematic space heating and cooling in Albania, and to start the direct use of the ground heat for this purpose, we have presented a proposal for building a demonstrative installation in Tirana (school, hospital, residence etc.) (Frashëri et al. 2003).

Heat quantity, temperature at Earth surface, and geothermal gradient in shallow geological section, are conditioned by geographical location, geomorphological conditions, ground and bedrocks lithology, specific heat and humidity, season and weather. According to the multi annual meteorological surveys solar radiation contribution on the ground results to be in order of 140,000 calory.cm^{-2} on average, during the summer at the plane areas of the Albania. Heat quantity reaches 120,000 calory.cm^{-2} in the northeaster mountains regions [Gjoka L., 1990].

There are some particularities in the distribution of the temperature at 100m depth (Fig. 2):

Area	Temperature, in ^{o}C		
	Minimum	Maximum	Average
Littoral	16,60	18,8	17,80
Western plain	17,15	18,41	18,00
Hilly-mopuntain	6,70	18,60	14,75

According to the analyze of the geothermal regime of the shallow geological section is concluded that it is possible to use the ground heat for space heating and cooling, applied modern Borehole Heat exchanger – geothermal Heat Pump. Ground geothermal energy has heated the underground water reservoir. In Tirana underground water basin have a temperatures of 14-15 ^{o}C for the Quaternary gravel layer water and 15-16^{o}C for Quaternary sandstone layers waters. Consequently, it is concluded that water of the Tirana underground basin can be a heat source for the geothermal pumps.

4.2. Consumers for geothermal energy & thermal water (heat, spa, cooling, power production, drinking water, aquaculture, agriculture)

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

The oldest and important is Elbasani Llixha SPA, which located about 10 km south of Elbasani city and 61 km southeast of Tirana, in the Central part

of Albania. This area may be frequented by a large number of people from different Balkan and western Europe countries. These thermal springs are known since about 2000 years. There are seven spring groups that extend like a belt with 320^{o} azimuth. Surface water emperature is about 60^{o}C and yield in total 15 l/sec. In Llixha Elbasani water place actually are three SPA. All the seven groups of springs in Llixha Elbasani and Kozani-8 well geothermal area will have the possibility for modern complex exploitation. The beautiful landscape of Elbasani Lixha area will be not only for medical treatment but also as tourist place. This area is located near the renowned 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 "Mother Theresa" Rinasi (Tirana) Airport, near of the Adriatic coastline and Kruja - Skendergeg Mountain. There are all the possibilities for an echo-tourism development: thermal water, Ishmi beach at the Adriatic Sea , and mountains nearby. Land price in Elbasani region is 10-50 USD/m^2.

Benja and Sarandaporo thermal water areas and Postenani steam springs are located near of the Vjosa River valley. Peshkopia geothermal springs area is located near the Korrabi Mountain, highest mountain in Albania (2753m). The beautiful landscape of Vjosa valley, near Albanian-Greek border, and Peshkopia area near the Debar region in Macedonia, will be not only a thermal water bearing place for medical treatment but also a tourist place.

At present, there is not a law for thermal waters in Albania. Last years the draft of the law has been prepared.

4.3. Geological risk, financial possibilities to cover geological risk

No geological and financial risk for the exploitation of thermal water of geothermal springs and wells in Albania. Springs have constant hot water yield and temperature for a long period of time, more than a century. These data are evidence of a stable thermo-hydrodinamic reservoir regime.

4.4. 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 "Mother Theresa" Tirana Airport). By national road communication, Ishmi 1/b well is connected with Tirana, Tirana Airport, Durrësi and Shkodra cities. Kozani-8 well is located 35 kilometers southeast of Tirana, on a hilly area. Well connected by 1.7 km road with Tirana-Elbasani national road, and highway "Corridor 8" Durresi-Elbasan-Skopje. One km from Kozani 8 well is located Saint George Vladimir Monastery.

Elbasani Llixha SPA is located about 12 km south of Elbasani city and 61 km in southeast 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. Peshkopia geothermal springs are connected with Tirana by national road (182 km). Benja-Langarica, Postenani and Sarandaporo geothermal springs areas are located near the national road Tirana-Permeti (about 217 km)-Konitza (Greece).

5. THE AIMS AND OBJECTIVES OF THE PROJECT FOR DIRECT USE OF THERMAL WATERS OF LOW ENTHALPY

5.1. Goals of the platform

To examine, demonstrate and disseminate the positive technical and financial aspects of transfer and direct use of innovative geothermal energy technologies in Albania. Integrated and cascade direct use of geothermal energy will have an impact on the development of the regions by increasing their per capita income and at the same time ameliorating the standard of living of the communities.

This development will be achieved in parallel with the reduction of any negative environmental effects, 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 platform.

5.2. Objectives:

Integrated exploitation and cascade direct use of the geothermal energy has been proposed. The objectives of the platform:

- Country Geothermal Energy and mineral water resources evaluation.
- In-situ detailed investigation of the pre-selected zones with high energy potential and consumers of geothermal energy nearby of the springs, where will install the demonstrative unit. Among others this task will be concerned with intentions of users-thermal load inspections, initial energy balance analyses, and thermal characteristics of individual users, technical geothermal data collection, and 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 and bathing, aquaculture, mineral waters production, and extraction of the micro-elements and natural salts
c) Energy balance between different end-users,
d) Technologies to be applied
e) Preliminary design of the geothermal energy exploitation system
i) Definition of thermal demands
k) Energy conservation
l) Economic evaluation of thermal energy (space heating and hot water production installation cost, life cycle, energy product cost, pay back period). This evaluation must based on actual market prices for equipment, construction etc.

Based on the above analysis, for the best area selected, a feasibility study must 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.

Environmental protection must be improved, to well assist the eco-system 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, and selection of the most acceptable environmental methods for the disposal of the waste geothermal fluids.

Detailed projects for the implementation phase of the Platform necessary to 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 direct use of geothermal energy. This exploitation will be realized by integrated scheme of geothermal energy, heat pumps and solar energy. Such 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 fulfill the thermal energy demand for the selected area in order to get the maximum benefit from geothermal energy. The promotion of energy savings will be in place.

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.

6. APPLICATIONS AND TRANSFER TECHNOLOGY FOR A COMPLEX AND CASCADE DIRECT USE OF GEOTHERMAL WATERS ENERGY

Construction of the demonstrative units for direct use of the geothermal energy:
Building of SPA, with 30-40 beds, for the medical treatment (gynecological and rheumatic diseases), heating installation in the buildings, greenhouse for flowers and legumes, thermal pool for tourists, wardrobe and bar, installation of equipment for extraction of microelements and natural salts.
Construction of thermal supply installations: Installation of pipe – distribution system, heat exchanger, distributors, and control room monitoring. These pilot demonstrative units will help potential users overcome psychological barriers towards the utilization of new innovative technologies for direct application.

6.1. Preliminary cost for the investment

Cost estimation is performed only for the first phases, to realize investment step by step: Reconstruction of heating and thermal baths in the existing SPA clinic, and construction of demonstrative units: two thermal water equipments, two green houses, with a surface 2*3000 m^2, new SPA clinic (25 bed rooms, 40 beds), hotel building (15 doubles rooms and 10 single rooms), (****), and supplementary facilities (Outdoor-indoor thermal & swimming pool, conference room, ball sports-(tennis, volleyball, basketball, recreation - sauna, Turkish bath, solarium, fitness center with aerobic, restaurant, bar, meeting room, others (rent a car, coiffeur, boutiques). Total investment cost, exc. VAT, results 1 890 000 Euro.

6.2. Feasibility study

Technical and financial feasibility study for innovative geothermal energy utilization technology applications is necessary. Very important part is market penetration of geothermal energy analyze. Economic evaluation should include:

- First investments for the proposed schemes (integrated and 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, i.e. 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 must 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.

In tab. 2 and 3 are presented finacial bases and repayment of the credit for demonstrative geothermal unit (Fist phase of Hotel-SPA).

Financial bases (In Euro) Table 2

Proceeds	Years				
	1st	2nd	3rd	4th	5th
Room rental, food & beverage, others	276 593	284 276	315 155	326 428	358 339
Operating expenses (Personnel expenses, cost of goods sold, other)	187 603	190 666	207 134	211 606	225 493
Gross operating profit	88 990	93 610	108 021	114 822	132 846

Repayment of the credit (in Euro) Table 3

Moderate credit 1 100 000 Euro,

Financial bases	Years				
	1st	5th	10th	14th	15th
Gross operating profit	88 990	132 845	132 845	132 845	132 845
Interest		30 469	30 469		
Credit repayment	79 616	87 533	87 533		
Cumulating credit repayment	79 616	384 248	821 912		
Cash flow	9 374	14 844	14 844	132 845	132 845

Payback period is 13 years for hotel-SPA for first their phase, 40 beds (25 rooms), for one moderate credit of 1 300 000 USD (interest 3%, repayment period 15 years).

6.3. Work program

Methodology

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

First phase 6 months

The platform must be realized using a complex of methods according to the bjectives:

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

- Integrated geothermal, hydrogeological, hydrochemical surveys in the existing sources and wells of low enthalpy geothermal energy.
- Mathematical modeling for calculation of potential of geothermal energy in Albania, as well as for the study of reservoirs.
- Technical projects will be prepared for investments in more perspective areas.

Second phase. 6 months

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 be realized. During the winter there are more demands for the medical treatment. Good conditions in the SPA will help to have patient numbers increasing.
3. Greenhouse, up to 3000 m^2 surface, must be constructed nearby the thermal springs or wells.

Third phase. 24 months

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.

Fourth phase. 10 months

1. Unit equipment for the extraction of chemical microelements and salts, CO_2 and H_2S 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. Construction of an aquaculture plant, for fish and mushrooms.

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

7. ECONOMIC EVALUATION OF THE PROPOSED SCHEME FOR SPACE HEATING AND COOLING

A preliminary budget of the Open Loop Scheme: Borehole - Geothermal Heat Pump System for heating of the hotel, with a total surfaces 610 m^2, 20 rooms, 3 halls.
Heating System: heat water conveying-radiators.
Heating Capacity: 68.5 KW

Costs for different heating systems

Heating system	Specific istallation cost Euro/m^2	Specific cost for electrical energy or fuel for heating system, Euro/m^2	Specific energy or fuel for heating system kW/m^2 or l/m^2	Heating cost in the first year of the heating system installation, cent/kWh	Heating cost after payback period, cent/kWh
Gjeotermal: Borehole- Heat Pump	70,5	5,12	56,5	37,1	2,5
Air-Air conditioners	25,6	9,49	103	14,8	3,9
Oil fired boyler	44,3	22,07	22	28,8	9,6

Payback period for installation of the "Borehole-Geothermal Heat Pump" open loop system is 2 years. Payback period will be 5 years for "Borehole-Vertical Heat Exchanger-Heat Pump" closed loop system.

8. ECONOMIC EVALUATION OF THE PROPOSED SCHEME FOR GREENHOUSE CONSTRUCTION

Economical evaluation has been performed for the construction of the industrial glass greenhouse, with surface 4000 m^2. for meteorological conditions: minimal outside air temperature -5^{o}C, inside greenhouse temperature +12^{o}C. Heating capacity of system 547 kW. Cost for consumption of the electrical energy for geothermal heat pump system is 5,45 time cheaper than system with oil fired boiler, or 2.84 time for gas fired boiler. For projected greenhouse, with a 15-year payback period, result that income are 10.000 Euro/year and expenses 5.302 Euro/year. Consequently, geothermal heating greenhouses represent an economic effective investment.

9. GATHERING INFORMATION MATERIAL AND KNOWLEDGE DISSEMINATION

Task 1: Information material concerning the general principles of geothermal application and new technologies will be gathered.
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 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 must be performed.

Task 3.

- Creation of the permanent educational and informative structures.
- For further dissemination of the results of this platform will organize days of open conferences. Workshops, seminars, TV and radio-emissions, pamphlets, posters, and summer school will be organized. Finally, material will be also forwarded to the public authorities that are responsible for the awareness of users and therefore in close contact with them.

10. SIGNIFICANCE OF THE PROPOSED SCENARIO AND ITS EXPECTED ACHIEVEMENTS

The proposed scenario has great importance for Albania: Platform creates the scientific data base bank 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 the country. In these areas it is possible to start the investment for complex and cascade direct use of geothermal energy.

Transfer of new methods for R&D and evaluation of geothermal water resources, modern technologies and unit equipment for thermal waters exploitation in Albania will be realized.

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 Albania. The tourism will be developed.

Environmental protection, to assist the eco-system protection of thermal and mineral water source areas will be realized.

New modern studying technologies will be disseminated to the public institutions, scientific and business community of country, and to the students.

11. CONCLUSIONS

1. Albania has the resources of geothermal energy of low enthalpy, which is possible for integrated and cascade direct use as an alternative energy.
2. Resources of the geothermal energy in Albania are;
a) Natural springs and deep wells with thermal water, of a temperature up to 65.5°C.
b) Heat of subsurface ground, with an average temperature of 16.4°C, and Earth Heat Flow at the 2000-3000 meters depths.
3. Construction of the space-heating system, using shallow borehole heat exchanger (BHE)-Heat Pumps Systems present the most important direction of the use of geothermal energy in Albania.

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