GOTHERMAL ENERGY - SUSTAINABLE ALTERNATIVE

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ABSTRACT: *This paper presents the need, to reduce and rationalize the energy consumption on global level, as well the need to use renewable energy like geothermal energy***.**

Key words: *geothermal energy, performance, sustainability.*

1. General aspects

It is known and recognized that all technical activities need energy in various proportions and forms of. The building industry in general represents about 50% of technical activities and the share buildings is significant. Energy is needed for buildings to ensure the functioning of interior installations of air, water, heat and light that ensure a livable habitat for the user.

Sources of energy today are:

A. non-renewable:
1. fossil: coal, natural gas, oil;
2. nuclear: uranium, plutonium;

B. renewable sources:
1. biomass;
2. hydraulic;
3. sun;
4. geothermal;
5. wind;
6. mixed (heat pumps).

Sources of deposit (non-renewable) are finite in time and consequently (taking into account the principle of sustainable development) their provision is established by using the formula:

$$A = \frac{RR}{PMA} \qquad (1)$$

where:
A is the provision of resources in years;
RR - reserve of resources (known), in J;
PMA - mean annual production (estimated), in J/year;

In Romania the provision of resources (according to current projections) is:
- over 150 years for coal;
- 60 years for natural gas;
- 48 years for oil.

Note: Shale gas was not taken into account.

Something to be taken into account for the use of sources/resources of

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energy (of any kind) is the impact on the environment. Among the worst consequences form the point of view of environmental protection are the carbon emissions (due to combustion of fossil fuels) and water and land pollution, threatening not only human health, but even the future of Earth.

2. Approaching the sustainability concept

In 1987 the United Nations Brundtland Commission addressing the issue of sustainability has conditioned it on providing for the: `present needs without compromising the ability of future generations to meet their own needs`. This definition was interpreted and completed in 2006 by ASHRAE, replacing the term compromise with that of reduction. At the same time they introduced the notion of maximizing the efficiency of use of resources in order to minimize the impact of that use on the environment.

It is expected (by necessity required/mandatory) to be called on the concept of sustainability when needed to ensure energy. This means:
- To study all sources available;
- Use of energy resources of the end user including benefiting from improved technologies;
- Energy resources to be compatible with the climate;
- Rationalzation and reductions of energy consumption.

Accepting the idea of the need to increase energy consumption due to increasing population and their needs (forgetting the balance, rational, common sense, etc.), considering the size variations and importance objectives (- single family to condominium housing - schools, hospitals, supermarkets, multipurpose halls, workshops, industries of different profiles, etc.) it is recommended to call the procedure provided by McKelvey diagram presented in Figure 1.

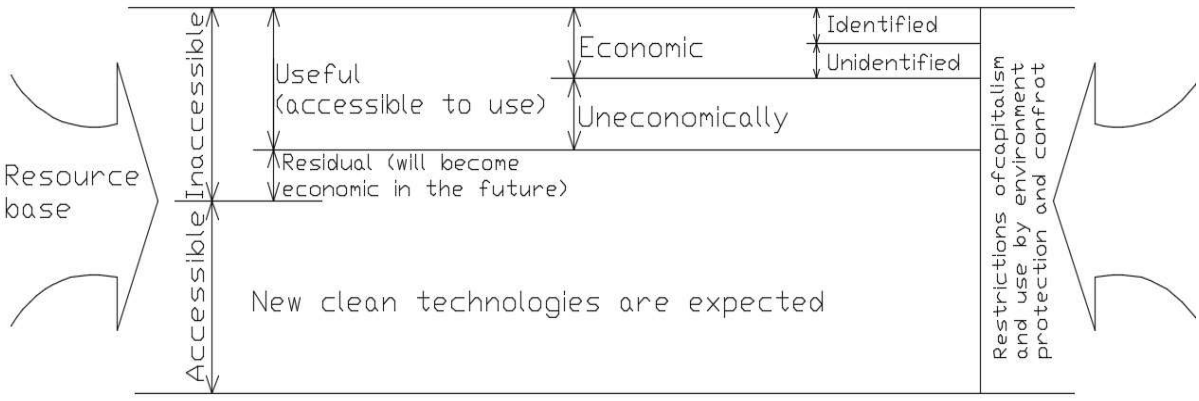

Figure 1. Evaluation and choosing of energy resources by using the McKelvey diagram.

If the question is what would be interesting about geothermal energy, the answers are multiple:

- Because it is there;
- It can replace fossil fuels (which are limited, as stated);
- Because there are no CO2 emissions;
- Can be ecological;
- Due to an increase of the cost of conventional energy;
- Can be advantageous in terms of energy;
- Represents a technical challenge.

It seems clear, even for a brief analysis of the McKelvey chart, the need/opportunity to deepen the studies and research on the selection/use/exploitation of potential energy for each source and giving up `pre-made solutions` (well-known and comfortable) often obsolete, wasteful polluting, energy-intensive.

Energy consumption - whatever is - besides`usefulness/efficiency` characterized by cost and maintenance, must be done in terms of unconditional environmental protection. Among the many aspects of environmental protection only water pollution (surfaces and/or groundwater) is mentioned an CO2 - emissions along the chain: source, transport, processing, manufacturing, distributions, use - (which must be reduced by 40% in the coming years).

For example, we mentioned the increase in CO2 emissions in 2006 compared to 2005:
- at global level - 25.1%
- China - 84.9%
- Middle East - 56.3%
- India - 42.1%
- USA - 8.8%
- Russia - 5.8%
- Europe (Western) - 5.5%

Note:
1. CO2 emissions know no borders.
2. Areas with relatively (and partially) developed technologies that have a rational development have a relatively rational CO2 emissions increase.
3. Areas with explosive economic development have lost out of control their CO2 emissions.
4. The situations can be considered alarming if we envisage the contribution/influence of CO2 emissions on climate change (ongoing, visible and felt, with direct effects, generally unfavorable).

Aware of the importance of sustainability in general and especially in

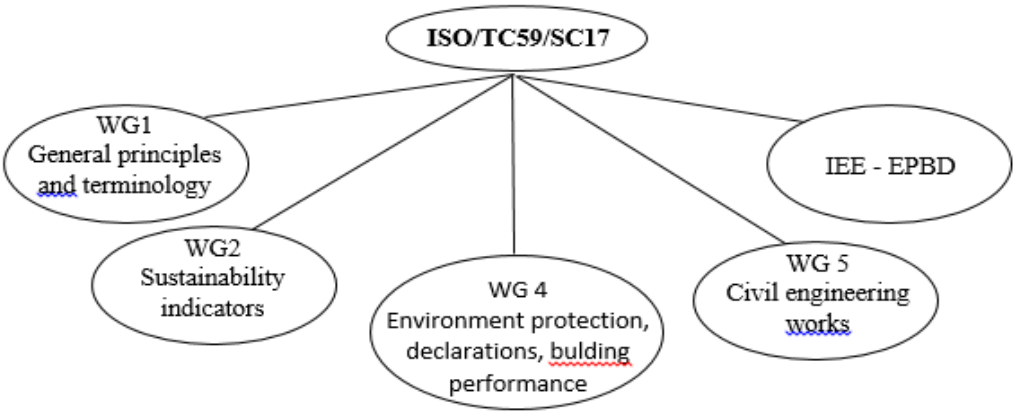

Figure 2. The general coordinating structure for applying sustainability

technology it is envisaged in the European Union - see Figure 2.
Is focused towards target objectives Figure 3.

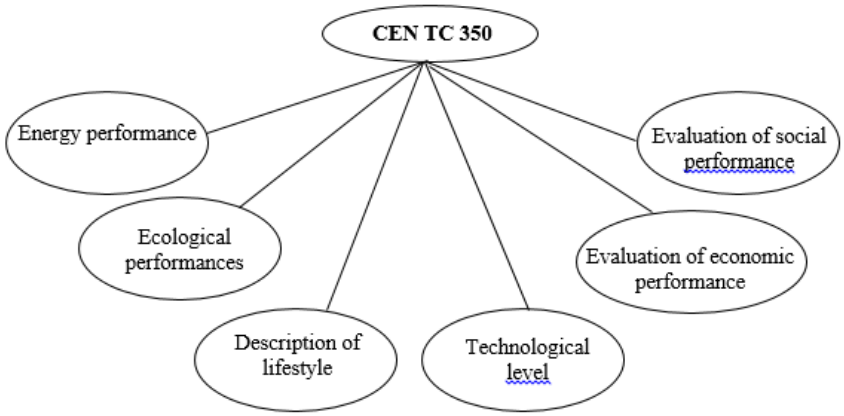

Figure 3. European evaluation norms and codes for sustainability in building.

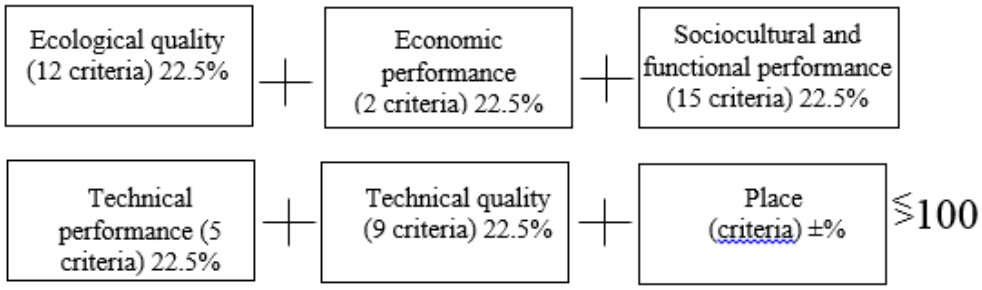

Figure 4. Sustainability, German model DGNB (the Sustainable buildings council Germany)

The German model DGNB can be considered eloquent (due to its simplicity) Figure 4.

Generalizing the quantification Sustainability Index (SI) expressed by the equation:

$$SI = S_{env} + S_{ec} + S_{soc} \quad (2)$$

where:

S_{env} - represents environment sustainability;
S_{ec} - Economical sustainability;
S_{oc} - Social sustainability;

where:
$S_{env}=\alpha_i \cdot P_{i,en}$;
$S_{ec} = \beta_j \cdot P_{j,ec}$;
$S_{soc} = \delta_k \cdot P_{k,soc}$
For which: $\sum_1^n \alpha = 0{,}4$; $\sum_1^n \beta = 0{,}3$; $\sum_1^n \delta = 0{,}3$;
in which: $P_{i,j,k}$ - the percentage of each index criterion (Obs. $\sum P_{env,ec,soc} = 100\,\%$).

3. Geothermal Energy

Knowing the temperature increase with depth in the Earth, we can advance the idea that the energy resources of the earth's crust can be:

a) Hydrothermal resulting from circulation in the depths of water;
b) Dry from volcanic activity (associated with magma) of radioactive sources which overheat the rocks they come in contact with.
c) Low thermal potential when soil temperature varies between 5 and 15℃.

The technical use of geothermal water is shown in Figure 5.

Depending on temperature the geothermal water can be classified as follows:

- High temperature, $\theta > 150$℃;
- Medium temperature, 90℃ < θ < 150℃;
- Low temperature, $\theta < 90$℃.

Geothermal water use can be successive (in stages), or single purpose, depending on the temperature - see Figure 6.

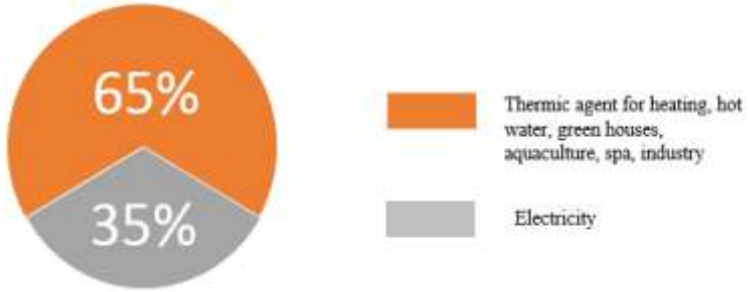

Figure 5. World level consume of water geothermal energy.

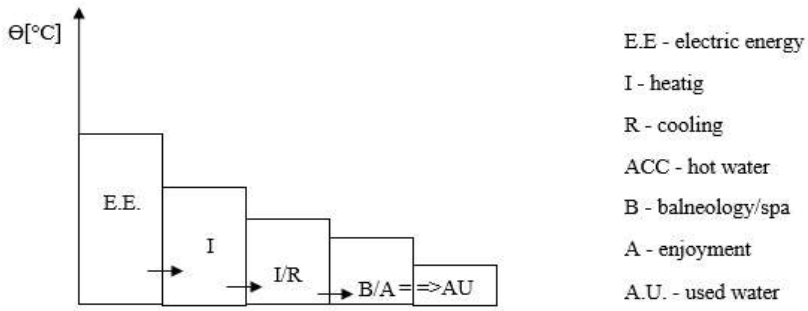

Figure 6. Successive use of geothermal energy potential.

In Figure 7 it is shown as an example in a scheme the way of taking energy form hydrothermal sources, in closed loop (a) or in open circuit (b).

Opting for one or the other circuits until now is made for financial, technical progress, the provisions legislative (or

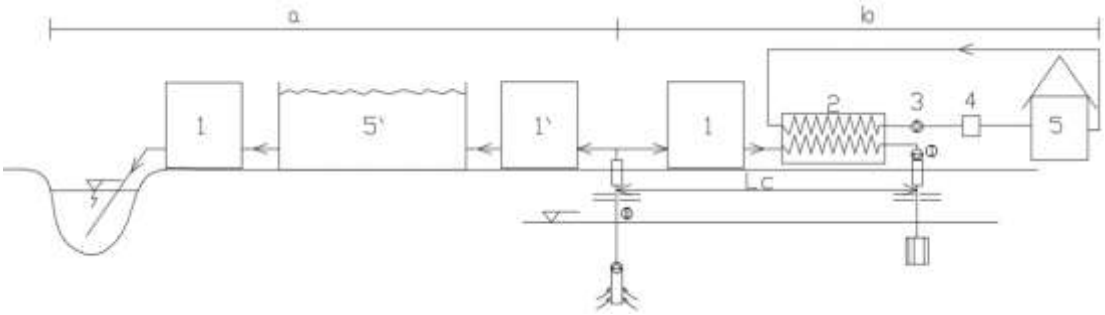

Figure 7. Methods of capitalization of geothermal energy

a) - open system, b) - closed system

1-Equipment system of production/extraction/intake; I - Equipment system for, 1, 1`, 1" - System of feature correction injection; 2 - Heat exchanger; 3 - Circulation pump; 4 - Auxiliary operation system; 5,5` - System of use

lack thereof) and obviously geothermal features.

The energy effect of geothermal waters, positive by excellence, must to overcome possible negative side effects such as:

A. Economic ones - financial expenses generated by investments and operations/maintenance of facilities, including the correction of some characteristics;
B. Electrochemical corrosion phenomena such as:
   a) formation of electrochemical cells (two metal contact);
   b) formation of aeration cells (varying degrees of aeration of the electrolyte);
C. The environmental pollution caused by:
   a) removal of some gas from water (if applicable) such as H_2S, CO_2, or capturing them;
   b) the level of radiation - in the case of radioactive geothermal waters.

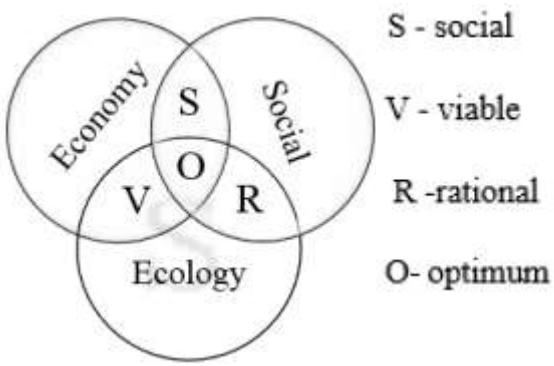

Figure 8. Development conditions for systems

Note: The warning on the negative effects serves to improve the recovery system in order to emphasize its positive/beneficial effect and sustainability. The advanced technology, materials/performant

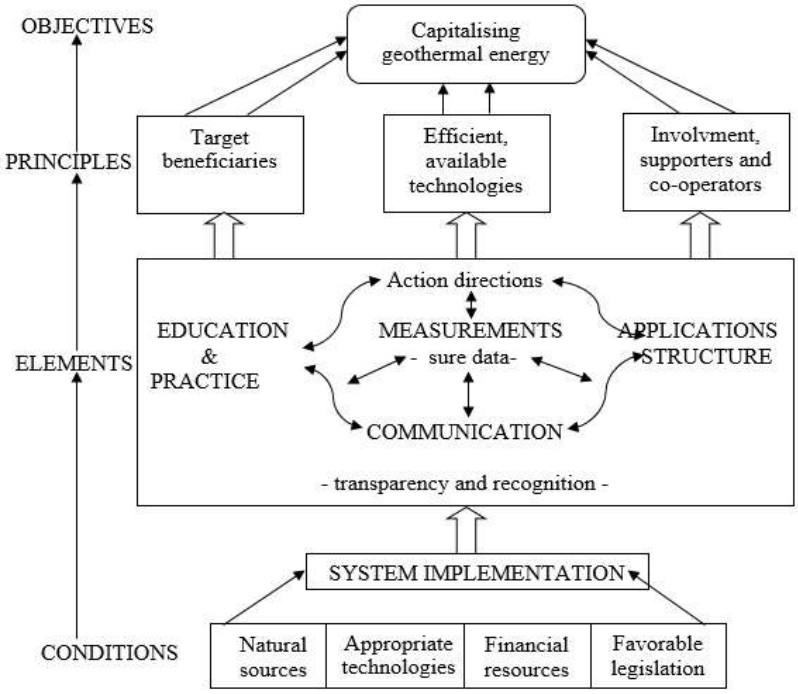

Figure 9. The base for implementation of geothermal energy

equipment and efficient maintenance increases the sustainability of the operation/exploitation of sources/ resources.

The variant of dry geothermal resourced is based on heat energy form inside the Earth in the form of hot water or steam trapped in areas with volcanic/tectonic activity (water temperature is over 180℃ for electricity production trough "Dry Central", "Flash" or "binary cycle").

Low thermal potential of the earth's crust can be used energetically by using heat pumps (eg. ground-air, rock-air, soil, ground-water, rock- water).

4. Conditions to exploit geothermal energy

Amid the energy crisis (more and more current) any solution to reduce energy consumption, for environmental protection, of replacement/modification of classical sources, should be considered, respecting, however, the balance between basic factors of development of society, according to Figure 8.

Also in the case of geothermal energy it is required to be considered for implementation, clear objectives, principles of their use, elements (conditions) to be met for successful completion; Figure 9 summarizes these things.

Based on "object validation" data/studies, in this case the exploitation

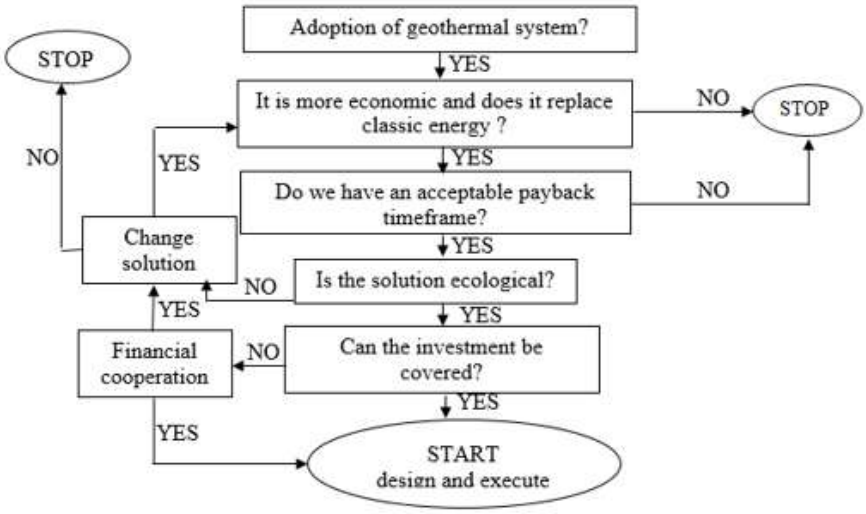

Figure 10. Establishing the technical variant - logical scheme

of geothermal energy we pass to sustainability analysis. Flow chart shown in Figure 10 is valid (in principle) for all types renewables.

The availability of geothermal energy existing in Romania, not insignificant, compels specialists and relevant responsible authorities to give special attention to an area with a particularity high and important recovery potential.

5. Final conclusions

The current energy crisis (which will continue) leads to reconsideration of strategies and appeal, on an increasing scale to unconventional/renewable resources/sources (EU member countries obligations is: 27% of total energy consumption). The construction area especially buildings that will be made, but also the existing ones must reconsider (decreasing and new sources) of energy consumption (for all uses: heating/ cooling, ventilation and air conditioning, domestic hot water, lighting, etc.).

Paper management of all energy resources (conventional and renewable resulting from new technologies and economies) in sustainable conditions, with unconditional environmental protection and by ensuring the same comfort of users is obtained on the basis of studies, research, testing with the support of education and legislation, without neglecting the (rational) finance profitability.

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