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The Use of Renewable Energy Within the "Castel Mimi" Tourist Complex

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Abstract: The problem addressed is the fight against climate change. The article examines 2 basic aspects: the commitment of the Republic of Moldova to contribute to the reduction of greenhouse gas emissions and the good practices of the "Castel Mimi" Tourist Complex in the use of renewable energy. The objective of the paper is to identify the good practices and motivations that led the owners of the "Castel Mimi" Tourist Complex to switch to alternative energy sources. The paper contains the following question, highlighted as a common thread: how can the objectives of the Paris Agreement on climate change be achieved by involving each economic operator? In order to answer this question, several actions were carried out, including: analysis of strategic materials at the global and local levels, participation in conferences, workshops, which addressed the mentioned subject, visiting the premises of the "Castel Mimi" Tourist Complex and discussions with its administration, interviews, discussions with specialists in the field and with economic operators who implement environmentally friendly practices. The value of the paper lies in presenting arguments for raising awareness among economic operators in the tourism sector of the need to use green technologies in order to ensure the sustainability of their own businesses and to engage in the fight against climate change.

Keywords: climate change; renewable energy; tourism; accommodation

JEL Classification: Q01, Z32, Q42

1. Introduction

The issue of climate change has been of concern to humanity for more than 200 years and is based on theories and research that identify its causes. Joseph Fourier, Svante

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Arrhenius, Guy Stewart Callendar, Charles Keeling are just a few of the personalities who have contributed to researching the causes of climate change and have strengthened the convictions of modern scientific theories through clear evidence that the increase in CO_2 levels is the main cause of global warming and current climate change.

Thus, one of the first researchers to address the issue of climate change is considered to be the French scientist Joseph Fourier who, in his work "Mémoire sur les températures du globe terrestre et des espaces planétaires", laid the foundations for understanding the thermal balance of the Earth's atmosphere. As mentioned by the French researcher Jean-Louis Dufresne in his work "Jean-Baptiste Joseph Fourier and the discovery of the greenhouse effect", Fourier established the fundamental principles underlying the temperature of the planet's surface and, in particular, the principles of the greenhouse effect: the adjustment of the surface temperature to achieve energy balance, as well as the essential role of the asymmetry between the radiative properties of the atmosphere in the solar spectrum (transparent atmosphere) and in the thermal infrared spectrum (partially opaque atmosphere)[1]. This theory is still used today to explain how the greenhouse effect, due to the Earth's atmosphere, although it helps maintain the general temperature of the Earth at a certain constant level and is beneficial for life, due to the increase in the level of carbon dioxide (CO2), leads to global warming, which consequently has a negative impact on the environment and on life on Earth. Modern computer climate models demonstrate that the main cause of global warming is the increase in the level of CO2 resulting from human activities. This fact is increasingly worrying the states of the world, which are convinced that the situation must be changed, a fact reflected in the Paris Agreement.

The 2015 Paris Agreement on climate change, which aims to limit global warming, reflects the concerns and concerns of states for the future of humanity[2]. The agreement, signed by 196 states, establishes a general global framework that is intended to contribute to reducing the impact of human activity on the environment, which has the effect of climate change. The objectives of the Agreement represent a necessity and an openness of states, based on the principle of shared responsibility, to react and reduce the danger posed by climate change. Among the main tasks that states have assumed are the reduction of greenhouse gas emissions, the reduction of non-degradable waste, the careful use of natural resources, etc.

[1] https://perso.ens-lyon.fr/patrick.flandrin/Fourier250/Dufresne-lamet-2006-1.pdf.

[2] https://eur-lex.europa.eu/legal-content/RO/TXT/PDF/?from=EN&uri=CELEX%3A22016A1019%2801%29&utm_source=chatgpt.com.

2. The Republic of Moldova's Objectives Regarding the Use of Renewable Energy

The Republic of Moldova ratified the Paris Agreement by Law No. 78/2017[1]. Thus, our country has assumed compliance with the provisions of the Agreement and is taking concrete actions to achieve them, including setting limits for reducing emissions throughout the economy. As an example, Moldova has set itself the goal of reducing greenhouse gas emissions by 70% by 2030 compared to 1990, an objective that can be achieved through the transition to alternative energy sources, such as solar energy, wind energy, geothermal energy and others. To this end, the respective regulatory framework has also been established, in particular by approving Law No. 10 of 26.02.2016 on promoting the use of energy from renewable sources[2].

The aforementioned law, which is in line with European Union legislation, in particular EU Directive No. 2018/2001 on the promotion of the use of energy from renewable sources, aims to establish the legal framework and national objectives regarding the use of energy from renewable sources.

As Moldova defines its legislative and strategic framework for sustainable development, the need to combine the efforts of all parties involved in the fight against climate change is increasingly relevant. In order to achieve the objectives set out in national legislation, both state authorities and economic operators are involved. One of the examples in the field of tourism worthy of imitation are the good practices implemented by the "Castel Mimi" Tourist Complex.

3. Brief History of the "Castle Mimi" Tourist Complex

The basis of the "Castle Mimi" Tourist Complex was the winery that was built, in the form of a castle, in the years 1893-1900, by Constantin Mimi[3]. Respectively, the name "Castle Mimi" is due to its founder, Constantin Mimi, the last of the governors of Bessarabia, at that time Bessarabia was under Russian occupation. The architecture of the Mimi Castle was inspired by French architecture, and the locals usually call this castle the "Versailles Palace of Moldova". At the moment, the "Castle Mimi" Tourist Complex is recognized as one of the 15 most beautiful wineries in the world.

[1] https://www.legis.md/cautare/getResults?doc_id=99251&lang=ro.

[2] https://www.legis.md/cautare/getResults?doc_id=144985&lang=ro.

[3] https://castelmimi.md/despre-noi/?srsltid=AfmBOor1P4gvearcSczw-q4c11MXELbIh5K4-MYlSjGDB9vdzfXrQHBr.

During the Soviet period, the castle functioned as a winery, as was the basic purpose of the construction. After the independence of the Republic of Moldova, the winery was renovated in 2011-2015, and the owners set themselves the goal of creating a tourist complex based on it.

Accordingly, in addition to the wine and ethyl alcohol production facilities, the "Castel Mimi" Tourist Complex has cellars where wine is stored (which can be visited), a hotel, a restaurant called "Bufnița Albă" (White Owl), a museum, art galleries, wine tasting rooms, halls and spaces for events.

The "Castel Mimi" Tourist Complex became better known after, in June 2023, it hosted the second Summit of the European Political Community - a platform for discussions on the future of Europe, which was attended by over 40 heads of state and government from all over Europe[1].

4. The Hotel of the "Castel Mimi" Tourist Complex

The "Castel Mimi" Tourist Complex offered capacities and possibilities for visiting, wine tasting, food, SPA services, organizing events: conferences, workshops, seminars, etc.[2], but did not have accommodation. Accordingly, one of the priorities of the winery was the development of accommodation services, both for large groups and for small groups, especially for families. The concept has existed since 2014-2015, but every year it changes, because new technologies, new solutions appear, and the "Castel Mimi" Tourist Complex is oriented towards implementing the most modern solutions/materials/technologies, in order to invest in what will be current for many years to come.

The hotel's activity was intended to be launched in 2019, before the pandemic. The Covid-19 pandemic appeared, the activity was stopped. At the beginning of 2022, it was decided to resume the finalization and preparation activities to launch the activity, and in February 2022, the Russian invasion of Ukraine took place and the war began, which again stopped the activities for a certain period.

At the moment, the hotel is functional and has 56 accommodation places contained in 21 rooms and 7 bungalows, which can be divided to provide the possibility of accommodation for 2 people each. Demand for accommodation is, especially for groups of 50-100 people, therefore it is planned to expand the accommodation spaces.

[1] https://www.euronews.ro/articole/care-e-istoria-castelului-mimi-din-bulboaca-locul-in-care-e-organizat-summitul-co.
[2] https://ro.wikipedia.org/wiki/Fabrica_de_vin_a_familiei_Mimi.

5. "Green" Economic Thinking

The construction of the Hotel was based on "green" economic thinking. The owners set several tasks for the constructors and equipment distributors, so that in the end the Hotel's activity would correspond to the "zero emissions" principle. This principle was the basis for the selection of construction materials, technologies used, suppliers of electrical equipment, heating/cooling systems, ventilation systems - only environmentally certified materials and technologies.

6. Solution Selection

How to choose the best solution? As a rule, each bidder praises the solutions they propose: they highlight the positive aspects and talk less or not at all about the disadvantages of the solutions. In the end, it is demonstrated that some materials are not the most suitable. The selection criteria are the "filters", which are based on both the accumulated information and their own experience. Among these, the following should be highlighted, allegorically speaking: "experience and loss of money," "all our bumps and bruises," "a list of good, very good, bad and very bad", etc.

It is important to set the right task. For example, the boiler room must be energy efficient but also oriented towards the smallest possible negative impact on production. These must take into account and be compatible with ventilation systems, heating/cooling systems, etc. Everything must be planned organically, in close connection with other components. For example, suppliers usually ask questions, most frequently regarding engineering aspects and offer energy-efficient solutions for the hotel (accommodation services), but which could have a negative impact on the temperature of the cellars where the wine is stored, in particular, on its quality over many years.

7. Efficient Energy Management

One of the approaches established to achieve the general objective of a "zero-emission hotel" is the efficient management of the energy used for heating/cooling/ventilating the Hotel, which is argued by the need to ensure a balance between all instruments for generating electricity and thermal energy.

The Hotel corridor is arranged in such a way as to create an atmosphere of being in nature. Natural (living) trees are planted in the floor and optimal living conditions are ensured for them, including lighting, irrigation and ventilation. Thus, the lighting is natural, through glass windows mounted in the ceiling, combined with electric lighting, if necessary. The hotel is located above the cellars in which to store wine. The floor of the hotel, including the corridor, the corridor is raised 60 cm from the

base ground (cellar), ensuring underground ventilation and an irrigation system for the trees.

8. Use of Geothermal Energy

The cooling and heating of the Hotel is carried out with geothermal heat pumps. The basic principle underlying geothermal heat pumps is heat transfer, namely: in winter the heat extracted from the ground is transferred inside the building, to heat it, and in summer cold air is transmitted from the ground into the room. This process is possible because the temperature in the ground a few meters deep is practically constant throughout the year, usually varying between 10 and 16°C.

In this context, it is worth mentioning that, according to the Study "Geothermal Potential of the Republic of Moldova", the Republic of Moldova has medium and low temperature geothermal resources that can be used efficiently for both heating and cooling processes[1]. As mentioned, this resource is also used by the "Castel Mimi" Tourist Complex.

9. Use of Solar Energy

Geothermal pumps are connected to photovoltaic systems, which use solar energy. Accordingly, all the energy consumed in the hotel is generated, primarily, by the sun and geothermal resources. Given that in the Republic of Moldova we benefit from many sunny days, especially in summer, the use of solar panels represents a considerable advantage for large consumers of electricity. In the case of winter, when sunny or partially sunny days are fewer than in summer, respectively, less energy is generated, and in order for the pumps to operate, a boiler that operates on the basis of pellets is used, the latter being made of waste resulting from the production of vegetable oil.

Thus, a closed energy production circuit is ensured, within which the energy generated by solar panels and geothermal pumps is practically sufficient both for the operation of the Hotel, and for the entire cycle of wine production and storage.

[1]https://energie.gov.md/sites/default/files/document/attachments/proiect_final_geotermal_moldova_final.pdf.

10. Thermal Energy Transportation

The hotel of the "Castel Mimi" Tourist Complex uses the latest generation of technological systems for transporting thermal energy, used in European countries, such as Germany and Austria.

For this purpose, metal pipes and modern equipment are used, which ensure minimal heat loss. Metal pipes are placed, welded, insulated and arranged using the latest technologies, taking into account the characteristics of the soil (clay, sand, stone, earth). A concrete layer is installed above the pipes, which ensures their protection for as long as possible, including protection in the event of natural disasters, such as earthquakes. At the same time, the technologies used ensure minimal heat loss. Thus, if the average heat loss in the case of pipe installation according to current technologies used in the country is about 10-15%, in the case of the technology used by the "Castel Mimi" Tourist Complex, heat loss is 2-3%.

11. Heating/Cooling Technologies and Systems

The underfloor heating system, which is considered more efficient and is frequently used in our country, does not apply to the "Castel Mimi" Tourist Complex. All heating/cooling systems were imported from other countries and operate according to the principle of "slowly, but well", with the main objective of ensuring the greatest possible comfort for people (clients).

The "cold ceiling" system deserves attention – a cooling system that is installed in the ceiling, between the basic ceiling structure and the suspended ceiling finishing system. This creates a cellar system with natural air circulation. Cold air naturally flows downwards, ensuring a more comfortable temperature environment for breathing, while the floor temperature is 2-1 degrees higher than at the respiratory level, which provides a higher level of compliance for humans.

12. Energy Efficiency of Walls

The heating/cooling approach used for the floor or ceiling is also used for the walls. A 2 cm wide space is provided between the base walls and the finishing system (plywood), through which hot or cold air circulates (depending on the season), thus contributing to reducing heat/cold losses. According to some estimates, the costs of investing in such technology used for walls are recovered within 1-2 years.

The materials used for finishing the rooms are certified according to international standards and are imported, mostly, from European countries.

Even the furniture, which although made in the Republic of Moldova, is made of imported materials, with the appropriate ecological certifications.

13. Monitoring Electricity Usage

For efficient electricity usage, the "smart home" (SMART) concept is used, with "standby" and "operation" functions set. To ensure the functionality of the system, each room is separately connected to the control panel of the electricity and heating/cooling system. For example, each socket is separately connected to the control panel (server). For this purpose, over 32 km of electrical cables were used.

All functions are set and checked electronically, and on the control panel it is possible to check any information, from calculations of energy consumption to identifying certain deficiencies.

In the cold season, while the room is in "standby" mode, the average temperature maintained in the hotel is about 16 degrees Celsius. The temperature in operation mode is set to 20 degrees. It takes about 8 hours to reach from 16 to 20 degrees. As a rule, the hotel check-in is at 12:00. When the request for accommodation for that day is received, the temperature regime for the targeted room is set from the control panel and at 4 in the morning the boiler room starts the heating system for the targeted room, so that at 12:00 the temperature in the targeted room is 20 degrees. Thus, using passive heating/cooling systems, with targeted setting and launch of commands, considerable savings in electrical and thermal energy are achieved.

Ensuring intelligent operation is conditioned by the volume of investments, which are quite large. At the same time, large investments at the beginning are recovered over a certain period (not too small) but generate large savings for a long period of activity, thus ensuring the sustainability of the Complex's electrical system. According to estimated calculations, the return on investment occurs within 5-6 years from the installation and launch of the heating/cooling system. The company that installed the electricity provides guarantees and provides maintenance, ensuring the correct use of the applied technologies.

Everything is argued through calculations and efficiency. For example, the system provided that the electricity in the room should be disconnected 60 seconds after the client leaves the room. As a rule, there are rare cases when clients return to the room after 40-60 seconds. The possibility of reducing the time for disconnecting the electricity from 60 sec. to 54 sec. was examined and the electricity savings were calculated. The results were convincing that reducing the disconnection time from 60 to 54 sec. generates a significant saving per month/year. Accordingly, the electricity disconnection system after the client leaves the room was reset to 54 seconds.

14. Improving the Activity of the "Smart Home" System

To make the activity more efficient and prevent heat/cold losses, periodic calculations and measurements are performed, as a result of which new opportunities for the efficient use of electrical and thermal energy are examined, as well as new sources of their generation are identified.

a) Changing the roof. Thus, as a result of such checks, it was found that large losses of heat (in winter), but also of cold (in summer) were generated by the condition and structure of the roof. As a result, based on cost/benefit calculations, it was concluded that it is more profitable to replace the roof with a new, high-performance one, using materials with high energy efficiency, while preserving some old but good materials, such as slate.

b) Redesigning the entrance door to the building. According to the initial project, the entrance for guests to the hotel was located quite far from the entrances to the rooms. As a result of the calculations presented by specialists in architecture and electricity, it was demonstrated that the large distance from the entrance door to the building to the entrance to the rooms generated high electricity costs, especially in the evening and at night. As a result, the decision was made to place the entrance door to the hotel as close as possible to the entrances to the rooms, which has already been achieved.

c) Use of heat generated in the technological process of manufacturing wine production. As a result of some manufacturing processes of some categories of wine products, heat is generated (about 90 degrees). The amount of hot water/air could be more than sufficient to heat the hotel spaces in winter, thus avoiding the need to use the pellet-fired boiler. In addition, the possibility is being examined that in case of overproduction of the heat in question, it could be transmitted free of charge for the winter heating of the local kindergarten, thus ensuring a social benefit for the locality.

15. Arguments in Favor of Using Renewable Energy

Among the basic arguments that convinced the owners of the "Castel Mimi" Tourist Complex to switch to alternative energy sources are the following:

- awareness of the risk that greenhouse gas emissions pose to the future of the planet;

- the belief that, in order to achieve a common goal, each individual's contribution is necessary;

- preserving the legacy for descendants, both at the level of natural resources and at the level of their own sustainable business;

- resilience to crises, given that renewable energy is the main source of energy for the future, which ensures stability for entrepreneurs in the geopolitical situation of the Republic of Moldova;

- providing arguments, through their own example, that alternative energy sources can be identified and used to provide sustainability to the enterprise's activity.

The basic motivation for rethinking the concept of the "Castel Mimi" Tourist Complex's activity was the need for resilience to crises. As an argument, reference was made to crises that caused enormous losses for the enterprise. Thus, during the energy crisis of 2022, when there was a sharp increase in prices for energy resources, such as natural gas, electricity, etc., within a month the enterprise recorded a loss of profit for a year and a half in the production of ethyl alcohol and wine.

16. Conclusions

a) The fight against climate change can be successful when the risks associated with these changes are recognized. This motivation was highlighted by the participants in the Green Forum held at the Green Future Conference 2025, which took place on March 13, 2025, in Chisinau, being the main argument in the decision of economic operators to implement "green" technologies.

b) The openness and involvement of economic operators is essential for the implementation of the objectives of the Paris Agreement on climate change. The Republic of Moldova creates a legislative framework conducive to the fight against climate change, but the main contribution is from economic operators, whose activity generates greenhouse gas emissions and, depending on the technologies applied, economic activity can contribute to reducing environmental pollution.

c) The Republic of Moldova is committed to implementing the objectives of the Paris Agreement. By ratifying the Paris Agreement, our country demonstrates political will and commitment to the fight against climate change.

d) The Republic of Moldova can successfully implement alternative energy sources. The experience of recent years and market studies confirm the potential of our country in the use of renewable energy, highlighting, in particular, solar energy, wind energy and geothermal energy.

e) The use of renewable energy sources gives businesses sustainability and resilience to crises. The crises of recent years, in particular, the energy crisis generated by Russia's war of aggression against Ukraine, caused great losses to economic operators in the Republic of Moldova due to the enormous increase in prices for energy sources and high dependence on energy resource suppliers. The installation of solar panels, wind installations, the use of geothermal energy, as well

as the conceptual approach to the circular economy, can ensure the energy independence of the enterprise or reduce dependence on external sources, which gives businesses sustainability. Moreover, the electricity produced in excess of domestic needs can be sold to the network, which generates additional income for the enterprise.

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