ИНСТИТУТ ЗА ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ НА БЪЛГАРСКАТА АКАДЕМИЯ НА НАУКИТЕ
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VALUE ASSESSMENT OF NATURAL MINERAL SPRINGS WATER USED IN SPA FACILITIES

Defining the value of mineral water when using it in spa facilities includes two components: on one hand is the meaning that mineral water has for guests when they are using spa procedures and on the other the resources which are being saved from not heating regular water. The subject of this study is to show the results of the development of a mathematical model created to evaluate the cost of using natural warm and hot mineral water springs compared to artificial warming of water in spa facilities. The research objective is mineral water as main asset source for spa users and economic source for spa facilities. An interesting topic is the level of influence of the water component for the choice of the consumers. The contemporary consumers of spa services change their requirements for the spa facilities and the availability of mineral water is additional advantage for them. Mineral water springs provide a natural resource that can improve the quality of life of many people. Spa tourism is one of the effective ways to use those springs, and it has the potential to become a key element of our vacation planning, choice of tourist destination and lifestyle. The main purpose of the study is to present a model for determining the value of the mineral waters, thus quantifying the potential benefits of using them in the spa facilities, which is the seeked and desired characteristic of spa services from tourists, and showing losses caused by the waste of such waters. Explaining the nature and significance of the mineral water springs gives the base on which we can say that besides a natural resource that can have beneficial properties for human health, the springs can be a valuable source of savings that can be achieved by using their thermal potential.
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Introduction

The reasons for the promotion of spa tourism can be sought in the entry of *new information and communication technologies* into the economic activity. The next factor in the development of spa services is the constant redefining and new *interpretations of the term "spa"* and its entry into activities different than tourism. Spa tourism also provides

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maximum profitability with a minimal negative impact on the environment. The user of spa services is intelligent and interested in his health and is therefore inclined to pay a higher price for the services provided. He invests more to preserve the cultural resources of the visited destination and takes into account the local features both to preserve nature and to provide quality and natural ingredients and materials for the future consumption of the spa services concerned. Today, the key issue that spa managers face is how to link a spa with business and, in particular, with tourism, how to maintain and enhance the quality of the service offered, based on industry specificities. This question can be answered in many ways, but the guidelines for its solution go through ***two main directions: improving the perception of customer service quality; reducing the cost of the service provided.***

Improving the quality of the service offered can be based on *a survey of consumer preferences for spa services and the reasons for taking a spa vacation*. Taking these features into account, tourist businesses can provide amenities that better meet consumer expectations. Spa companies offering spa services, on the other hand, can realize significant benefits, in our opinion, if they choose to use natural spas. The deployment of this potential is directly related to the culture, traditions and marketing of products and services. ***The model we have developed focuses on cost-cutting opportunities using warm and hot mineral water springs.***

The main objective of the study is to clarify the importance of mineral water springs for spa tourism and on this basis to present a model for determining their economic potential when spa facilities use those springs instead of regular water. The specific goal of the study is reached by solving specific ***problems***: clarifying the importance of mineral waters for spa tourism and their interconnection, defining the profile and motivation of the spa users, drawing up a model for calculating the potential economic effects of the mineral springs.

The scientific study aims to prove the ***thesis*** that there is a expressed economic benefit from the use of warm and hot mineral springs in spa facilities. Our hypotheses are: the use of warm mineral springs (37-60 °C) can bring significant savings from the cost of warming water in spa facilities; the use of hot mineral springs (above 60 °C) can eliminate the cost of warming water; waste of thermal mineral water leads to significant economic, environmental and other loss of benefits; there are significant measurable additional benefits of time savings and travel costs that tourists make when visiting nearby spa sites.

Achieving the goals and proving the research thesis implies the use of a corresponding set of approaches and methods. The applied methods are: comparative analysis and synthesis; induction; deduction; expert analysis; mathematical analysis. By their nature, they are instruments of the dialectical, historical, inductive-deductive, and systemic approach.

The study aims to create methodological tools to facilitate the planning of investment projects in spa tourism. Those tools will empirically identify and compare the predicted economic effects of using warm or hot mineral springs in spa facilities. The methodology has been expanded with further approaches to water consumption in spa facilities by creating a tool that calculates the amount of spa treatments that can be performed with an available water resource. A method has been developed to determine the maximum number of consumers that can utilize a spa for a certain amount of quantity and temperature of water. This method is indicative because there are a large number of variables that are specific to the different spa facilities but can be used in combination with the method of determining the number of spa procedures to predict the optimum volume of potential and real spa facilities. In any case, the determination of the economic effects of mineral springs in spas should be done on a non-discriminatory basis in order to make them more visible. Isolation of other factors of influence in real conditions is a difficult and impossible task.

State of the Problem

Today, the term "spa" is used as a word that provokes association with health, beauty and rest. Researchers say it has nothing to do with the idea of healing water in the 19th century. [Velikova, 2015: 86-87] The spa is erected in a "cult of its own" by all those who want to take better care of themselves and take adequate measures to preserve their health. Spa is an idea of the 20th and 21st centuries that is revolutionary for the traditionalists. Researchers of the phenomenon point out that in today's context, based on 2500 years of experience, it is believed that ***spa necessarily involves water procedures*** [Benge, 1999: 25-33]. *In most spa resorts, the procedures that are offered use regular water. According to Cohen and Bodekeer [2008: 10-18], this is the main reason for the terminological difference between spa tourism and balneology. It is therefore* ***important to determine to what extent mineral water brings economic benefit to facilities that do they use it, and are there any economic reasons why is it appropriate for spa tourism facilities to be built near mineral springs.***

The modern spa tourist does not need a precise definition for spa service or resort. They recognize the spa services at the moment they see them. The discussion about the spa definition was officially closed when SRI International launched its first report in 2007 about the "The Global SPA Economy". While studying this global case, SRI International analysts concluded that the following ***broad definition*** will satisfy customers, allowing professionals in the work field to meet the stated goals: *"Spas are establishments that promote wellness through the provision of therapeutic and other professional services aimed at renewing the body, mind, and spirit." [*SRI International, "The Global SPA Economy", 2007*]*

Nowadays all over the world the spa resort is a place of rest and recovery with a comprehensive approach to the harmony of mind, body and spirit. According to Ellis [2009] serious health problems can be treated in spa resorts or they can be used for pleasure and rest. Therefore, ***the combination of therapies and experiences is infinite*** and the debate about what spa is and where the term comes from will continue. The definition for SPA in the XXI century is health, beauty and relaxation and it will probably tell us ***how spa resorts will be considered in the future*** – as two types, ***such as those with and without mineral water.*** A possible modern definition, which can be accepted unanimously by all participants in the sector, may be: *spa is a place that is visited to deal with everyday problems and illnesses in a welcoming environment*. [Velikova, 2014: 57] *In today's concepts spa is a wellness complex offering treatments based on the use of water – mineral, fresh, marine, as well as seaweed and salts, curative mud and healing plants.* It is a new type of tourism supply. Technologies using natural products as well as Oriental techniques are the main features of these new spa places. Spa procedures are increasingly entering the mass market and shift activities like thalassotherapy and balneotherapy.

Research in this area is still not very thorough, which makes it difficult to define the concept, as well as to provide a general definition of spa tourism. [Lazarus, 2000: 23-50] *The attempt to clarify the term is beneficial to both theory and practice, as tourism businesses can identify the services they will offer more clearly.* Such a clear differentiation of terminology will also facilitate ***legal initiatives*** in the sphere of spa services from the point of view of categorizing and licensing spa facilities. Despite the changes introduced in the ***Law of Tourism in Bulgaria***, *the term "spa" is still used extensively as a marketing name that seeks to attract tourists rather than clearly designate the nomenclature and range of spa services, facilities and amenities offered*. The introduction of uniform tourism standards worldwide is a difficult task that has not yet been resolved. Therefore, this omission is somewhat minimized by additional instructions from tour operators that define the supply standards of the hotels they work with, according to their own classification criteria. These differences inevitably affect spa tourism as the lack of uniform terminology further disturbs the creation of common criteria for the standardization of spa services. Defining these criteria is from extreme importance for offering the right services to tourists, as well as for forming specific expectations which in turn create the satisfaction level that the tourists have from visiting a spa facility. It is also important that we clearly state if mineral water is being used.

The spa industry is emerging as a global phenomenon, through convergence from industries, traditions and therapeutic practices. Spa therapies have existed since ancient times in many different forms, reflecting on the cultural, social and political environment in which they are integrated. These practices are now rediscovered, borrowed and branded to create a new global industry that matches and attracts other industries. They include beauty, massage, hospitality, tourism, architecture, construction, landscape design, fashion, food and drinks, fitness and recreation, personal development as well as complementary conventional and traditional medicine. In this aspect, the use of mineral water contributes to a considerable extent.

Although there are no established standards of what water should be used in spa procedures, it is of utmost importance that mineral water is used in the spa industry, which is also necessary in the historical context. Various studies have been conducted to determine the healing qualities of mineral waters, their composition, useful properties, diseases for which they can be used, etc. For obvious reasons, many spa resorts have emerged in places where this extremely useful natural resource is available. ***Spa tourism also benefits from the use of mineral water in the different procedures it offers. This is why it is important for us to identify the main economic effects that tourist businesses achieve in using mineral water.*** On this basis, spa companies can make informed decisions about what kind of water to use.

In our opinion mineral springs have effects of a ***mixed character***. Besides the health effect, which is undisputed, the mineral water can also be used to increase the economic efficiency of the tourist enterprise. Therefore, besides establishing the basic consumer preferences for the spa industry, we are developing a model for determining the economic efficiency of mineral water and applying it to specific sites to determine the economic effects of mineral water applications in spa facilities. In this way, the extra effects that may be beneficial for the business development are derived.

Tourist businesses offering spa services do not yet use the full capacity of the mineral springs by omitting certain benefits from the availability of this resource near the place where they operate. Apart from spa procedures, mineral water can also be used for other purposes in spa facilities, and we will try to prove this need and the opportunity to increase the economic performance of tourist companies. As a result of the analyses and research we made, we give specific recommendations for the development of the spa businesses. ***In our opinion, the economic effects from the construction of spa facilities near mineral springs are significant. Such springs can be found throughout the whole territory of Bulgaria.***

Previous economic analyses and assessments regarding spa tourism emphasize the fact that mineral water is not needed in spa facilities. The scientific literature even claims that spa tourism is invented by countries where mineral springs are not available in order to benefit from the popularity and benefits of this industry. No attempts have been made to evaluate the effects that tourist sites may have when replacing regular with mineral water. ***Demonstrating the benefits of the natural mineral springs' water reveals new opportunities for the business expressed in concrete values.***

The application of the model we developed aims to determine the economic benefits of the use of mineral waters in spas. As well as to establish the additional time and logistics costs and to propose a method of determining the maximum number of consumers. The determination of these benefits should be done all other things equal. *The other benefits of mineral water, such as its medicinal properties, as well as chemical or physical characteristics that have a beneficial effect on visitors, including the overall effect of spa visits, are an additional advantage beyond the scope of the present study.* ***That is why we believe that the use of warm and hot mineral waters in spas is a significant economic resource that will become more and more important in the future.***

Role and Importance of Natural Mineral Spring Water for the Spa Industry

Bulgaria has over 240 major mineral water springs. Their resources are estimated at more than 5600 l/sec. Their composition and quality vary greatly and the temperatures are in the range of 20°C-100°C according to Lichev [2011, p. 15]. Significant quantities of mineral water exist in many countries around the world, with varying levels of resource utilization. This is a substantial and widespread resource that can be used and help the improvement of the quality life and economic growth. Its effective use can not be achieved without a clear understanding of what and where the value of thermal waters is. The market determines the purchase value of the spa services offered through the use of tap or mineral water, but the value of the resource behind the service is basically determined on the basis of state regulations and commission decisions (such as the EWRC in Bulgaria).

There is a need to clearly distinguish between the value added by the company (through marketing, advertising, the provision of a desired product) and the value of the resource itself. There is also a clear understanding that high market profit is not necessarily associated with high efficacy. For example, bottling companies manage to market the product they offer at a high price (and with high profits). This does not mean, however, that they do not waste the thermal component of mineral water, which often has significant value, although it is usually difficult to be used beyond the spa services and sometimes for heating purposes. *Therefore, what is happening is significant amount of waste due to high perceived value of one product over another.* ***The same waste is avoided when combining spa services with thermal springs where the thermal and water components can be used effectively.*** On the other hand, the market evaluation of a liter of water is far lower when used for spa services than for bottling. ***This creates a clear need for research, first for the value assessment of this resource, that will lay the ground for mathematical and philosophical analysis through the prism of various usage alternatives- spa, bottling, heating.***

In our opinion, the use of natural mineral springs water can lead to significant positive economic effects in spa tourism. They range from ***indirect effects*** caused by improved health and working ability of spa users to the ***direct effects*** of using mineral water as a renewable resource. In order to stick to the measurable economic effects, we assume that the different benefits from the point of view of improving the health and working capacity of natural mineral springs and ordinary, heated tap water are insignificant. For this reason, the focus is on the economic effects associated with: ***savings from water heating; environmental friendliness of spa; diversification of the investment focus due to the location of the mineral springs.***

The saving of resources from warming mineral waters depends on many factors. In general, we can divide them in the following way: characteristics of the thermal (warm or hot) mineral spring; conditions of the concluded concession contract or contract for use; fuel or electricity prices; efficiency of heating facilities; losses caused by specific factors such as distance from the thermal mineral spring, pipe insulation and others.

Knowledge of current trends and opportunities for spa tourism development is of fundamental importance to the strategic planning of the sector and can help spa centers find their way to a better investment position, guarantee a competitive advantage and increase the benefits levels and customer satisfaction. ***The continuous development, growth and enrichment of spa services*** can be defined as the most striking trend towards the end of the 20th and the beginning of the 21st century. This is valid for many places around the world, especially in Europe where traditionally such services are offered in historically established spa centers like Baden-Baden, Budapest, Bath, Spa, Karlovy Vary. Despite the economic crisis of 2008, ***spa centers continue to be a popular way of spending leisure time in many developed and developing countries.*** This development is related, first of all, to the changes in the world economy that are relevant to all countries in the world – both developed and developing and, secondly, changes in customer and consumer profiles – the situation is related to change in the characteristics of visitors to spa centers.

While in the late 1980s and early 1990s, every proposed “good” thing contained the prefix "eco", in the late 1990s it was largely displaced by the magical word "spa". This is particularly true for tourism, where up to 2001 the number of tourists choosing a spa holiday more than doubled each year. ***The 21st century can be seen as the spa era or even as a completely new era in tourism.*** Due to this fact, the question of the nature of this "new" form of tourism and of "spa clients" is emerging as being different from "normal" tourists. *It is therefore important to determine the specifics of the spa and to study the consumer's behavior so that we can determine **whether the use of mineral water in spa facilities will lead to satisfied tourists**, which will also increase the economical efficiency of spa facilities.*

Spa Services Consumers

Earlier, the main group of spa services users were families and couples. Nowadays these are more and more unwed men and women. In addition, programs are offered for women with children (childcare) as well as training programs for improving the state of health. Changes in customer profiles are also very important for the spa industry. The largest group of spa users in the last decades of the 20th century are women and the primary segment of spa visitors are middle-aged and elderly people. It is noted that there is an increase in the number of visitors from a lower age group (less than 30 years). The teenager segment is the fastest growing in the industry. There have been changes in gender comparisons, with the number of men recently increasing at high speed. [Pearce, 2005: 67-72] ***The continued growth in demand, as well as an increase of the range of the consumer segments, has turned the spa industry into a significant economic sector generating significant worldwide revenue.***

Compared to well-developed segments and markets in the industry, studies aimed at examining the behavior of the spa user are relatively new and scarce. They show that the segment prefers mostly ***health and spa packages and products*** (eg healthy / functional / natural / organic food, vitamins, etc.) instead of spa services. [Hanel et al, 2016] This in itself shows that there is still no clear understanding of the spa industry in the business environment, in economic studies or the market itself. Further analyses are needed in this area to extend the knowledge for the profile and motivation of the spa user and to gain a better understanding from a global perspective. Existing studies give us a basic understanding of the key segments, behaviors and trends [see Tsvetkova, 2014].

In a broad sense, the user can be classified into two categories when it comes to his relationship with the spa industry. The first group is the *spa-oriented users, actively enjoying spa services*. This includes people interested in a healthy lifestyle – fitness, health or wellness. These users have the skills and knowledge and their profile is quite similar to that of a typical spa visitor. They are open to new and different ideas of health, exercise and beauty, have time, and have enough money for such activities, and for them spa services are not unnecessary luxury. Many of these types of users are motivated by the first signs of aging, both in terms of appearance and health. The second group is *consumers who respond to health problems, not particularly active spa visitors*. This includes people who suffer from illness or have health problems looking for new and alternative approaches to treat their condition or alleviate symptoms. These users are disappointed with the inability of traditional medicine to solve their problems and, as a result, explore alternative methods and non-standard treatment approaches. This segment is potentially a much larger part of the population, and is also a large group of people who are not fond. In fact, going for a facial massage (or using another spa service) can combine for those users the pleasure of spa treatment and alternative medicine, according to the SRI International report, [2010: 25-34].

Among the most important ***target groups*** of the future spa market are: *elderly* but still involved in the work process and the workload and therefore need energy and balanced rest to deal with constant stress; people with *growing social and family problems* in the modern world (divorce, heavy work, etc.) need help, inner strengthening and problem-solving competencies; people with *increasing demands in work and personal life*, need new techniques to increase their mental capabilities, whether they are managers in order to achieve optimal career results, or elder people struggling with weakening memory; people dealing with the confrontation *of a world full of norms, boundaries, constraints and coercion*, and are seeking ways of development towards the internal eradication of borders; this affects all societal strata and can become a major challenge in the future in terms of climate change and its associated lack of resources; people seeking *satisfactory and meaningful ties and relationships* in a world devoid of values, and disaster-filled world, but also, those who want to retain and *maintain "constant" attractiveness* in competitive struggle [Friedl, 2006].

To sum up, we can say that rising turnover and positive outlook for the future of spa tourism can be explained by the following factors:

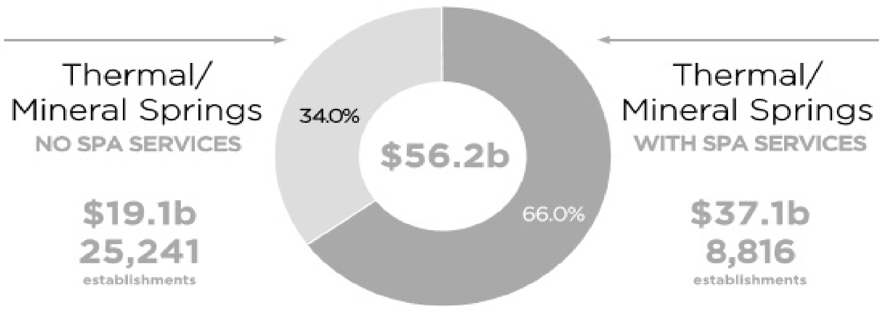
- Today the population put greater emphasis on good health than a few years ago. The increase of health self-awareness leads to more spending on health care and treatment. In the future, we can even expect that individual responsibility for health will increase even more and that will increase the availability of spa services.
- As a result of demographic change and an aging population, there is an increased need for more health products and services.
- Both healthcare policies and healthcare funds in the future will increasingly stimulate prevention along with rehabilitation. That is why the spa tourism market will be gaining more and more momentum.
- Within the spa sector, there is considerable effort to improve the quality and transparency of supply. If the implementation of these events succeeds, consumers' interest in spa supply will increase.

The growing importance of spa tourism and the inclusion of more and diverse activities inevitably leads to an increase in the number of consumers who will benefit from its services. As we have seen, a significant part of the importance of spa tourism is due to its health contribution. Without further exploring the health effects of mineral waters, as there are significant studies devoted to them, we can conclude that ***offering spa services based on mineral waters will greatly contribute to increasing the popularity, image and attendance of the spa who offer them.*** GWI [2018, p. XV] established that thermal/mineral springs bathing experiences appeal to a growing segment of consumers who are seeking to connect with nature, experience cultural traditions, and pursue alternative modalities for healing, rehabilitation, and prevention. Responding to these trends, both private investors and governments are investing in the sector. In countries with long-established thermal bathing traditions, governments are increasingly promoting these as a key wellness tourism offering. They are investing in renovation and reopening of primitive, outdated, and closed-down facilities, as well as upgrading service standards and training to meet the expectations of international tourists. The presence of mineral springs in Bulgaria has created an image for the country in the balneology field and the combination of this natural good and the trends in demand can be used as a competitive advantage for Bulgarian spa facilities.

GWI [2018, p. XIV] defines also the thermal/mineral springs industry as encompassing revenue-earning business establishments associated with the wellness, recreational, and therapeutic uses of waters with special properties. The majority of thermal/mineral establishments around the world are rustic and traditional bathing and swimming facilities. They target their local markets and charge relatively low admission fees. About a quarter of the establishments are higher-end, targeting tourists and offering value-added spa services. Those that offer spa services account for a much greater share of industry revenues (66%), and also experienced higher revenue growth (7.4% average annual growth versus 0.5% for those without spa services, over 2015-2017).

Figure 1

Thermal/Mineral spring industry in 2017



Note: The thermal/mineral springs revenue estimates include all revenues earned by these establishments, from bathing/swimming offerings, spa/wellness services and other treatments, other recreational activities, food & beverage, lodging, and other services. See Appendix A for additional definitions and descriptions of categories.

Source: Global Wellness Institute

Our studies and experience show that ***the use of mineral water for spa procedures brings additional benefits to the spa in the form of a positive image, additional health effects on visitors, marketing benefits, environmental benefits.*** In addition, warm and hot mineral waters can be used to heat buildings (hotels, spa centers), as well as economies from heating of the water in the pools and other spa facilities (Jacuzzi, baths, hydrostorms, etc.). All this leads to significant additional potential that can be realized as a result of the construction of the spa facilities near an available thermal spring.

Model To Study the Potential Economic Effects of Natural Mineral Springs Water

The model is ***a description essay and theoretical simulation of the use of mineral springs in spa facilities***. It examines both ***ideal and realistic scenarios to evaluate their benefits and problems***. Mineral water is considered as a direct substitute for water coming from the water supply network and the economic value is divided into three components: water, thermal, and mineral, gas and biological (considered as one component).

The model application can happen in ***two ways***. The first is by introducing the characteristics of the spring, the flow, degrees in °C and others resulting in: how many different procedures can be performed with the available water; whether it can save costs by using thermal springs; how many procedures can be made simultaneously (from a list of different procedures) with the available water from the source; what would be the cost if the water available from the spring should be replaced by an alternative source with the same water flow and temperature; and others. The second way, based on the desired spa procedures (bath, hydrostorm, shower Vichy, etc.), focus on the characteristics of a suitable mineral spring to be used for possible investment activities.

This model can be applied to different mineral water sources in Bulgaria and abroad, thus easily and conveniently revealing the possibilities for their application in the spa sector. It can also help with considering various alternative options for the use of mineral water as well as assessing alternative options. The model seeks to cover the basic and most important features of the mineral springs through the prism of the spa industry and the economic benefits of using a mineral spring in a spa. It seeks *measuring or presence of certain quantitative characteristics, in order to create quick and easy a clear picture about the potential for the development of a mineral spring*. Thus, creating ***the basis for measuring the economic effects arising from the use of mineral springs water in spa facilities.***

The limitations of the model are as follows: it does not consider the health benefits potentially associated with mineral waters and the economic effect associated with it; does not consider the benefits of advertising and promoting spa facilities using mineral water; does not consider effects of increase eco-friendliness of the spa facilities using mineral spring water; does not consider specific conditions for the construction of spa facilities near mineral springs as well as the potential additional costs associated with them, with the exception of additional transport costs for consumers; does not consider the composition of the water thoroughly, merely by considering expert opinion (if any) that the water is suitable for use for balneological and drinking purposes. To avoid overestimating the potential of mineral springs water when using them in spa facilities, we assume that mineral waters are equivalent to non-mineral springs.

The full look of the model can be viewed through the following link: https://bit.ly/2LoHai8. It is a collection of 6 complex tables with over 3750 variables and over 120 formulas, currently covering 27 springs and collection of springs in Bulgaria and around the world. The model is a ***convenient and flexible base and can be a useful tool for quantitative-economic presentation of the potential of the mineral springs***. It can be useful for investors looking for economic reasons to invest as well as for researchers who can develop it further and formulate conclusions based on the indentified quantitative economic effects.

The water quality is determined by the water quality characteristics – Physical, Chemical, Microbiological, and Biological characteristics according to Laboratory of Echohydrology [ECHO]. For the developing of the model the in-dept characteristics of every aspect of the wates are not necessary. The reason is that for the creation of this model (and every economic model) the main focus is on the usage of the mineral water and the mandatory conditions for that usage. Through the prism of spa tourism, it is important that the mineral water can be used for therapeutic needs. For that purpose, we will present the water characteristics in different groups: water component; thermal component; biological and chemical component. ***The water component is the main component*** of every water source. Its quantity is essential for its development. ***The thermal component*** is indicative for the thermal energy that is contained in the water. More energy content in the water means various different options for its use are available, but there is a higher danger of various contaminants of chemical and biological origin to contaminate it. ***The biological and chemical component*** represent all other properties of the mineral water. Including different organisms, mineralization, gasses and others. They can be of main importance when deciding hot to use the water. Also, they impact the way the infrastructure is maintained.

Water component includes the physical characteristics of water including its flow rate, static pressure, speed of flow and others. The temperature is not included as it is a part of the thermal component. Most important from economics point of view are: ***the flow rate in l/sec.*** – it is determined by the quantity of water that can be used and can be determined quantitatively; ***the static pressure in MPa*** from ground zero – which determines if the water can be used directly or there is a need for additional expenses for pumps, which will increase the expenses and add some complexity to the usage of the mineral spring.

The flow rate of a mineral spring as a water volume have its monetary value, that can be determined as equivalent to the value of water flowing in the water supply network, before its additional treatment. It is important to point out, that water no matter if it came from a spring or dam, is equal right of every citizen of the country. The latter does not mean that it does not have value. On the contrary, the usage has to be paid. For example, “Sofiiska voda” JSC values the delivery of 1 m^3 of water on 1st may 2016 – 1.04 levs without VAT, and “V I K” – 0.78 levs or 1.48 levs when the water is pumped [EWRC]. In this price the maintenance of the water system is included, and this is the price of the closest alternative when there is an investment in a balneological (spa) facility. The price for sewage can be accepted as equal. In Bulgaria legally there are two ways for a mineral spring to be used. Under a concession or right of use. The prices of mineral water under concession is determined individually, but under right of use is the following:

Table 1

Price in leva per **m**^{3} mineral water

	Under 30 °C	30-50°C	Over 50 °C
Water supply use	0.031	0.030	0.029
Health related use in specialized hospitals for treatment and rahabilitation	0.04	0.045	0.05
Other uses	0.15	0.35	0.50

Source: authors

This means that if we have a hypothetical mineral spring with flow of 1 l./sec.:

Table 2

Price of using a mineral spring with total flow of 1 l./sec. in leva for different peridos

Health related use	Total flow in l.	Under 30 °C	30-50°C	Over 50 °C
Daily	84600	3.38	3.8	4.23
Montly	2538000	101.4	114	126.9
Yearly	30879000	1234	1387	1544

Source: authors

If we consider the law as a base point for evaluation, we can say that water + mineral content = 0.15 lv/**m**^{3} and the price is increased with 0.2 lv/**m**^{3} for the thermal waters between 30 and 50 °C and 0.15 lv/**m**^{3} for temperatures over 50 °C [MOEW].

There is a possibility that due to the different characteristics we can have an additional need for pumping of the water and creating the pressure for its usage. The minimal pressure over the ground zero for the communal water supply network is: for one story building – not less than 0.1 MPa (1 bar); for more floors – 0.04 MPa (0.4 bars) per floor; maximum allowed pressure in the water supply is 0.6 MPa (6 bars). [Darjaven vestnik, 2005]

Taking into account these regulations we can use the formula to calculate the required energy for pumping water. [Engineering toolbox, 2019; Sharon, 2010]

$$P_{h(kW)} = \frac{q * \rho * g * h}{3.6 * 10^6}$$

Where $P_{h(kW)}$= hydraulic energy in kW

q= flow in **m**^{3} per hour

ρ= liquid density in kg /**m**^{3}

g= gravitation (9.81 m/sec)

h= needed water column.

If we accept that the spring reaches ground zero of the terrain, we will need pumping only to bring the water to its destination over the terrain. If we accept that the building where the water will be used for spa treatment is four flors high, we will need a pressure that can reach 22 meters or around 0.22MPa (2.2 bars). This complies with the minimal requirements by the law. To simulate a real situation, we can use a spring flowing with 1 liter per second or 3.6 m^3 per hour. We accept that the water is used 100%, and is pumped constantly. This way we can see what is the maximum potential electricity spent for the pump.

$$P_{h(kW)} = \frac{3.6*1000*9.81*22}{3.6*10^6} = 0.21582\text{kW}$$

The achieved value by this formula is ideal. In order to be closer to the real values, it is mandatory to take into consideration the efficiency of the pump. The additional friction cannot be taken into account, as it is highly dependent on each system, so we accept that it is insignificant.

The overall efficiency of the pump is a combination of the efficiency of the motor (usually electric) and the efficiency of the propellers (in case of a centrifugal pump) that increases the pressure of the water. The standard electromotors have efficiency around 90%. [Foray, 2014: 5] The efficiency of the pumps may vary dependent on the revolutions of the pump, the kept pressure, flow and others. Highly efficient industrial centrifugal pumps have efficiency around and higher than 80% [Foray, 2014: 5, DAB pumps, 2019]. Smaller pumps for personal use can have efficiency even less than 60%. For the current model we will use efficiency of 75% because we accept that the pump would not always be working at its optimal efficiency. This leads to the following:

$$\frac{0.21582}{0.75} = 0.28776kW$$

Consequently, 0.28776 kW is the energy, that the pump will need for 1 hour to pump 3.6 m^3 of water with a pressure of 2.2 bars. The price of the spent electrical energy can be monetarily valued on the base of the prices given by the Energy and Water Regulatory Commission. According to them, kWh of electrical energy for non-household needs, delivered by CEZ Electro Bulgaria without considering night, day and peak electricity usage cost 0.14131 leva [EWRC, 2019] + 0.01745 for access and + 0.02933 leva [EWRC, 2019] for distribution = 0.18809 leva before and 0.22571 after tax.

In this case, if the pump works for 8 hours per day the price for a day will be 0.37 leva/day, 11.06 leva for a month and 132.75 leva yearly. We did not include the price of the pumping installation and additional expences for the infrastructure that may occur because of the usage of mineral water. We accept that those additional expences are important but impossible to calculate due to the different nature of every pumping installation. That is why they are not included in the calculations.

In the model the part for the water component will look like this:

Table 3

Characteristics of the water component

Water flow in l./sec.	°C	Static pressure in MPa	Needed pressure in MPa	Water pump efficiency
1	37	0	0.22	0.75
Price of electricity for kW in BGN	Price for mineral water for m^3 in BGN	Price of water from the watter supply system in m^3	Sewage price for m^3 water in BGN	Resource usage in %/100
0.22571	0.35	0.75	0.57	0.7
Results				
Time in minutes for filling 25-meter (400 m^3) pool	Time in minutes for filling 50-meter (2000 m^3) pool	Price in leva for filling 25-meter (400 m^3) pool	Price in leva for filling 50-meter (2000 m^3) pool	Alternative (water supply price) for filling 25-meter (400 m^3) pool
111.1	694.4	60 BGN	375 BGN	300 BGN
Alternative (water supply) price for filling 25-meter (400 m^3) pool	Price for pumping 100% water flow for a year. (4 story building)	Price for pumping 8 hours a day 70% of the water flow.	Price of the mineral water 100% usage	Price of water supply water 100% usage
1875 BGN	569 BGN	133 BGN	4730 BGN	23652 BGN
Price in leva for 8 hours a day 70% of the mineral water flow.	Price in leva from the water supply for 8 hours a day, 70% water flow.	kW for pumping 100% usage	Price for 100% usage of mineral water + pumping+sewage	Combined price for mineral water and pumping 100% usage
1104 BGN	5519 BGN	2521 KW	25173 BGN	7197 BGN
Combined price for mineral water and pumping 70% usage 8 hours a day	Sewage price 100% usage	Sewage price 70% 8 hours a day usage	Total price per year for 70% usage 8 hours a day	Total price for using water supply[3] 70% usage 8 hours a day
1679 BGN	17976 BGN	4194 BGN	5874 BGN	21196 BGN

Source: authors

In conclusion, we can say that the water component in the model is difficult for totally accurate economic evaluation, because there are a lot of variables that can significantly alter the results. There are basic variables like water flow and static pressure that have significant economic effect and are essential when evaluating an investment in mineral water spa.

[3] For example will be used the price of water in Sofia supplied by ViK, which is 0.78 BGN per **m^3**

Thermal component can have a significant economic effect. This effect come from the economy of fossil fuels or electricity for water heating. ***The economy from thermal mineral water depends on multiple factors.*** Overall, we can separate them in the following manner: characteristics of the thermal (hot or warm) mineral spring; conditions of the concession contract; price of fossil fuels and electricity; efficiency of the heating installations; losses caused by specific factors like distance from the thermal mineral spring, pipe insulation and others; others.

To reach universal conclusions the main focus will be put on the characteristics of the thermal mineral spring and the efficiency of the heating installations. Thermal mineral springs with temperature over 100°C can be used efficiently for producing electrical energy, as well as for heating purposes. Such hot mineral springs are a rarity, especially those that have high flow rate. The artificial creation of such springs is usually very expensive and economically efficient only on certain locations. ***The efficient usage of thermal mineral springs with temperature under 100***°C is a difficult task. Only by using them for spa all three components of thermal mineral water can be used. The mineral component (included in the chemical composition of water) can be used for bottling usually if the water contains relatively low mineral composition. If there is a high mineralization it is possible for the minerals to be extracted for use in the cosmetic industry. In spas the usage of low and high mineralized water is possible.

There are different types of concession payments, that are paid to the state or different municipalities, depending on who is the owner of the thermal mineral spring. As an example of concession, we can review the one for bottling water in Gorna banya [National concession register, 2019]. There the payments for 1 m^3 of water is $2,6 and $10700 initial payment. The maximum permitted usage of water is 186 000 m^3 of water per year [Petrov, 2019]. Another example is the concession in Hisarya, where for bottling the prices are $2,65 per m^3 and 6000 leva initial payment, with maximum of 62200 m^3 water per year. [National concession register – Hisarya, 2019]

There is another way for the mineral water to be used called – permission of use. Their price of m^3 water according to the Ministry of Environment and Water is 0.35 leva for m^3 for waters under 50°C and 0.50 leva for waters over 50 °C. [MOEW, 2019] For comparison sake, we will use 0.35 leva per liter as a price of mineral water. This can be compared to the price of cold water in Sofia supplied by "ViK" – Sofia, that according to the Energy and Water Regulatory Commission costs 0.75 leva without VAT [EWRC, 2019]. This price will be used as a reference price from now on, that way we can compare price results as well as find different tendencies that otherwise will be heavily influenced by the different prices depending on location. Heated water will be used for comparison of the price of consumed electricity or natural gas with 90% efficiency boiler. The comparison with the prices of a city heating system would not be proper, because the prices cannot be universally applied.

The characteristics of thermal mineral springs**,** as we mentioned are: flow rate, temperature and chemical composition. The same are the characteristics of water in the water supply network. The maximum flow is determined by the cross-section of the pipes and the pressure inside the pipes. We will accept that the water supply can deliver the same quantity of water as the thermal mineral spring. The average temperature of the cold water depends according to the source and the geographical location. Overall in temperate climates this average varies between 10 and 13 °C [GFX Technology, 2019: 1-2]. We will use a reference temperature of 10 °C. The chemical composition of water is relevant, but because our goals are to develop a universal system, this factor would not be taken into account.

For water heating we can use the formula, used since the time of Lavoisier for calculating the energy content of water: [Drake and Kim, 2019]

$$\frac{Q \times 4 \times \Delta T}{3412} = kW/h$$

Q – quantity of water in liters;

ΔT – desired temperature increase;

4/3412 – coefficient for specific heat capacity of water;

KW/h – kilowatt per hour electroenergy, needed for heating the water to the desired temperature.

In one cubic meter natural gas there are around 11,16 kWh energy [Utilitessavings.co.uk, 2019]. This way we can determine that for heating 1000 liters of water (m^3) with 27 °C – from 10 °C to 37 °C we need 31.65 kW/h. energy or 35.17 kW/h. if we consider 90% efficiency of the boiler. That way we can determine that for heating 1000 liters of water from 10 to 37 °C we need around 3 m^3 natural gas. For price for 1 m^3 natural gas we will accept the prices according to Overgas, one of the biggest suppliers of natural gas in Bulgaria. The prices are the following:

Table 4

Price of natural gas according to Overgas

Up to. $\mathbf{m}^3$	Price in BGN non consistent usage	Up to. $\mathbf{m}^3$	Price in BGN consistent usage
5000	0.781	50000	0.658
50000	0.76	100000	0.65
100000	0.75	200000	0.642
200000	0.74	400000	0.635
400000	0.729	600000	0.63
600000	0.723	800000	0.627
800000	0.719	1000000	0.624
1000000	0.715	5000000	0.606
Над 1000000	0.691	5000000	0.598

Source: Overgas, "Prices of natural gas for Sofia and Bojurishte municipality": https://www.overgas.bg/documents/16421/28553/Актуални+цени+за+разпределение+и+снабдяване

The consumption when heating the water would be non consistent, so in the model we will use price in leva non consistent usage. For heating of 10000 m^3 water we will need around 30000 m^3 natural gas, or 316500 kWh energy (1139 GJ). This means that the heating of water (including the efficiency loss of 10%) would cost: $\frac{1139 \times 100}{90} \times 22{,}69$ = 28 716 BGN. The same way, for heating from 22 °C to 37 °C we will need 17=59 kW for heating 1000 liters of water. For 10000 m^3 we will need 175900 kWh or 633 GJ, $\frac{633 \times 100}{90} \times 22{,}69$=15 958 BGN. (90% efficiency).

The consequences for the environment are also significant. The natural gas produces 56.1 grams of CO_2 per MJ (megajoule) [University of Helsinki, 2019] or 56.1 kg CO_2 per 1 GJ. This means that in the first case 63898 kg of CO_2 are produced, and 35511 kg CO_2 in the second case. In 2014 the average new car exhaust in the atmosphere 124,6 grams CO_2 per kilometer [USEPA, 2019]. This means that we need to drive a car for 512825 km to produce the same pollution as in the first case given (63898 kg of CO_2). If we accept that an average car is driven for 10000 km per year, this means that those are the equivalent emissions of 513 cars.

The problem with the thermal energy is that it is difficult to be used efficiently. The water law in Bulgaria gives an convenient way for the thermal water to be used – the right of use, but it incentivizes the drinking and household usage as well as the specialized medical centres, while the spa services are taxed with the highest prices. [MOEW, 2012]

Several features of the thermal component of mineral water have to be taken into account. Firstly, the efficient extraction of thermal energy from mineral water is a complex process requiring temperatures above 150 °C. [Georgieva, 2010] The highest temperature spring is in Sapareva Banya 103 °C, and also in Bulgaria there is no place favorable in terms of volcanic activity and shallow presence of terrestrial layers with high temperature. Thus, ***the establishment of efficient thermal power plants is highly unlikely***. Secondly, ***if the thermal mineral water is used for bottling, the latter loses its thermal component.*** Although, according to the legal framework the prices for the use of thermal waters for “other purposes” implies relatively high price, it should be noted that this also includes spa facilities. Thirdly, ***the use of thermal mineral water for heating purposes in building heating systems requires a high temperature (above 80 ° C) using the classic two-circuit principle***. The direct use into the system is efficient for temperatures over 40 °C but may cause forming of mineral and other deposits along the pipes that need extra-investment for cleaning.

The cost of the thermal component of mineral water in the current model will be based on several key elements. The thermal energy contained in the water, is equal to the energy required to heat 10 °C water to the temperature of a thermal mineral spring with the same flow rate. A 90% efficiency boiler is used for heating, taking the latest gas price data from a relevant source to calculate the water heating price. On the basis of the energy content of the natural gas used, the amount of energy in kW is determined. The CO_2 produced as a result of heating is equal to the pollution that can be avoided by using thermal mineral springs. Two more variables, has to be taken in order to calculate realistically the values. These two are: resource load and water usage time. The mineral water usage can only be a certain percentage of the total flow. The reason for this is that some of the thermal component is wasted, and this process can only be slowed down, but not prevented. The water outside the spa's working time can be used for other purposes as well. For example, its use is effective for warming greenhouses, for filling pools or bottling, but in the latter case the thermal component is wasted. The economic cost of the thermal component using a test spring with 1 l./sec. water flow and 37°C, would look like this:

Table 5

Characteristics of the spring

Water flow in l/sec.	Temperature of the water °C	Price GJ (NSI, 2016)	Mineral water usage percentage in %/100
1	37	21.07	0.7
Boiler efficiency	Hours of usage per day	System losses in %/100	
90	8	0.1	

Source: authors

Taking into account the characteristics of the test spring, we can calculate ***its potential to save natural gas.*** Respectively, this potential is absolute, 100% of the usage.

Table 6

Potential of the spring (absolute units)

Heating per year in GJ	Cost of heating per year (in BGN)	Consumption for water heating per year (in kW/h)
3594	75710	998209
Consumption of natural gas for 70% load and 8 hours a day usage		
Natural gas in GJ	Natural gas in m^3	Price of natural gas in BGN per m^3
754.65	19348.89	0.532 (EWRC, 2016)

Source: authors

Therefore, the amount of natural gas per year would be equivalent to over BGN 10000 per year.

The chemical and biological component also includes gases, microbiological and other pollutants. They are essential for the spa facilities as far as they provide a chemical composition that is or is not suitable for different spa treatments. They could have additional benefits for the consumers that are outside of the scope of our analysis.

The biological component is as essential as the other two since even the minimum quantities of biological elements in water are indicative of its purity. The presence of biological pollutants can make the water unusable in spa and wellness centers. Since water safety and suitability assessment requires special expertise and is not quantifiable, in the model these components will be presented as ***factors to be taken into account before using any spring for spa purposes.***

Table 7

Assessment of the biological and chemical component

Mineralization in g/l.	pH	Biologically suitable for spa usage	Chemically suitable for spa usage
0.33	9	1	1
Result: The water has low mineralization, thus suitable for usage in spa facilities.			
Mineralization in g/l.	pH	Biologically suitable for spa usage	Chemically suitable for spa usage
Low mineralization	Moderately alkaline 8.5	Yes, organic pollutants within acceptable norms	Yes

Source: authors

Through "1" we can determine that the test spring is biologically and chemically suitable for usage whereas when we have "0", it is not. That has to be done by specialists and after a thorough study of the specific springs. Such research is done regularly on the various mineral springs used for drinking and spa needs.

To determine accurately, how much water is needed for each procedure turns out to be a complicated process. Spa procedures often use a wide range of water consumption, and the amount is rarely used evenly during the procedure. Some of the assumptions of Stevens and Smolenaars's study [2007] will be used in the model, and we will also make some conclusions. We will look at the different procedures and how much water is used for them, because we will then be able to identify how many and what procedures can be performed with waters of a given mineral spring.

Table 8

Consumption of water for several spa treatments and their duration.

	Values used in the model (liters per procedure)			Duration of the procedures	
Procedure	Low	Medium	High	Duration (minutes)	L/s per procedure (maximum)
Hydrostorm	350	350	350	10-20	0.5833
Foot soak bowls	4	4	4	5-10	0.0133
Saloon basins	40	50	80	5-10	0.267
Manicure bowls	1	2	3	1-3	0.05
Pedicure bowls	2	4	14	1-10	0.2333
Stone heaters	2	4	7	10-30	0.0117
Spray booths	3	6	12	10-30	0.02
Vichy	70	375	750	20-30 (Calthorp, 1931)	0.6250
Tubs	170	350	650	5-20	2.1667
Spas	150	340	600	5-20	2.0
Showers	50	70	170	10-30	0.5667

Source: Adaptation of Stevens, D., Smolenaars, S. (2007) ASPA Water Wise Project. Physical Audits, Australian Spa Association, Carlton South Victoria, Australia.

This table is important for determining of the necessary mineral springs flow rate through the prism of the proposed spa-investment project in the future. Its precision is largely indicative, as the empirical study of Stevens and Smolearas does not go into detail and is limited to the quantity of water used. For further refinement, a more in-depth study is needed to provide more data on the amount of water and the nature of its consumption, the duration of procedures, and more. The quantities of water are averaged but have a different character. For example, when using a bathtub, there is a great deal of water consumption when filling the bathtub. Subsequently, this consumption decreases and may even be stoped until the end of the procedure. According to the EU standards, the maximum flow rate of kitchen faucets should be no more than 8 l./min., for bathtubs and sinks – no more than 7 l./min., and for showers – no more than 9 l./min. [Calthorp, 1931]

Reviewing *Table 9* we can notice that there are some discrepancies between the mean values and the maximum possible ones. This is due to the limits imposed by the EU on the maximum allowable flow of fountains and showers sold within the Union. These values, however, provide us with a good basis, because they limit the peaks in water use. The problem is that it is very difficult to calculate how many spa procedures of a certain type with uneven water use will max out the available flow rate. For example, when filling water, in the presence of taps without a legal limitation of the flow rate and the only limitation is the water supply pipes, it is possible even for one of the smallest size pipes used for the DN20 (internal diameter ~ 22.3 mm) at a sufficient pressure the flow rate to be in excess of 0.40 l./sec. This would fill a bathtub (~ 200 liters) for 8 minutes and 20 seconds. With water limitations in place, 0.117 l./sec would fill the bathtub for 28 minutes and 30 seconds, which would be too long, but would provide a lower load on the water supply network and the provided available flow rate.

Table 9

Water consumption for spa procedures

Procedure	Even use of water	Even average consumption (l./sec.)	Maximum legal consumption (l./sec.)(JRC, 2019)
Hydrostorm	Yes	0.3889	-
Foot soak bowls	Yes	0.0089	0.117
Saloon basins	No	0.1111	0.15
Manicure bowls	Yes	0.0167	0.117
Pedicure bowls	Yes	0.0121	0.117
Facial bowls	Yes	0.0039	0.117
Stone heaters	Yes	0.0033	-
Spray booths	Yes	0.0050	-
Vichy	No	0.25	-
Tubs	Yes/No	0.4667	- /0.117/
Spas	Yes	0.4533	-
Showers	Yes	0.0933	0.15

Source: authors

Even consumption can be achieved through a reservoir of mineral water, so the peaks of consumption would be flattened by it. In direct use, knowing the water consumption peaks is particularly important, because they can lead to water pressure and water flow reductions, even with sufficient water resource capacity. The legal limitations help to limit these peaks and respectively, to save water. In some cases, however, the presence of that constraint could lead to problems, for example when filling a bathtub, it is necessary to fill it for a reasonable time. If we use a limited water supply, it would mean that to fill 350-liter bath, it would take nearly 50 minutes, which is extremely inefficient.

By combining the different aspects of mineral water and its consumption in the spa facility, we create a holistic model that we can apply to different mineral water springs. Which would allow an empirical research on the mineral springs to verify and regulate the model. In table 10 is examined a test spring with a flow rate of 1 l./sec. and a temperature of 37 °C. With the implementation of this model, water prices from the water supply network, electricity and natural gas, will be used as a constant. The reason for this is to create a comparative idea on the same basis for the potential of the mineral springs. Having a spreadsheet for calculation allows us to easily enter other values that in turn gives a more precise idea which would be useful while applying the model.

Table 10

Characteristics and theoretical usage of mineral springs – test spring

Name of thermal mineral spring	Location	Water flow in liter per second.	Temperature °C	Static pressure MPa
Test spring	Test	1	37	0
pH	Mineralization	Acceptable biological properties	Acceptable chemical properties	Price in BGN Per m^3 from water main
7	0.75	Yes	Yes	0.75
Price of mineral water in BGN. Per m^3	100% water flow in m^3 per year.	Price of electrical energy in kW	Price of natural gas in BGNPer m^3.	Needed water pressure MPa
0.35	31536	0.22571	0.76	0.22
Efficiency of the water pump in %	Price of sewage in BGN Per m^3.	System losses in %	Base temperature °*C*	Boiler efficiency %
0.9	0.57	10%	10	90%
Hours of usage	Resourse usage in %	Working days	25m. pool volume in m^3	50 m. pool volume in m^3
8	70%	7	400	2500
Comparison between a mineral spring and water mains water usage				
kW for 1 year heating of mains water to the mineral spring temperature	Natural gas yearly in GJ	Natural gas yearly in m^3	Price in lv. For heating for 100% usage	Price in lv. For heating with assigned load
998209	931.66	27815.44	81594	20942
Time in hours to fill a 25-meter pool	Time in hours to fill a 50-meter pool	Price in BGN. for filling a 25-meter pool with mineral	Price in BGN for filling a 25-meter pool with mains	CO_2 emissions saved in kg. in 100% use of

Name of thermal mineral spring	Location	Water flow in liter per second.	Temperature °C	Static pressure MPa
		water	water	mineral water
111.1	694.4	163.98	300	201598
CO2 emissions in kg. 8 hours a day 70% of available water used	Number of average cars emissions not released in the atmosphere (100% water usage)	Number of average cars emissions not released in the atmosphere (8 hours 70% water usage)	Price of water per year in BGN (8 hours 70% water usage)	Price of mineral water per year in BGN (8 hours 70% water usage)
51743	162	42	5519	2575
Price of water in BGN per year (100% water usage)	Price of mineral water in BGN per year (100% usage)	Pumping and mineral water price in BGN (100% usage)	Pumping and mineral water price in BGN (8 hours 70% water usage).	Sewage price in BGN (100% usage)
23652	11037.6	11749	2741	17975.52
Sewage price in BGN (8 hours 70% water usage)	Electrical energy used in kW yearly for pumping (8 hours 70% water usage)	Maximum kW/h electrical energy used (100% water usage)	Total price + heating in BGN tap water (8 hours 70% water usage)	Total price + heating in BGN mineral water (8 hours 70% water usage)
4194.29	735.23	0.360	30655	6935.68
Number of possible spa procedures with the available water flow				
Hydrostrom	Saloon basins	Manicure bowls	Pedicure bowls	Spray booths
3	8	15	15	200
Vichy	Capsules	Tubs	Spas	Showers
4	7	2	2	8

Source: authors

Determining what volume of water on average a person uses in a spa is a difficult task, which need consistent and in-depth empirical researches. Different authors give different data for the used quantity of water per person. The quantities of water given in such way can be used as a way to determine the quantities of water used for a spa facility. We have to point out that the given quantities are for the water usage in the whole hotel, and they are divided by the number of guests. We can see the tendency in Europe that the water usage is significantly lower. As previously mentioned in the recent years the European regulations help to limit the water sewage. According to the European standards in European Union the maximum flow rate of the kitchen sinks should be no more than 8 l/min, those for bathtubs and other sinks no more than 7 l./min., and 9 l./min. for the showers. [Calthorp, 1931] This means that one 10-minute shower can use between 50 and 90 liters of water, which corresponds to the low figures given by Stevens and Smolenaars (see table 8). The specialized hospitals for rehabilitation – National Complex give the figure 200 liters per person per day [SHFR – NC, 2019]. Another way to decide the water used per person is to rely on the report created by the architectural and urban planning subdivision of Sofia Municipality. They determine the potential usage of water between 100 and 250 liters per person. [Sofia municipality, 2019] We will use 200 liters mineral water per customer, and from now on we will use these figures for determining the maximum number of customers that can be served with given quantity of water.

The research of using mineral springs waters in spa facilities is not enough for determining exhaustively the economic effects, that can be caused by them. There are additional factors that can give additional value to the usage of mineral water rather than tap water. Therefore we can summarize that mineral waters have significant economic value, even if we do not consider other than the most direct metrics to evaluate them.

Approbation of the Model Towards Real Mineral Springs

The desire of spa tourists to receive services that include mineral water makes us want to try and define the options for building spa centers in proximity to mineral springs. This means that spa facilities will be remote and thus creating more transport expenses. Investments in real estate also create significant costs but that is a subject-matter for a different study. [see Stefanov, 2018]

In order to determine the costs, as time and money for the road, we must first determine which are the main modes of transport used to move to spa destinations. Following the analysis of the logistics market in Bulgaria for the period 2010-2016 [Vodenicharova, M., 2016] in this study, we consider only the most popular travel option, namely, a personal car. Moreover, according to Gutovski [2013: 320], road transport has a very big advantage over other modes of transport, it is extremely flexible. Yordanov [2012: 53] says that auto transport takes a significant part when it comes to short-distance trips.

Table 11

Costs and duration of travel by car to some spa destinations in Bulgaria

Starting point: Sofia		Automobile expenses lv.			Diesel expense + 50.00% lv.		Gasoline expense + 50.00% lv.	
Spa destination	Km.	Diesel	Gasoline	Time	For 2/5 People	For 5/5 people	For 2/5 people	For 5/5 people
Varshec	93.9	11.11	13.19	01:36	8.33	3.33	9.89	3.96
Hisarya	175	20.71	24.57	01:49	15.53	6.21	18.43	7.37
Velingrad	136	16.09	19.10	01:54	12.07	4.83	14.32	5.73
Momin prohod	70.1	8.29	9.84	00:58	6.22	2.49	7.38	2.95
Haskovo mineral baths	223	26.39	31.31	02:33	19.79	7.92	23.49	9.39
Pavel Banya	221	26.15	31.03	02:33	19.61	7.84	23.28	9.31
Sandanski	171	20.23	24.01	02:10	15.17	6.07	18.01	7.20
Burgas mineral baths	374	44.25	52.52	03:31	33.19	13.28	39.39	15.76
Albena	477	56.44	66.98	05:06	42.33	16.93	50.24	20.09
Total	1941	229.66	272.56	22:10	172.24	68.90	204.42	81.77
Average	216	25.52	30.28	02:27	19.14	7.66	22.71	9.09

Source: authors

From Table 11 we can see the time and cost of traveling by car to some popular destinations in Bulgaria. We can note that, depending on the characteristics of the road, there are significant deviations between the distance to the different spa resorts. For example, the time of travelling 93.9 km to Varshets is an hour and 36 minutes, while for travelling 175 km to Hisarya takes 13 minutes more. An average car traveling to Varshets goes one kilometer for one minute and one second while traveling to Hissarya for only 37 seconds.

Nowadays, using a variety of commonly available tools, such as GPS navigation, Google Maps, and others, we can accurately calculate the time needed to travel between two points. Google Maps even provides the capability to track real-time random events, such as traffic jams and incidents. This allows you to reach your desired destination on an efficient route. Consideration of the average values in Table 12, therefore can not provide high accuracy but covers possible scenarios that may be the basis for extrapolations.

Table 12

Features and average travel prices to certain destinations by car.

Price per liter gasoline	Average expense per 100 km.
2.05	6.85
Price per liter diesel	Average expense per 100 km.
2.04	5.8
% maintenance	50
Filled spa resorts	Average time per kilometers
9	0:00:41
Average price for liter per kilometer for 2/5 people	
Diesel	Gasoline
0.08874	0.10531875
Average price per liter per kilometer for 5/5 people	
Diesel	Gasoline
0.035496	0.0421275

Source: authors

When 9 spa resorts are filled, the average time per km journey is 41 seconds. As mentioned earlier, there is a significant variation, depending on the specific conditions. However, this base allows us to understand approximately how long an arbitrary journey would take us. The sampled average is intended to serve as a guide when precise information about a particular route is missing.

On the basis of the exported data, we can claim that the travel to mineral springs outside the territory of Sofia leads to significant time and money investments. That is why the described resorts are visited mainly during the holidays, weekends and when on leave. The fixed position of the mineral springs leads to the fact that spas, which are close to a large number of consumers, often use tap water and are usually combined with a gym. There is also a perception that the use of mineral baths is purely hygienic or curative. This has resulted in the decline of many public baths since the Second World War due to their replacement by widespread domestic baths.

To demonstrate the efficiency of the model we ***apply it to the springs in Velingrad***. The simulation helps us to find out what potential savings can be made using the spring of mineral water for the purposes of spa tourism. The model can easily be applied to other potential spa resorts domestically and abroad.

Velingrad is a town in Southern Bulgaria, founded in 1948 by the merger of the villages Ladzhene, Kamenica and Chepino. It is located in Pazardzhik region and it is the second largest in the area after the regional center. The town is an administrative center of the municipality of Velingrad. In the following table, you can observe results from the model we developed, which describes and evaluates the available mineral water resources in the town of Velingrad and the possibilities for their use in spa facilities:

Table 13

Assessment of the potential of the mineral springs in the town of Velingrad

Name of spring	Location	Flow rate l/sec	Temperature°C	Static pressure in MPa
Velingrad (total)	Velingrad	114.83	56.3	0
pH	Mineralization	Eco. Appropriate	Healing appropriate	Tap water price in BGN per m^3
8.2-9.2	Low	Yes	Yes	0.75
Price of mineral water	100% flow rate per year in m^3	Price of electricity per kW in BGN	Price of natural gas per m^3 in BGN	Pressure required in MPa
0.35	3621279	0.22571	0.691	0.22
Effectiveness of electric water pump in %	Sewerage cost per m^3 in BGN.	Energy losses of the system in%	Base temperature in °C	Heater efficiency in %
0.65	0.57	10%	10	90%
Hours of use daily	Water resource load in%	Working days of the week	Pool volume 1 (25m) in m^3	Pool volume 2 (50m) in m^3
8	70%	7	400	2500
Comparison of mineral springs and use of water from the water supply network				
kW of energy for one year of heating the tap water to the temperature of the mineral spring	Natural gas per year in GJ	Natural gas per year in m^3	Price in BGN for heating at 100% load	Price in BGN for heating at set load
196559452	183455	5477199	3784744	971418
Time in hours needed to fill pool 1 (25м)	Time in hours needed to fill pool 2 (50м)	Price to fill pool 1 (25 meters 400m^3 in BGN with mineral water	Price to fill pool 1 with tap water	CO_2 emissions saved in kg. in 100% use of mineral water
1.0	6.0	163.98	300	39697144
CO_2 emissions saved in kg. at a set load of mineral water	Emissions from vehicles per year for 100% use of	Emissions from vehicles per year with specific	Price of water for one year at a set load from the water supply	Price of water for one year at a set load of

Name of spring	Location	Flow rate l/sec	Temperature°C	Static pressure in MPa
	mineral water	mineral water usage	network in BGN.	mineral water in BGN
10188933	31860	8177	633724	295738
Price per year at 100% load from the water supply network in BGN	Price per year at 100% mineral water load in BGN	Pumping water + mineral water 100% load in BGN	Price for pumping water + mineral water set load in BGN	Sewerage Price at 100% Load in BGN
2715959	1267448	1342833	313328	2064129
Price of sewerage at set load in BGN.	Electricity in kW per year for pumping at set load	Electricity in kW / h maximum for pumping at 100% flow rate	Total price + heating at specific load of tap water in BGN	Total price at specific mineral water load in BGN
481630	77932	38.127	2086772	794958
Number of possible spa treatments with available water flow rate				
Hydrostorm	Washbasins	Manicure	Pedicure	Water jets
295	880	1718	1779	22966
Shower Vichy	Water capsule	Bathtub	Jacuzzi	Shower
459	787	246	253	944

Source: Authors

With the proven flow rate of mineral water at an average of 200 liters per person, an 8-hour working day and 70% water efficiency usage, up to ***11575 people can be served daily***. This makes Velingrad the resort with the largest potential capacity in Bulgaria. The relatively high temperature and abundant water resources allow you ***to save up to 40,000 tons CO_2,*** equivalent to the emissions of an average 8177 cars a year. From the table you can see many more advantages of the mineral springs compared to the use of tap water. It should be noted, that the mineral waters could not be stored easily. The reason is that, when using shut-off valves (as is the case with tap water), there is a serious danger of development of dangerous bacteria in the water. Therefore, the efficient use of mineral springs, such as those in Velingrad, means the distribution of available water, and inevitably wasting the water that is not used. In other words, ***not using the mineral springs leads to waste of significant resources and potential.***

Conclusion

The study of the economic efficiency of mineral springs is important in terms of their development. The quantitative measurement of the usable characteristics of this gift from nature leads to a better understanding of its economic value and supports the planning of the costs and potential future revenue from its use. The rapid development of computer and information technologies gives us an unprecedented opportunity to handle quantitative measures and formulas quickly and easily, with the possibility of dynamic data management and access everywhere.

Mineral springs are a gift of nature, the use of which is important in order to save resources. With the advent of the 21st century, attention is increasingly drawn to the economy in its essence, namely resource-saving in order to achieve high efficiency and minimal impact on nature and people. This new trend gives the opportunity for the development of the mineral springs, especially the thermal ones. In recent years, there has been a growing interest in mineral water not only for their use for bottling, but also for spa treatments. According to many sources, the interest in the sector is steadily increasing, within Europe (including the countries of the former USSR), revenues from thermal mineral water projects exceeding 20 billion dollars.

There are a variety of economic effects from the use of mineral water, which can be grouped into three main groups: effects caused by the use of the water component; effects caused by the use of the thermal component; effects caused by the mineral, biological and chemical composition of water. By applying the proposed model, we can determine the key positive effects, and present them through quantitative measures. Each of these effects groups is presented in detail in the model, with a number of measures being developed. An exception is the last group for which expert judgment is required. The reason is that the use of water for spa purposes is determined by its appropriate biological, chemical and mineral characteristics, as potential contamination or preservation of water can lead to serious negative effects.

There is a need for current empirical studies related to spa procedures. Creating an accepted and constantly developing a system for the quantity of water needed for each spa treatment, as well as the actual ways to use it, would greatly enhance research opportunities. This necessity is justified by the creation of additional efficiency in the use of mineral waters and the achievement of additional economic efficiency in the use of mineral waters in spa facilities. Such research would support efforts to save water, which would contribute not only to the lower cost of services but also for a smaller environmental footprint.

As a result of the evidence presented in this study and in the model, we could conclude that:

- the use of hot springs (37-60 ° C) (with a sufficient flow rate) can result in significant savings in the cost of warming water in spa facilities, even springs with temperatures below 37 °C, such as in Ovcha Kupel lead to appreciably lower costs;
- the use of hot mineral springs (above 60 °C) with sufficient flow can eliminate the cost of warming water in spa facilities;
- the waste of thermal mineral water leads to significant economic, environmental and other loss of benefits, as observed in Velingrad example, these missed benefits amount to nearly 1 300 000 leva as well as saved emissions of up to 40 000 tons of CO_2;
- the hypothesis that there are additional benefits of time-saving and transportation costs that tourists make when visiting closer spa sites is confirmed.

All of those enable us to conclude that the mineral springs water is a valuable natural resource, which used in the right way could lead to significant economic effects in short, medium and long term. We can clearly state that given the natural mineral waters available in Bulgaria, every year millions of euros are wasted. Due to the increasing popularity of the spa services among the consumers, in the future investments in thermal mineral springs could be quite profitable.

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