Albania’s Geothermal Sector: A Case Study on UNFC and UNRMS Application

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National Agency of Natural Resources

ASSURING SUSTAINABILITY IN RESOURCE MANAGEMENT

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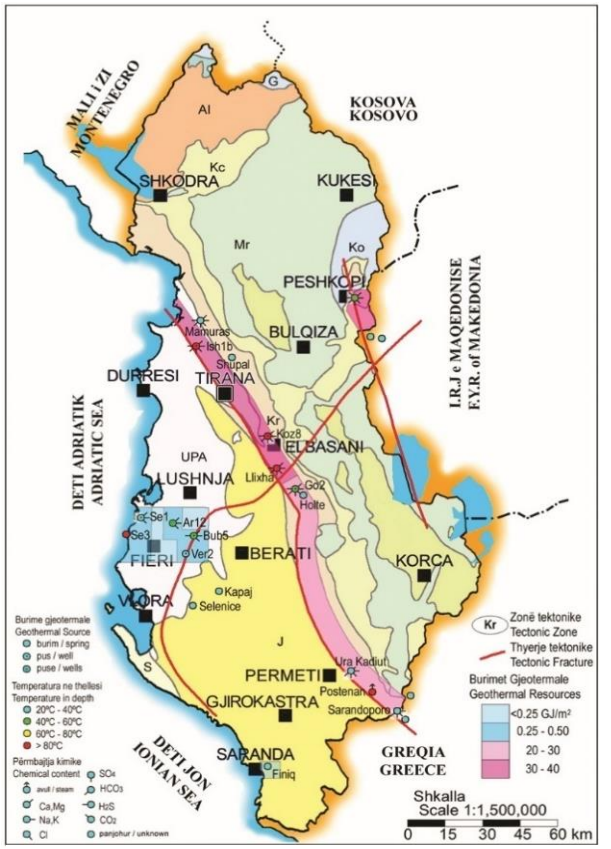
- The geothermal fluids, are found as natural springs and wells, and are located in three zones: Kruja, Ardenica and Peshkopia. The three zones differ from each-other by the geological characteristics and thermo-hydrogeological features. They are related with the regional tectonic and the seismological activities.



Geothermal map of Albania

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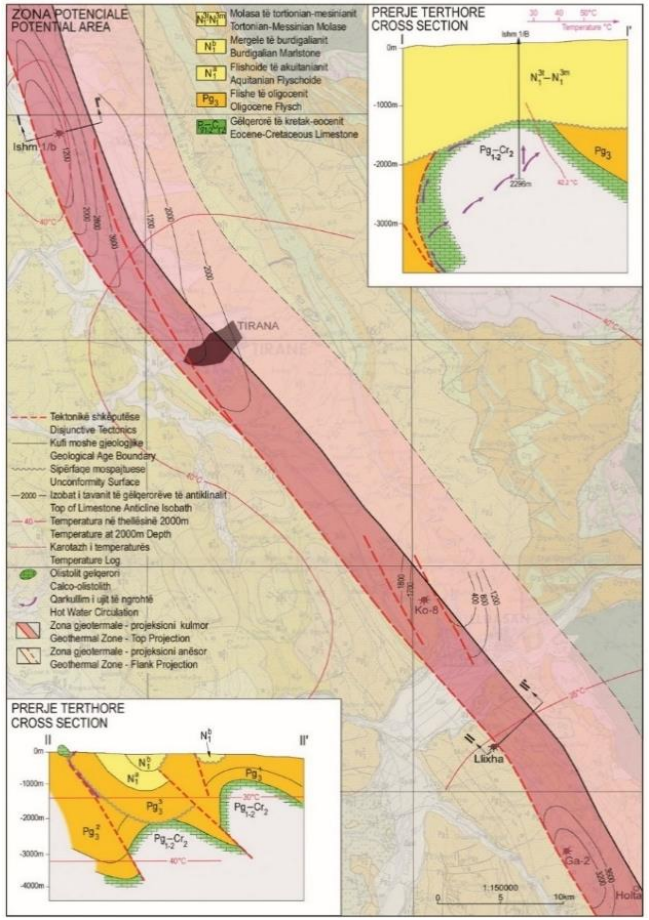
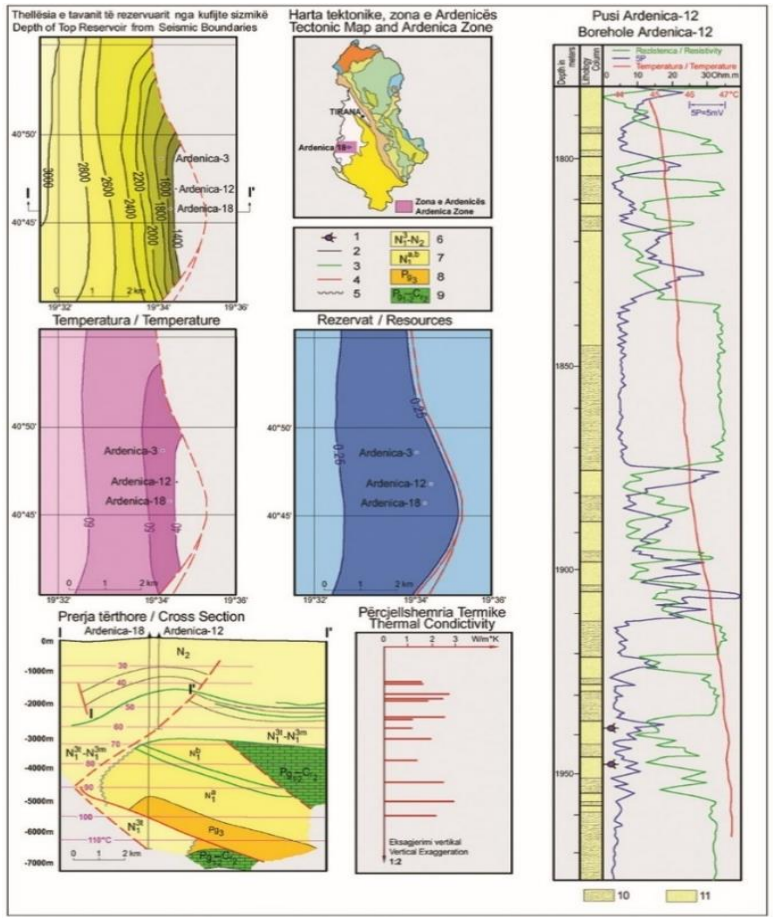
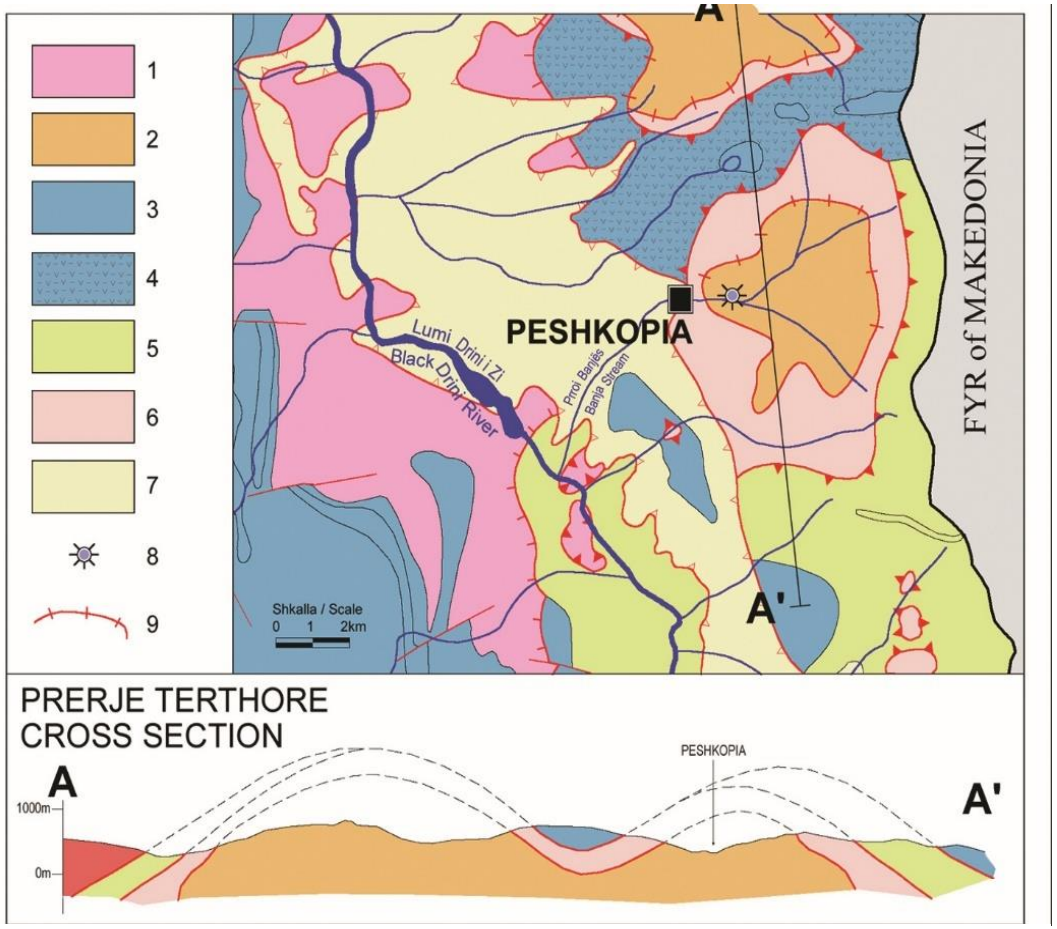


Kruja geothermal zone map



Ardenica geothermal zone map



Peshkopia geothermal zone map

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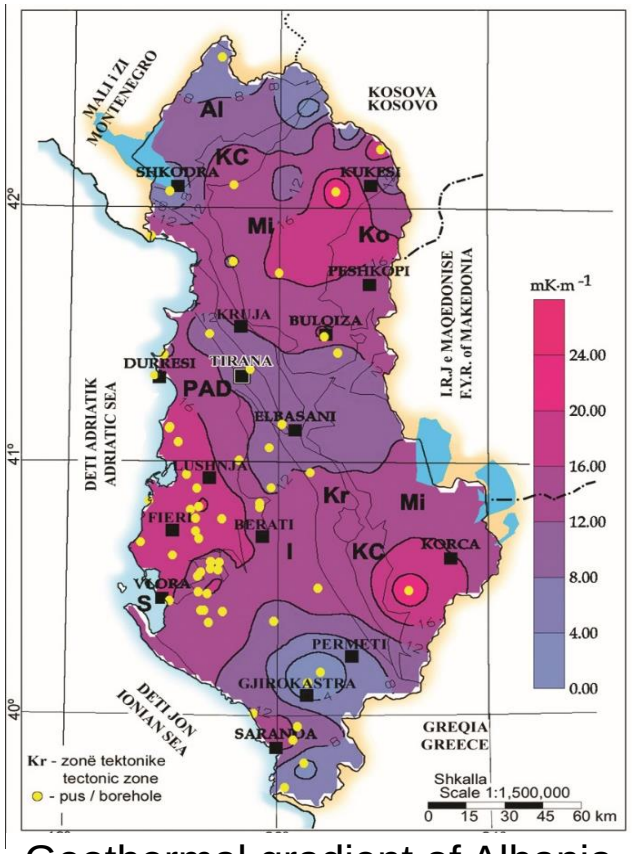
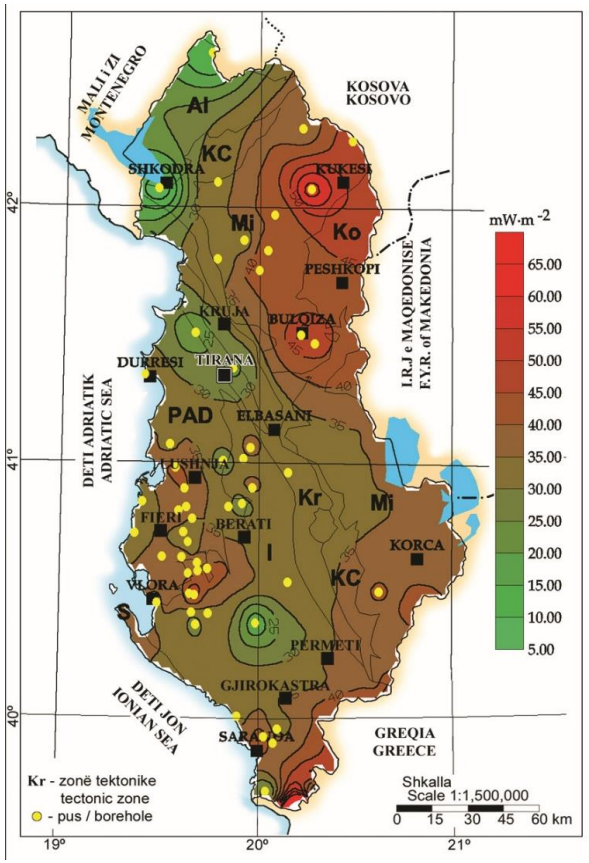


Geothermal gradient of Albania



Heat flow density of Albania

Geothermal springs of Albania

No	Spring and location	Temperature (°C)	Coordinates		Yield (l/s)
			Latitude (N)	Longitude (E)	
1	Mamurras 1 & 2	21÷22	41°42'24"	19°42'48"	11.7
2	Shupal	29.5	41°26'9"	19°55'24"	<10
3	Llixha, Elbasan	60	41°02'	20°04'20"	15
4	Hydraj, Elbasan	55	41°1'20"	20°5'15"	18
5	Peshkopia	43.5	41°42'10"	20°27'15"	14
6	Katiut Bridge, Lëngarica, Përmet	30	40°14'36"	20°26'	>160
7	Vronomer, Sarandaporo, Leskovik	26.7	40°5'54"	20°40'18"	>10
8	Finiq, Sarandë	34	39°52'54"	20°03'	<10
9	Holta Creek, Gramsh	24	40°55'30"	20°33'36"	>10
10	Postenan, Leskovik	Steam source	40°10'24"	19°48'42"	N/A
11	Kapaj, Mallakastër	16.9÷17.9	40°32'30"	19°39'30"	12
12	Selenicë, Vlorë	35.3	40°32'18"	19°39'30"	<10

Geothermal wells of Albania

No	Well	Temperature (°C)	Coordinates		Yield (l/s)
			Latitude (N)	Longitude (E)	
1	Kozani 8	65.5	41°06'"	20°01'6"	10.3
2	Ishmi 1/b	60	41°29'2"	19°40'4"	3.5
3	Letan	50	41°07'9"	20°22'49"	5.5
4	Galigati 2	45÷50	40°57'6"	20°09'24"	0.9
5	Bubullima 5	48÷50	41°19'18"	19°40'36"	
6	Ardenica 3	38	40°48'48"	19°35'36"	15÷18
7	Semani 1	35	40°50'	19°26'	5
8	Semani 3	67	40°46'12"	19°22'24"	30
9	Ardenica 12	32	40°48'12"	19°35'42"	
10	Verbasi 2	29.3			1÷3

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- The geothermal utilization

Hotel PARK Llixha-1937

Hotel HYDRAT Elbasan

The balneological center PESHKOPI

SARANDAPORO

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- What after?!!!!!

KOZANI 8

LLIXHA-Elbasan

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- Following UNFC and UNRMS guidelines is necessary to develop adequate geological models of the geothermal aquifers and conducting extensive studies to evaluate their possible further development. Additionally, conducting ESIA studies and extensive public consultations with stakeholders are crucial for the socio-economic viability of the project. To further advance geothermal utilization in Albania, continued efforts towards capacity building, technology transfer, and knowledge dissemination could be implemented.

- At the **Llixha-Elbasan hot-springs** area could be concluded that:

  ✓The water temperature is expected to be stable in the future;
  ✓The geothermal reservoir temperature at 4500-5000 m depth is thought to be about 220°C;
  ✓The water starts to cool down when it reaches 160 m depth;
  ✓The geothermal water from the Llixha hot springs fulfils all requirements for district heating's in the region;
  ✓Considerably higher temperature expected through further well drilling.

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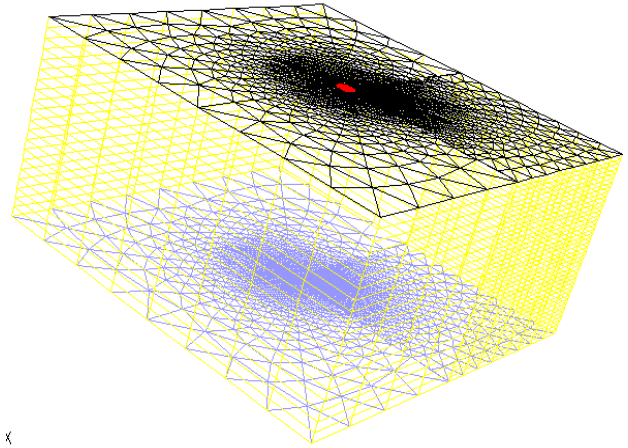
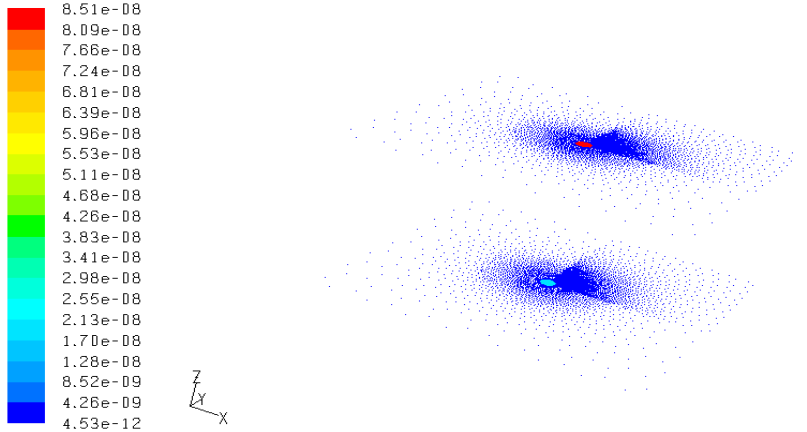
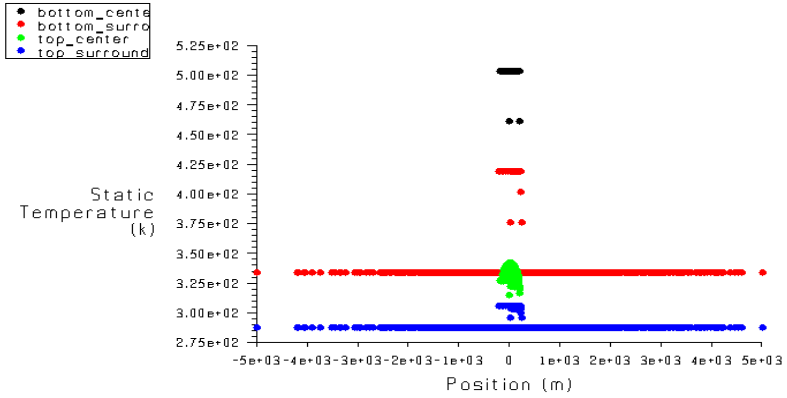


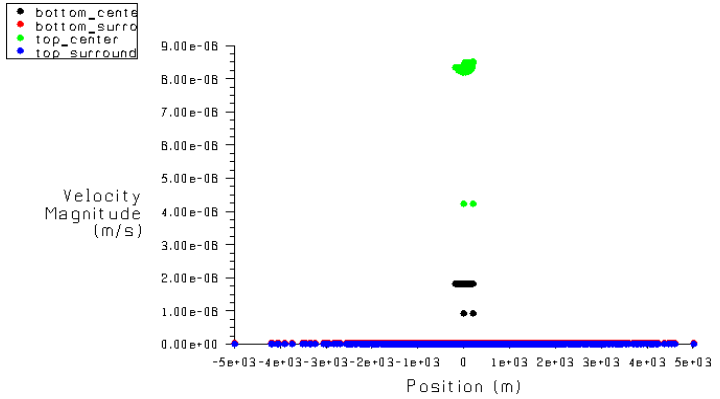
The finite volume grid used to model temperature and flow conditions in the Llixha region



The temperature magnitude



The fluid density magnitude



The velocity vectors

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- At the **Kozani 8 geothermal well** could be concluded that:

  - ✓ The Kozani-8 water temperature is suitable for the supply of a recreational center, including geothermal indoor and outdoor pools;
  - ✓ The water temperature is suitable for feeding of two cascades;
  - ✓ The hybrid system will improve the economic efficiency of the project;
  - ✓ The construction of the center will improve the energetic balance of the region;
  - ✓ The construction of the center will help on diversifying the energy resources in Albania;
  - ✓ The degasified and desalination line will improve the environmental status of the area, as actually is highly polluted;
  - ✓ It will improve the living standards of the community;
  - ✓ The economic analyses show that it is feasible.
  - ✓ The risk analysis shows very optimistic data for the future of the investment.

Recreational/balneological centre Kozani-8, Shijon

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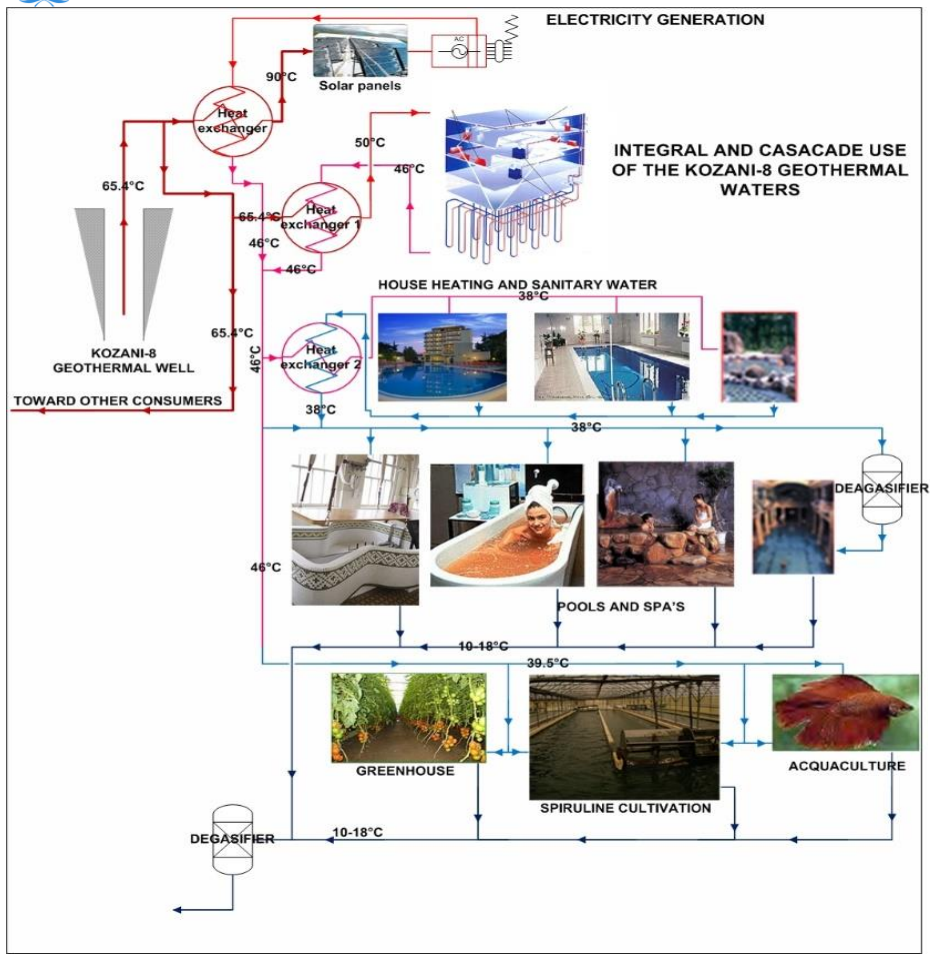
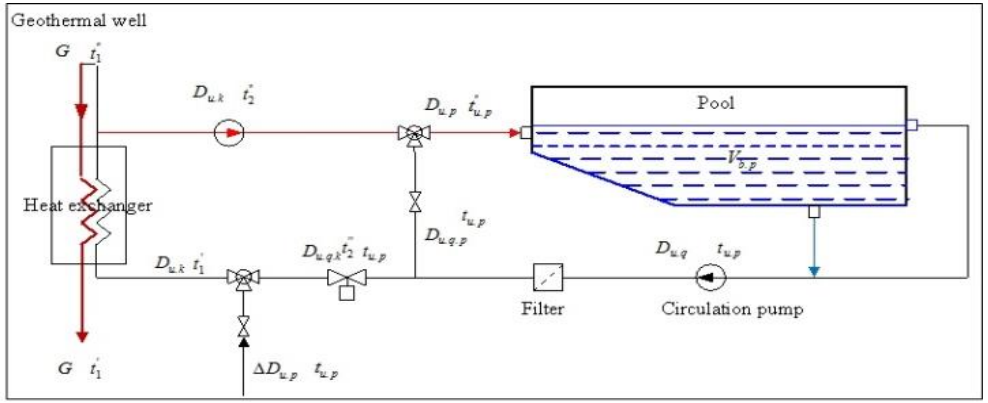
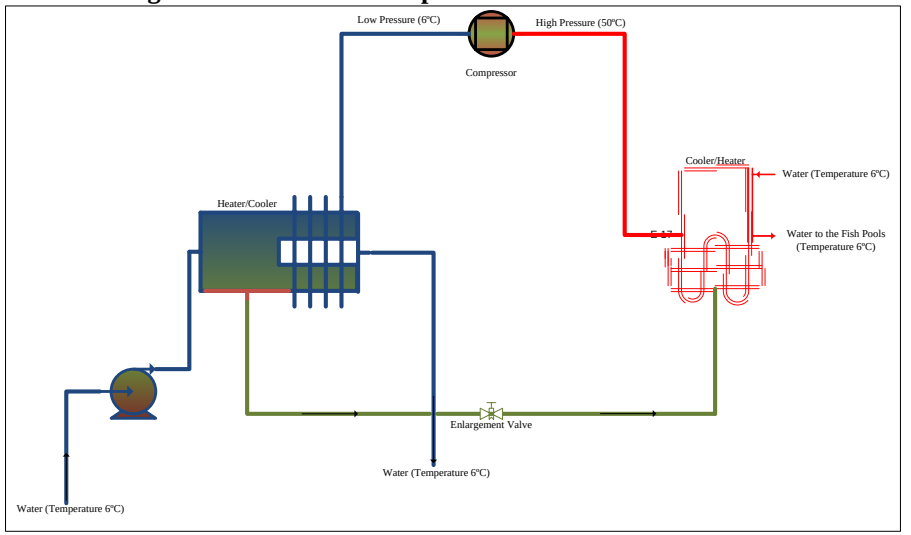


Principal sketch of the integral, cascade and hybrid use of the Kozani – 8 geothermal water use



The geothermal/fresh water pools circulation scheme



Heat exchanger and heat pump functional sketch

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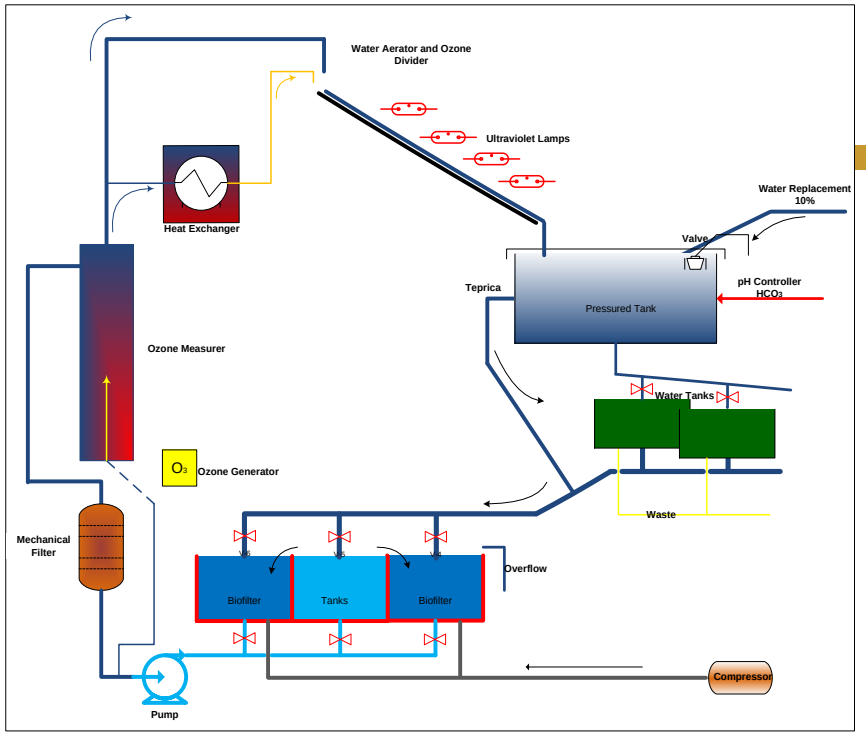

Acquaculture cultivation principal sketch

Indoor pool parameters

Environment	Parameter
Indoor Pools	V_{air}=45 [m^3/hm^2]
	Q_{floor}=220 [W/m^2]
	$Q_{sanitary\ water}$=0.90 [kW/m^2]

Room/environment	SUMMER			
	Thermal load [kW]	Air [kW]	Sanitary water [kW]	Total [kW]
Main Building	100	130	53	283
Indoor Pools				130.5
Geothermal Pool (10x 8) m				72
Sweet Water Pool (10x5m)				45
Kids Pool (5x3m)				13.5
Subtotal				413.5
Indoor Pool (Water)				
Geothermal Pool (Water)				
Sweet Water Wool				
Olympic Pool (Water)				
Total				413.5

Room/environment	WINTER			
	Thermal load [kW]	Air [kW]	Sanitary water [kW]	Total [kW]
Main Building	512	420	80	1012
Indoor Pools	32.3	63.6	130.5	226.4
Geothermal Pool (10x 8) m	18	35	72	125
Sweet Water Pool (10x5m)	11	22	45	78
Kids Pool (5x3m)	3.3	6.6	13.5	23.4
Subtotal				1236.4
Indoor Pool (Water)				68
Geothermal Pool (Water)				48
Sweet Water Wool				20
Olympic Pool (Water)				1300
Total				2674.4

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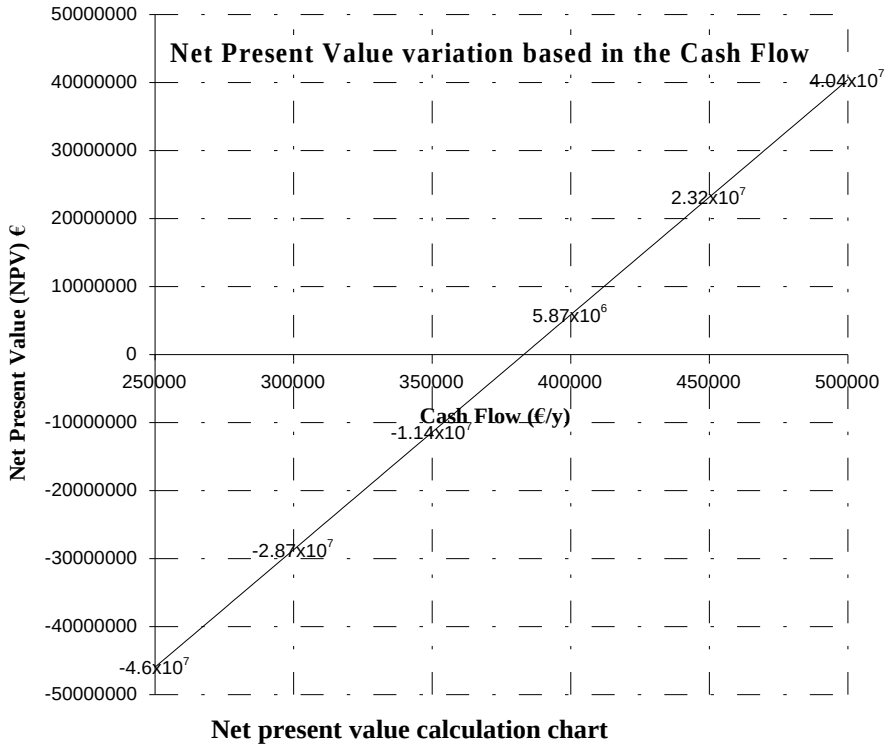
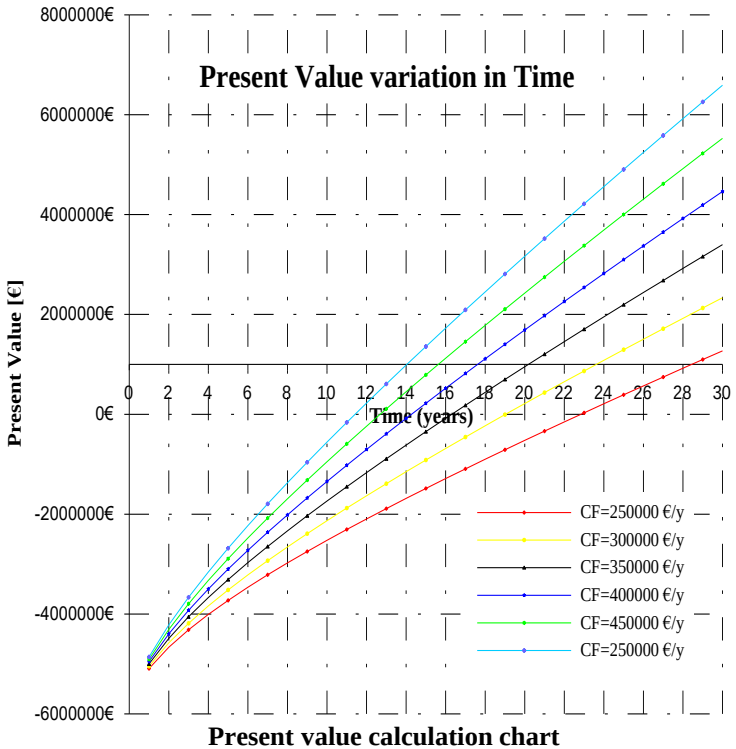
Costs calculations for the Shijoni Recreative Geothermal Centre & SPA

Constituent	Investment [€]
Property (land)	440 880
Hotel-Clinic	
- Building	3 808 280
- Acclimatize System	654 560
- Furniture	229 670
Greenhouse	186 710
Spirulina Cultivation Centre	252 085
Aquaculture Installations	136 100
Total [€]	5 708 285



Net present value calculation chart



Present value calculation chart

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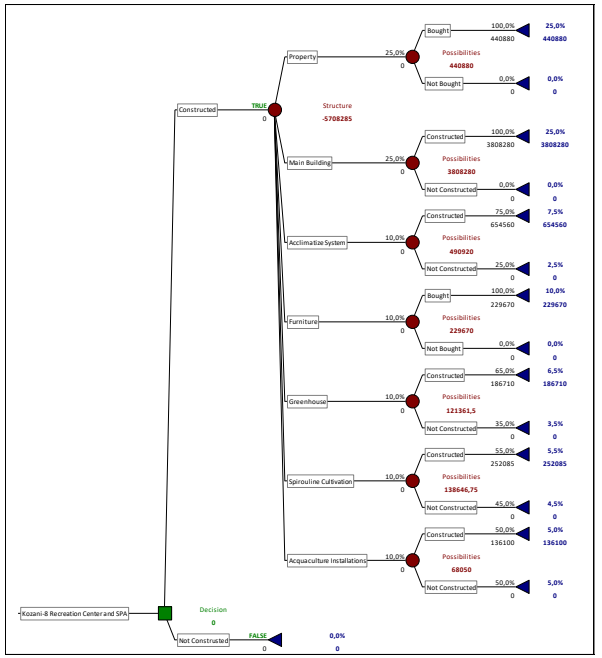
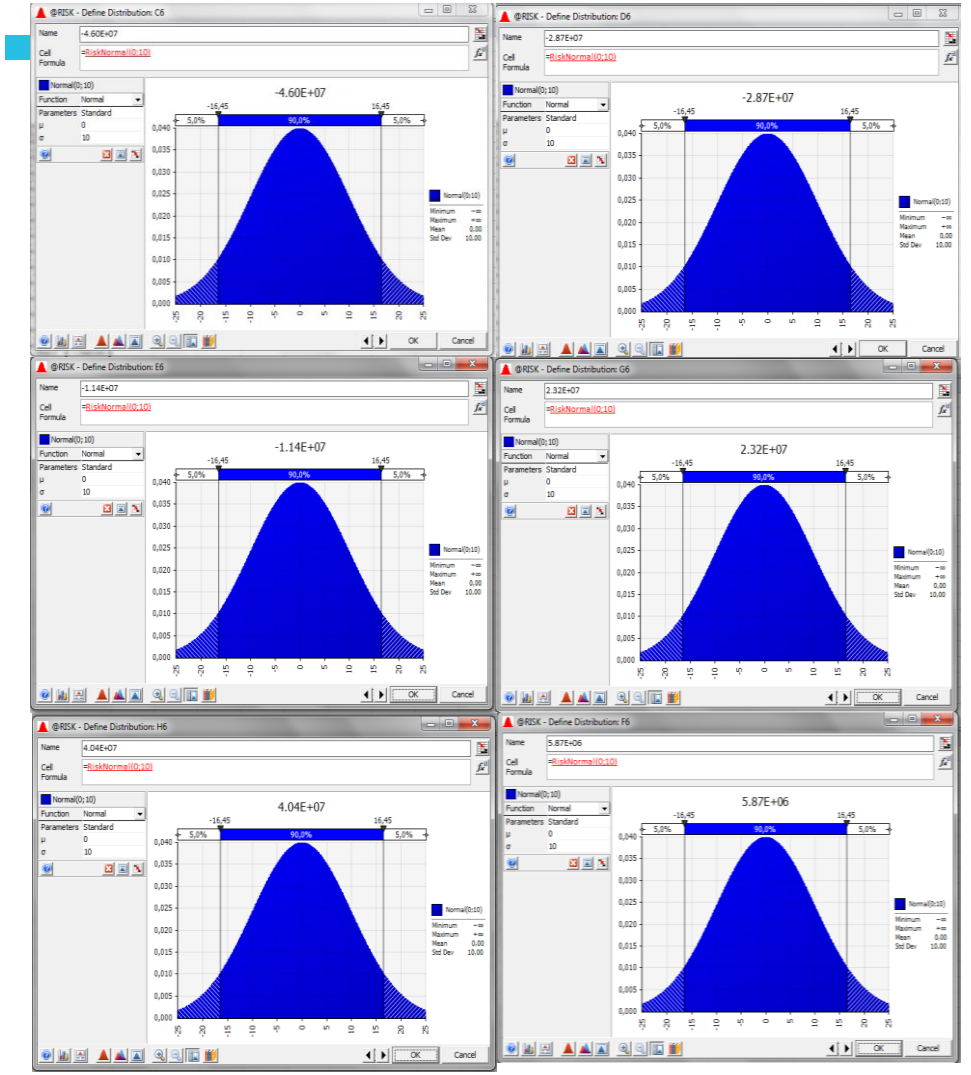
Time [years]	Present Value for Different Cash Flow					
	250000 [€/y]	300000 [€/y]	350000 [€/y]	400000 [€/y]	450000 [€/y]	500000 [€/y]
1	-5.09E+06	-5.05E+06	-5.00E+06	-4.95E+06	-4.91E+06	-4.86E+06
2	-4.67E+06	-4.58E+06	-4.49E+06	-4.40E+06	-4.31E+06	-4.22E+06
3	-4.32E+06	-4.19E+06	-4.06E+06	-3.93E+06	-3.79E+06	-3.66E+06
4	-4.01E+06	-3.84E+06	-3.67E+06	-3.50E+06	-3.33E+06	-3.16E+06
5	-3.73E+06	-3.52E+06	-3.31E+06	-3.10E+06	-2.89E+06	-2.68E+06
6	-3.46E+06	-3.22E+06	-2.97E+06	-2.72E+06	-2.48E+06	-2.23E+06
7	-3.22E+06	-2.93E+06	-2.65E+06	-2.36E+06	-2.08E+06	-1.79E+06
8	-2.98E+06	-2.66E+06	-2.34E+06	-2.01E+06	-1.69E+06	-1.37E+06
9	-2.75E+06	-2.39E+06	-2.03E+06	-1.68E+06	-1.32E+06	-959775
10	-2.52E+06	-2.13E+06	-1.74E+06	-1.34E+06	-950671	-557274
11	-2.31E+06	-1.88E+06	-1.45E+06	-1.02E+06	-591445	-162458
12	-2.10E+06	-1.63E+06	-1.17E+06	-702794	-238538	225717
13	-1.89E+06	-1.39E+06	-889616	-390386	108844	608073
14	-1.68E+06	-1.15E+06	-616532	-82596	451340	985275
15	-1.48E+06	-915709	-347315	221079	789472	1.36E+06
16	-1.29E+06	-684191	-81569	521053	1.12E+06	1.73E+06
17	-1.09E+06	-455596	181041	817677	1.45E+06	2.09E+06
18	-900107	-229656	440796	1.11E+06	1.78E+06	2.45E+06
19	-710218	-6140	697937	1.40E+06	2.11E+06	2.81E+06
20	-522379	215148	952675	1.69E+06	2.43E+06	3.17E+06
21	-336429	434380	1.21E+06	1.98E+06	2.75E+06	3.52E+06
22	-152225	651708	1.46E+06	2.26E+06	3.06E+06	3.87E+06
23	30358	867264	1.70E+06	2.54E+06	3.38E+06	4.22E+06
24	211429	1.08E+06	1.95E+06	2.82E+06	3.69E+06	4.56E+06
25	391087	1.29E+06	2.20E+06	3.10E+06	4.00E+06	4.90E+06
26	569420	1.50E+06	2.44E+06	3.37E+06	4.31E+06	5.24E+06
27	746506	1.71E+06	2.68E+06	3.65E+06	4.62E+06	5.58E+06
28	922416	1.92E+06	2.92E+06	3.92E+06	4.92E+06	5.92E+06
29	1.10E+06	2.13E+06	3.16E+06	4.19E+06	5.23E+06	6.26E+06
30	1.27E+06	2.34E+06	3.40E+06	4.46E+06	5.53E+06	6.59E+06
N.P. V	**-4.60E+07**	**-2.87E+07**	**-1.14E+07**	**5.87E+06**	**2.32E+07**	**4.04E+07**



Risk analysis chart for the Kozani-8 recreation centre construction



Risk analysis charts based on the NPV

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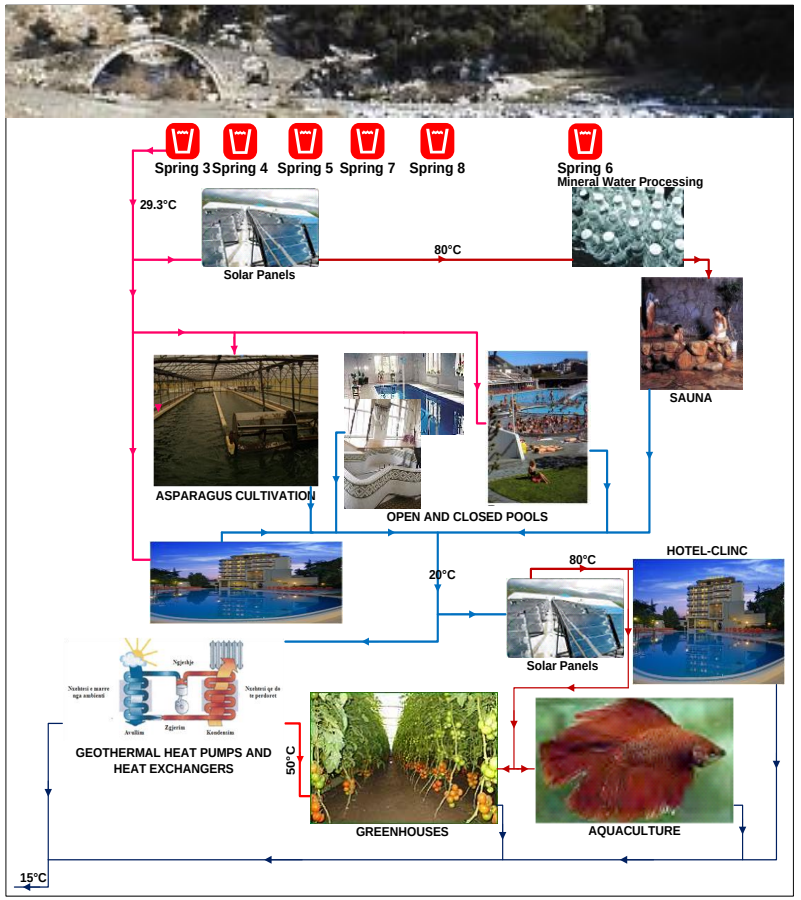
- At the **Bënja geothermal springs** could be concluded that:
  - ✓ The Bënja springs, water temperature is suitable for the supply of a recreational center, including geothermal indoor and outdoor pools;
  - ✓ The water temperature is suitable for feeding of two cascades;
  - ✓ The hybrid system will improve the economic efficiency of the project;
  - ✓ The construction of the center will improve the energetic balance of the region;
  - ✓ The construction of the center will help on diversifying the energy resources in Albania;
  - ✓ The degasified and desalination line will improve the environmental status of the area, as actually is highly polluted;
  - ✓ It will improve the living standards of the community of the Bënja village;
  - ✓ The economic analyses shows that it is feasible;
  - ✓ The electricity generated by the combined scheme will improve its efficiency;
  - ✓ The geothermal systems are environmentally friendly;
  - ✓ Risk analysis shows that there is not any added risk for the proposed investment;
  - ✓ Direct utilization of the low enthalpy geothermal resources of Albania will help in diversifying of the energetic resources mitigating so the supply problems faced in the near past.



Bënja geothermal springs utilization sketch

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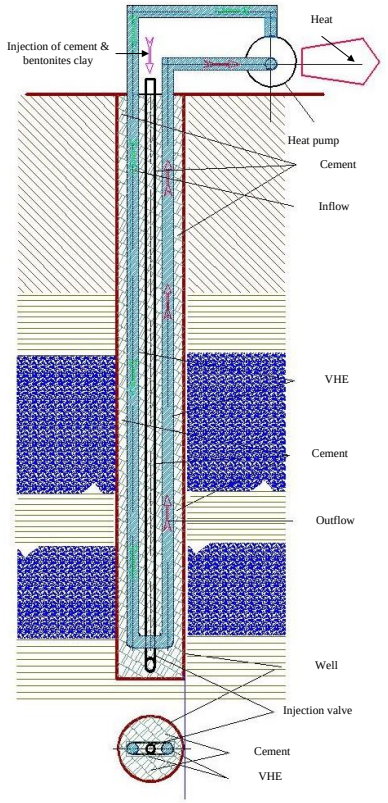
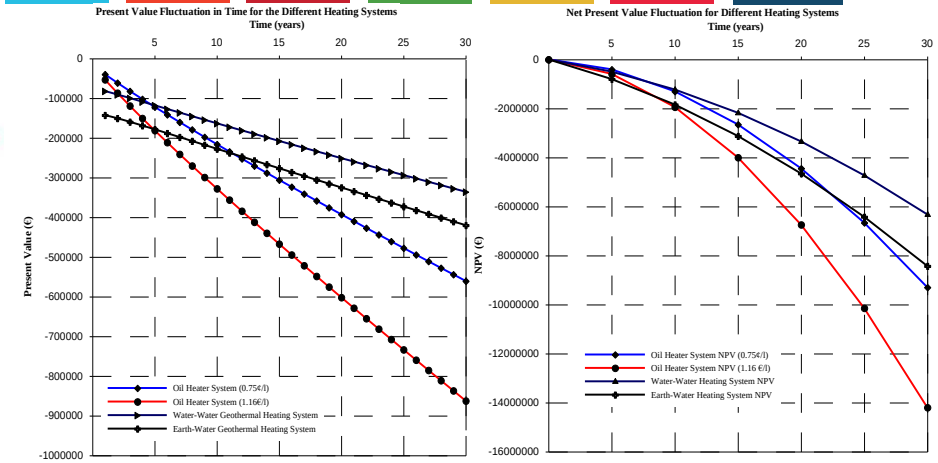
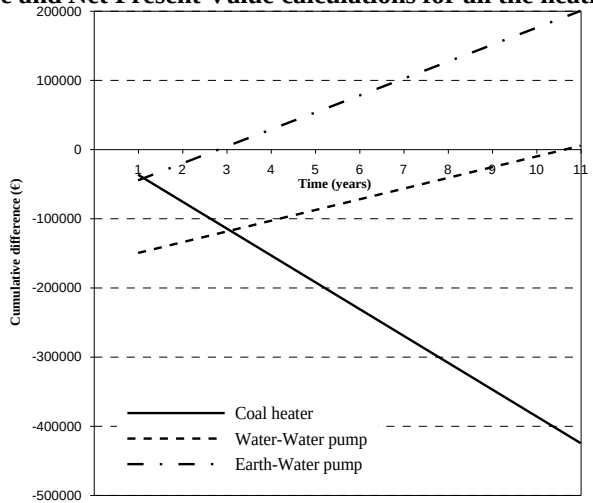
- At the **Korça & Tirana universities campus** could be concluded that:
  - ✓Albanian geothermal regime allows different scale borehole heat exchangers applications;
  - ✓The heating system of the "Fan S. Noli" University campus was discussed between the oil and geothermal systems;
  - ✓The geothermal regime of Korça allows use of both geothermal systems: Water-Water and Earth-Water;
  - ✓The Water-Water system is the most viable;
  - ✓The Oil Heating systems are the less viable, despite the oil price;
  - ✓The geothermal system has also very good environmental impact;
  - ✓This project application will help the diversification of the Albanian energetic system;
  - ✓Demographic and geological features of the student's city (Tirana) allow, and furthermore are feasible the borehole heat exchanger's utilization.



VHE installation



Present Value and Net Present Value calculations for all the heating systems



The economic analyses of three different systems

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- Pursuant to the UNFC & UNRMS critierias and requirements all proposed geothermal project of Albania are classified as **E2** Axis given that: development and operation are expected to become environmentally-socially-economically viable in the foreseeable future;
- Given that their technical feasibility for more extensive project development is subject of further evaluation, because the existing preliminary studies, provide sufficient evidence of the potential for development. Only further and more in depth studies shall confirm the feasibility of development. These are the reasons why all proposed potential projects are classified as **F2**.
- The lack of financing and reliable data's, generate a moderate level of confidence regarding the resource & reserves uncertainty, geologic uncertainty and facility uncertainty, therefore they are classified as **G2.**

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- Recommendations:
  - ✓ Conducting more detailed geological studies to understand the geothermal aquifers, including the reservoir conditions, temperature, permeability, porosity, and flow rate.
  - ✓ Developing adequate geological models of the geothermal resources to enable realistic evaluations of their potential further development.
  - ✓ Conducting extensive environmental and social impact assessments (ESIA) studies, including public hearings and consultations with residents, local and central governments, and other stakeholders as per international and national laws and regulations.
  - ✓ Develop Albanian UNFC and UNRMS guidelines and standards for resource classification, reporting and management.
  - ✓ Improving the capacity building of local experts and stakeholders in geothermal resource management and development.
  - ✓ Establishing a regulatory framework for geothermal resource management and development to ensure sustainable development and protection of the environment.
  - ✓ Encouraging investment in geothermal projects by providing incentives, including tax breaks, subsidies, and favorable policies.
  - ✓ Strengthening the partnership between the public and private sectors to facilitate geothermal development in the country.

The location, stakeholders' engagement, technical data, land properties rights and issues, proximity with the capital of Albania (Tirana) and economics analyzis, shows that the best location to start with the completion of the pre-feasibility and feasibility study is KOZANI – 8 GEOTHERMAL WELL. These studies shall prove that also in Albania, despite the unfavorable geothermal regime, under the latest development of the energy sector, these immense resources are fully competitive and shall support the entire country sustainable development.

Thank you!

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NANR
Date 20 I 06 I 2023, Tirana

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