CCEI

Cleaner and more cost effective industry in Macedonia

New greenhouses supplied with waste energy from REK Bitola

Developed under the project “MAK-09/006 Cleaner and more cost effective industry in Macedonia“ funded by the Norwegian Government and implemented by Norsk Energi and Centre for Climate Change

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The Norwegian Ministry of Foreign Affairs is funding the program MAK-06/009 Cleaner and more cost effective industry in Macedonia (CCEI), implemented by Norsk Energi and Centre for Climate Change. For more information about the program see www.ccei.org.mk. This pre-feasibility study is developed under the framework of the program in order to support the transition to a low carbon society in Macedonia.

The aim of this report was to assess the potential for using low temperature waste heat from REK Bitola to heat new greenhouses in the vincinity of the power plant. It was concluded quickly that the temperature of the cooling water at REK Bitola is not sufficiently high cover the need on greenhouse businesses. However the study provide useful input to potential future development of district heating system in the region based on heat produced at REK Bitola. The potential heat demand from greenhouses in the area along a future district heating main pipeline between REK Bitola and Bitola is assessed to 35 MW.

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Contents

Glossary of terms

cm	Centimeter
Country	Republic of Macedonia
ERC	Energy Regulatory Commission
EU	European Union
EUR	The EURO currency
GDP	Gross Domestic Product
The Government	The Government of Republic of Macedonia
ha	Hectares
IPARD	Instrument for Pre-Accession Assistance for Rural Development
kg	Kilogram
mg	Milligram
MKD	Macedonian Denars
mm	Millimeters
NATO	North Atlantic Treaty Organization
Nm3	Normal cubic meter
PPP	Public Private Partnership
REK	Rudarsko Energetski Kombinat (Mining and Energy Company)
SSO	State Statistical Office of Republic of Macedonia
SWOT	Strengths, Weaknesses, Opportunities, Threats

1. Greenhouse heating models

1.1. Overview

In the following section will be explored all the greenhouse heating models currently used in Macedonia by the most serious agricultural producers. All entities have to be aware that the Macedonian market in the area of the production of agricultural goods in greenhouses using heating is underdeveloped. This means that as of the moments very few business persons have constructed or are in the process of constructing the same. However, this market condition has to be viewed as a positive thing, since the potential for construction of new greenhouse heating capacities in the country is huge.

In the moment there are three types of greenhouse heating models mostly exploited in Macedonia, as following:

- Wood
- Natural hot spring water, and
- Gas

1.2. Wood heating systems used in Macedonia

In the moment, in Macedonia, the most widely used model for heating greenhouses is the wood heating system. Many of the agricultural producers use this model for various reasons, but the two most important are a) because it is cheap to build the stove and the entire system, and b) because wood is the most available and cheap resource in Macedonia.

The cost of the equipment for this kind of heating system is very low as compared to conventional fossil fuel systems.

However, it has to be clear that wood heating systems are used by smaller producers – up to one hectare, because the cost-benefit of using wood for larger capacities is negative. Additionally, the wood industry in Macedonia was not regulated in the past, but in the last few years there is a trend to limit the uncontrolled devastation of the Macedonian forests. This indicates that wood will become more expensive and harder to get in the coming years.

1.3. Heating systems using geothermal water

In Macedonia there are only a couple of places where natural hot spring water is utilized for greenhouse heating. The four most famous places are the village of Bansko, near the city of Strumica, located in Southeastern Macedonia, as well as the cities of Gevgelija, Kochani, and Vinica. These two areas are famous for the natural hot spring water, and the population there uses it for various purposes, most notably for greenhouse heating.

However, the usage of natural hot spring water in Macedonia is not regulated, and it is expected that in the following years there will be changes in this segment. Finally, this

two places offer limited possibilities for expansion, since most of the thermal water resources are already used by existing producers.

1.4. Gas heating system

Gas is used by the largest producers of agricultural goods in Macedonia. Sometimes it is used only as a supplement to other methods of heating, but mostly it is used as the main source of heating. Even though, this method is the most expensive as of the moment, it represents the most reliable resource for the business people in the agricultural sector. It has to be explained that Macedonia has limited resources and infrastructure for gas, but there are governmental and municipal plans for gasification of entire regions in Macedonia in the coming decade.

When gasification is implemented the business sector will get priority and privilege for its utilization, compared to the private and public sector facilities, which are planned for the second phase of gasification. That is why it is expected an increased usage of gas in the heating of greenhouses in the future, as the most reliable resource.

1.5. Heating model that will be potentially used around REK

TPP Bitola is a potential efficient source of thermal energy for district heating of the town of Bitola and for agriculture production in greenhouses. Two out of three turbine units of the TPP Bitola can be reconstructed to work as combined heat-and-power (CHP) plant for electricity and heat generation. For the purpose of heat generation partly utilized steam can be used, with low work capacity, which has already performed significant amount of mechanical work in the high and intermediate pressure turbine stages. Such working medium has still enough high parameters, required to obtain heat for district heating system. According to the operational experiences related with power plants of the same or similar capacity and design characteristics, with reconstruction of two units of TPP Bitola it will be possible to obtain a thermal energy source for distant heating with a maximum capacity of 2x200 MWt, which is more than enough for covering present and future demands of the town and of the agriculture producers in the near-by area.
From a technical aspect, in order to be capable to deliver thermal energy for heating purposes, it is necessary to provide reconstruction of the steam turbines intermediate and low pressure stages on the Units 2 and 3 and to install the necessary equipment in order to be technically capable for regulated steam withdrawal. They will serve as baseline heat sources. The steam that will be used should be low pressure, of the order 1.3÷2.5 bar and 180-200^{o}C (note: higher steam pressure for this purpose results with bigger energy losses!).
It will be necessary to install base-mode equipment for distant heating in the heat exchanging & pump station (HEPS): baseline heat exchangers, circulating pumps, collectors, pipeline connections, regulation & control equipment, etc., which will be located in the premises of TPP Bitola. In steam-water heat exchangers of the HEPS, water will be heated and then transported via transmission pipeline system (130^{o}C/70^{o}C) to the town and to greenhouses.
The logical trace of the transmission pipeline TPP Bitola-Bitola town will pass through high-quality soil for agricultural production. Thus, there have to be connection(s) on the

pipeline for the municipality of Novaci, for greenhouses and, possibly, for heating of some households. Due to the expected capacity of this part of the system (for heating of greenhouses), which is about 60 MWth, there have to be a heat exchanging and pump station in Novaci and several sub-stations, with all the necessary equipment and installations.
An extra heating facility (local boiler plant) may be needed just as a preventive measure, for a case of unexpected interruption of heat supply from the power plant.
All of these factors must be included in the final business plan before the final decision to construct such a heating system.

1.6. Future trends

Macedonia and the agro business people in the country are modernizing the production of agricultural goods, and it is expected that immense changes will occur in this industry in the coming decade. All of these changes will be initiated by:

- The increased financing of agriculture by the Macedonian banks and EU funds (IPARD), which require implementation of modern technology and ways of cultivating crops in order to receive financing.
- Increased subsidies by the Macedonian government, which in the last couple of years go beyond 100 million euros per year and are motivating the producers to increase production.
- The accession of the country in the EU and NATO, which will open the borders and increase export, and in the same time motivate foreign investors to come and open businesses in Macedonia in this sector, and
- The emerging trend for planned production, which will stabilize the agricultural sector and make Macedonian producers more competitive on the domestic and foreign markets.

2. Location analysis

2.1. SWOT analysis of the Pelagonia region

Strengths:

- The geographic location of the region
- Extensive regional and local infrastructure
- High potential for dynamic development of agriculture in the region
- High rate of economic development in the region
- Beneficial conditions for the use of alternative energy sources

Weaknesses:

- Underdeveloped infrastructure in rural regions
- Demographic ageing of the population and its limited educational upgrade
- Threatened environment as a result of energo-industrial polluters
- Limited use of alternative energy sources
- Underdeveloped and old-fashioned agriculture

Opportunities:

- The utilization of alternative energy sources for industrial and agricultural needs
- Increased EU and governmental financing in the agricultural sector
- Construction of new modern greenhouse capacities
- Entry in the EU and NATO and the opening of foreign markets
- Possibilities for investment in the agricultural sector by foreign companies

Threats:

- The demographic composition of the population
- Political stagnation in the EU and NATO accession talks
- Continued disobedience and non-compliance with state laws and regulations
- Lack of modern educational facilities for agricultural studies
- On the basis of the SWOT analysis we can identify the potential areas in which the region can invest and develop:
- Crafting and implementing a regional strategy for the utilization of alternative energy sources
- Modernization of the agricultural sector by using EU funding in order to modernize the production and produce quality crops suitable for export in the EU countries
- Motivating young people to stay and work in the region

- Utilizing the vast amount of available arable land for increased production of agricultural products
- Opening regional agricultural storage and cooling centers to help the producers with their warehousing needs (because as of the moment the producers unable to sell their produce have to throw it or sell it at lower prices)

2.2. Profile of the Pelagonia region

Geographic characteristics

The Pelagonia region is comprised of the Pelagonia and Prespa valley basins, and it covers an area of nearly 4,700 squared kilometers or around 19% of the territory of the Republic of Macedonia. This region includes nine municipalities with 343 populated areas, of which 338 are rural areas and the rest small towns and cities. In the pre-feasibility study are included only three municipalities – Bitola, Novaci, and Mogila, since they are situated on the way from REK Bitola to the city of Bitola, where it is planned to pass the future heating infrastructure.

Additionally, around 68% of the population lives in urban areas, and there is a tendency this number to increase in the future, which will leave less people in the rural areas resulting in smaller numbers that will work in the agricultural sector. This may be changed with investment in this sector and stimulation of the population by various means, such as EU financing and government subsidies.

The population density is 50 people per square kilometer, and it is far below the country average.

The region is connected with two country borders – Greece and Albania, which enables transport and export of fruits and vegetables directly to foreign markets.

Environmental characteristics

The Pelagonia region has good climate conditions for the development of agriculture, and especially for cultivating industrial crops. The agricultural land in the region represents 276,777 ha or around 23% of the total agricultural land in Macedonia, of which nearly 117,000 ha is arable land.

The most important water resource in the Pelagonia region represents the Pchinja River, from which around 100,000 ha of arable land can be irrigated. Additionally, for irrigation purposes of the agricultural land in Pelagonia of imminent importance are the water accumulations Strezhevo and the Lake Prilep. Finally, the government also plans constructing, in the coming decade, two other accumulations on the Crna river – Chebren and Galishte.

Population

According to the 2002 census, there are 238,136 people living in the Pelagonia region, 1.8% less compared to the previous census in 1994.

The educational structure of the population in the Pelagonia region shows that, despite the negative demographic trends, the region has high literacy rate and quality human resources.

Business and industry

On the basis of the data from the State Statistical Office (SSO) the Pelagonia region had GDP of 6,342 EUR per capita in 2005, which is 4% higher compared to the average in the country, and around 28% of the EU27 average.

These numbers put the region in the second place in Macedonia from the total of eight regions, and it represents 12% of the total country GDP. Small businesses recorded significant growth of 48% in 2006 compared to 2003, but it was not enough to cover the losses of the big industrial capacities.

The movers of the economic development in the region are the small enterprises, which participate with 55% in the total production and employ around 60% of the total employees in the region as of 2006 (the last official census).

The agricultural sector in the region participates with 4% in the total production and employs around 5% of the population in the region. Even though, these numbers are low we should have in mind that large numbers of the agricultural producers are small individual farmers in the informal sector, or they are unregistered as business entities – which dictate the statistical numbers.

In reality, the natural conditions for the development of agriculture in the region point that this sector has huge potential to initiate fast economic growth in the future if the resources are utilized optimally. The current conditions in the agriculture show that the Pelagonia region is characterized with strong specialization in the production process of numerous crops, including: cereals (wheat, barley, maize, sugar beet, and sunflower), tobacco (Virginia), vegetables (peppers and onions), and fruits (apples).

Transportation infrastructure

The region is characterized with modern roads and other infrastructure that connects it with Greece and Albania, as well as with all the major roads, highways, railways, and airports in Macedonia.

The roads Bitola – Florina (GR), Bitola – Korcha (AL) – Ioannina (GR), Bitola – Elbasan (AL), as well as the railroad Bitola – Thessaloniki (GR), are of huge importance for the region.

The geographical position of the region and the city of Bitola as the largest populated area in it initiated the development of new transportation networks around Bitola, with continental main roads, regional and local roads, and railroads.

The most important traffic and communicational directions are Bitola – Prilep (marked with M-5) a main road that is connected to the highway that has an international meaning (E-75 or M-1); then Bitola – Ohrid (M-26 or M-5) that is connected to the western main road; as well as the road Bitola – Florina (GR) (marked as M-5).

The routes Bitola – Krushevo, Bitola – Demir Hisar – Kichevo, Bitola – Pelister, Bitola – Nizopole, Bitola – Novaci, Bitola – Bistrica – Dragosh, Bitola – Bach, Bitola – Makovo – Rapesh – Staravina belong in the group of regionally important roads. The most numerous are the roads with local characteristics, namely Bitola is connected to almost every village in the local community by a modernized or non-modernized local road. The most important roads are Bitola –Kazani – Capari, Bitola – Mogila, Bitola –Crneec, Bitola – Lopatica and others.

The city is also connected through a railroad in the direction Bitola – Prilep – Bogomila – Veles, and from there with directions to Skopje, Gevgelija or Shtip. Bitola is connected by railroad with Greece, through Florina, Edessa and Thessalonica.

The physical closeness of the state border is a special feature of the geographical position of Bitola that increases the city's attractiveness as a regional business center. The importance of the traffic communications can be increased only if several transport closely related and dependable functions are developed.

Thus, the majority of transportation companies, customhouse section with the terminal, and the frontier crossing Medzitlija – Kremenica, are in function of the traffic and all together take part in the potential of developing Bitola into an important traffic gravitational region.

Generally speaking, the city located in the central-south part of the Republic of Macedonia, stands for the second largest economical center after Skopje. Set in a region with developed agriculture and important industrial potentials, Bitola is becoming an important center, not only in the Pelagonia Valley, but also wider in the southwestern part of the Republic of Macedonia, to make a broader international gravitational influence.

The developed infrastructure gives a huge boost to business people and companies and helps them communicate and trade with foreign partners directly. Infrastructure is an important precondition for developed trade and business, especially agriculture, since huge quantities of materials and products have to be transported to and from Bitola, and the Pelagonia region as a whole.

3. Climate analysis

3.1. Climate in the Pelagonia region - overview

Bitola, the Bitola region, as well as the whole Pelagonia Valley are rather southern positioned and due to the latitude have an altered Mediterranean climate.

But, although the Pelagonia Valley is at a distance of 155 kilometers from the Adriatic Sea, and at about 130 kilometers from the Aegean Sea, still the Mediterranean climate influence is not much felt, because of the high mountainous surrounding of the valley, and its own height above the sea level (it is between 571 and 770 meters). That is why the temperate-continental, continental and mountainous climate are mostly felt.

Generally speaking, if we analyze the characteristics and the appearance of the climate phenomena during a year, we will see that Bitola and Pelagonia belong to a warm continental area.

The climate in Bitola has moderate – continental characteristics with an emphasized continental component, because of the closeness of the mountainous relief, the height above the sea level, the near-by valley etc., and these facts make the climate in Bitola and Pelagonia very dynamic and unstable.

According to the Koeppen's climate classification, the climate in Bitola can be marked with CSW "ax" – a specific variant of the etezic climate with dry and very warm summers, and a rainy winter period, divided into a shorter cold and dry periods, with the first maximum rainfall in autumn and the second one in spring.

This variant is called Macedonian variant of the etezic climate because it is typical for Macedonia, especially for the regions at 500-600 meters height above sea level. Bitola is a typical representative of this variant, with dry and very hot summer, and winters and springs with abundant rainfall.

Temperature

Officially Bitola is a main meteorological station in the Republic of Macedonia since March 16, 1945.

Average air temperature in Bitola in the period 1951-1995 is 11.1 degrees centigrade, the temperature amplitude is 22.5 degrees centigrade, and a year sum of monthly middle temperatures is 134.1 degrees centigrade. But, in some years the average air temperature reaches a great deviation.

The warmest months in the period 1926-1995 are July, with average monthly temperature of 22.2 degrees centigrade, and August – 21.7 degrees centigrade. The coldest months are January with average monthly temperature of 0.6 degrees centigrade, December – 1.15 degrees centigrade, and February – 1.8 degrees centigrade.

In some years there are certain deviations for about 4 to 12 degrees in some particular months.

In Bitola, seasonal air temperatures in the period 1926-1995 are: in winter 1.3 degrees centigrade, in spring 10.9 degrees centigrade, in summer 21.1 degrees centigrade, and in autumn 12.2 degrees centigrade. But, there are some deviations for about 4 to 8 degrees for some seasons.

The highest temperature measured in the whole 1926-1995 period is 40.5 degrees centigrade measured before the war, on August 22, 1939, and 41.2 degrees centigrade measured on July 6, 1988. The lowest temperature for the same period is 24.3 degrees centigrade below zero measured before the war, then 29.4 degrees centigrade below zero measured on January 27, 1954, and 30.4 degrees centigrade below zero measured on January 7, 1993.

Rain

The Bitola region is one of those regions characterized with misbalanced and modified Mediterranean pluvial-metrical precipitation order. This regime is characterized with heavy falls in winter and dry summers.

Average year sum of the precipitation (for the 1926 – 1995 period) was 613.9 mm - a value that is recurrent every 2 to 3 years. In some years the average precipitation sum drastically varies from 358.8 mm (in 1953), 365 mm (in 1977), 426.4 mm (in 1993), 879 mm (in 1935) and 851.9 mm (in 1981).

The minimal sum of the precipitation occurs approximately once in 10 years, and the maximal sum of the precipitation occurs approximately once in 8 to 10 years. These two sums are characteristic for the two extremes – disastrous droughts and disastrous floods.

Late autumn has the most abundant precipitation and the first maximum of the precipitation is in November (about 77.2 mm), October (60.4 mm) as well as the first month of the winter – December (69.3 mm) and it is 34% of the average year value. The second maximum of the precipitation is in the late spring – May (57.8 mm) or about 10% of the average precipitation year value.

The maximal precipitation value has been noticed in December 1935 (252.6 mm), then in November 1943 (202 mm), November 1979 (221.5 mm) and in December 1990 (196.8 mm). The main precipitation minimum or more exactly the most drought months are July (34.2 mm) and August (33.8 mm), and the secondary minimum is in September (40.6 mm).

The average value of the precipitation in the vegetation period is 261 mm or 42% of the year sum, and the cold period is richer with precipitation – 352.9 mm or 58%.

The average number of the days with precipitation varies from under 70 to over 140 days – average about 114 days a year.

The average period of snow is lasting from December to March. The latest snow appears in April, and rarely in the beginning of May.

The average number of days with a snow covers thicker than 1 cm is 34 days.

Air humidity

The relative air humidity in Bitola is pretty high, and almost every month it is over 50%, and it has outstanding deviations throughout the year, which is characteristic for the Aegean Mediterranean regions.

The lowest relative air humidity can be noticed during the months with the highest average air temperatures, that is June (58%), August (58%) and July (57%). Conversely, in the course of the months with the lowest average air temperature, and abundant precipitation, the relative air humidity is the highest.

Relative air humidity per season is 79% in winter, 66% in spring, 57% in summer and 70% in autumn. The air humidity is 61% during the vegetation period (April to September), and 76% in the cold period (December to March), and the average year air humidity is 68%.

Hail

Hail usually falls during the period between April and October and it is most frequent in June, July and August and less frequent in April and May.

There are about 40 days a year with thundering and about 1 or 2 days with hail.

The size of the hail is between a few millimeters and one centimeter, and it falls for about 10-15 minutes, often damaging the vegetation, sometimes with a disastrous effect on the agriculture.

Icy

In Bitola and in the Bitola region the period with ice lasts about 168 days (between October 21 and April 6), and 84 of them are real days with ice (or 23% of the days in a year). The ice as a phenomenon appears between the end of October and the beginning of May. The period with ice occurs when the minimum temperature is below zero degrees centigrade.

Monthly average number of days with ice vary from: in December – 19 days, in January – 22, in February – 17, in March – 11, in November – 9, in October – 3, and in April – 2 days. The coldest months are January, and then December and February.

The average length of the period without ice in Bitola and the Bitola surroundings is 212 days. This shows that it is possible to grow plants with a long vegetation period, although the period without ice varies between 168 and 257 days.

Insolation

In Bitola, July and August are the months with the longest insolation, and December and January – the shortest.

The difference of the two extremes is 484.7 hours. The insolation is longer in spring than in autumn, or it is longer in spring – summer than in autumn – winter.

The average year sum of insolation for the 1951-1990 period is 2,325.6 hours, which is about 6.3 hours a day.

The evaporation during summer is enormous. The average year evaporation for the April – October period is 751 millimeters that is three times more than the precipitation (256 millimeters) for the mentioned months.

Climate and agriculture

Based on the above mentioned climate facts and information we can conclude that the combination of Mediterranean-continental climate is ideal for agricultural production. The vegetation period (March to October) is long enough to guarantee ideal conditions for quality crops.

The warm weather indicates that for most of the year heating would not be required, since summers and autumns are warm enough. However, during the coldest winter months, heating of the greenhouses will be required.

The demand for heating will be the highest in December, January, and February, while for November and March will depend on the year and the weather, if it is warm or cold.

The capacity that will be potentially built to heat the greenhouses around REK Bitola should take into consideration these facts, especially the fact that heating would not be required during the entire year. Therefore, there needs to be plan of how to use or dispose of the hot water during warm months.

3.2. Emissions of harmful substances from REK Bitola

The following information is provided by REK Bitola, which conducts regular measurement of emissions of harmful substances from REK Bitola into the air. These include:

- Emission of SO2 (sulfur dioxide) – the measured concentrations in REK Bitola vary between 1,700 to 2,200 mg/Nm3. The maximum permissible levels of Sulfur Dioxide in the air is 400 mg/Nm3
- Emission of NOx (Nitrogen Oxides) – the maximum permissible emission levels of NOx are 400 mg/Nm3. The measured levels in REK Bitola are between 340-490 mg/Nm3
- Solid particles (dust) - the measured concentration of solid particles is 100-300 mg/Nm3, while the maximum permissible level is 50 mg/Nm3.

Six to seven kilometers from REK Bitola in the villages Gneotino, Ribarci, and Dedebalci are positioned fixed stations to measure the levels of the harmful substances in the air. These stations measure the parameters required by law, as following: smoke, sulfur dioxide, and aero-sediment.

All three parameters are constantly below the maximum permissible levels, and the official results are as following:

- The measured concentrations of emissions of smoke are between 0-30 μg/m3, while the maximum permissible levels of concentration are 50 μg/m3
- The emissions of SO2 are between 1-15 μg/m3, and the maximum permissible concentration is 150 μg/m3
- The measured concentrations of aero-sediment are between 25-170 mg/m3, while the maximum permissible concentration is 300 mg/m3

If the plan to construct the heating system goes ahead, and if investors decide to invest in new greenhouse capacities, a study needs to be made by experts about the quality of the crops that will be produced in this area, and about the potential health risks from these products, because of the presence of REK Bitola, and the harmful substances it releases in the air around the complex.

4. Legal analysis

4.1. Legal Analysis

For the purposes of the project and the pre-feasibility study a legal analysis was also completed. It includes all the legal norms that should be implemented and observed before the eventual start of the project implementation.

Regardless of the legal form under which the contractor and/or the developer of the project will appear the legal norms and regulations for all entities in Republic of Macedonia are the same, in the sense that it does not matter if the contractor/developer will be the state as a complete investor, a private entity, or the investment will be completed through a Public-Private-Partnership (PPP).

In any case, when the realization of a project concerns land that is in private ownership, all the legal acts are regulated by the Law of Expropriation. This implies that if there is any private land around REK Bitola and around the pipeline from REK Bitola to the city of Bitola it should be dealt under this Law.

This law regulates the expropriation of property and rights, which refers to land, buildings and other facilities (real estate) for construction and installation of facilities of public interest, determination of the public interest, and the determination of fair compensation for the expropriated real estate.

Public interest determined by this Law is the arrangement, rational use and the humanization of the space, and protecting and improving the environment and the nature with the construction and realization of the activities provided in the legal acts for space planning, including:

- Construction of railways, roads, bridges, airports and associated facilities and installations;
- Construction of power plants for electricity generation, buildings, facilities, and installation lines intended for transmission and distribution of that energy;
- Construction of buildings and facilities for postal, telephone and telegraph traffic; facilities for radio and television communications and information systems;
- Construction of facilities for defense and civil protection;
- Construction of border crossings;
- Construction of buildings and facilities for research and exploitation of minerals and other natural resources;
- Construction of water facilities and installations;
- Construction of streets, squares, parking grounds, and parks;
- Construction of landfills, treatment plants and other facilities for protection of the nature and the environment;
- Construction of gas and oil pipelines, similar infrastructure;
- Construction of cemeteries, water supply, sanitation, heating, and other communal facilities;
- Construction of education, science, culture, health, social care and sports facilities, where the activity is performed as a public service, and construction of

settlements in case of major natural disasters (earthquakes, floods, fires and landslides) and relocation of settlements (submersion, environmental reasons and construction of complex objects).

Public interest for construction of facilities and realization of other activities can be determined by other laws. The determination of the public interest to expropriate Estate of particular cultural and historical value determined by law is performed under conditions and manner specified by a separate law.

The beneficiary of any expropriation is the state. The expropriation is done for the needs of public service entities, public enterprises, public funds and the local government. Beneficiaries of expropriation can also be other legal or natural persons, when this is determined by a separate law. By expropriation, all ownership and other property rights are terminated (complete expropriation). By expropriation the state may limit the right of ownership with the establishment of the right of easement, lease, and temporary occupation for conducting preparatory works on a land (incomplete expropriation). The right of easement is established upon real estate in order to construct water, sewer, power lines, and other facilities of public interest.

When public interest is involved in real estate owned by natural or legal entity, and the expropriation entity does not know or could not know, it is considered that the property is expropriated, and the former owner is entitled to compensation under the provisions of this law within five years. The expropriated property belongs to fair compensation that can not be lower than the market value of the property. For the determination of fair compensation is determined a market value of the property based on criteria established by this law at the time of submitting the proposal for the expropriation or at the request of the owner or holder of any property right in the moment of determination of compensation. The compensation for the expropriated property and the expenses for the procedure for expropriation shall be borne by the user of the expropriated property.

If during the expropriation process of one part of a property it is determined that the owner has no economic interest from using the rest of the property then the expropriation is performed on the entire property. The request for expropriation of the remaining portion of the real estate may be submitted until the first instance decision.

A proposal for expropriation submits the beneficiary of the expropriated property to the Department of Property and Legal Affairs (authority for expropriation).

The proposal for expropriation in particular contains information about:

1) The proposer of the expropriation;
2) The property for which expropriation is proposed;
3) The owner of the property and holders of other property rights over it and their residence address;
4) The facility, or to perform other activities for which the expropriation is proposed.

In addition to the proposal for expropriation shall be submitted:

1) Statement from the Act on Spatial Planning, or the act which it replaces;
2) Numerical data for the real estate which is proposed for expropriation, and which is prepared according to the procedure and manner provided for in the regulation for geodetic work;
3) Offer for the type and amount of compensation for the property which is proposed for expropriation;
4) Proof of ownership of the real estate offered as a replacement for the expropriated real estate;
5) Proof of funds intended for compensation for the expropriated property.

Against the decision of the authority for expropriation an appeal to a Government Commission can be submitted

In the case of conversion of the purpose for which the expropriation was carried out, the decision for expropriation is canceled ex officio if the former owner of the expropriated real estate agrees with this. Concerning the cancellation of the decision for expropriation decides the authority that brought the decision. Property - legal relations between the beneficiary of the expropriation and the former owner, in the case of annulment of the decision for expropriation or cancellation of the proposal for expropriation, is solved in a procedure for determining compensation envisaged by this Law.

4.2. Determination and procedure for compensation

The compensation for the expropriated property shall be determined by rule, by giving other suitable property or money, if the former owner or holders of other property rights and the expropriation beneficiary do not agree otherwise. Compensation for the expropriated land shall be determined by giving in exchange other land that in size, quality and location is appropriate to the expropriated land. If the expropriation beneficiary does not have suitable land, or because of other circumstances (mass expropriation, expropriation of part of a small parcel) cannot compensate the owner, then the compensation is determined in financial terms. The market value of the expropriated land is determined on the basis of elements based on which, according to the customs and conditions and depending on the time and place, the market value of the property is determined.

When determining the market value of an expropriated land such as agricultural, forest and similar, the following things are taken into consideration: the worthiness and cadastral class of the land, the climate and economic conditions, the construction suitability, and the location's attractiveness.

The former owner of the expropriated land is entitled to compensation for the non-amortized value of the investments that are of importance for the purpose, the preservation and the improvement of the land. The former owner is also entitled to compensation for the crops, forest and the fruits, if previously the same are not included in the price.

The market value of the expropriated property determined by this law cannot be less than the price for the same or similar property that prevails in the free market. The market value is proportional to the price prevailing in contracts in the free market.

The expropriation beneficiary is obliged to the former owner, who lives in the expropriated facility, or operates a business, if he so requires, to give the owner another object which in size, quality, purpose and location is appropriate to the expropriated facility.

If there is a sharp difference between the value of the expropriated object and the object given as compensation, the expropriation beneficiary or the former owner is obligated to the other side to pay the difference in value.

4.3. Regulation of energy prices in Macedonia

The current Energy Law in Macedonia regulates the following elements: the objectives of the energy policy and the method for its realization, the energy activities and the method of regulating these energy activities, the construction of energy facilities, the functioning of the Energy Regulatory Commission (ERC), the electricity market, the market for natural gas, the market for crude oil and the oil derivatives market for heating and geothermal energy, the conditions for achieving energy efficiency, and the promotion of the use of renewable energy and other important energy issues.

According to the current Macedonian Energy Law all the legal and natural entities that produce energy, use the transmission and/or the distribution networks, and sell the energy to third persons are regulated by this Law. This implies that if REK Bitola continues with the completion of the project for heating greenhouses with low temperature heat, and sells this energy to third persons, in this case agro-business people, then it has to possess a license issued by the Energy Regulatory Commission. This implies that the price of the heating energy sold to agro-business people have to be determined according to the Law and the Energy Regulatory Commission.

Nevertheless, the consulted legal experts in relation to this problem, state that this issue is vaguely defined in the current Energy Law, and that there is no possibility as of the moment to provide correct interpreting of the Law, and whether the current methodology for calculating energy prices for the residential sector applies to greenhouses heated by low temperature heat from REK Bitola.

Finally, there are no additional laws regarding the construction of greenhouses. The investors need only a construction approval from the local office of the cadastre. Additionally, the investors have to make sure that they have an agreement for electricity supply with EVN, and a water supply permit from the local offices responsible for water supply and irrigation.

The objective of the Energy Law is to provide:

1) Reliable, safe and quality supply of energy to consumers;
2) Creating an efficient, competitive and financially sustainable energy sector;
3) Effective development of the energy sector;
4) Promotion of competition in energy markets, respecting the principles of non-discrimination, objectivity and transparency;
5) Increasing energy efficiency and encouraging the use of renewable energy;
6) Protection of the environment from negative influences in the performance of individual activities in the field of energy.

Activities in the field of energy in terms of the Energy Law are:

1) Production of electricity;
2) Transmission of electricity;
3) Distribution of electricity;
4) Managing the system for distribution of electricity;
5) Managing the electro-energy system;
6) Organizing and managing the electricity market;
7) Power supply to wholesale tariff customers;
8) Power supply to retail tariff customers;
9) Transportation of natural gas;
10) Managing the system for transportation of natural gas;
11) Distribution of natural gas;
12) System for distribution of natural gas;
13) Natural gas supply to tariff consumers connected to the transportation system of natural gas;
14) Natural gas supply to tariff consumers connected to the distribution system of natural gas;
15) Transport of oil and oil products by pipeline or product-lines;
16) Processing of oil and oil derivatives;
17) Storage of oil and / or petroleum derivatives;
18) Production of heating energy;
19) Production of geothermal energy;
20) Distribution of heating energy;
21) Distribution of geothermal energy;
22) Supply of heating energy;
23) Supply of geothermal energy;
24) Energy production from renewable energy sources;
25) Transit of electricity, natural gas, and oil or oil derivatives;
26) Trade with electricity, natural gas, systemic services for electricity and natural gas, and trade with oil and oil derivatives

The activities envisaged in the Law of Energy, can be performed by local and foreign legal entities on the basis of a license issued by the Energy Regulatory Commission under terms and conditions stipulated by this law, for each of the activities.

The activities can be carried out if the facilities, equipment and the installations for performing those activities meet the prescribed standards, technical norms, and quality

norms, and with their functioning do not endanger the people, any material goods, the environment, and the nature.

The public interest in the performance of the activities is provided by the executor of the activity by meeting the obligation to provide public service in a manner and procedure stipulated by the license for the respective energy activity, and in accordance with the conditions laid down in this law or other regulation.

The legal entity performing energy activities that are of public interest, if carries out additional energy activity that is of public interest, is obliged in his accounting books to provide separate accounting for each of the energy activities of public interest that it performs. The legal entity performing activities of public energy interest shall submit its annual audited financial reports to the ERC, as well as consolidated accounts for other activities and balances with an overview of revenues, expenditures, sources of financial investment resources, the manner of financing the investments and the results of each activity individually.

4.4. Energy Regulatory Commission of Republic of Macedonia

The issues concerning the regulation of certain issues in the performance of energy activities prescribed by law are carried out by the Energy Regulatory Commission of Republic of Macedonia. The ERC is completely independent in its operations and decision making within the frames determined by the law. ERC is a legal entity.

The Energy Regulatory Commission according to the rules for forming the prices of certain types of energy and other regulated services, is organizing the manner of formation, approval and control of the prices for power generation for tariff consumers, the supply service to tariff consumers, and the prices for regulated services for transmission and distribution of energy in the areas of: electricity, natural gas, oil products, heating, and geothermal energy.

Legal and natural persons are obliged to adhere to the prices approved by the ERC in accordance with the decision referred to in Article 22 paragraph 2 of the law.

With the provisions for the pricing of certain types of energy and other regulated services, it should be considered: the balance of interests of the providers of energy services and the consumers, the protection of consumers from monopoly prices, the creation of measures to encourage efficient operation of the regulated providers of energy related services, the creation of incentives for the development of competitive energy market for those energy activities that may be market related in this sector, the removal of cross subsidies between different consumer groups and between individual providers of licensed and unlicensed energy activities, and providing non-discriminatory terms and application of objective criteria and transparent methods. The ERC through the regulations for pricing of certain types of energy and regulated services should enable the wearers of the licenses to cover the costs of carrying out energy activities and adequate return on capital.
By the tariff systems for separate types of energy are determined: the criteria and measuring instruments for determining the categories of consumption and categories, groups and subgroups of consumers, computational elements for determining the

compensation for the supplied energy, power, and basis and methods for formation of tariff rates and their application on the accounting elements. Tariff systems for certain types of energy are prescribed by the ERC.

By the decision about the prices of separate types of energy and prices of certain services in connection with the performance of the regulated energy activities are determined the prices of individual energy types and/or service, in accordance with the relevant regulations for pricing.

The conditions for the supply of certain types of energy from the energy systems, in cooperation with companies supplying various energy service activities, are prescribed and adopted by the Energy Regulatory Commission.

The documents, data and information which are of confidential character are utilized and stored by the ERC in a manner specified by an Act in accordance with the regulations on data protection.

The holders of the licenses for performing certain energy activities are obliged to submit to the ERC: monthly, quarterly, annual and other reports concerning the activity, in a manner, terms, and content determined by the appropriate licenses.

4.5. Licenses

The energy service providers may not commence with work without a license for performing energy activities issued by the Energy Regulatory Commission.

No license is required to perform the following activities: production of energy exclusively for personal needs without using the transmission or distribution system, transmission and distribution of energy through direct lines, storage of oil and oil derivatives for personal needs, retail trade of oil and oil derivatives, retail sale of liquefied gas in pressured vessels, heat or geothermal energy production for personal needs, and transport of oil and oil derivatives with auto or rail tankers and other vehicles and their storage.

The license is issued for a period of three to 35 years depending on the type of energy activity, the volume of funds needed to carry out the energy activity, the duration of the right to use the appropriate energy resource, as well as the request of the energy services provider. One person or company may receive multiple licenses to perform multiple operations only under the conditions specified in the law.

The state institutions which, in the framework of their responsibilities defined by the law, carry out inspection and supervision over the operations of the license holders are obliged upon request from the ERC to provide information that is of importance for issuance or revocation of licenses. The license shall be terminated at the expiration of the period for which it was issued, by official revocation or at the request of the holder of the license. A license cannot be transferred to other legal or natural entities.

ERC shall issue the license if conditions stipulated by the Energy Law and the regulations based on this law are fulfilled not later than 90 days from the date of sending an official request.

The license shall enter into force on the date of the issuance of the approval for employment of a facility. The license can be changed at the request of the Licensor, if such change is not contrary to the law and other official regulations.

The ERC will initiate a procedure for changing the license ex officio if changes in the laws and other regulations occur, which govern the exercise of energy activities for which the licenses were issued.

5. Market analysis

Production of vegetables										
In tons	Potatoes	Onions	Garlic	Beans	Peas	Cabbage	Tomatoes	Paprika	Cucumbers	Watermelons
Republic of Macedonia	187.754	34.934	4.604	5.976	2.448	75.347	121.637	141.729	40.620	129.288
Pelagonia Region	26.296	9.488	1.025	884	190	5.276	7.901	26.449	2.233	19.280
Bitola	*9.195*	*2.474*	*411*	*396*	*146*	*1.599*	*2.634*	*4.720*	*605*	*3.101*
Prilep	*4.634*	*1.201*	*103*	*102*	*13*	*1.405*	*642*	*3.036*	*568*	*7.680*
Resen	*4.144*	*852*	*164*	*149*	*7*	*778*	*913*	*1.530*	*0*	*0*
Demir Hisar	*3.939*	*403*	*27*	*80*	*0*	*282*	*375*	*1.619*	*94*	*0*
Mogila	*1.256*	*541*	*238*	*34*	*0*	*324*	*1.830*	*2.133*	*612*	*3.849*
Krivogashtani	*1.115*	*1.350*	*36*	*33*	*6*	*225*	*648*	*8.712*	*60*	*550*
Krushevo	*761*	*1.860*	*0*	*33*	*4*	*232*	*320*	*3.112*	*30*	*710*
Dolneni	*642*	*322*	*4*	*26*	*0*	*171*	*202*	*647*	*120*	*1.221*
Novaci	*610*	*485*	*42*	*31*	*14*	*260*	*337*	*940*	*144*	*2.169*
Percentages	14,01%	27,16%	22,26%	14,79%	7,76%	7,00%	6,50%	18,66%	5,50%	14,91%

State Statistical Office

5.1. Production of vegetables

In the table are presented the vegetables that are mostly produced in Macedonia and the Pelagonia region. The potential producers that will use the heat from REK Bitola will also produce these vegetables, especially tomatoes and paprika.

However, the production will not be limited to these crops, because if there is a demand for other good from potential traders and buyers of vegetables then the producers may switch production.

On average around 15% of all vegetables produced in Macedonia are grown in the Pelagonia region, which indicates that the region has high potential for modernized and increased production.

Traditionally, the owners of greenhouses in Macedonia produce tomatoes, since greenhouses provide the ideal conditions for tomato production. Additionally, the domestic and foreign demand for tomatoes is huge, which dictates higher price too. Therefore, the potential investors in greenhouses that will use heat from REK Bitola will probably produce tomatoes intended for export.

Export quantities and value of vegetables				
Vegetable	Exported quantity/kg	Export value / EUR	Average price EUR/kg	Average price MKD/kg
Tomatoes	62.256.314	21.356.743	0,47	28,69
Watermelons	51.303.023	4.364.885	0,09	5,23
Cabbage	39.887.754	7.833.785	0,21	12,78
Cucumbers	20.717.836	8.091.191	0,49	30,05
Onions	9.581.215	1.533.952	0,20	12,27
Potatoes	2.783.339	635.826	0,22	13,65
Beans	92.850	87.218	0,94	57,71
Paprika	60.335	32.269	0,52	31,97
Garlic	25.948	9.071	0,35	21,48
Peas	1.098	171	0,16	9,57
Total	**186.709.712**	**43.945.111**		

State Statistical Office

5.2. Export of vegetables

On the basis of the most recent information published by the State Statistical Office in Macedonia, the country is regarded as one of the biggest producers and exporters of vegetables in the region.

The value of the TOP-10 exported vegetables from Macedonia represents nearly 44 million euros. Additionally, the amount of the TOP-10 exported vegetables from the country is nearly 188 thousand tons.

The biggest trading partners and export destinations for the Macedonian vegetables are the countries from the Former Yugoslav Republic – Serbia, Montenegro, Bosnia and Herzegovina, Croatia, and Slovenia.

Nevertheless, the Macedonian traders and producers, in the last couple of years, are opening new markets for vegetables in Europe of which the biggest are Bulgaria, Russia, Poland, Austria, and others.

With the construction of new modern greenhouses the quality of the Macedonian vegetables will significantly increase, which will make them more attractive for export in the largest EU countries, and with this motivate the producers to increase production capacities.

5.3. Potential heat users

The number of the potential heat users will depend on the cost of the heating energy supplied from REK Bitola. The price of the energy will, on the other hand, depend on the value of the investment and the strategy of the investor about the payback period of the investment. The price of thermal energy additionally depends on the Energy Regulatory Commission, which has clear rules and norms for setting energy prices on the territory of R. Macedonia.

Mostly, the heat users will come from the Pelagonia region, but the demand is not limited, because if the cost/benefit of their investment is positive then there is a possibility that investors from all around the country, as well as foreign investors, may be interested in investing in new greenhouse capacities around REK Bitola.

As of the moment estimating the demand for potential heat users is not possible, since it is not known if the heat system will cover only the area around REK Bitola, which is limited in space, or it will cover the entire area around the pipeline from REK Bitola to the city of Bitola. Moreover, the capacity of the entire system is still unknown.

The potential heat users will need to be, but are not limited to, financially stable business people, who can invest enough funds in order to construct greenhouses, since the technology for building modern greenhouses is expensive.

If, after this stage, the investor decides to invest in the heating system then an extensive market analysis can be conducted by specialized companies for market research.

Finally, if the project is supported by the Macedonian government and the EU office in Macedonia, and accordingly advertised, then the potential to attract numerous investors will significantly increase.

5.4. Market potential

According to the information provided by the management of the TPP REK Bitola, the land outside the borders of the TPP is owned either by the state or by private entities. There is no information available about how much land is owned by the state and how much by citizens.

Additionally, the land that is situated on the way from REK Bitola to the town of Bitola (12 km distance) is mostly private land owned by agricultural companies and small farmers. Based on the data provided by the municipality and the local branch of the Ministry of Agriculture there are around 5,000 hectares of agricultural land on the specified range.

Today this land is mostly used for agriculture or growing industrial crops, such as maize, wheat, sunflower, and tobacco. Additionally, there are numerous industrial facilities, especially on the entrance of the city of Bitola.

If we assume that 5% of the agricultural land, situated on the way from REK Bitola to the town of Bitola, is used to construct greenhouses (around 250 hectares) then the total production of tomatoes (if tomatoes are grown in the greenhouses) could be from 12,500 to 25,000 tons, because based on information received from agricultural experts, the minimum production of tomatoes in greenhouses is between 5 and 10 kg per square meter, depending on the season.

5.5. Potential investors

Potential investors in the heating system may be:

- REK Bitola – as the owner and seller of the heat energy to the agricultural producers
- Private investors – one or more private investors that will invest in the construction of the entire system and sell the energy to potential producers, and which will pay a fee to REK Bitola for the heat energy
- The government – can appear as an investors which promotes the agriculture and the business in the country
- Public Private Partnership – a combination of investors (REK Bitola, the Government, and Private investors) which will finance the entire heating system

6. Economic analysis

6.1. Cost of constructing greenhouses

The majority of greenhouses constructed in Macedonia in the last five to ten years are modern greenhouses using modern technology for growing crops.

This modern technology is significantly more expensive compared to traditional greenhouse models used to be constructed in the country in the last 20 to 30 years.

The biggest producers of modern greenhouse technology are countries such as Italy, Spain, the Netherlands, Greece, and Israel. According to agricultural experts and engineers from Macedonia, the average cost of modern greenhouses is between 25-40 euros per 1m2 depending on the technology used during the construction process and the transportation costs of the materials.

The cost of the traditional greenhouses is lower since they are covered by nylon instead of plastic or polycarbonate. Their cost varies, but in the majority of the cases it is between 5 and 15 euros per square meter, depending on the quality of the materials, and the technology used to grow the crops.

In the construction of the latest models of greenhouses are included the following elements:

- Materials for construction of the greenhouse – metal, plastic, and/or polycarbonate
- Heating and cooling equipment
- Sewage and drainage equipment
- Irrigation system
- Reservoirs
- Computer systems for regulating the irrigation, micro-climate, and nutrition, etc.

The cost of constructing the greenhouses around REK Bitola will be lower, since the value of the heating system and all the complement technology that goes with it will be excluded, which represents a considerable cost.

We have to mention the fact that with the help of IPARD funding the total cost of investments in the agricultural sector have become considerably lower, since IPARD finances 50% of all new investments that follow the strict rules of the agency.

Therefore, in order the heating system to be a success story, the support from the government, the IPARD agency, and all other governmental and non-governmental institutions related to this issue is essential and of huge importance.

6.2. Cost of operating greenhouses

The issue concerning the total cost of operating greenhouses in Macedonia was discussed with three major producers of vegetables. All three were not able to provide

detailed information about total costs, since, as they say, the costs vary continuously. Some of the major costs for operating greenhouses they cited were the following:

- Labor costs
- Pesticides and herbicides
- Other preparations needed to nourish the plants
- Seeds and seed materials
- Fertilizers
- Machinery
- Nylon
- Electricity
- Heating
- General and administrative costs, etc.

The majority of the total costs, according to the agro-business people, are variable costs, and they cannot be estimated with accuracy, since they depend on many external factors, such as weather conditions, price of vegetables, plant diseases, etc.

However, they were able to provide vague information about the share of heating costs compared to total costs. According to agro-business people, they use heat only for about 100 days in the year, and for the remainder of the year the production continues without heating. They put the ratio as 1:5 or around 20% of the costs are for heating.

Additionally, there were able to provide rough numbers for heating of one hectare of greenhouses or 10,000 m2. Based on this information, a business person has to spend between 125 and 200 euros a day depending on the type of fuel he/she uses – wood, gas, petroleum jelly, coal, etc.

6.3. Cost of construction the heating system

The estimation of the cost for constructing the heating system as of the moment is not possible. In order to estimate the total cost of the heating system we have to know the following information:

- The cost of the technology that will be used
- The capacity that will be heated
- The length and the quality of the pipelines
- The cost of the equipment that will be used for the system, and
- The cost of any facilities that need to be constructed.

7. Conclusions

The objective of this pre-feasibility study is to examine the feasibility of constructing a heating system using low temperature heat from REK Bitola to heat greenhouses.

The results show that the Pelagonia region has huge potential for increased production of vegetables in greenhouses because of the climate conditions, the tradition to produce quality crops, the geographical position, and the water resources.

If the heating system is limited only to the area around REK Bitola then expropriation procedures of private land and property in the area should be considered. Additionally, the level of harmful substances in the air and in the soil in the area should also be considered.

The whole investment may be financed by various means, but the most viable options are: the state as the complete investor, private entities as complete investors, and/or Public Private Partnership between the government and private business entities.

The sale, operation, distribution, and transmission of energy related products and services are regulated by a special law in Macedonia, and the Energy Regulatory Commission is the legal entity that determines all the elements in such cases.

Official statistical data show that Macedonia is a major producer and exporter of vegetables in the region, and with more modern agricultural technology and greenhouses it can cement its position. This will create a lot of economic activity and jobs.

The cost of constructing new greenhouse capacities using the latest technology is between 25 to 40 EUR per m2. The Macedonian government provides increased financing and subsidies in the agricultural area, and together with the IPARD agency and funds it is a major initiator of increased investments in this industry sector.

The cost of the heating energy will create the demand for constructing greenhouse capacities in the region, therefore the cheaper the heating costs the more the investors will invest in new greenhouses.

The project can succeed only with professional promotion and support from the government, the EU office in Macedonia, and all the governmental and non-governmental entities related to this issue.

With the accession of Macedonia in the EU and NATO in the coming years, an increased number of foreign investors in the agricultural sector are expected.

Appendix 1:

List of experts and professionals consulted:

Aleksandar Bozinov – PR and Marketing specialist – Macedonian PR Association – President of Managing Council

Nikola Sredovski – professional lawyer

Vasil Pockovski – Expert engineer in agriculture

Zhivko Jovev – CEO and owner of Frosina d.o.o. – owner of greenhouses and producer of vegetables

Appendix 2:

Map of the Municipality of Bitola, REK Bitola, and part of the Pelagonia region