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DOCTORAL THESIS SUMMARY

ECONOMIC IMPACT OF THE ENVIRONMENTALPOLICY IN THE EUROPEAN UNION. CASE STUDY: THE THERMOENERGETIC SYSTEM WITH GEOTHERMAL PRIMARY SOURCE FROM BEIUŞ, ROMANIA

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Contents of the doctoral thesis

Keywords

Environmental policy, environment, sustainable development, tools, cost benefit analysis, risks' analysis, sensitivity analysis, geothermal sector, geothermal resource, thermo energy balance sheet, economic and financial analysis, life cycle analysis.

Introduction

According to neoclassical approaches, economic and social phenomena and processes are analysed both in terms of several branches of science, such as, of course, the economy, and biology, sociology, psychology, and through an approach enlightened by the Newtonian mechanics in formulating laws of long-term evolution, per capita national income calculation under the influence of production factors, neglecting economic modernization and structural change by a non-thorough analysis of natural resources and by the appearance of environmental damage, pollution etc.

For these reasons, we found it necessary to analyse the relevant phenomena in the economy, by studying their real behaviour, their multitude of influences and the environmental protection. Furthermore, I noticed that a term associated to the environment is that of pollution, the latter being one of the most debated issues of the contemporary and one of importance to the development of society. In the current economic climate and beyond, pollution represents the price people pay for the benefits of new technologies applied in all spheres of economic and social life. In recent decades, globally, the degradation of the environment has fared increasingly worrying, reduction of pollution being one of the priorities of the European Union.

The theme that we propose is inciting in its timeliness and importance that it presents in the context of a globalized economic environment, in which environmental policy, namely its correlation with a renewable resource of energy is a challenge for both European authorities and national.

The motivation for choosing this theme is explained by the fact that we found insufficient awareness of the economic impact of environmental pollution through the use of traditional energy sources and the need to use renewable sources whose environmental impact is far less destructive. Over the centuries, the individual was on constant interaction with environmental factors also exerting a major influence on them. The environment, as an ecosystem shaper of human development, has often been labelled as a valuable resource, but its use has often proved to be irrational.

Other determining factors in the choice of the research theme were:

- knowledge of environmental policy and economic perspective gained during academic studies and training;
- significant impact it has on the subject, both in terms of theory, but especially in the practical one;
- the passion that I have proved for the study of renewable sources of energy, namely geothermal water, as demonstrated by the research carried out so far for the preparation of the thesis and embodied by the 11 scientific papers published;
- congruence between the profile and the topic's requirements and the interest for research;
- possession of material concerning this subject, plus access to knowledge sources necessary for this work.

Through this study we want to offer a comprehensive and current view on issues regarding the economic impact of environmental policy in the European Union, the influence of Community environmental legislation on economic growth, with applicability in the field of renewable energy sources, geothermal energy.

Over the scientific approach, I noticed that in the Nordic countries, such as Iceland, Norway, Denmark and the Netherlands, geothermal water has proven to be an energy source to address a complex set of requirements: on the one hand, the need of the population to have access to a clean environment and, on the other hand, the need to use new energy sources for growth and sustainable and efficient economic development.

We passed these considerations through the filter of economic thought, and mathematical, and after I studied several national geothermal areas, such as those in Oradea, Felix, Săcuieni, Acâş Tăşnad, Livada de Bihor etc, I chose to study Beiuş area. Beiuş exploitation perimeter peculiarity is that it is the only city positioned in a Neogene basin in the western part of Romania, where space heating is performed using geothermal energy.

I studied the impact and the multiplication factor of using geothermal water in Beiuş, which in the sense of Godea I. will lead to a horizontal development of the regional economy due to issues such as:

- encouraging the active involvement of local and regional businesses and the local and central authorities in the process of using renewable energy resources;
- creation of new jobs both during the realization of the investment and during the period of operation by construction/modernization of production capacities for thermal energy from geothermal water;
- increasing thermal comfort and thermal energy production capacity from geothermal water for 55% of the population of the municipality Beiuş.

Beiuş geothermal perimeter is an example to be followed by the other areas that have geothermal factor, as investment in heating system with geothermal primary source is in the benefit of citizens and lead to keeping the environment clean.

Thus support the idea of such an investment and encourage other local authorities to implement projects to exploit this natural resource available at their disposal.

Starting from the title of the doctoral thesis **"Economic impact of the environmental policy in the European Union. Case study: the thermoenergetic system with geothermal primary source from Beiuş, Romania"**, I analysed both economic prospects enforcement of regulations of environmental policy and we have demonstrated economic and environmental efficiency investment with the use of renewable energy sources.

The overall objective of this thesis is to analyse the economic and environmental efficiency of a thermoenergetic system with a geothermal primary source in accordance with the environmental policy of the European Union.

The specific objective of this paper is to formulate answers to the following questions of research:

i. How complex is the concept of environment in direct connection with economic growth?
ii. What is the field of action of Community environmental policy and from which perspectives is this analysed?
iii. What are the tools for implementing environment policy and how are these interrelated at the national / Community level?
iv. What is the method of analysis to determine and evaluate the effectiveness of the means of protecting the environment? What are the costs and benefits of applying environmental instruments on economic growth?
v. What is the structure of the geothermal sector at European level, but also in Romania?
vi. What are the analysis prerequisites of the efficiency of a thermoenergetic system? What are the assumptions to demonstrate the reliability of energy investment?
vii. What is the possibility of assessing the environmental impact of geothermal waters? What are its stages?
viii. What are the prospects of research? What are the limits of research in this case?

In order to look more closely at the way in which environmental protection is achieved, but also its impact on the economy, we analysed the legal framework of environment policy, history and underlying causes of environmental options, but also the trend regarding the type of protection opted for within the EU. Thus, the present PhD thesis highlights issues raised by the legislation and the way it may affect economic development, while focusing on EU environment policy.

Moreover, I have also conducted an economic financial analysis of the investment of implementing a thermoenergetic system with geothermal primary source in Romania, in the town of Beiuş, using efficiency indicators such as net present value, internal rate of return, and profitability index payback date, and investment risk analysis.

On the one hand, by implementing the investment project analysed, the investor will be able to concretely evaluate its investment that will generate the following effects: reducing energy costs in the first year after commissioning, the use of efficient energy solutions, optimization of costs regarding maintenance and operation on energy sources, reducing CO_2 emissions, dislocation of significant amounts on investment in non-conventional energy sources and their allocation to other areas, as well as outsourcing the energy services to a private operator.

On the other hand, creating economic and social opportunities of this high impact in the sustainable development of Beiuş will generate a significant financial contribution to the local budget. These contributions may be formed in investments in infrastructure (roads, sewerage, modernize the municipal stadium, security of citizens), social infrastructure (school maintenance, child protection, protection of elderly and vulnerable people social activation), but it can also lead and create opportunities for interconnection of the city, at regional, national and international level.

Methodology of research

The methodology used within this doctoral thesis allowed us to define adequately the studied area, to apply own rules and principles of research to economics and not only, to establish working tools for the collection and interpretation of data, of their critical and factual analysis and also to develop and apply theoretical construction or reconstruction strategies.

We consider present PhD thesis to be an inter- and transdisciplinary scientific approach, trying to approach efficiency in the use of alternative sources of energy in four intertwining perspectives: economic, environmental, mathematics and physics. The economic outlook relies on the other three, using them for better browsing and understanding of objectives.

Within the thesis we used the following methods of scientific research:

i. *The causal relationship (including the conditioning relationship, namely the interdependence one)*

   The causal relationship represents permanent connection between two or more processes or economic events, a cause-effect relationship. It will be often found in this paper in order to determine, for example, which would be the effect of limiting pollution processes.

ii. *The inductive method respectively deductive*

   The inductive method starts from a set of ideas generated by analysing specific cases leading to a series of conclusions with a higher or lower degree of generalization. It has been used in this paper to demonstrate the reliability of an investment using a renewable source of energy with a low environmental impact.

   The deductive method is based on the general aspects of which an attempt is made spinning off some particular ideas. This method will be used throughout the paper as the primary method of interpreting the data, for example, to shape concrete responses needed to fulfil the study.

Division and decomposition is used for a better understanding of economic realities by analysing its component elements.

We have considered that this process may be used in this doctoral research mainly in the analysis of environmental policy instruments in the European Union as the cause of compliance with the norms and principles of community and economic regulation, being subdivided in order to determine the causes on which these support.

iii. *The process of grouping*

The process of grouping takes into account the delimitation of homogeneous groups of units and will be used to present the links between the statistical characteristics of the economic indicators that we will consider.

iv. *Analysis and Synthesis*

Analysis and synthesis are two inextricably interconnected operations. While the analysis notes the importance of each element of the entire, synthesis reconstructs the object of the elements discovered as a result of the analytical process.

These will be used, for example, to analyse factors on which was founded the economic growth and development of the European Union under the impact of environmental policy but also in the implementation of an investment project for production of thermal energy by using renewable sources.

v. *The process of comparison*

The process of comparison is one of the processes encountered and mainly used in the case study of this paper, for example, a comparative study between a conventional and one unconventional thermoenergetic system.

vi. *The econometric model*

The econometric model represents a harmonious combination of economic theory, economic modelling, economic statistics and mathematical statistics. The role of econometrics consists of making available techniques for the testing of an economic model and translates it into an econometric model that can effectively be used to predict the evolution of the economic variables.

This model is used in the case study and it consists in creating an outline of thermo energy balance sheet which is used to predict the profitability of a thermoenergetic system from geothermal primary source by determining energy efficiency.

Information collected for the theoretical part of the thesis derives from different sources, such as international and domestic specialty literature, reflected in books, articles and studies, sources of Community legislation and relevant international sources. For scientific documentation concerning the elaboration of this work, after informing on the sources, we collected the necessary data from official sources such as those offered by the Organisation for Economic Co-operation and Development, the European Environment Agency, European Geothermal Energy Council, the European Renewable Energy Council, National Statistics Institute etc.

In developing the case study, we processed the data provided by the investor and the data obtained from measurements on the ground, in order to achieve cost-benefit analysis of implementing the investment project for production of thermal energy by using geothermal energy in Beiuş. We used methods for collecting and processing statistical and mathematical data and methods for their interpretation, for example, that thermo energy balance sheet and the Sankey diagram. Based on information obtained, we conducted a factual analysis which I illustrated by tables and graphs achieved through dedicated programs such as Corel, AutoCAD, Visio, Excel respectively by the software RET Screen International.

Expected results

Regarding the expected results, they will automatically lead to the goals and finding answers to research questions mentioned in the *Introduction* to this work.

On the one hand, we intend through this scientific research to support researchers in the field of economics, environmental and mathematics with an innovative approach of the paper with interdisciplinary character.

On the other hand, we want to raise awareness among economic operators respectively local authorities, also taking into account local development investment projects of renewable energy sources. This type of project is, in our opinion, one advantageous economically, with low levels of pollution, giving a 95.4% yield conventional energy and has favourable economic indicators: Net Present Value (NPV) >0, internal rate of return (IRR) > discount rate, payback date (DRA) < economic life of the investment and the profitability index (PI) >1.

The limits of scientific research were given by:

- limited access in obtaining some agreements for the use of data related to energy systems in the geothermal sector;
- difficulty of obtaining accurate information of the cost per meter drilled of geothermal wells in the geothermal perimeter Beiuş;
- lack of information regarding thermal wastewater reinjection.

We appreciate that the boundaries of scientific research can be transformed into scientific research perspectives, the latter being future research directions, namely:

- developing a research tool enabling research of statistical databases both at Community level and at national level regarding energy systems and environmental indicators;
- identifying economic profitability in terms of geothermal wells and its cost per meter drilled;
- analysis of costs resulting from thermal waste water reinjection.

Synthetic presentation of chapters of the doctoral thesis

Chapter 1. Conceptual approaches related to the environment and environmental policy

After a brief presentation of some of the fields and defining environmental variations, we concluded the need for an interdisciplinary approach, that of *green economy*, reason why we have analysed *the forms and types of eco-economic growth and development* and *the benefits and costs of eco-economic growth and development*.

In order to understand and explain in detail the concept of environmental policy, we appreciated that it is necessary to first define the basic terms underlying the concept. We intend to develop more broadly the impact of environmental policy in terms of sustainable development strategy as an element of major relevance and practical importance.

We studied the level of implementation of environmental policy provisions, the latter being currently evaluated by using the indicators of impact-state-response system developed by the Sustainable Development Commission of the United Nations in order to evaluate economic components of environmental and social sustainable development. The Organization for Economic Cooperation and Development (OECD) implements these indicators of sustainable development as environmental indicators.

With a view to the prioritization of environmental indicators, depending on the importance and relevance that these presents for us, we carried out a study of the impact indicators, status, respectively response, present in various environmental problems, using the coefficients of importance 1 to 5 (1 - least important; 5 - very important). To this end, we conducted a group of environmental issues according to the field characteristic in which they are found.

In conclusion, we appreciated that the term eco-development involves building a relationship between economic development and the natural environment, represented by all natural resources that must be managed sustainably through the ecological processes that support life on the planet and respecting production dependent ecosystems.

Chapter 2. Tools and principles of EU environmental policy

In the specialized literature studied so far, we have not found a classification of environmental policy instruments based on the principles of Community environmental protection and conservation and depending on their field of application, so I felt the need to fill this gap in theory and we have concentrated efforts to carry out such a distinction.

In our view, to implement environmental policies, the Member States use a range of tools such as: *economic-financial*, treated in terms of two-way related to the integration of environmental issues into other sectors of public policy and environmental management; *administrative legislative*, treated from the perspective of directions related to the level that would have imposed environmental standards; respectively *technical*, treated in terms of a direction related to the assignment of duties in a system of multilevel governance.

The classification of instruments according to their nature was based on analysis of documents, treaties and EU environmental legislation in which I have surprised various principles.

In our opinion, *economic-financial instruments* can be classified into two categories: community economic instruments: funding; respectively national fiscal instruments: environmental taxation, tradable permits systems, respectively direct subsidies.

On the one hand, the *legislative instruments* create the legal framework of the Community for environmental protection. EU Environmental Acquis represents both all legislation and all policies and institutions created to certify the application and further development of this legislation. On the other hand, *technical tools* ensure compliance with environmental quality standards and using best available technologies, underpinned by the principles outlined above.

Chapter 3. Cost-benefit analysis of the application of environmental policy in the European Union

Environmental actions together with their related economic activities provide, on one hand, benefits, and on the other hand, create cost. The cost of implementing environmental policy is an element of particular importance, which has a major impact on economic regulation and in particular those with an impact on the environment. It is therefore necessary more and more the integration of environmental issues in macroeconomics.

For these reasons, we chose to consider a method of analysis which determines the effectiveness and evaluate ways to protect the environment by identifying costs respectively benefits. Tracking an efficient distribution of society resource using methods of assessing costs and benefits at the society level, we decided to choose this method of research.

I exposed its theoretical context by researching conceptual approaches on this analysis, transposed into the socio-economic context by relating the resulting values with economic operators (externalities) and identifying the main economic results at European level according to the 2020 Strategy.

Analysing the results expected, we believe that environmental policy: enhances productivity of factors of production; stimulate innovation in technologies and processes aimed at energy saving; increase employability of the workforce; improves trade balance; increases capital through productive investment in renewable and energy efficient buildings, clean technologies, which will also lead to a further increase of the economic productivity; supports public finances; promotes the economic cohesion; respectively encourages the transition to a robust and sustainable economy.

We wanted to expose that economic operators that choose to implement an investment project in the energy field should know the economic results of the application of environmental policy measures, they succeeding thus to preview, but more concretely to assess their investment.

Chapter 4. Description of the study area and the exploitation of geothermal resources

During our research, we found that in the Nordic countries, such as Iceland, Norway, Denmark and the Netherlands, the geothermal water is an energy resource that connects national need to increase the consumption of energy for development and the need for people to have access to a clean environment.

I appreciated thus, after field trips and after a thorough study of several national geothermal areas, such as those in Oradea, Felix, Săcuieni, Acâş, Tăşnad, Livada de Bihor etc, that we should focus our research towards Beiuş area because it proves a nationally distinctive character with regard to the exploitation of geothermal water drilling, because from a structural viewpoint we are dealing with a special tectonic context in which the collectors with fissure type, of Triassic age, positioned in a stratified edifice of the Codru Nappe System also form the basis for a western Neogene basin, the Beiuş basin.

The main economic particularities that have determined our choice are represented by the using of geothermal energy for heating and hot water, respectively the efficiency of the system for the use of geothermal water for reducing the long-term maintenance costs of facilities and the most efficient use of geothermal resources.

We conducted a market analysis of the European geothermal sector based on market reports provided by the EU Commission, European Geothermal Energy Council (EGEC), European Renewable Energy Council (EREC) or International Geothermal Association (IGA)).

Chapter 5. Case Study: Analysis of economic and environmental efficiency of the thermal power system as geothermal primary source

In this context, we present within this case study a project to increase the efficiency of energy services for production of thermal energy for heating and domestic hot water, locally, at scale level / block, by installing modular thermal points and use of the thermal agent geothermal water. Input data that formed the basis for determining the consumption of thermal energy (heating and domestic hot water) for the modular thermal points and energy analysis carried out, were obtained by measurements carried out by us on the field, measurements made with specialized equipment and at various hourly intervals, daily, during the reference year 2012 and checked against measurements in 2008-2011, provided by the investor.

We believe that by implementing the investment project analysed, the investor can have the following advantages: reducing energy costs in the first year after putting into service the use of efficient energy solutions, reducing maintenance and operation costs of the energy sources, reducing CO_2 emissions, dislocation of large sums on investment in energy sources and allocating them elsewhere, and outsourcing energy services to a private operator.

Combining our knowledge in mathematical modelling with elements belonging to physics, we were able to work in an efficient manner with the investor for the conception of a mathematical model applicable in the economy. The usefulness of the model application derives from the need of the investor to determine the energy efficiency of such an investment project, which is why I have chosen to present it both theoretically and practically.

In order to determine the reliability of an investment project is absolutely necessary to conduct a cost-benefit analysis in order to highlight the costs but also benefits attached to this project. For this reason, we chose to perform this analysis in this case study and to determine the key financial indicators.

Economic and financial analysis of proposed measures to increase energy efficiency in the investment project CT1 Aurel Vlaicu Beiuş, presumes the following questions:

i. To what extent the investment is profitable?
ii. What investment is more profitable:
   - one made from its own sources of funding?
   - the one achieved out of 30% of own financing sources and 70% of borrowed sources?

In developing a cost-benefit analysis for a particular project, I have a risk assessment comprising: sensitivity analysis; the probability distribution of critical variables; risk analysis; assessment of acceptable levels of risk and risk prevention. Risk analysis includes any method used to study and measure the imminent risk of an investment project.

As regards the evaluation of the environmental impact of geothermal waters, we wanted to choose the most appropriate instrument in order to make a correct analysis that takes into account mainly the environmental component. If we previously referred to cost-benefit analysis and economic analysis of the product as geothermal water, we are talking in this case about an environmental one.

We performed life-cycle analysis following steps such as: the purpose and objectives, life cycle inventory, life cycle impact assessment respectively interpretation of results of the life cycle analysis. In this case, the limit of the research is the lack of a clear definition of the categories of generated effects.

Conclusions and research perspectives

In order to reduce the phenomenon of pollution, to conserve resources and their exploitation for a period as long as possible, the state has no alternative but to impose through the legislation intended for the environment new rules concerning resource exploitation and processing. In this regard, the environmental actions, together with their adjacent economic activities create, on the one hand, the value, and on the other hand, cost. We appreciate that the way in which the research, the development and adoption of new technologies for limiting pollution, maintenance of the quality and protection of the environment will react to environmental policies and regulations makes it difficult to estimate the long-term environmental costs.

I noticed therefore the need to achieve cost efficiencies at both national and individual levels. We refer to maintaining a reasonable cost in terms of preventing and combating pollution, while granting financial incentives at individual level.

In this research paper, we structured chapters so as to catch the thread of our research both theoretically and practically, and to formulate answers to research questions that we have proposed. We appreciate that we managed to find answers within our approach to research and therefore we want to highlight *personal contributions* which are distinguished in the paper.

In accordance with researched issues, the most relevant *own contributions* are focused on: contextualization of proposed topic, analysing the manner most efficient of exploitation of renewable natural resources, environmental indicators analysis, market analysis of the European geothermal sector, the balance sheet of thermo energy, as well as the analysis of the role of applying cost-benefit analysis.

The analysis of exploitation modality in order to make the best use of renewable natural resources, and the way in which can be contacted efficiency and sustainability of EU environmental policy by using environmental costs and benefits, is the subject of this paper. Environmental benefits are determined by two criteria: quantitative, consisting of

frequency relationships with the environment, and qualitative, consisting of environmental value for the wellbeing of individuals living in the exploited environment.

We want to emphasize that the environmental assessment of existing regulations and environmental policy instruments and principles lead to the maximization of social welfare in the European Union. Thereby we support the idea found in Palgrave Dictionary of Economics, according to which finding links between the economy and ecosystems leads to reducing the gap between economy and ecology.

With the purpose of assessing the economic components, environmental and social aspects of sustainable development, we conducted an analysis of environmental indicators present in various environmental issues: resource depletion, waste and dispersion of chemicals with high toxicity; climate change, ozone depletion and air pollution and acidification; reduced biodiversity, marine and coastal areas respectively water pollution and water resources. We made thereby the classification of indicators in impact-state-response indicators in order to obtain the ranking of environmental indicators depending on the importance and relevance that these present for us.

In this regard we consider depletion of resources as the most serious environmental problem in the idea that between resources and other environmental components there is a close interdependence. In the case study of this paper I caught this relationship using a renewable energy resource, designed to reduce waste and air pollution and acidification.

We realized the contextualization of the proposed theme by classifying the main instruments and their correlation with the principles of EU environmental policy. In all the works studied during our scientific approach (books and articles, official reports, legislative rules), we have not found a clear classification of environmental policy instruments based on EU principles of environmental protection and conservation, but also according to their field of application. I felt the need to fill this theoretical void and we consider one of our main contributions that give value to this work, as being represented by conducting environmental classification tools.

In this regard, I realized the classification of instruments into economic-financil instruments (Community instruments of economic nature, respectively national instruments of fiscal nature), administrative-legislative, and also technical.

Thus, we obtained a complex picture of economic developments and trends of social development in the context of environmental policy. Contextualizing is necessary to ensure an appropriate approach to environmental policy seen from an economic perspective, in the sense of optimizing resource consumption in the medium and long term, while taking account of their limited character.

The market investigation of the European geothermal sector can also be found embodied in market analysis of geothermal space heating systems (GeoIS) and it denotes an upward trend for the future development of GeoIS at European and national level. GeoIS technology becomes competitive, being often installed without the benefit of subsidies, while implementation of investment projects in the geothermal sector leads to economic, environmental and social benefits.

Geothermal water has become the link between sustainable economic growth and development and ecology, and between conservation and environmental protection, in Nordic countries, such as Iceland, Norway, Denmark and the Netherlands. In this regard, we chose to study a national geothermal perimeter, the latter being distinguished from the others analysed by positioning it in a west Neogene basin where space heating is practiced on a large scale.

Drawing up the thermo energy balance sheet highlights the more efficient economically and environmentally energy services for the production of thermo energy from geothermal primary source. At the bottom of its establishment we had plans to create interdisciplinary connections in the idea that a mathematical model can be applied in sciences such as economics and ecology. The usefulness of this econometric model is the need of the investor to determine the energetic efficiency of an energy investment project. The main benefits identified are to reduce energy costs, and reduce CO_2 emissions.

The analysis of the role of applying cost-benefit analysis within environmental policy disposes of an expanded utilization within efficiency problems and it consists of assessing the ways to protect the environment by comparing costs with environmental benefits by following an efficient distribution of society resource.

On the one hand, we presented the theoretical background of this analysis, we transposed it in a social-economic context by relating the resulting values with economic operators (externalities) and we have identified the main European economic results also according to Strategy 2020. We thus noticed that environmental policy: enhances productivity, stimulates innovation, increases employment (and / or employment status of labour), improves the balance of trade, increases capital, supports public finances, promotes the economic cohesion, respectively encourages transition to a solid and sustainable economy. We consider the knowledge by operators of enforcement of environmental policy on any economic activity in the European Union as being utterly essential.

In order to determine the effectiveness and profitability of exploitation of a renewable resource, we conducted economic and financial analysis on the implementation of a project for the production of thermal energy through a thermo energy system of geothermal primary source in the area Beiuş.

In the economic and financial analysis, we determined the following financial indicators: net present value (NPV), internal rate of return (IRR), payback date (DRA) and profitability index (PI). These indicators are favourable if NPV >0, IRR > discount rate, DRA <economic life of the investment, and IP >1.

In this regard, starting from the premise to what extent the investment is profitable, we found which investment is more profitable: that conducted from its own financing sources or that achieved by 30% of own financing sources and 70% of borrowed sources. We demonstrated the investment return at least for the following reasons: both investment assumptions meet the conditions for profitability, but the second clearly stands out from the first. Also, the economic life of this energetic investment project for thermal energy technologies is halved (7.29 years respectively 7.30 years) than the

economic life of a certain energy investment project (15 years), regardless of the manner of funding.

From a financial standpoint, we recommend the investor to opt for financing the investment from own sources 30% and 70% of borrowed sources, given that he has both immediate liquidity considerably higher and a return and profitability higher than for the full investment financing from its own resources. The difference between the total investment and equity capital can be thereby oriented towards environmental protection technologies (e.g., installation a wastewater treatment plant).

We also opted for *the making of a life-cycle analysis of geothermal water*, which has an extensive use in assessing the environmental impacts of a product-system, in this case geothermal water, also facilitating a better understanding of the environmental effects associated with the products of economic operators. This analysis helps reduce environmental emissions and therefore reduce environmental pollution and can be used to reduce production costs, leading to improved profitability.

On the other hand, we want to conclude this work by answering two questions:

i. what are *the prospects of scientific research*?
ii. which were *the limits of scientific research*?

Regarding the first question, we believe that this research paper comes both in support of theorists and practitioners through innovative contribution on the applicability of economic approach in EU environmental policy and in Romania. Thereby, we believe that it demonstrated that there can be achieved a cost-benefit balance in the use of renewable energy in the idea of which we opt for systems which lead to low levels of pollution while achieving the primary objective of any economic operator, namely maximizing profit.

An important aspect of this work is outlined by focusing on sustainable development in the context of eco-economy; its overall objective consists in ensuring optimal interactions between the economic, the social, the environmental and respectively the technological system. As regards the essence of sustainable development, it is to solve problems of

economic growth in view of environmental requirements and human needs. Economic growth can be sustainable only if it is self-sustaining in its development, respecting the models of cyclicality in nature. This specifically involves stopping the development of intensive exploitation of natural resources, because their consumption exceeds the regeneration process.

In this regard, we consider that the goal of sustainable development is to ensure resources for future generations through a review of the method for extensive use of natural resources, the limits imposed using them according to renewable capabilities; ensuring people's right to a clean environment from an ecological point of view; ensuring easy access of the population to work, food, water, energy, healthcare and utilities; to provide access to environmental information and the active participation of the population within environmental decision making and integration of environmental decisions in the economic and social decisions.

With regard to the second question, we consider that the answer lies in solving the starting obstacles stated in the *Introduction* of this paper.

If, on the one hand, I had access to statistical data at Community level regarding environmental indicators used in evaluating environmental policy, and regarding geothermal energy systems sector, on the other hand, we had to draw up our own classification of environmental policy instruments based on the principles of the Union and depending on their field of application.

Both finding *the cost per drilled meter* within geothermal wells and *the execution of interference tests* necessary to determine the environmental impact of geothermal perimeter Beiuş constitute research limits.

If cost-benefit analysis gives an economic analysis, we see that life cycle analysis provides us an analysis of the investment environment. In this case, we consider the development of impact categories within *the impact assessment* as being a limit of research, given the fact that this requires a comprehensive scientific approach, conducted over a period of time and performed with a dedicated program.

In the context of an energy balance approach used in analysing the economic and environmental efficiency of the energy system, we can see its classification by type of energy carrier, in electro energetic, thermo energetic, respectively complex balance sheets. Given only thermal energy production in Beiuş geothermal area, we could not perform the *electro energetic balance sheet* respectively *the complex* one.

Another direction which can be enhanced in the future is investment strategy by analysing relevant technologies from renewable primary sources and which reduce negative impacts on the environment by reducing pollution levels: the installation of non-phenolization, non-ionization, purification stations; reinjection of thermal wastewater etc.

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