SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN

MUNICIPALITY OF VALANDOVO

Period 2020-2030

Municipality of Valandovo

September 2019

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Name:
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Date:

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SUMMARY

This Sustainable Energy and Climate Action Plan represents a key document which defines the long-term vision of the Municipality of Valandovo to adapt to the inevitable impact of climate change through improvement of the energy efficiency and introduction of renewable energy sources in the buildings and transport sector, improving the management in the sector water and strengthening the capacity of the municipality.

This Plan defines the activities to be undertaken for achievement of the set of goals, the timeline for their implementation and institutional responsibility. The preparation of the document was incited by the “Covenant of Mayors” as one of the most important initiatives of the European Union focused on active involvement of the local and regional authorities against climate change. It is also the first and most ambitious initiative of the European Commission directed towards continuous urban involvement of the administration and the citizens themselves against the global warming.

Local authorities are key drivers of the energy transition and adapt to climate change at level of governance, which is closest to citizens. Local authorities share the responsibility to adapt to climate change with the regional and national authorities and are prepared to act whether or not the other parties fulfill their obligations. Local and regional authorities pave the way in the adaptation in all socio-economic circumstances and at all geographic locations in order to decrease the vulnerability of their areas to various consequences of climate change. Although decreasing of the greenhouse gas emissions is ongoing, the adaptation to climate change is necessary and requires additional actions in mitigation.

In accordance with the data for the reference 2018, Municipality of Valandovo has a total final energy consumption of 115,313.9 MWh at annual level. In addition, the tertiary sector has not been entirely processed due to lack of relevant information. The residential sector and the transport sector have been processed in accordance with the “top-down” methodology due to insufficient data at local level. It is recommended that the municipality performs a survey to collect sufficient data on energy consumption in the residential, commercial and service sector. Proposal for a questionnaire is annexed to this document.

The table below presents the estimated percentage of CO_2 emission reduction by implementation of the proposed measures for each sector and sub-sector separately.

Table 1: Planned reduction of CO_2 emissions on the territory of the Municipality of Valandovo

Sector	Estimated reduction of CO_2 emissions
Buildings sector – EE measures for reconstruction of the buildings’ envelope	
Municipal buildings	49.5 %
Buildings in the tertiary sector	58.9 %

Residential buildings	15.3 %
Buildings sector – EE measures for installation of solar collectors	
Municipal buildings	0.53 %
Buildings in the tertiary sector	2.6 %
Residential buildings	0.4 %
Buildings sector – EE measures for replacement of the existing lamps with energy efficient lamps	
Municipal buildings	1.1 %
Buildings in the tertiary sector	1.8 %
Residential buildings	2.4 %
Sector public lighting	
Public lighting	68.3 %
Sector transport	
Municipal transport	5.2 %
Private and commercial transport	0.06 %
Sector water	
Water	80 %

INTRODUCTION

The European Union (EU) is leading a global combat against climate change as one of the most important priorities. The EU is committed to reducing the total CO_2 emissions by at least 20% by 2020 compared to 1990 levels. Since according to official statistics from the Statistical Office of the EU (EUROSTAT), EU urban areas account for 80% of energy consumption and CO_2 production, local governments play a key role in meeting EU objectives and energy climate provisions.

Therefore, on 29 January 2008, the European Commission launched a major initiative to link the mayors of the European cities to a permanent network (Covenant of Mayors) with the aim of exchanging experience in implementing effective measures to improve energy efficiency in urban areas. Local governments have a leading role in mitigating climate change. Participation in the Covenant supports them in this endeavor and gives them recognition, resources and networking opportunities to raise their energy and climate commitments to a higher level. The “Covenant of Mayors” on climate and energy is open to all democratically constituted local governments with elected representatives, regardless of their size and the stage of implementation of energy and climate policy. Local authorities that join the initiative commit to submit an Sustainable Energy (and Climate) Action Plan within two years of the official signature, including streamlining reflections on appropriate policies, strategies and plans. So far from our country only the City of Skopje has joined the initiative and in 2011 prepared a Plan for the period until 2020.

Changes in this area that occur and are being ascertained globally, have necessitated the goal of reducing the overall CO_2 emissions, so the signatories with their new action plans are now committed to reduce the CO_2 emissions for at least 40% by 2030 and adopt an integrated approach to climate change mitigation and adaptation. This Covenant defines the role of the local authorities in implementation of activities through energy efficiency measures, renewable energy projects and other energy related activities in different areas that are under the jurisdiction of local authorities..

The signatories support common vision until 2050: speeding up the decarbonization on their territories, strengthening the capacity to adapt to the inevitable impact of climate change and enabling access to safe, sustainable and affordable energy for the citizens.

“Covenant of Mayors“

“Covenant of Mayors“ is one of the most important initiatives of the European Union focused on active involvement of the local and regional authorities against climate change and at the same time the first and most ambitious initiative of the European Commission directed towards continuous urban involvement of the administration and the citizens themselves against the global warming.

The signatories have common vision for sustainable future, regardless of the size of the cities or municipalities or their geographical location. This shared vision encourages efforts to address the interconnected challenges of climate change mitigation, adaptation and renewable energy. The signatories are prepared to adopt concrete, long-term measures that will provide ecologically, socially and economically stable environment for the present and future generations. They have

common responsibility to create more sustainable, more attractive, resilient and dynamic living areas.

Climate change is already happening and is one of the greatest challenges today at global level. It is necessary to act immediately and to cooperate with local, regional and national authorities from all over the world.

Local authorities are key drivers of the energy transition and adapt to climate change at level of governance which is closest to citizens. Local authorities share the responsibility to adapt to climate change with the regional and national authorities and are prepared to act whether or not the other parties fulfill their obligations. Local and regional authorities pave the way in the adaptation in all socio-economic circumstances and at all geographic locations in order to decrease the vulnerability of their areas to various consequences of climate change. Although decreasing of the greenhouse gas emissions is ongoing, the adaptation to climate change is necessary and requires additional actions in mitigation.

Climate change mitigation and adaptation mean number of benefits for the environment, society and the economy. When these problems are tackled together, new opportunities are created to promote sustainable local development. This includes building inclusive, climate resistant and energy efficient communities, improving the quality of life, stimulating investment and innovation, developing the local economy and creating jobs and improving stakeholder participation and collaboration. Local solutions for problems related to energy and climate change provide citizens with safe, sustainable and competitive energy at affordable prices, thereby contributing to the reduction of energy dependency and protecting the vulnerable consumers.

The Covenant has common vision that includes decarbonized areas, contributing to keep the global warming below + 2°C compared to the temperature in the pre-industrial period.

In accordance with the international Agreement achieved at the COP 21 in Paris in December 2015, this is a preparation for the inevitable adverse effects of climate change and acknowledgement of the need for universal and secure access to sustainable energy services and affordable prices for everyone to improve the quality of life and security of energy supply.

In order to achieve the vision, the “Covenant of Mayors” obliges the signatories to reduce the CO_2 emissions (and possibly other GHGs) for at least 40% by 2030, for more efficient utilization of the energy and for greater use of renewable energy. By sharing their adaptation to climate change, they will share their vision, results, experience and knowledge with other local and regional authorities inside and outside the EU through direct cooperation and exchange, especially in the context of the “Covenant of Mayors”.

The signatories of the “Covenant of Mayors” have the following responsibilities:

- Strong political leadership,
- Setting ambitious long-term goals that go beyond political mandates,
- Coordinated action and coordination of mitigation and adaptation by activating of all involved city and municipal services,
- Intersectoral and integrated territorial approach, allocation of human resources, technical and financial resources,

- Involvement of all relevant stakeholders in the urban areas,
- Enhancement of the citizens as key energy consumers, as producers-consumers as well as participants in the energy system that fits the demand,
- Urgent action, especially through undoubtedly useful, flexible measures,
- Implementation of smart solutions to address technical and social challenges during the energy transition,
- Regular adaptation of the measures in accordance with the monitoring and evaluation results,
- Combined horizontal and vertical cooperation among the local authorities and other levels of governance.

What does the Sustainable Energy and Climate Action Plan represent

The Sustainable Energy Action Plan (SEAP), or the new Sustainable Energy and Climate Action Plan (SECAP), describes how the local authorities will achieve their commitments until 2020/2030.

In the summer of 2015, the European Commission and the Office of the mayors – signatories of the Covenant, with the support of the European Committee, launched a consultation process for the regions to collect the views of the stakeholders on the future of the "Covenant of Mayors". The answer was united: 97% opted for new target after 2020, and 80% for a longer-term goal. Most supported a goal of at least 40% reduction in greenhouse gas emissions until 2030. Thus, the signatories will commit to support the 40% reduction greenhouse gas emissions in EU by 2030 and adoption of a common approach to tackle climate change mitigation and adaptation.

The SECAP is based on the BEI (Baseline Emission Inventory) and the RVA (Risk and Vulnerability Assessment), that includes analysis of the current situation. These elements serve as a base for identification of comprehensive set of activities that the local authorities plan to undertake in order to achieve the goals of climate change adaptation and mitigation. The signatories also undertake to report on progress every two years.

The Plan uses the results from the Inventory of reference emissions to identify the most important areas where concrete activities can be undertaken and which have the greatest potential for achieving targeted CO_2 reduction by the local authorities. The plan defines specific mitigation measures, as well as timeframes and responsibilities that will transform the long-term strategy into concrete achievable activities.

The "Covenant of Mayors" is based on activities at local level that are responsibility of the local authorities. The SECAP shall focus on measures that will assist in the CO_2 reduction and the reduction of the final energy consumption by the end users. The obligations under this Covenant apply to the entire geographical area of the signatories. Therefore, the Action Plan should cover activities for both public and private sector. However, local authorities are expected to set an example and therefore undertake most of the measures related to construction, transport, public lighting etc. The main target areas are the building sector, public lighting and urban transport. Local authorities may decide to define overall CO_2 reductions as absolute or "per capita" reductions. The

document may also cover activities related to local electricity production (development of PV, wind power, combining of CHP, improvement of the local energy production), as well as production of energy for heating and cooling.

Besides, the document shall include areas where local authorities can influence the consumption on the long run (such as spatial planning), to encourage the market towards energy efficiency products and service (representation), as well as changes in the behavior of the final user (work with citizens and other stakeholders). On the other hand, the industrial sector is not a key objective of the "Covenant of Mayors", and local governments may choose to include activities in the sector or not. In any case, the factories covered by ETS (European Emissions Trading Scheme) should not be included unless they are included in existing plans of local authorities.

Primary area of activity is energy saving, programs and activities in public buildings owned by the local authorities that represent significant energy consumers, such as the heating and lighting. In addition, important measures for reduction of the energy utilization might be achieved also in other services, such as the public transport (if any) and public lighting.

Spatial planning and organization of the transport system are the responsibility of most of the local and regional authorities, and strategic planning as well as introduction of energy standards for construction of new buildings might significantly reduce the energy consumption.

Local authorities can assist to inform and encourage its citizens, business sector and other entities at local level to use the energy more efficiently and to perform activities for awareness rising regarding the inclusion of the whole community in the support of the energy efficiency policies. They can also work for the promotion of the local energy production and encourage the citizens to implement own RES projects and activities through provision of financial support.

These obligations and roles of the local authorities arising from the "Covenant of Mayors" will be achieved through the development of an emissions inventory as a basis for development and implementation of the Sustainable Energy Action Plan. During the implementation of the Action Plan, local authorities should submit regular reports on its implementation to the European Commission every two years and regularly inform the public on the results, benefits and opportunities for utilization of the energy in a more efficient manner. For the smooth implementation of all these activities, it is necessary to adapt the structures of local authorities and provide sufficient human resources. Adapting the structures of the local authorities and to provision of sufficient human resources is necessary for the efficient implementation of all these activities. Throughout the process, local authorities will share experience and knowledge with other cities and municipalities, organize energy days and contribute to the annual conference of EU Mayors for a sustainable energy in Europe.

The selection of proposals for projects and activities that comprise the local Sustainable Energy Action Plans, shall consider the specific conditions of the local community and the structure of the document itself as defined by the guidelines of the Covenant of Mayors at the very beginning. This practically means that the local communities themselves are given considerable freedom to decide and select projects. For each of the proposed measures, they decide on the time of implementation (start and end), responsible persons for implementation, costs (unit or total per measure), savings (%, kWh, liters of fuel, MKD), i.e. potential for emission reduction (tCO_2e) and associated costs

(€/MWh). A proposal for the source of funding for implementation of each measure is also provided.

It should be taken into consideration that the first activities to be defined are the so-called 'soft measures' (measures of organizational nature) that should be connected to the mobilization of all stakeholders in the local community. At the very beginning of implementation of activities, it is also very important to define the organizational structure and assigning responsibilities to all actors within the local community that will participate in the implementation of the Action Plan measures, whether they are those that adopt decisions or anyone involved in their implementation.

Since this usually is a long process, the successful execution of the activity is related to its status in the municipal administration. It is important to emphasize that the Action Plan is multidisciplinary and intersectorial document and as such must be included in the daily activities of the municipal administration and of all departments that can find direct measures.

Goals for development of local sustainable energy action plans:

- Local employment;
- Local economic growth of the local community;
- Utilization of natural (local) resources (RES);
- Improving the living standard of the citizens;
- Reduction of the greenhouse gasses emissions.

METHODOLOGY AND DEVELOPMENT OF ACTION PLAN

Structure of the process

The process of development, implementation and monitoring of the Sustainable Energy and Climate Action Plan can be broken down in following six main steps:

- Preparatory activities for initiating of the process (political will, coordination, stakeholders),
- Preparation of Action Plan,
- Adoption of the Action Plan as official document of the Municipality,
- Execution of activities in accordance with the plan of priorities and activities and the schedule and timeframe set,
- Monitoring and control of measures set in accordance with the priority plan,
- Preparation of Report for completed projects in the provided timeframe.

Preparatory phase for development of the Action Plan

After the establishment of the working team, it is necessary to establish also working groups. The persons in the working team will be assigned to a working group in accordance with their qualifications, as well as a person that will be responsible for the tasks of each group. Since the successful development and implementation of the Action Plan is of the benefit of the citizens directly or indirectly, the participation of the stakeholders in all phases of implementation is very important. The stakeholders shall monitor the specifics of their concrete roles and tasks in the process of development, implementation and monitoring of the Action Plan. Participation of large number of stakeholders is the first indicator for changes in the attitudes and the behavior of the citizens toward the energy and the environment and their understanding and affiliation to the local community.

The city/municipality that is signatory of the “Covenant of Mayors” shall include the citizens in the development and the implementation of the Action Plan. Therefore, all those stakeholders that have interests related to the Action Plan in any way, whose activities influence on the Action Plan, whose ownership, access to information and expertise is needed for the development of the Action Plan, are involved in the development and the implementation of the Action Plan.

Preparation of the Action Plan

The first activity in the preparation of the Action Plan is determination of the timeframe for implementation, i.e. the selection of reference year. It is recommended to choose a reference year for which the city/municipality has information on the energy consumption and emissions. For Valandovo it would be 2018. The Action Plan will be prepared for the period until 2030, for which period is required preparation of Priority Activities and Measures Plan which will lead towards the achievement of the goals set for reduction of the CO_2 emissions.

Key element in the development of the Action Plan is to set a goal for reduction of the CO_2 emissions at municipal level until 2030. The Action Plan shall set the goals for reduction of the CO_2 emissions per sector and sub-sector for the energy consumption at municipal level.

In order to set realistic goals for energy saving and to decrease the CO_2 emissions until 2030, it is necessary to gather quality data on the energy situation and consumption for the reference year and the first step is classification of the sectors of energy consumption at municipal level.

The conducted energy analyses will assist in identifying the priority sectors of action, which will be elaborated in detail during the development of the Action Plan. Successful analysis of the energy consumption is a precondition for the quality of the delivered and processed data and their results represent input parameters for the development of the reference CO_2 inventory. The systematic collection of data and their processing is one of the most important activities for the development of the Action Plan.

Therefore, the development of the reference CO_2 inventory, which is being prepared in accordance with the IPPC protocol (Intergovernmental Panel on Climate Change), is very important activity within the Action Plan. Based on the data for CO_2 emissions for various sectors and sub-sectors, the situation regarding the energy in the reference year is being analyzed, forecasts for energy consumption until 2030 are being made and measures and activities for energy efficiency and renewable energy sources determined, as a Priority Measures and Activities Plan. The Plan will determine measures and activities that can result in CO_2 reduction of with satisfactory economic and energy parameters.

Key activity of the Action Plan is establishment of a legislation framework. All proposed measures and activities must be relevant to the local regulations, then with the national as well as with the EU legislation. Based on all activities that have been undertaken, it is necessary to set a realistic goal for CO_2 emissions reduction at municipal level until 2030.

Adoption of the Action Plan

The adoption of the Action Plan as official document of the municipality is a key element for its further implementation and achievement of the goal for reduction of CO_2 emissions until 2030. Therefore, it is very important that the leading representatives of the municipal administration participate in the preparation of the Action Plan and to monitor its implementation.

Implementation of the Priority Measures and Activities Plan at municipal level

The execution of some of the energy efficiency measures that will directly contribute to the reduction of the CO_2 emissions until 2030 is the most difficult phase in the process of development, implementation and monitoring of the Action Plan, which requires time, efforts as well as particular financial resources. The phase of preparation of the Action Plan will be finalized with the preparation of Priority Measures and Activities Plan, which includes identified measures for energy efficiency, potential for energy savings and accompanying reduction of CO_2 emissions. After the adoption of the Action Plan as official document, the municipality officially starts with the implementation, which is very complex and depends on several factors: economic, social,

commercial, societal, etc. The Action Plan requires successful collaboration of all partners and stakeholders on municipal level.

Monitoring and control of the implementation of the Action Plan

Monitoring and control of the Action Plan shall be carried out simultaneously at several levels:

- Monitoring of the dynamics and implementation of concrete measures for energy efficiency in accordance with the Plan,
- Monitoring of the successfulness of implementation of the Project,
- Monitoring and control of the goals for energy saving set for each measure of the Plan separately,
- Monitoring and control of the achieved reduction of CO_2 emissions for each measure separately.

The Advisory Board for energy efficiency and climate change is conducting the monitoring of the dynamics and the success in the implementation of the Priority Measures and Activities Plan.

Reporting on the results achieved with the implementation of the Action Plan

The signatories of the “Covenant of Mayors”, the cities/municipalities, commit to prepare Sustainable Energy and Climate Action Plan and commit to report to the European Commission on the dynamics and the success of its implementation every two years. The European Commission has prepared a form, which describes the key characteristics of the Action Plan. Since the Action Plan is comprehensive document for which review and control takes a longer period, it is sufficient that the signatories submit a completed form, which European Commission examines, `provides its opinion and forwards to the responsible person of the municipal administration. It is very important to set a real goal for reduction of the CO_2 emissions until 2030 in the municipality.

MUNICIPAL DATA

Valandovo is urban municipality in the Republic of North Macedonia with a population of 11,980[1]. There are 29 settlements on the territory of the municipality, the town of Valandovo, which is the seat of the municipality with a population of 4,402 inhabitants and 28 villages. The annual population growth rate is 10.4% and the population density is 35.88 inhabitants per km^2.

Geographical and climatic characteristics

Municipality of Valandovo is situated in the southeast part of the country. It covers an area of 331 km^2 between northern latitude 41°14' and 41°28' and eastern longitude 22°23' and 22°45' with an average altitude of 226 meters. The municipality is completely located in the Valandovo Valley, which is situated between the mountains Belasica, Gradeshka Planina, Plavush, Pogana, Kozhuf and Marjanska Planina.

With the new territorial division from 2005, the Municipality of Valandovo borders Municipalities of Gevgelija, Bogdanci, Dojran, Strumica, Konce and Demir Kapija, while defining the state border of the country with the Republic of Greece with a small share of eight kilometers.

According to the geographical characteristics, there is a domination of flatland villages (12) in the Municipality of Valandovo and only four are hill villages (Bashibos, Kazandol, Kochuli and Prsten.

The roads leading to Strumica, Dojran, Bogdanci and Gevgelija pass through the Municipality of Valandovo. On the left side of the River Vardar passes the Corridor 10/E-75. All settlements are connected by asphalt roads, which rank as IV, and connect the village with the city, with the regional road routes P-110 (village Udovo - village Rabrovo), P-604 (Orangeries - village Marvinci) as well as the local roads with which the Municipality connects with other settlements. Regional roads cover an area of 46.5 km, and local roads 74.3 km. The municipality is 26 km from the border crossing Dojran and 30 km from the border crossing Bogorodica, as well as 48 km from the border crossing Novo Selo.

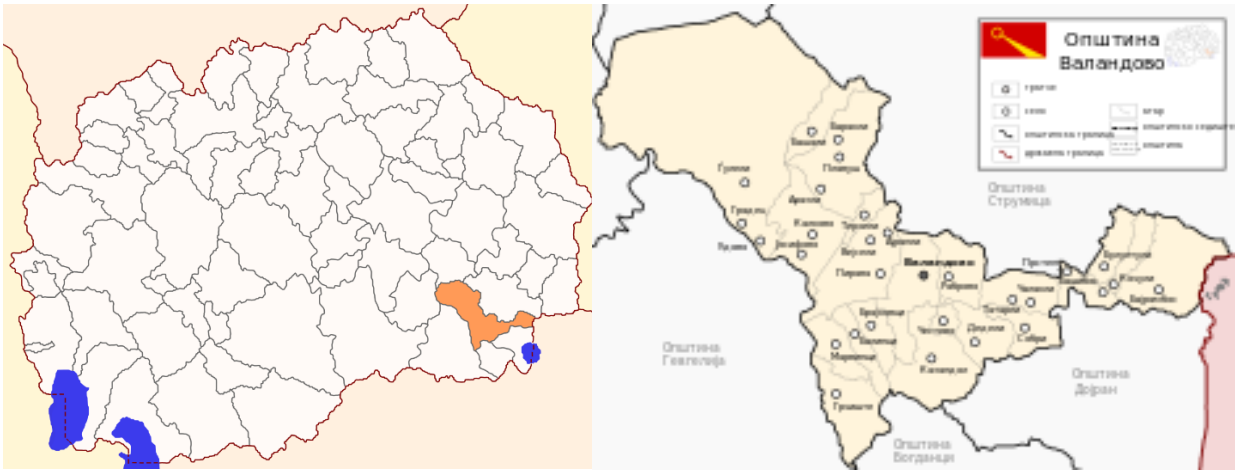

Figure 1: Location and map of the Municipality of Valandovo

[1] Statistics of the Census of Population, Households and Dwellings in the Republic of North Macedonia, 2002, Book XIII.

Significant part of Valandovo Basin falls under the thermal influence of the Aegean Sea (Mediterranean climate impact). The average annual temperature here is 14.5°C. The Mediterranean climate impacts are particularly evident in the cold season, which is also reflected in the relatively high temperature values in the winter months. The average temperature in January is 3.6°C. Due to the relatively good openness of the Valandovo Valley to north, quite low temperatures occur in the colder seasons, especially in the winter months, which disrupt the temperature stratification of the Aegean, sea climate influence. Temperatures below -8°C occur almost every year. The average freezing period lasts 118 days in the Valandovo Field. The average period with ice lasts 118 days in the Valandovo Field.

The values higher than 40°C happen once at every 4 to 5 years, while values above 35°C every year. High values of the heat regime are also manifested through increased number of summer and tropical days, i.e. days in which the daily maximum air temperature is equal or higher than 25°C (summer) or 30°C (tropical days). In average, there are 135 summer and 73 tropical days. The warmest month is July, with an average monthly temperature of 25.2°C. It can be said that the Valandovo Valley is most threatened by the spring frosts, especially those that appear during April. They have a particularly damaging effect on fruit plantations during their flowering period.

The precipitation regime in the Valandovo Valley is under Mediterranean climate influence. Summer months are low in rainfall, with the maximum fall in the late autumn months. The average annual amount of rainfall is 646 mm. The precipitation is highest in November with 85 mm, followed by December and October with 75 mm. The precipitation is lowest in July and August, with an average of about 30 mm. Autumn is a season with highest precipitation with an average of 203 mm and season with lowest precipitation is the summer with 108 mm. The precipitation is mostly of rain, and there are only 6 to 10 days of snow a year. Although the annual precipitation is quite high, dry periods occur with high frequency. Dry periods with duration of 10 to 15 days are very often. Hail appears almost every year, from April to October. The intensive hail often causes significant damages on farming.

Valandovo Valley is an area that has solar radiation, which lasts the longest period in Macedonia, with over 2,600 hours, i.e. the cloud coverage has the lowest value (average 4.3 tenths). The most prominent are the winds along the River Vardar: “Vardarec” from the North and “Jugo” from the southeast (Lazarevski, 1993). The mentioned climatic features provide excellent opportunities for development of diverse agricultural production, and in particular, cultivation of certain Mediterranean plants such as pomegranate, olive, fig etc.

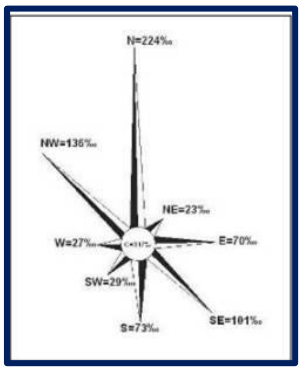

Figure 2: Rose of winds

Additional data about the municipality are provided in Table 2.

Table 2: General data about the Municipality of Valandovo

Description	Information
Address	St. “Ivo Lola Ribar“ bb
Website	www.valandovo.gov.mk
E-mail	administracija@valandovo.gov.mk
Part of larger municipality	/
Region	Southeast Region
Postal number	2460
Phone prefix	+389 (0)34
Municipal characteristics	
Area [km^2]	
City of Valandovo	1.2
Municipality of Valandovo	331,4
Population	
City of Valandovo	4,402
Municipality of Valandovo	11,980
No. of households	
Municipality of Valandovo	3,545
Land	
Agricultural land [ha]	10,000
Forests [ha]	24,910
Geographic characteristics and climate data	
Altitude (m)	110-150
Geographic characteristics	
latitude (° , ”)	(41°91'36“)
longitude (° , ”)	(22°42’52“)
Climate zone	1
Climate data	Heating season
Temperature for design of heating installation (°C)[2]	7.7
Average temperature during heating season (°C)	118
Length of heating season (days)	2,080

[2] Reference value for design of heating installations.

Potential for utilization of renewable energy

Municipality has significant potential for generation of renewable energy as described in the table below.

Table 3: Potential for utilization of renewable energy in the Municipality of Valandovo

Renewable Energy Sources	Description
Hydro energy	The River Anska as well as the rivers Hamadashi, Demidare and Elazdere pass through the territory of the Municipality of Valandovo. In accordance with the Study[3] for utilization of the hydro potential in this region, in event of construction of all planned SHPPs, the total annual electricity production would be around 1.13 GWh. The following watercourses have potential for construction of SHPP: › *Barlenski d. (with an installed flow of 0.225 м^3/s, installed power of 150 kW and produced energy of 580 MWh)* › *Demidere (with an installed flow of 0.183 м^3/s, installed power of 74 kW and produced energy of 288 MWh)* › *Elajzder (installed flow of 0.126 м^3/c, installed power of 68 kW and produced energy of 264 MWh)*
Geothermal water	Based on the study "Geothermal potential in eastern and southeastern Macedonia – creation of preconditions for utilization of the geothermal resources in the region Bregalnica – Strumica", the future research work in eastern and southeastern Macedonia should focus on already registered areas where there are indications of increased earth thermal flow and recorded surface manifestations based on previous geothermal examination, such as the region of Delcevo, extension of the geothermal area Vinica and Kocani, the region of Probishtip, the region of Valandovo, the region of Dojran – Valandovo and Gevgelija, in the zone of Vardar and contact area with the Serbian-Macedonian massif in the region of Bregalnica - Strumica.
Solar energy	Estimation of the potential in the residential sector can be carried out if assumed that 25% of the households in the Municipality of Valandovo will install solar collectors for hot water, meaning: 3,545 households x 25% x 2.2 m^2 x 600 kW/m^2 = 1.17 GWh Currently, on the territory of the Municipality of Valandovo there are two legal entities registered with a status of preferential generator of electricity 49.98 KW (204 panels @ 245 W) and 962.36 KW (3,928 panels @ 245 W) with a total installed capacity of 1,012.34 kW.
Wind energy	In accordance with the existing data and the prepared preliminary Atlas of winds of Macedonia, there is no location with potential suitable for utilization of wind energy identified on the territory of the Municipality of Valandovo.
Biomass (forest, agricultural and farm waste)	**Waste from logging of woods:** Forests occupy about 21,000 ha, or 63% of the territory of the municipality. Most of these areas (over 99%) are state owned forests. Private wood loggings are very small and are used exclusively for private use (firewood). The possible annual felling,

[3] Study for possibility for mini and small hydro power plants in the SR Macednia, National Committee for Energy of SR Macednia 1982

	meaning the total possible annual wood logging is just over 14,000 m^3. The planned gross annual volume of the PSC Saladjak - Valandovo on the territory of the Municipality of Valandovo is around 11,070 m^3, with anticipated waste by the norm of 10.31% or about 1,140 m^3. Assuming that the volume mass of such waste is 650 kg / m^3, and the heat capacity is 14.5 MJ / kg, it represents an energy potential of: 1,140 x 650 x 14.5 = $7.53x10^6$ MJ/year, or 2,100 MWh/year or 187 toe (tons of oil equivalent) year. **Waste from agriculture:** The total available area of agricultural land in the municipality is 8,449 ha out of which about 3,424 ha are used agricultural land. With an annual production of 3 tons of vine rods per hectare obtained while pruning, about 2,343 tons of biomass waste is produced for the total area of 781 ha of vineyards. The practical availability of vine rods is estimated at around 879 tons per year. If assumed a thermal power of the rods of about 11.5 MJ / kg, the total energy potential contained in them is: 879,000 kg/year x 11.5 MJ/kg = $10.104x10^6$ MJ/year, or 2,807 MWh/year or 241 toe (tons of oil equivalent) year. For a production of at least 1 ton of waste per hectare, about 224 tons waste from biomass is obtained from the pruning of orchards. **Waste from livestock:** The livestock waste contained in the manure is used for energy purposes primarily through biogas obtained by anaerobic fermentation. Cattle, sheep, goats, pigs and poultry are being breaded on the territory of the Municipality. In accordance with the Study on the potential and utilization of renewable energy sources in the cross-border region[4], in the Municipality of Valandovo, the manure waste from livestock and poultry is estimated at around 10,000 tons per year. It can produce a total of about 258 m^3 of biogas per year with a total energy of about 1.72 GWh or about 150 toe (tons of oil equivalent) per year.

The assessment of biomass in the region of Valandovo is presented in the table below:

Table 4: Gross wood mass produced in 2008[5]

No.	Subsidiary	Max. annual logging (m^3)	Planned annual logging (m^3)	% of utilization	Planned production of wood mass in 2008				
					Technical wood (m^3)	Firewood (m^3)	Total wood mass (m^3)	Waste wood (m^3)	% of waste wood (m^3)
	1	2	3=7+8	4=3:2*100	5	6	7=5+6	8	9=8:3*100
7	"Salandzak" - Valandovo	16,866	13,322	78.99	0	11,984	11,984	1,374	10.31

[4] Study on the potential and utilization of renewable energy sources in the cross-border region (Southeast region in the Republic of North Macedonia and southwest region in the Republic of Bulgaria)

[5] Popovski, K., Armenski, S., Popovska, E., Vasilevska, S., Energy from biomass in the Republic of North Macedonia

STRATEGY OF THE MUNICIPALITY

The initiative of the Municipality of Valandovo to prepare a document such as this Action Plan following the template of the "Covenant of Mayors", represents its commitment to implement activities and measures that will contribute to a 40% reduction in emissions by 2030. In accordance with the analysis carried out, the table below presents the measures that should be implemented per priority sector and objectives.

Table 5: Strategic sectors in the municipality

Sector	Subject of intervention	Type of measure
Buildings (municipal buildings, buildings in the tertiary sector and residential buildings)	Building envelope	Placement of thermal façade, replacement of the carpentry and insulation of the roof surface
	Renewable sources of energy for preparation of hot water and heating system support	Placement of solar systems for preparation of hot water and heating system support
	Energy efficiency in the system for public lighting	Replacing the existing lamps with new energy efficient technologies
	Introductions of systems for remote heating such as modernization and expansion of the existing systems	Construction of new systems for central/remote heating, as well as expansion and modernization of the existing heating systems
Public lighting	Complete program for revitalization of the public lighting	Replacing the existing lamps with new energy efficient technologies with prior energy audit and guidelines for procurement of new lamps
Transport	Modernization of the municipal fleet	Procurement of vehicles with lower greenhouse gas emissions, LPG propulsion fuel
	Increasing the energy efficiency of the municipal vehicles	Introduction of systems for energy management for the municipal vehicles
	Promoting the use of bicycles as means of transportation	Constriction of cycling pathways and supply of bikes for rental
Water	Set of measures for the water sector	These measures foresee placement of frequent regulation of the existing pumps, as well as supply pumps with incorporated frequent regulation in future. In addition, it is proposed construction of accumulation reservoirs and installation of renewable energy sources as a source of electricity for the pumps.

5 ANALYSIS OF THE SECTOR WITH VISION FOR FUTURE

Sector Buildings

5.1.1 Municipal buildings

The list of inventory of municipal buildings includes three types of facilities:

- Educational facilities
- Social protection facilities
- Administrative facilities

Regarding the educational facilities, there are two central primary schools (PMS) in Valandovo and Josifovo, ten regional primary schools (RS/RPS) and one secondary school (SMS).

In the municipality of Valandovo there is one central kindergarten “Kalinka” with regional facilities in the villages of Josifovo, Pirava, Udovo and Brajkonci. In 2019 started the central building that includes measures for energy efficiency. The kindergarten in the village of Udovo is extension of the existing school and is into operation since 2017. The kindergarten in the village of Brajkovci is a new building that started working in September 2019. For these reasons, this building will not be analyzed due to nonexistence of energy consumption history.

In addition, the municipality owns also the administration building and the Regional center for certification for which the municipality has not provided any data. The House of culture and the Fire station will be also excluded form the analysis.

Table 6: Overview of the municipal buildings

Type of municipal building	Description	No. of users[6]	Total area (m^2)
Educational facilities	- PMS “Strasho Pindzur”“ Josifovo	350	2,300
	- RS “29 Noemvri“ Kalkovo	49	191
	- RS “Jane Sandanski“ Grchishte	7	216
	- RS „Mito Simeonov“ Marvinci	30	333
	- RPS “Strasho Pindzur“ Udovo	67	573
	SMS “Goce Delchev“ Valandovo	258	3,400
	PMS “Josip Broz Tito” Valandovo	470	7,535
	- RS “Goce Delchev” Pirava	136	1,095
	- RS “Dame Gruev“ Brajkovci	40	323
	- RPS “Ham’k Kemal“ Chalakli	73	494
	- RS “Jeni Gjun“ Bashibos	9	153

[6] No. of users represents the total number of users of the facility. For example, for school it represents the total number of students and personnel of the institution.

	- RS “Mosha Pijade“ Dedeli	21	311
	- RS „Cvetan Dimov“ Kazandol	19	124
Social protection facilities	Kindergarten “Kalinka” Valandovo	169	1,022
	Kindergarten “Kalinka” Josifovo	46	140
	Kindergarten “Kalinka” Pirava	33	50
	Kindergarten “Kalinka” Udovo	44	130
Municipal administrative facilities	Municipal building	34	607
	Regional center for certification		230
	TOTAL	**1,855**	**19,227**

The following table presents the energy consumption and the related costs for each building separately.

Table 7: Annual energy consumption in the municipal buildings

End user	No. of users	Total area of the building m^2	Total heated area m^2	Electricity consump-tion kWh/a	Heat energy consump-tion kWh/a	Total energy consump-tion kWh/a	Specific electricity consump-tion kWh/(m^2.a)	Specific heat energy consump-tion kWh/(m^2.a)	Specific energy consump-tion kWh/(m^2.a)	Energy expenses MKD/a
Educational facilities										
- PMS “Strasho Pindzur”“ Josifovo	350	2,300	2,300	31,372	125,023	156,395	14	54	68	571,559
- RS “29 Noemvri“ Kalkovo	49	191	191	2,773	30,240	33,013	15	158	173	83,706
- RS “Jane Sandanski“ Grchishte	7	216	191	627	26,880	27,507	3	141	144	58,532
- RS „Mito Simeonov“ Marvinci	30	333	333	875	30,240	31,115	3	91	93	67,317
- RPS “Strasho Pindzur“ Udovo	67	573	573	3,809	50,400	54,209	7	88	95	132,493
SMS “Goce Delchev“ Valandovo	258	3,400	3,400	31,832	194,000	225,832	9	57	66	1,160,748
PMS “Josip Broz Tito” Valandovo	470	7,535	7,535	38,146	225,041	263,187	5.1	29.9	34.9	1,035,688
- RS “Goce Delchev” Pirava	136	1,095	1,095	8,214	75,014	83,228	8	69	76	310,932
- RS “Dame Gruev“ Brajkovci	40	323	323	1,300	28,002	29,302	4	87	91	102,960

End user	No. of users	Total area of the building m^2	Total heated area m^2	Electricity consump-tion kWh/a	Heat energy consump-tion kWh/a	Total energy consump-tion kWh/a	Specific electricity consump-tion kWh/(m^2.a)	Specific heat energy consump-tion kWh/(m^2.a)	Specific energy consump-tion kWh/(m^2.a)	Energy expenses MKD/a
- RPS “Ham’k Kemal“ Chalakli	73	494	494	3,173	57,120	60,293	6	116	122	140,282
- RS “Jeni Gjun“ Bashibos	9	153	153	391	10,080	10,471	3	66	68	23,291
- RS “Mosha Pijade“ Dedeli	21	311	311	1,959	16,800	18,759	6	54	60	49,419
- RS „Cvetan Dimov“ Kazandol	19	124	124	259	16,800	17,059	2	135	138	35,436
Total educational facilities	**1,529**	**17,048**	**17,023**	**124,730**	**885,640**	**1,010,370**	**7.3**	**52.0**	**59.4**	**3,772,363**
Social protection facilities										
Kindergarten Valandovo	169	1022	1022	34,815.10	175,031.50	209,846.60	34.1	171.3	205.3	923,224.48
Kindergarten Pirava	33	50	50	8,599.73		8,599.73	172.0		172.0	74,217.61
Kindergarten Josifovo	46	140	140	23,151.70		23,151.70	165.4		165.4	199,805.33
Kindergarten Udovo	44	130	130	8,174.86		8,174.86	62.9		62.9	70,549.00
Total social protection facilities	**292**	**1,342**	**1,342**	**74,741**	**175,032**	**249,773**	**55.7**	**130.4**	**186.1**	**1,267,796**
Municipal administrative facilities										
Municipal building	34	607	607	54,047		54,047	89		89	568,809

End user	No. of users	Total area of the building m^2	Total heated area m^2	Electricity consump-tion kWh/a	Heat energy consump-tion kWh/a	Total energy consump-tion kWh/a	Specific electricity consump-tion kWh/(m^2.a)	Specific heat energy consump-tion kWh/(m^2.a)	Specific energy consump-tion kWh/(m^2.a)	Energy expenses MKD/a
Regional center for certification		230	230	2,566		2,566	11		11	27,010
Total municipal facilities	**34**	**837**	**837**	**56,613**		**56,613**	**67.6**		**67.6**	**595,819**
TOTAL	**1,855**	**19,227**	**19,202**	**256,084**	**1,060,672**	**1,316,756**	**13.3**	**55**	**69**	**5,635,978**

5.1.2 Buildings in the tertiary sector

There are no official relevant data for the tertiary sub-sector that include commercial and service buildings, as necessary for the energy analysis. Regarding commercial buildings in the Municipality of Valandovo, in 2018 according to the database of the State Statistical Office, there were 343 active business entities, but the total area of these buildings and their energy consumption is unknown.

Regarding the service facilities, only the PHI Healthcare house Valandovo has collected information related to the energy consumption and the heated area. Од услужните објекти, единствено ЈЗУ Здравствен дом Валандово има колектирани информации во однос на потрошувачката на енергија, како и вкупната грејна површина. Therefore, it is recommended that the Municipality conducts a survey using a questionnaire for all existing entities performing commercial and service activities on the territory of the Municipality of Valandovo, which will provide the detailed data needed for further analysis. A template for the proposed questionnaire is attached to this document and can be used for data collection.

For the further analysis in the tertiary sector will be considered the data provided for the PHI Healthcare house Valandovo.

The Healthcare house is a two-story building with a total area of 2,800 m^2 of which 2,700 m^2 is heated area. The beneficiaries include 59 staff as well as the patients being served in this healthcare house. For the reference year 2018, the total number of patients was 26,474. The building is without a thermal façade, with old wooden windows that need urgent replacement. The following table provides overview of the energy consumption for the PHI Healthcare house Valandovo.

Table 8: Annual energy consumption in PHI Healthcare house Valandovo

Tertiary buildings	Electricity (kWh/год)	Heat energy (kWh/год)	Total (kWh/год)	Specific electricity consumption (kWh/м^2))	Specific heat energy consumption (kWh/м^2))	Specific energy consumption (kWh/м^2))
PHI Healthcare house Valandovo	97,826	465,600	563,426	36.2	172.4	208.7

5.1.3 Residential buildings

The data from the database[7] of the State Statistical Office database were used for the analysis of the data in the residential sector, as well as the publication "Energy consumption in households, 2014", prepared by the State Statistical Office and funded by the Energy Community. For the Municipality of Valandovo, the analyses are based on the data for the Southeast Planning Region,

[7] http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef

where this municipality belongs geographically, and as a percentage divided by the municipality's share in the total number of inhabitants in the planning region. Since the data in this publication are given for 2014[8], the data has been normalized according to the number of inhabitants of the Municipality of Valandovo for 2018[9], which is taken as a reference for further analysis. In terms of energy consumption, data normalization was performed based on the heating degree-days for this region.

The buildings of the residential sector in the Municipality of Valandovo are devided in two groups:

1. Individual residential buildings (49.7%)
2. Collective residential buildings (50.3%)

The average number of persons in the household in the Southeast Planning Region is 3.54, the average number of rooms in the household is 3.47 while the average dwelling area is 76.9 m^2 of which 39.77% or 30.58 m^2 are heated area.

Consequently, in the municipality of Valandovo the total population of 11,673 for 2018, live in 3,297 total of households, of which 1,639 live in individual family buildings and 1,658 in collective residential buildings. The total area of the dwellings is 253,539 m^2 of which 100,833 m^2 are heated area. There is no remote heating system in this municipality.

According to the construction period, most of the dwellings in the Southeast Planning Region were built before 1991, i.e. 84.22%. Only 15.78% of the total building stock was built after the Macedonia's independence, which is important for the analysis of the existing condition of buildings.

Regarding the insulation of the existing building fund, in the Southeast Planning Region only 7.44% of the total number of households is insulated. Below is provided data on other specifics related to the period of placement of the insulation, which structural elements and type of insulation used.

Table 9: Participation of the households in the total number of households according to the insulation used in the Southeast Planning Region

Insulation placing period:						Insulation placed on:												
						Exterior walls, with:				Roof, with:				Ceiling, with:				Floor, with
Before 1991	1991 - 2001	2002 - 2006	2007 - 2009	2010 - 2012	After 2012	Styrofoam	Tervol	Glass / stone wool	Other	Styrofoam	Tervol	Glass / stone wool	Other	Styrofoam	Tervol	Glass / stone wool	Other	Styrofoam
1.43	0.97	0.97	0.12	2.08	1.87	4.80	2.69			3.56	1.04			5.61	0.65			2.08

[8] http://www.stat.gov.mk/PrikaziPoslednaPublikacija.aspx?id=74

[9] In accordance with the database of the State Statistical Office, the estimated number of inhabitants in the Municipality of Valandovo in 2018 is 11,673. In accordance with the last Census from 2002, the population in Municipality of Valandovo was 11,980 inhabitants.

						7.49	**4.60**	**6.26**	**2.08**

In terms of existing carpentry, 70.86% of the total number of households has wooden windows, 19.25% PVC windows; aluminum is present in 9.18% while 0.71% of households have windows from other materials.

Table 10: Year of last placement of windows in %

Year of last placement of windows					
Before 1991	**1991 - 2001**	**2002 - 2006**	**2007 - 2009**	**2010 - 2012**	**По 2012**
59.96	**14.55**	**3.63**	**3.12**	**12.37**	**6.36**

The analysis of the heating energy consumption in the households, shows that the largest share are using wood and wooden residues for heating (85%), 11% use electricity, and the other fuels have insignificant participation[10]. The analysis of the types of heating used by the households shows that more than 80% use boilers on liquid and solid fuel, 12% use electric thermal storage heaters as the primary heating system and 4% as additional heating, while central heating with individual boilers is present in 6% of the households. Air conditioners, electrical panels and heaters are commonly used as additional sources of heating.

[10] The publication „Energy consumption in households, 2014“, does not provide information on the heating energy consumption in the Southeast Region for natural gas and oil for heating. The values for these heating fuels are transferred from the total fuels consumption for the region, normalized for the Municipality of Valandovo.

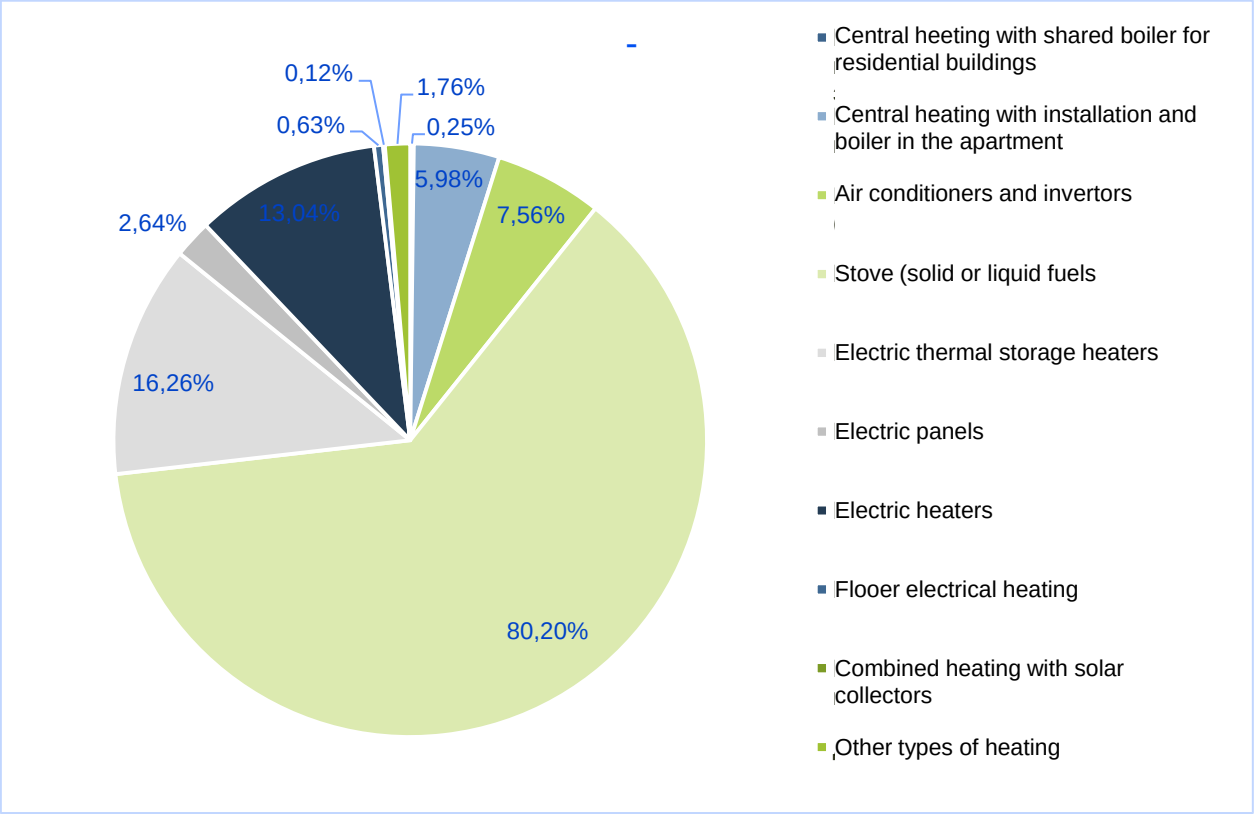

Figure 3: Types of heating in the residential sector in the Southeast Region

Regarding the total consumption, residential sector participates with 32,288 MWh on annual level of which 22,561 MWh are energy for heating or 70% of the total energy consumption in the households is being used for heating. The specific consumption per unit of area is chosen as indicator for energy consumption, and in relation to the total consumption, it is 127 kWh/m^2 on annual level, while the annual specific heating energy consumption is 224 kWh/m^2.

Table 11: Energy consumption in the residential sector in the Municipality of Valandovo

Residen-tial buildings	Area (m2)	Electricity (kWh/year)	Firewood (kWh/year)	Wood from orchards or other types of plant waste (kWh/year)	Wood residues, briquettes and pellets, (kWh/year)	Coal (kWh/ year)	LPG (kWh/ year)	Natural gas (kWh/ year)	Heating oil (kWh/ year)	Heating energy from public boiler (kWh/year)	Total (kWh/ year)
Heating energy consump-tion	100,833	2,423,095	17,352,999	154,631	1,722,591	1,992	699,512	31,276	174,615	-	22,560,711
	100,833	10.74%	85.24%			0.01%	3.10%	0.14%	0.77%	-	100.00%
Total energy consump-tion	253,539	12,150,352	17,352,999	154,631	1,722,591	1,992	699,512	31,276	174,615	-	32,287,968
	253,539	37.63%	53.74%	0.48%	5.34%	0.01%	2.17%	0.10%	0.54%	-	100.00%

Table 12: Indicators for energy consumption in the residential sector

Residential buildings	Area (m^2)	Electricity (kWh/year)	Heating energy (kWh/year)	Total (kWh/year)	Specific electricity consumption (kWh/m^2))	Specific heating energy consumption (kWh/m^2))	Specific energy consumption (kWh/m^2))
Heating energy consumption	100,833	2,423,095	20,137,616	22,560,711	24	200	224
Total energy consumption	253,539	12,150,352	20,137,616	32,287,968	48	79	127

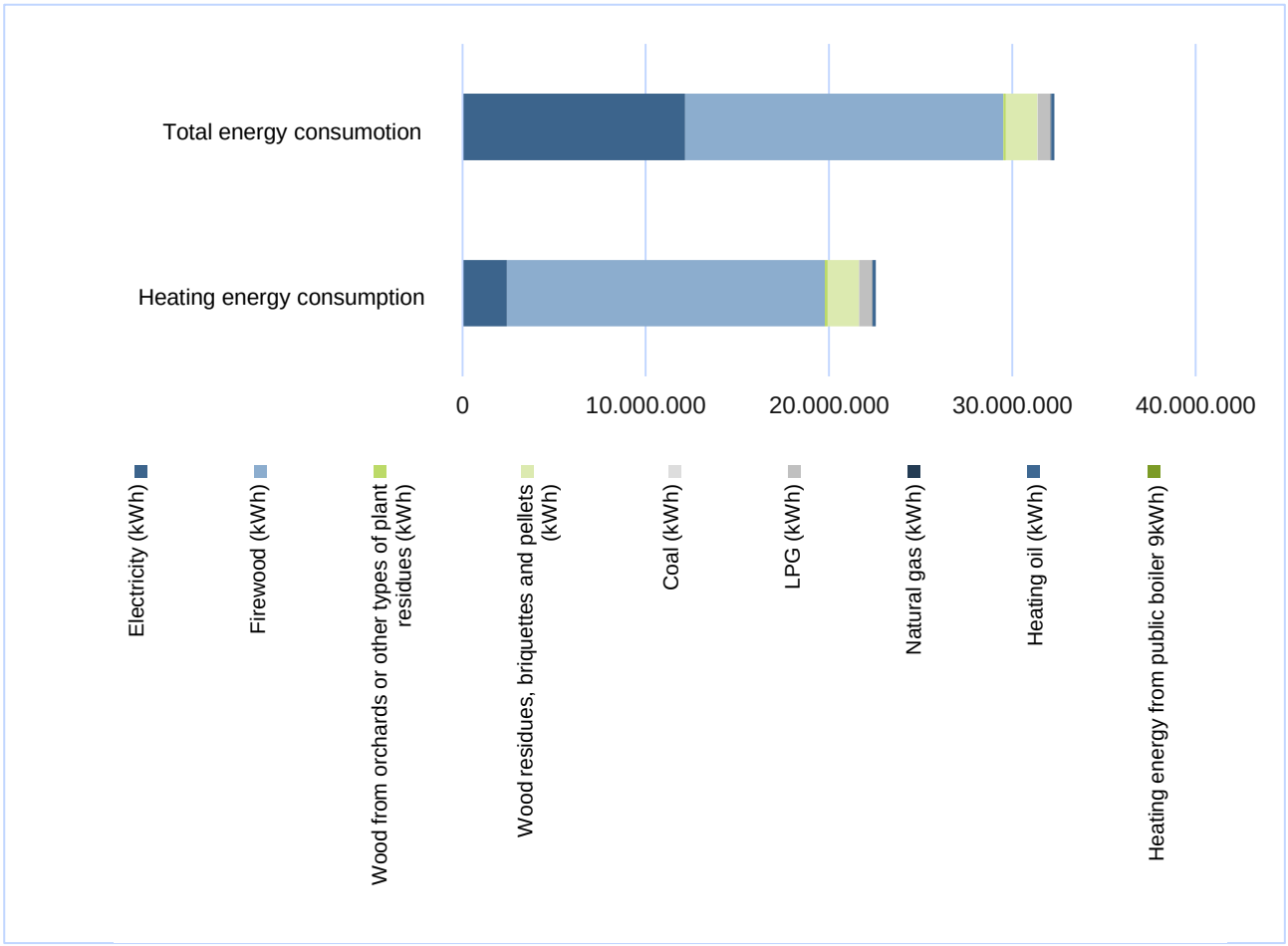

Figure 4: Overview of the energy and heating energy consumption per fuel

The analysis of energy consumption of residential buildings shows very high potential for energy savings of electricity and heat. The existing building stock has irrational consumption and it is necessary to continuously undertake numerous energy efficiency measures in order to streamline energy consumption and decrease the accompanying CO_2 emissions.

5.1.4 Overview of the total energy consumption in buildings sector

For the analysis of the total consumption in the building sector, a table with summary has been prepared to present in detail the energy consumption along with the electricity and heat energy costs. This overview provides details of each sub-sector, ie municipal buildings, tertiary sector buildings and residential buildings.

Note: in order to present the total consumption of the tertiary sub-sector and its share in the building sector it is necessary to conduct a survey for collecting additional information for the commercial and service entities.

Table 13: Overview of the total energy consumption in the buildings sector in the Municipality of Valandovo

Buildings sector	Area	Electricity consump-tion	Heat energy consumption								Total energy consump-tion	Electricity expenses	Expenses for other sources of energy	Total energy expenses
	m^2	[kWh/a]	Heavy oils [kWh/a]	Extra light oil kWh/a	Wood kWh/a	Wooden pellets kWh/a	Coal kWh/a	LPG kWh/a	Natural gas kWh/a	Other kWh/a	kWh/a	MKD/a	MKD/a	MKD/a
Municipal buildings														
Educational facilities	17,048	124,730	/	619,077	238,560	28,003	/	/	/	/	1,010,370	1,037,963	2,734,400	3,772,363
Social protection facilities	1,342	74,741	/	175,032	/	/	/	/	/	/	249,773	510,599	757,197	1,267,796
Municipal administra-tive facilities	837	56,613	/	/	/	/	/	/	/	/	56,613	595,819	/	595,819
Total municipal buildings	**19,227**	**256,084**	**/**	**794,109**	**238,560**	**28,003**	**/**	**/**	**/**	**/**	**1,316,756**	**2,144,381**	**3,491,597**	**5,635,978**
Tertiary sector buildings														
PHI Healthcare house Valadovo	2,800	97,826	/	465,600	/	/	/	/	/	/	563,426	844,238	2,424,000	3,268,238
Total tertiary sector	**2,800**	**97,826**	**/**	**465,600**	**/**	**/**	**/**	**/**	**/**	**/**	**563,426**	**844,238**	**2,424,000**	**3,268,238**

Buildings sector	Area m^2	Electricity consump-tion [kWh/a]	Heat energy consumption								Total energy consump-tion kWh/a	Electricity expenses MKD/a	Expenses for other sources of energy MKD/a	Total energy expenses MKD/a
			Heavy oils [kWh/a]	Extra light oil kWh/a	Wood kWh/a	Wooden pellets kWh/a	Coal kWh/a	LPG kWh/a	Natural gas kWh/a	Other kWh/a				
Residential buildings														
Residential buildings	253,539	12,150,352	/	174,615	17,352,999	1,722,591	1,992	699,512	31,276	154,631	32,287,968	57,252,459	40,169,539	97,421,997
Total residential buildings	**253,539**	**12,150,352**	**/**	**174,615**	**17,352,999**	**1,722,591**	**1,992**	**699,512**	**31,276**	**154,631**	**32,287,968**	**57,252,459**	**40,169,539**	**97,421,997**
TOTAL	**275,566**	**12,504,262**	**21,663,888**								**34,168,150**	**60,241,078**	**46,085,136**	**106,326,214**

5.1.5 Vision for future for buildings sector

After the analysis of the current condition, the following measures are proposed as priority for investment:

- Reconstruction of the buildings' envelope (placement of thermal façade, replacement of the carpentry, placement of roof insulation);
- Installation of solar collectors for preparation of hot water and as support to the heating system;
- Replacement of the existing lamps with energy efficient.

Reconstruction of the building's envelope

Mostly it is intended for buildings with an earlier date of construction, without thermal insulation, with dilapidated facade carpentry. EE measures reduce the heat consumption as well as the CO_2 emissions and heating costs.

Table 14: Influence of the EE measures – reconstruction of envelope – on the CO_2 emissions reduction

Type of building	Estimated value of the investment [MKD]	Estimated energy saving [MWh/a]	Estimated value of the CO_2 emissions reduction [tCO_2/a]
Municipal buildings	23,975,000	685	274
Buildings from the tertiary sector	8,326,600	316	126
Residential buildings	496,400,000	14,600	2,920
Total	**528,701,600**	**15,601**	**3,320**

Installation of solar collector for hot sanitary water

It is recommended installation of solar collector for preparation of SHW but as well as support to the heating system where applicable. The table below presents the influence of the implementation of this measure on the CO_2 emissions reduction.

Table 15: Influence of the EE measures – installation of solar collectors – on the CO_2 emissions reduction

Type of building	Estimated value of the investment [MKD]	Estimated energy saving [MWh/a]	Estimated value of the CO_2 emissions reduction [tCO_2/a]
Municipal buildings	88,800	5.92	2.96
Buildings from the tertiary sector	127,000	8	5.6
Residential buildings	5,735,000	365	73
Total	**5,950,800**	**378.92**	**84.56**

Replacement of the existing lamps with energy efficient

The lamps in the buildings sector are usually from older technologies. It is proposed measure for reduction of their consumption through installation of more energy efficient lamps.

Table 16: Influence of the EE measures – replacement of the existing lamps with energy efficient – on the CO_2 emissions reduction

Type of building	Estimated value of the investment [MKD]	Estimated energy saving [MWh/a]	Estimated value of the CO_2 emissions reduction [tCO_2/a]
Municipal buildings	185,280	8	6
Buildings from the tertiary sector	74,400	3	3.8
Residential buildings	7,284,000	607	449.2
Total	**7,543,680**	**618**	**459**

Sector public lighting

5.2.1 Analysis of the sector public lighting

Municipality of Valandovo has public lighting system that covers the city of Valandovo and additional 15 settlements. EVN Macedonia owns 90% of the total number of lighting poles while the

municipality owns the remaining 10%. The payment for street lighting is based on the utility fee for public lighting presented in the electricity bills, while the monthly bills issued by EVN Macedonia are paid from the municipal budget.

The payment for the street lighting is based on a communal tax for public lighting included in the electricity bills of the households and EVN transfers the funds entirely to the municipality. Then EVN issues monthly invoices to the municipality for the consumed electricity for public lighting, which is being paid from the municipal budget.

Major reconstruction of the public lighting has been carried out in 2014, which included also obligation for the contractor to maintain the system for the next three years, starting from the date of completion of the works. With this reconstruction, the quality of the lighting regarding area of coverage and intensity can be assessed as satisfactory in accordance with the existing standards for lighting of public spaces. Only the illumination of the promenade “Marshal Tito” was left substandard and its modernization is among the investment priorities of the municipality.

After the expiry of the 3-year warranty, the maintenance and replacement of lamps of the entire public lighting network is handed over to the municipality where a public, lighting monitoring unit operates. The person in charge of this unit has complete inventory of the public lighting and keeps detailed record of the current condition of the lamps per measuring pole, as presented below.

Table 17: Structure of the light sources of the public lighting system in the Municipality of Valandovo, reference year 2018

Type of lighting	Type of poles	Installed power (W)	No. of poles	Total No. of poles	Total installed power (kW)
(HPS) High-pressure sodium lamp	1 lamp/pole	70	1,424	1,424	113.9
	2 lamps/pole	70	48	96	
	1 lamp/pole	150	32	32	
	2 lamps/pole	150	9	18	
Eco lamps	1 lamp/pole	40	176	176	11.04
	2 lamps/pole	40	38	76	
	4 lamps/pole	40	6	24	
LED	1 lamp/pole	5	18	18	0.37
	2 lamps/pole	5	28	56	
HPS	2 lamps/pole	2x36	19	38	2.76
			TOTAL	**1,958**	**128.07**
			Total No. of poles		**1,798**
			No. of burnt lamps		**261**

The figures below present that the mercury halide lamps and the high-pressure mercury lamps represent about 95% of the total no. of lights compared to the installed capacity.

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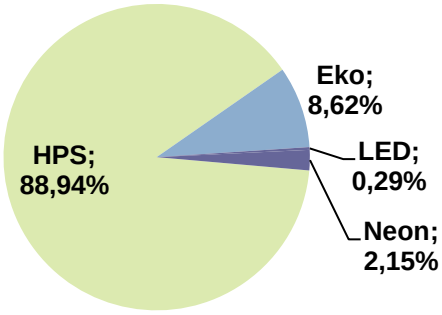

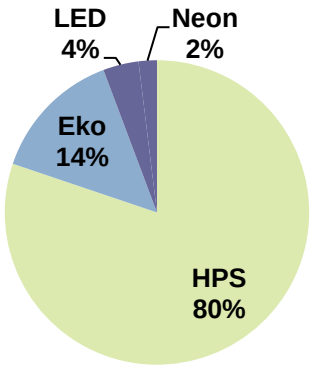

Figure 5: Types of lamps – capacity **Figure 6: Types of lamps – total No.**

The public lighting system does not have automatic control. There is a need for installation of timers as well as regulation of photometric parameters in groups, continuously, with electronic controllers.

Table 18: Overview of illuminated roads

Type of road	Total length of the road (km)	Total illuminated roads (km)	Percentage of illuminated roads (%)
Main streets	19.9	19	95.48
Secondary streets	38.9	38.5	98.97
Regional road	38	9.5	25

Table 19: Illuminated squares

Squares	No.	Area [m^2]	Total area [m^2]

The figure below presents the recorded consumption of electricity for 2016, 2017 and 2018, based on the data provided by EVN.

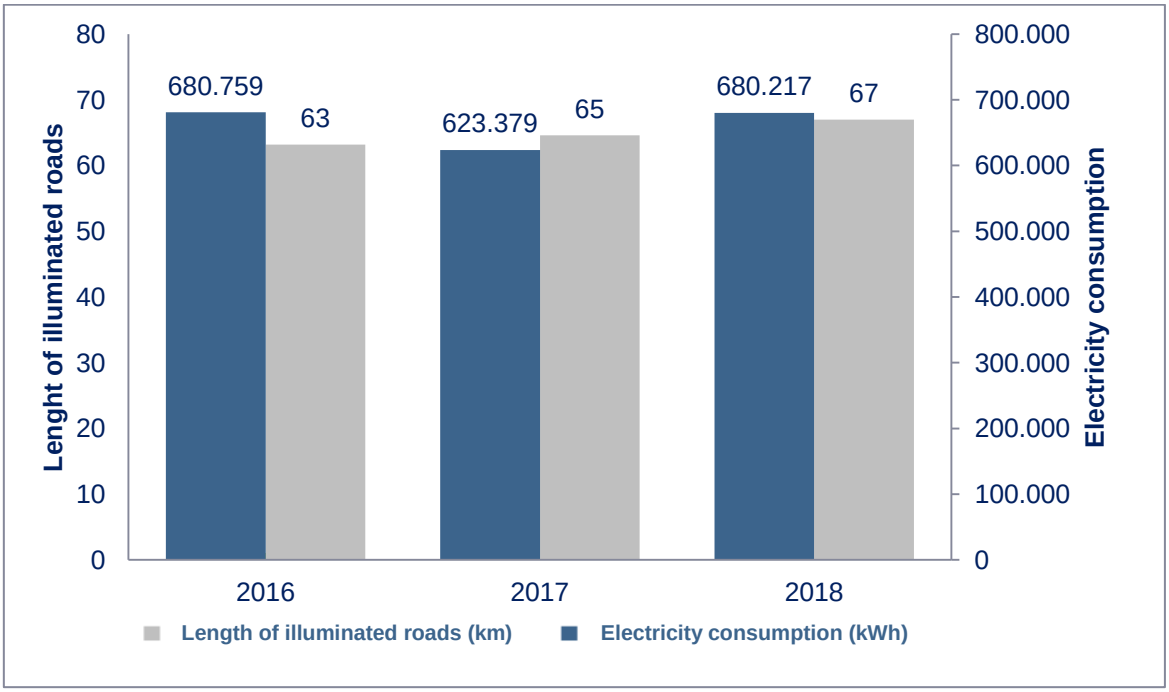

Figure 7: Electricity consumption for public lighting (kWh) and illuminated roads (km)

As presented on Figure 7, the electricity consumption does not show significant changes during the years. Available data show that the public lighting system has not been renovated for the past three years that are subject of the analysis; only replacement of burnt lamps has been performed. The length of illuminated roads is also remained unchanged for the past three years.

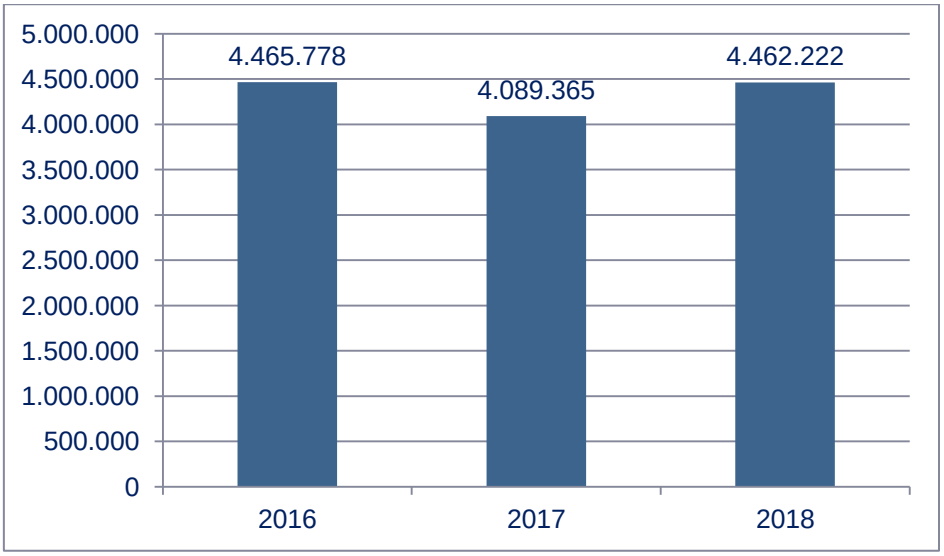

Figure 8: Annual expenses for public lighting **(MKD), 2016-2018**

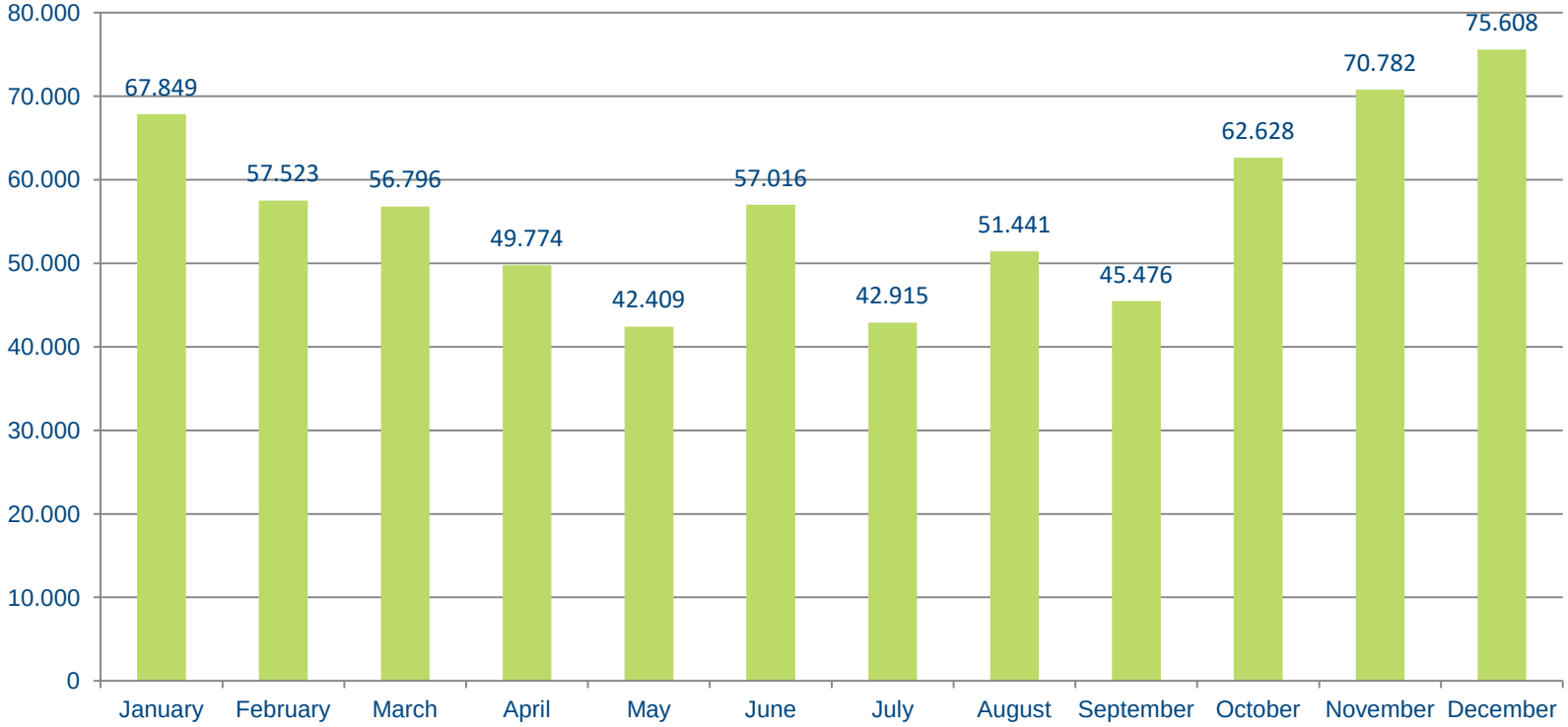

Figure 9: Electricity consumption (kWh) for the reference year 2018

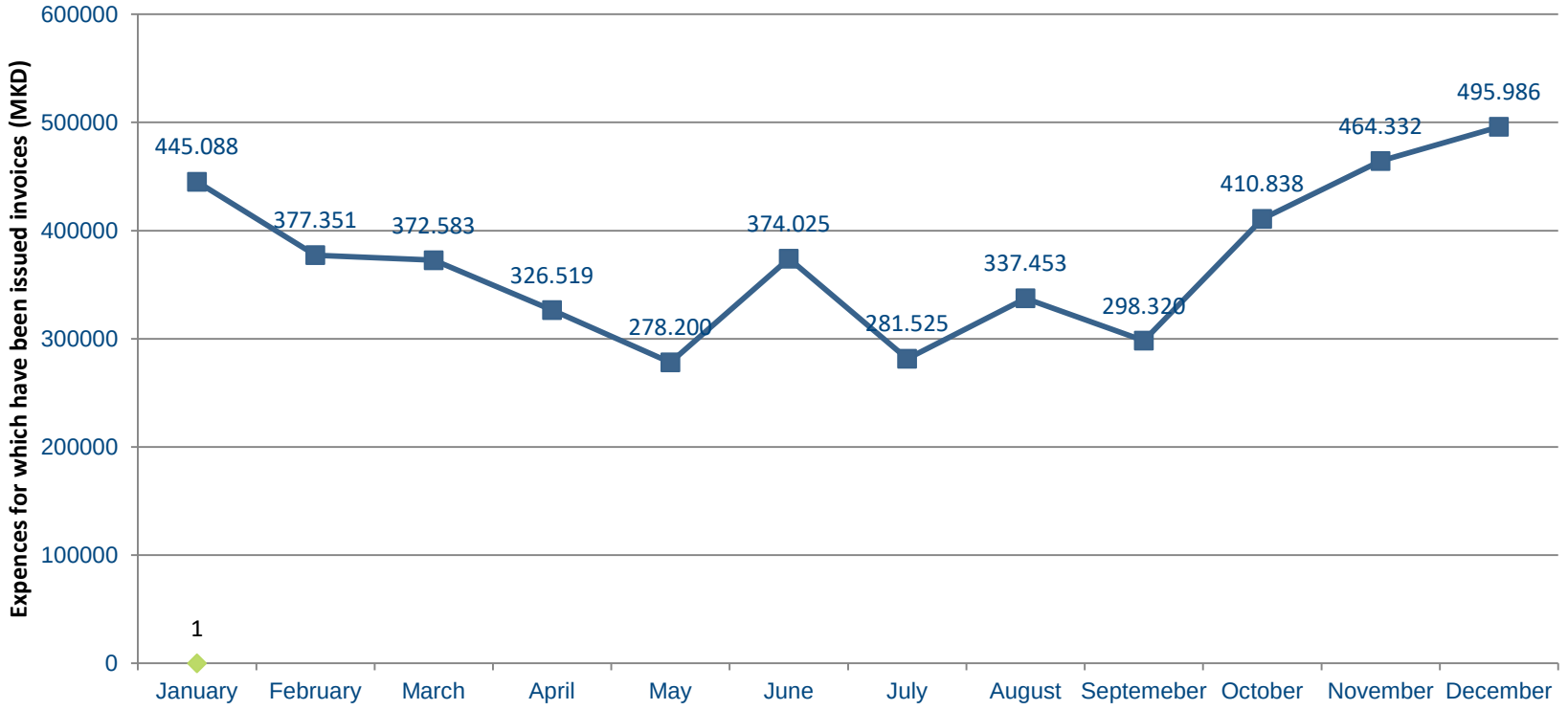

Figure 10: Expenses for electricity (MKD) for lighting for the reference year 2018

Table 20: Annual electricity consumption for public lighting, reference year 2018

System for public lighting	No. of poles for public lighting (pcs)		Total road length (km)		Total length of illumi-nated roads (km)	Electricity consump-tion in public lighting (kWh/a)	Electricity consumption per illuminated pole [kWh/(per pole.a)]	Consumed electricity per km of road [kWh/(km.a)]	% of illumine-ted city roads (%)
Public lighting in the Municipa-lity of Valandovo	1 lamp/pole	1,650				680,217	378.3	10,152	69.3
	2 lamps/pole	142							
	4 lamps/pole	6							
Total	**1,798**		**96.8**		**67**				

Regardless of the previously conducted reconstruction, and due to the development of new technologies, the change of street lighting is however feasible for the municipality, and with the use of renewable energy sources (for example the square Marshal Tito), the investment costs can be reduced in the development and installation of new network.

5.2.2 Vision for future of the sector public lighting

The most dominant light source in the Municipality of Valandovo is high-pressure sodium lamps (HPS). This technology, along with the high pressure mercury (HPM) lamps are considered obsolete and should be discarded from utilization in accordance with Regulation 245/2009. After their removal, it is expected that these types of lamps will not be available in the future. New light lamp technologies can significantly increase the efficiency of the lighting and offer longer lifespan. The purpose of this recommendation is to assess the current efficiency of the lighting and to implement upgrades where necessary.

Modernization can deliver the same levels of illumination with lower energy consumption, thereby reducing greenhouse gas emissions and operation costs. Extended lifetime reduces the maintenance needs and costs, as well as the disruptions in operation, thus improving public health and safety.

This project would include three sub-projects as follows:

- “Integrated program for assessment of the public lighting” to audit the existing inventory, as well as assessment of the operational activities and activities for maintenance which will assist in identifying appropriate measures for significant increase of the energy efficiency.
- “Guidelines for procurement of new street lamps” that can be used while replacement of broken lamps. It shall also include data on the minimum light-technical characteristics that must be met when purchasing new lamps.

- "Modernization of the street lighting" where physical replacement of the existing lamps with new EE lamps will be performed.

The selected scenario includes replacement of the following:

› Existing 1,520 high-pressure sodium lamps (HPS), 70W each, with 1,520 new LED lamps, 25 W each;

› Existing 50 high-pressure sodium (HPS) lamps, 150 W each, with 50 new LED lamps, 70 W each;

› Existing 275 ECO high-pressure lamps, 40W each – will not be changed;

› Existing 74 LED lamps, 5 W each – will not be changed.

Table 21: Overview of measures for the sector public lighting in the Municipality of Valandovo

EE Project	Estimated investment [MKD]	Estimated energy savings (MWh/a)	Potential for energy savings (MKD/a)	CO_2 emissions reduction (tCO_2/a)
Complete program for revitalization of the public lighting	20,340,000	464	3,040,000	424.6

Sector industry

The industry sector is optional and is not a key objective of the "Covenant of Mayors". It is recommended thoroughly analysis of this sector in the future by collecting the key data on industrial capacities and their role in overall CO_2 emissions.

Sector transport

The transport infrastructure in the municipality represents a basic precondition for the realization of the planned spatial organization, i.e. connecting the settlements in one transport system.

There are two basic levels that are important in the transport infrastructure: roads linking the municipality with the wider region (highways, regional roads) and roads linking the center of the municipality with the other settlements in the municipality (local roads).

Municipality of Valandovo is a junctioncrossroad of many important roads leading to the cities of Skopje, Gevgelija, Dojran and Strumica. The E-75 Skopje-Gevgelija highway passes through the Municipality of Valandovo with a total length of 8 km on the territory of the municipality as well as the regional roads R-110, R-604, R-116 and R-119.

In accordance with the data obtained from the database of State Statistical Office for 2018, in the Municipality of Valandovo there is developed local road network with a total length of 98 km. Half of

them are asphalt roads (45 km), 12 km under macadam, 21 km are unpaved, while 20 km are not yet constructed.

The following sub-division was performed for the analysis of the energy consumption in the transport sector:

- Municipal transport – fleet owned by the Municipality of Valandovo;
- Public transport and
- Private and commercial transport.

5.4.1 Municipal transport

The fleet of the Municipality of Valandovo consists of passenger and freight vehicles owned by the Municipality.

In accordance with the data provided by the municipality, there are five passenger and four freight vehicles out of which seven use oil and two are petrol. The data on the fuel consumption are given in the table below.

Table 22: Fuel consumption for the vehicles owned by the municipality

Type of fuel	Fuel consumption (l/year)	Energy consumption (kWh/year)	Share
Petrol	1,920	17,710	18.18%
Oil	7,840	79,726	81.82%
Total	**9,760**	**97,436**	**100.00%**

82% of the total fuel consumption is from oil while the petrol fuels account for 18% of total municipal transport.

5.4.2 Public transport

There is no organized public transport in the Municipality of Valandovo, therefore this point is not analyzed in this Action Plan.

5.4.3 Private and commercial transport

In accordance with the data from the database of the State Statistical Office at national lever for 2018, the passenger cars including taxi vehicles covered 9,452 million passenger kilometers or translated into unit length factor of 4.68 passengers per vehicle, it is 2,020 million km. Taking into consideration that the total number of registered passenger cars for 2018 at national level is 415,062 vehicles, it means that one passenger vehicle in average travels 4,867 km per year.

In terms of commercial vehicles at national level, the total number of registered freight, labor, tow vehicles and trailers for 2018 is 51,597. The same year, freight transport accounts for 10,637

million ton kilometers. For average freight factor of 7.2 t/vehicle, there is a total of 1,477 million kilometers for commercial vehicles or 28,632 km/vehicle.

Since there is no detailed information related to the private and commercial transport at municipal level, the data obtained for private and commercial transport at national level will be used for further analysis of the transport sector in the municipality.

In 2018, in the Municipality of Valandovo there were 2,660 registered vehicles, most of which were passenger cars (85.3%), then freight and work vehicles (10.7%) and the rest were motorbikes, towing vehicles and tractors (4%).

Below is presented the share per fuel for passenger vehicles of which 60% use oil and 37% use petrol.

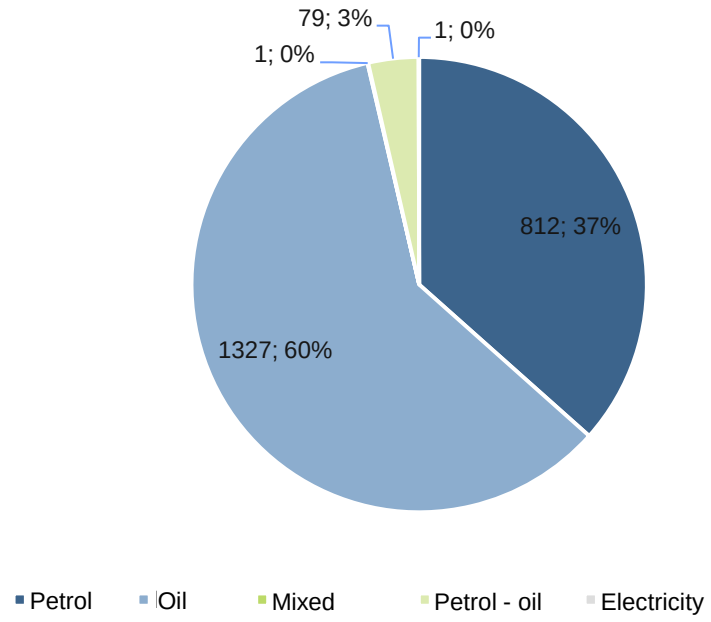

Figure 11: Share per fuel for passenger vehicles at municipal level

Most of the commercial vehicles use oil (86%) and only 11% use petrol.

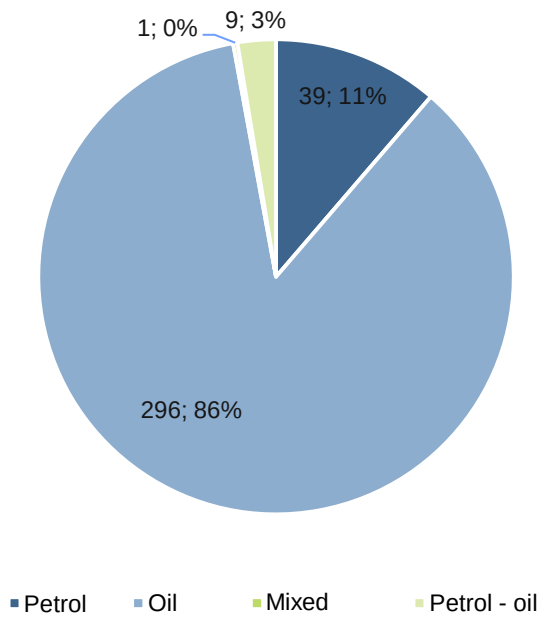

Figure 12: Share per fuel for commercial vehicles at municipal level

Data on the number of vehicles and fuel consumption on municipal level for the sub-sector passenger and commercial vehicles are provided in the table below. The share per fuel type for this sub-sector is presented on Figure 13.

Table 23: Number of vehicles and fuel consumption for the sub-sector private and commercial transport

Category	No. of vehicles	Fuel consumption			Energy consumption (kWh/year)		
		Petrol (l/year)	Oil (l/year)	Electricity (kWh/year)	Petrol	Oil	Electricity
Passenger cars	2,220	399,405	452,096	1,119	3,684,177	4,597,416	1,119
Commercial vehicles (freight, work and tow vehicles)	346	1,030,752	6,102,052	0	9,507,812	62,052,513	0
Total	**2,566**	**1,430,157**	**6,554,147**	**1,119**	**13,191,989**	**66,649,929**	**1,119**
						79,843,037	

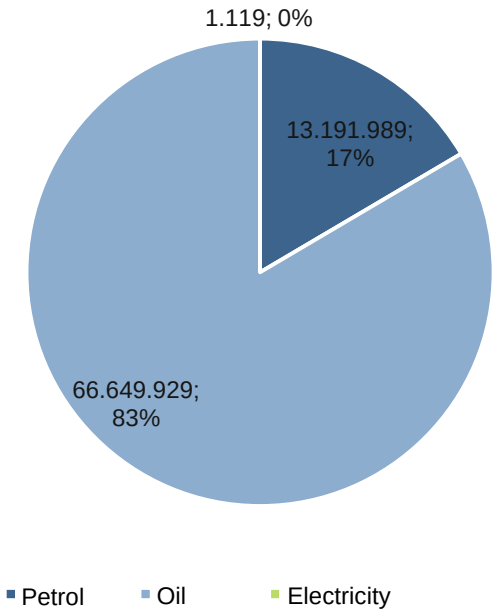

Figure 13: Share per type of fuel in the total fuel consumption in the sub-sector private and commercial transport

5.4.4 Overview of total energy consumption in the transport sector

The analysis of the fuel consumption in the transport sector on the territory of the Municipality of Valandovo shows significant share of the private and commercial transport. Cumulative data on the consumption of fuels at municipal level are given in Table 24.

Table 24: Fuel consumption in the transport sector

Transport sector	No, of vehicles	Fuel consumption			Energy consumption (kWh/year)			Total energy consumption (kWh/year)
		Petrol (l/year)	Oil (l/year)	Electricity (kWh/ year)	Petrol (l/year)	Oil (l/year)	Electricity (kWh/ year)	
Municipal transport	9	1,920	7,840	0	17,710	79,726	0	97,436
Public transport	/	/	/	/	/	/	/	/
Private and commercial transport	2,566	1,430,157	6,554,147	1,119	13,191,989	66,649,929	1,119	79,843,037
Total	**2,575**	**1,432,077**	**6,561,987**	**1,119**	**13,209,699**	**66,729,655**	**1,119**	**79,940,473**

The energy consumption in the transport sector in Municipality of Valandovo is 79,843 MWh where the private and commercial sectors participate with more then 99%.

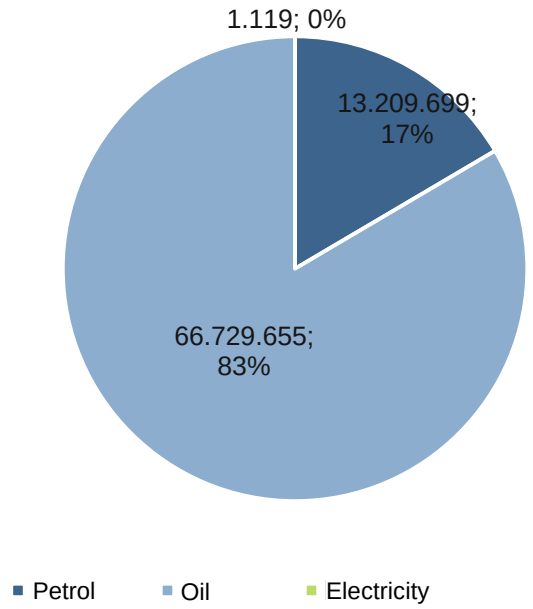

Figure 14: Energy consumption in the transport sector per fuel

5.4.5 Vision for future in the transport sector

In accordance with the recommendations of the European Commission, the proposed measures include the following categories:

- Measures for municipal transport
- Measures for private and commercial transport
- Planned measures for CO_2 emissions reduction in the transport sector and improvement of the transport sector in the Municipality of Valandovo

Measures for municipal transport

Although the share of the municipal transport in the total consumption of the transport sector is small, it is recommended introduction of energy management system as a prerequisite for efficient use of the municipality's fleet and primarily for monitoring and controlling energy consumption. The introduction of such system includes:

- Determination of the current situation travel routes, types of vehicles, types of fuels, consumption, etc.)
- Proposed measures to increase the efficiency (regular service of the vehicles, technical examination)
- Monitoring of the implementation of the measures.

Measures proposed with the Action Plan that refer to the municipal transport:

- Procurement of environmentally friendly vehicles (vehicles with reduced GHG emission), that use LPG as fuel
- Introduction of energy management system for the vehicles owned by the municipality.

Measures for private and commercial transport

There are no proposed measures and activities for rationalization of the utilization of the private cars and commercial vehicles on the territory of the Municipality of Valandovo that have been included in this Action Plan regarding the reduction of the fuel consumption (and the reduction of the CO_2 emissions), since it is currently impossible to monitor and control the results in this sector.

It is proposed to increase the pedestrian zones in the municipality, which will enable to decrease the use of the private cars.

Planned measures for CO_2 emissions reduction in the transport sector and improvement of the transport sector in the Municipality of Valandovo

Planned measures imply activities whose implementation directly influence the improvement and promotion of the transport sector on the territory of the Municipality of Valandovo, which of course also affects the reduction of CO_2 emissions.

The following planned measures are proposed for this Action Plan:

- Construction of cycling and pedestrian trails on the territory of the Municipality of Valandovo
- Encouraging the use of public bicycles as a means of transportation
- Promotional, informative and educational measures and activities

The planned measures foresee construction of cycling trails in the central urban area of the municipality together with organization for awareness rising campaigns for the citizens related to the use of the bicycle as mean of transportation as well as for the utilization of public bicycles. The rent of public bicycles would increase citizens' mobility, facilitate the communication as well as the transportation to workplace, school, etc. This measure is of public importance as a socially responsible measure that reduces air pollution, encourages people to physical activity and improves the tourist offer.

Overview of all three proposed measures

Table 25: Proposed measures for the transport sector in the Municipality of Valandovo

Measure	Estimated investment (MKD)	Проценета заштеда (MWh/a)	Estimated reduction of CO_2 emissions (tCO_2/a)
Municipal transport			
Procurement of environmentally friendly vehicles (vehicles with reduced GHG emission),	1,580,000	4.3	1.1

that use LPG as fuel			
Introduction of system for energy management for the vehicles owned by the municipality	600,000	1	0.249
Planned measures for reduction of CO_2 emissions in the transport sector and promotion of the transport sector in the Municipality of Valandovo			
Construction of cycling trails and encouraging the utilization of bicycles and procurement of public bicycles	1,000,000	25	6.2
Promotional, informative and educational measures and activities	60,000	25	6.2

Water sector

5.5.1 Drinking water

The water supply system in the Municipality of Valandovo is organized through six independent systems: one water supply system of the city covering the settlements of Valandovo, Rabrovo, Dedeli and Chalakli and five separate systems for the rural parts of the municipality. All six systems are operated by the Valandovo-based Public Utility Enterprise “Communal Service”, established by the municipality. Four of the five rural systems listed in the public utility system are included in March 2018. In addition, there are several more rural systems still managed by the local communities and are planned to be incorporated into the existing communal management system in the future.

The construction of the water supply system started in 1958 and covers only one municipality with about 10.000 inhabitants. All end users of the system have installed water consumption meters (water meters), while there is a lack of a main water meter to measure the flow exiting from the tanks and record the total amount of water delivered to the system. An exception to this is the main pipeline for the city of Valandovo where a magnetic flow meter was installed in December 2018.

The water supply system of Valandovo is fed by three springs of water from three wells connected to a single reservoir of reinforced concrete with a total capacity of 1.300 m^3. The pipeline of this system has not been renovated since its installation in the 50s and is mainly consisted of asbestos pipes with a high loss rate of about 50-60%. Therefore, this system is characterized as an energy inefficient system.

In the rural areas, each of the system consists of a power supply pump and a tank of reinforced concrete with a capacity of 100-120 m^3. Regarding the water quantity control, the absence of electricity connectors as precondition for placement of appropriate floaters for automatic supply of the reservoirs, represents the biggest challenge. In these rural areas, the pipelines have been installed more recently from PE/PVC pipes, which results with minimal, loses in the network.

Nine pumps are included in the system. Their characteristics have been summarized in Table 26. All pumps are without frequency control and they do not have automatic on/off switching as necessary measures for the energy efficiency of the system.

Table 26: Characteristics of water pump equipment

Type of equipment	Age of equipment (years)	Installed capacity of pump [kW]	Capacity [l/s]	Type
Pump No.1 Valandovo	1 year	75 kW	25 l/s	Submersible pump
Pump No.2 Valandovo	6 years	25 kW	18 l/s	Submersible pump
Pump No.3 Josifovo	15 years	5,5 kW	6 l/s	Submersible pump
Pump No.4 Josifovo	3 years	7,5 kW	10 l/s	Submersible pump
Pump No.5 reserve pump in separate well Josifovo		5,5 kW	6 l/s	Reserve pump
Pump No.6 Grchishte	5 years	3 kW	4 l/s	Water pump
Pump No.7 Brajkovci	6 years	5,5 kW	6 l/s	Submersible pump
Pump No.8 Balinci	8 years	5,5 kW	6 l/s	Submersible pump
Pump No.9 Marvinci	1 year	5,5 kW	6 l/s	Submersible pump

Figure 15 presents the data related to water production and electricity consumption for the last three years. The quantity of potable water produced in 2016 is twice as lower compared to the quantity in the next two years, 2017 and 2018. Taking into consideration the weather conditions in the spring and summer of 2016 when the overflows of the Kalkovska riverbed has been recorded, the correlation between the precipitation and the amount of water produced is obvious. This leads

to the conclusion that the water from the water supply system, besides for the needs of the households is being used also for irrigation[11].

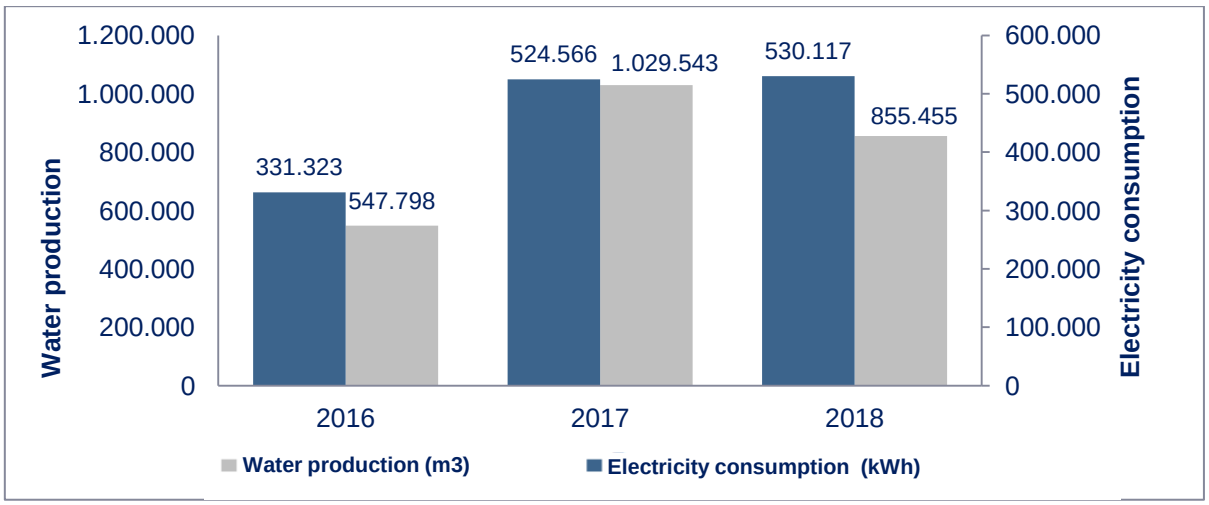

Figure 15: Water consumption and electricity consumption in the period 2016 - 2018[12]

The decrease in water produced on one side, and the increase of electricity consumption on the other for the period of 2017 and 2018 occurs due to the inclusion of four more rural settlements in the charging system in March 2018, which results with an increase in the total recorded electricity consumption.

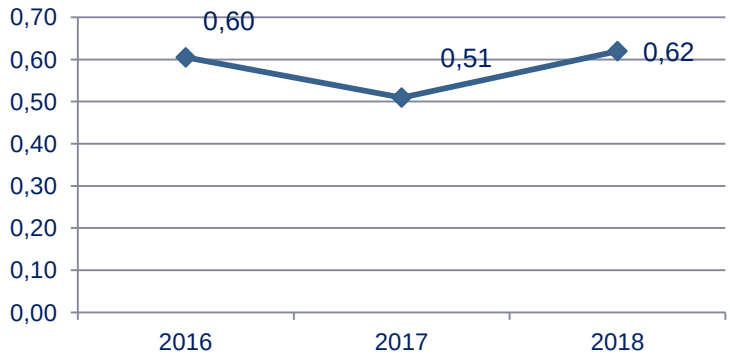

Figure 16: Specific water consumption in kWh/m^3, 2016 - 2018

[11] With the start of the project for the South-Vardar valley, there will be investments in modern irrigation system for the agricultural land in an area of 2,000 ha Valandovo field in a total amount of EUR 24, 3 million, financed by KfW.
[12] During March 2018, four additional pump stations from the rural areas in the municipality have been included in the system.

Figure 16 presents the trends of specific consumption of drinking water. These trends occur due to the inclusion of four more rural settlements in the water supply system of the Municipality of Valandovo.

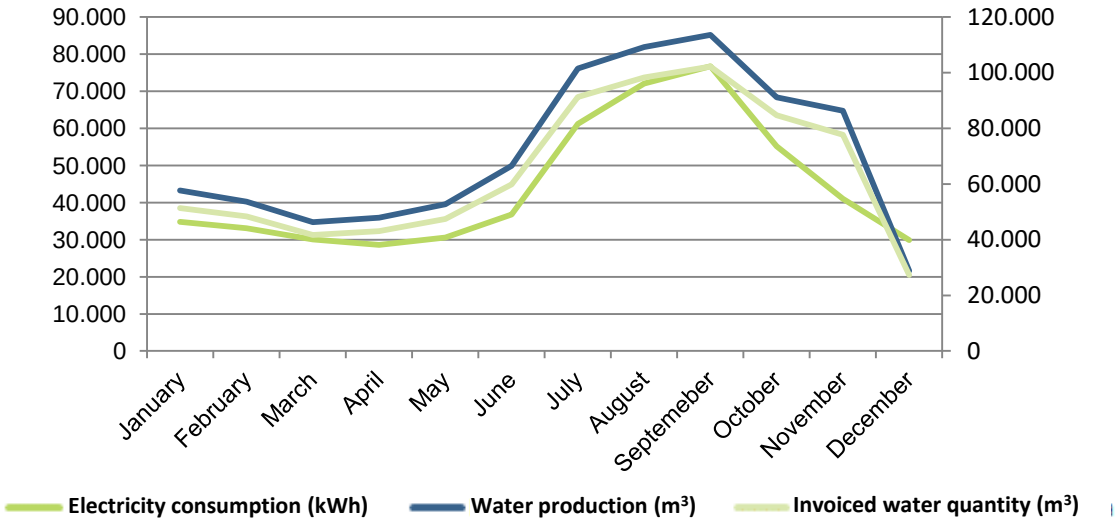

Figure 17: Consumption of electricity, production of water and quantity of water for which invoices have been issued, for the reference year 2018

As presented on Figure 17, the level of water consumption throughout the year is not constant. Fluctuation occurs due to the needs and the habits of the citizens as well as their awareness related to the utilization of the water. The summer is the period of the year with highest consumption of water, especially in July and August; therefore, the production of water is highest during these two months. The reason is that the drinking water is heated in the pipes that lead from the water supply system to the households. While using the water for drinking, people tend to leave the water flow from the tap running until it becomes cooler. In addition, people living in houses tend to use tap water to cool their yards on the hottest days of summer.

The percentage of non-revenue water (that has not been charged) for the reference year is 10%, which includes system losses and unbilled water.

Table 27: Annual energy consumption for the sector drinking water, reference year 2018

Water supply system	No. of inhabi-tants	Annual production of water for 2018 (m^3)	Consumption of energy for production of water (kWh/a)	Specific consumption of drinking water [kWh/($m^{3.}$ a)]	Percentage of non-charged water (%)
Water supply system of the Municipality of Valndovo	8,508	855,455	530,117	1.15	10%

The main challenges related to drinking water are: (1) major loses in the water supply system related to the supply of the city of Valandovo, and (2) lack of automatic control. These two issues are result to several factors presented below:

- The water supply network of the Municipality of Valandovo has not been restored since the initial installation in the 50s. Due to degradation, the water supply system suffers large water losses estimated at over 50%;
- The water supply network is consisted of asbestos pipes that have negative impact on human health and require urgent replacement;
- Unsustainable plan for investment in the water supply network by the responsible institutions;
- Small or no investments in alternative sources of water for irrigation;
- Lack of involvement of the private sector in the construction of own wells for water supply;
- Lack of electrical installation near the tanks;
- Low level of awareness and irrational use of the drinking water that characterize the behavior of the local population;
- Low level of awareness and irrational use of the drinking water such as leaving the water flow from the taps running to cool during the summer, or to avoid freezing of the pipes in winter;
- Irrational use of the drinking water for irrigation of yards and agricultural land.

Some measures might solve the problems:

- Preparation of plan for investment in the water supply system of Municipality of Valandovo;
- Modernization of the water supply network and improvement of the dimensioning and standardization in accordance with the users' needs;
- Regular maintenance of the water supply network;
- Improvement of the system for regulation of the water consumption;
- Conducting appropriate electricity installation to the existing reservoirs;
- Keeping record, regulation of the existing wells and implementation of standards for further drilling of wells for water;
- Finding alternative sources for irrigation of yards such as accumulation of rainwater;
- Rising public awareness about the irrational utilization of the water.

5.5.2 Waste water

In the Municipality of Valandovo, the Utility Enterprise “Communal Service” is responsible for the communal activities. The sewage system covers the city of Valandovo and the villages of Josifovo, Udovo and Pirava with a total sewage network of 20 km. In addition, in the city of Valandovo there is a 1.5 km long storm water drainage network.

There are no pump stations or plants for treatment of the wastewater in this system, meaning that the entire system for wastewater works based on gravity and the water is being discharged in Anska Reka. For this reason, this section will not be considered in the further analyses.

5.5.3 Vision for future for water sector

It is recommended to embed frequent regulation in all existing pumps and if new pumps are procured, they should have integrated frequent regulation.

In addition, it is recommended construction of accumulation reservoirs that would be filled throughout the night when the electricity costs are lower. They would supply the end-users with using the gravity. The pumps would be switched on only occasionally, only in case of support of the reservoirs.

Due to lack of electricity in the existing pump stations, it is proposed to have a stand-alone power supply and a backup power supply system.

The table below presents the estimated savings of energy and the investments for their implementation together with the CO_2 emissions reduction.

Table 28: Overview of measures in the water sector for the Municipality of Valandovo

Sector	Estimated value of the investment [MKD]	Estimated energy saving [MWh/a]	Estimated value of the CO_2 emissions reduction [tCO_2/a]
Set of measures for water sector	1,000,000	424	388

ORGANIZATIONAL AND FINANCIAL ASPECTS

For financing of the measures proposed in this Action Plan may be proposed various sources of funding. Energy efficiency as specific area is expanding and becoming the focus of various financial bodies. However, the general economic situation in Macedonia does not enable allocation of significant public funds, which puts an emphasis on the international funds and private equity.

The budget is a basic financial document of the municipality gives the estimation on the revenues and determines expenditures for one year. Budget funds are used to finance the operations, functions and programs of the municipality to the extent necessary for their execution. The total financial assets in 2018 amounted to MKD 66,975,000. Most of the municipality's revenues are generated in the form of tax revenues. Given the complexity and high administrative costs, as well as the running costs, there is no significant financial potential in the municipal budget for financing of large projects and measures proposed in this action plan. Therefore, it is necessary to find other sources of funding for the planned measures. The Chapter 10 describes in detail the possible sources of funding.

Technical supervision of the work will be provided through local consulting companies with contracts concluded with the Municipality of Valandovo. Submission of project monitoring and implementation reports will be organized and guided by the responsible person in the Municipality.

REFERENCE INVENTORY OF CO_2 EMMISSIONS

6	**Inventory of basic emissions**		
7			
8	**1) Inventory year**	2018	
9			
10			
11	**2) No. of citizens in the inventory year**	11980	
12			
13			
14	**3) Emission factors**	☑	IPCC
15		☐	LCA (Life Cycle Assessment)
16			
17			
18	**4) Reporting emissions unit**	☐	tonnes CO_2
19		☑	tonnes CO_2 equivalent
20			

Слика 18: Референтен инвентар на емисиите

Table 29: Final energy consumption per sectors in the Municipality of Valandovo

Sector	FINAL CONSUMPTION OF ENERGY (MWh)															
			Fossil fuels								Renewable energies					
	Electricity	Heating / Cooling	Natural gas	LPG	Heating fuel	Diesel	Petrol	Lignite	Coal	Other fossil fuels	Vegetable oil	Biofuel	Other biomass	Solar energy	Geothermal energy	Total
BUILDINGS, EQUIPMENT/PLANTS & INDUSYRTRIES																
Municipal buildings, equipment / buildings	256.1				794.1								266.5			1316.7
Tertiary (non-municipal) buildings, equipment / buildings	97.8				465.6											563.4
Residential buildings	12150		31	699	174.6			1.1					19228.5			32284.2
Public lighting	680.2															680.2
Industry — HE -ETS																0
Industry — ETS (not recommended)																0
Subtotal	13184.1	0	31	699	1434.3	0	0	1.1	0	0	0	0	19495	0	0	34844.5
TRANSPORT																
Municipal vehicles						79.7	17.7									97.4
Public transport																0
Private and commercial transport						66650	13192									79842
Subtotal	0	0	0	0	0	66729.7	13209.7	0	0	0	0	0	0	0	0	79939.4
OTHER																
Agriculture, forestry and fishing	530															530
TOTAL	13714.1	0	31	699	1434.3	66729.7	13209.7	1.1	0	0	0	0	19495	0	0	115313.9

Table 30: Adopted emission factor for CO_2 (tCO_2/MWh)[13]

Electricity		Heating / Cooling	Fossil fuels							Renewable energy sources					
National	Local		Natural gas	LPG	Heating fuel	Diesel	Gas	Lignite	Coal	Other fossil fuels	Vegetable oil	Biofuels	Other biomass	Solar thermal energy	Geothermal energy
0.915	0.915	0.259	0.202	0.227	0.267	0.267	0.249	0.364					0.403		

[13] Presented emission factors are in accordance with the Rulebook for energy audit (Official Gazette of the Republic of Macedonia, No. 94 from 04.07.2013)

Table 31: Emissions inventory per sectors in the Municipality of Valandovo

Sector		Electricity	Heating / Cooling	Natural gas	LPG	Heating fuel	Diesel	Petrol	Lignite	Coal	Other fossil fuels	Vegetable oil	Biofuel	Other biomass	Solar energy	Geothermal energy	Total
BUILDINGS, EQUIPMENT/PLANTS & INDUSYRTRIES																	
Municipal buildings, equipment / buildings		234	0	0	0	212	0	0	0	0	0	0	0	107	0	0	**554**
Tertiary (non-municipal) buildings, equipment / buildings		89	0	0	0	124	0	0	0	0	0	0	0	0	0	0	**214**
Residential buildings		11117	0	6	159	47	0	0	0.4	0	0	0	0	7749	0	0	**19078**
Public lighting		622	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**622**
Industry	HE-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Subtotal		12063	0	6	159	383	0	0	0.4	0	0	0	0	7856	0	0	**20468**
TRANSPORT																	
Municipal vehicles		0	0	0	0	0	21	4	0	0	0	0	0	0	0	0	**26**
Public transport		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Private and commercial transport		0	0	0	0	0	17796	3285	0	0	0	0	0	0	0	0	**21080**
Subtotal		0	0	0	0	0	17817	3289	0	0	0	0	0	0	0	0	**21106**
OTHER																	
Agriculture, forestry and fishing		485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**485**
OTHER NON – ENERGY RELATED																	
Waste management																	**0**
Waste water management																	**0**
Other non-energy related																	**0**
TOTAL		**12548**	**0**	**6**	**159**	**383**	**17817**	**3289**	**0**	**0**	**0**	**0**	**0**	**7856**	**0**	**0**	**42059**

ASSESSMENT OF THE CLIMATE RISKS AND CHANGES

Municipalities have very important role to play in tackling climate change on two levels; the first consists of measures to reduce local greenhouse gas emissions, which means that municipalities with their local share participate in the achievement of the national emission reduction targets, but are also directly targeted at reducing the risks of climate change to the local community.

In numerous analyses Valandovo is referred to as a region in the country of extreme temperatures, such as highest values of the annual air temperature in Macedonia, which according to data obtained from the National Hydro meteorological Service in 2013[14] was higher than 14°C,. Additionally, this region is also indicated by the characteristic noticeable heat waves, when the number of days with a maximum air temperature of Tx> 25°C (summer days). According to an analysis made by GIS technology in the period 1971–2000, most of the summer days occurred in this region.

In accordance with the analyses elaborated in the document „Climate Risk Profile of Republic of North Macedonia“[15], and the climate projections for the country until 2050, the average air temperature will increase for1 - 3°C; precipitation in summer will decrease between 5% and 17%; and the frequency and severity of drought will increase. Therefore, in the agricultural sector is expected reduced productivity of cereals, damages of cereals but also to livestock and soil erosion; in the water sector is expected decreased water availability, decreased water quality and increased flood risk; in the energy sector - damage to energy infrastructure and decreased hydro potential for electricity generation; and in terms of ecosystems - loss of biodiversity, degradation and reduced forest productivity.

The municipality of Valandovo as a region is under the sub-Mediterranean climate influence. Its climate characteristics are already described in Chapter 3.1 of this Plan, so this section provides more details on the available recorded data related to the influence of climate risks and changes.

Taking into account the lack of sufficient relevant data for the Municipality of Valandovo, and the fact that the territory of the country is relatively small, available national as well as data for the Southeast Planning Region, where the municipality belongs were also used for the preparation of this document. Southeast Planning Region is considered the most vulnerable in the country in terms of climate change, as indicated in all three national climate change plans.

As stated in the document “Climate scenarios in Macedonia”[16], more i more intense rise of the air temperature in the 21st century is expected in the summer season then in winter. It is expected that this increase in Macedonia will be much greater than the expected global temperature change. At the same time, more significant decrease in the precipitation is expected in summer, while in winter it will not that significant. The daily temperature range is expected to decrease in winter and

[14] Third National Communication on Climate Change, http://www.unfccc.org.mk/content/Documents/TNC_MK_draft.pdf
[15] Climate Risk Profile of Republic of North Macedonia, 2018, https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID_Macedonia_CRP.pdf
[16] Climate change Scenarios for Macedonia, Klemen Bergant, 2006 http://www.unfccc.org.mk/content/Documents/Climate%20Change%20Scenarios%20Macedonia%20summary.pdf

increase in summer. Local climate change projections indicate that different climate regions in Macedonia will respond slightly differently to large-scale climate change.

The Third National Communication on Climate Change, such as numerous other examinations and studies assess the Southeast Region as particularly vulnerable at extreme climate conditions such as floods and droughts, which puts the focus of this document on this particular region.

Regarding the vulnerability and adaptation to climate change especially the climate fluctuations, this document indicates that in Macedonia according to the analyses, the period 1994 - 2012 had consistently higher average annual temperature than the multiannual average, with difference of the average annual temperature which ranges from 0.2°C to 0.5°C compared to the period 1961 to 1990. According to the available data from all meteorological stations for the period from 1951 to 2010, the hottest years have become more frequent in the last decade. The highest maximal air temperature in the country of 45.7 ° C was recorded on July 24, 2007.

On the other hand, the rainfall analysis which particularly focused on May and November as мост раинѕ months in the year, indicates that there is a general trend of decrease of precipitation. However, due to changes in precipitation levels from year to year, it is difficult to determine the exact amount of this decrease in relation to the total annual precipitation.

It can also be noted that the number of summer days has significantly increased in the recent years compared to the beginning of the analyzed period. Similarly, there has been a significant increase in the number of tropical nights in recent years. From the analysis of cold waves and cold weather, it can be concluded that cold waves occur less frequently than heat waves.

In terms of scenarios and projections for climate change by 2100, for the period 2025 - 2100, compared to the reference period 1961 - 1990 is expected:

- Probability of constant rise of the temperature;
- That the changes are most intense in the warmest time of year;
- Probability that the average monthly temperatures during the transition between winter and spring become equal;
- Declining of the precipitation at all seasons and annually, with largest decrease during the summer;
- Highest intensity of change in the warmest season of the year (in July and August, there may be no precipitation at all); and
- Decrease in precipitation by as much as 40% of the average monthly quantities in the cold season of the year.

The vulnerability of climate change adaptation shown by sectors with focus on the Southeast region can be described as follows:

- **Water resources** are considered sensitive to climate change both in terms of quantity and quality. By 2100, total average precipitation is expected to decrease by up to 13%. Significant reductions in available surface water and reduced groundwater recharge in the Vardar River Basin are also expected. General water availability in Macedonia is expected

to decline by 18% until 2100. The basin of the river Strumica which is relatively poor in water resources, is expected to have 34% less water by 2025. The priority measures for climate change adaptation should focus on developing and improving water storage and supply infrastructure; coordination of water use; introduction of measures for water saving; improving the water supply and the techniques in agriculture and industry; pricing and management measures in the energy sector; and measures to reduce the risk of disasters as elements that further contribute to the situation in the sector.

- **Agriculture** is a climate-sensitive area, especially due to the fact that a significant proportion of the country's rural population, especially rural communities, is dependent on this activity. It is one of the most vulnerable sectors that is at risk as result of the climate change and is subject to increasingly intense heat waves, droughts and floods. The past extreme climate events (such as those in 2007/2008 and 2011/2012) with long dry periods and heat waves are causing significant damage to the sector. The fact that only small percentage of agricultural land is irrigated further exacerbates the situation. in summer there is a lack of water. The impact of climate change on agricultural production is closely related to the demand and availability of water elaborated in the analysis of the Impact of climate change on Macedonian agriculture[17], which estimates that agricultural water consumption will increase by about 6% to 16% compared to the current water consumption.
- Capital investments in irrigation equipment can mitigate the negative impacts of climate change on medium and high climate change scenarios, but over time this will put additional stress on the existing limited water resource. According to Climate Change and Agriculture Country Note[18] which summarizes the information relevant to climate change and agriculture, the estimates given in 2010 for the period until 2050 are that an increase of 1.9°C of the average annual temperature can be expected, and the highest warming is expected to occur in summer period (with an increase of 2.5°C); decline in average annual precipitation by 5% is expected by 2050, with summer drop of 17%; more marginal and risky agricultural production environment, as climate change will exacerbate the already significant cereal deficits, especially during summer; increased exposure to new pests and diseases of the crops, forests and livestock; increased breeding seasons will allow for the development of new crops, increased productivity and changes in harvest patterns.

  Vulnerability assessment in this sector in the Southeast region leads to the conclusion that many crops with a basal temperature of at least 5.6°C will start to grow earlier; the growth stages will change significantly, wheat yields will decrease by 25% between 2040 and 2050, of corn by 56% and up to 86% in 2050. Applying adaptation measures such as changes in sowing or irrigation is one of the recommendations that can contribute to a significant reduction in the effects of climate change, but significant water resources will be also needed. Economic analysis has shown that by applying climate change adaptation measures, wheat losses can be reduced, but for corn, for the period from 2025 to 2050 climate change adaptation scenarios still show negative economic results.

[17] An Exploratory Analysis of the Impact of Climate Change on Macedonian Agriculture, 2018, https://www.mdpi.com/
[18] Climate Change and Agriculture Country Note, 2010, https://openknowledge.worldbank.org/bitstream/handle/10986/21836/954090WP0Maced00Box391416B00PUBLIC0.pdf?sequence=1&isAllowed=y

Increased temperature will also have impact on the **livestock sector** where for example a decrease in the number of live pigs per year is expected, prolonged conception, etc., which will contribute to significant economic losses. Recommended adaptation measures include breeding of species that are genetically resistant to heat, specially prepared fodder and feeding techniques in the periods of increased temperatures; adequate ventilation, cooling and air conditioning of farms, monitoring of productivity, etc.

Viticulture including both table and wine grapes varieties is particularly vulnerable to the rise in temperature, and the recommended adaptation measure is effective irrigation and placement of UV blocking nets.

- **Biodiversity** has been identified as a particularly sensitive sector despite the limitations and disadvantages for an in-depth analysis, such as insufficient data on climate impacts and significant absence of biodiversity monitoring, lack of functional system of protected area that takes into account climate impacts and shortages of ex situ protection efforts. For some of the total 18 vulnerable habitats identified, 58 plant species and 224 animal species identified, the Third National Communication on Climate Change points to threats in the proliferation and even disappearance.
- Significant impacts of climate change are also expected in the **forestry**, which as sector is sensitive to rising temperatures and fires (which are recorded in great numbers) that impact productivity and cause significant direct or indirect economic impacts. The management planning, use, protection of forests, hunting and tourism and forestry are considered particularly influential on the vulnerability.

  Examinations of water availability for trees (soil moisture) show water insufficiency in most of the trees tested, and in the case of extreme climatic events, adverse effects on their health can be expected by 2025. Although higher tree productivity is possible due to higher temperatures and increased CO_2 levels by 2025, water insufficiency as well as natural disasters can result in reduced productivity. Measures to adapt this sector to climate change in accordance with the Third National Communication on Climate Change include development of comprehensive program for adaptation of the forestry to global climate change, establishment of five monitoring stations in the forest regions, introduction of technologies for efficient use of biomass in forests, procurement of appropriate firefighting vehicles, thorough biomass inventory and incorporation of the climate change into forest management plans.
- Although there is insufficient data, it can be said the health sector and the healthcare system in the Southeast region are particularly sensitive to climate extreme conditions (floods and droughts). Floods and frequent heat waves in the SE region, but also cold temperatures will result with health implications in future, which also reflect the state of the health system, namely healthcare institutions, healthcare centers and homes.
- It is recommended to improve the cross sectorial involvement and coordination of central and local authorities, to improve the knowledge on climate risk management in health sector, information and transparency in the food safety system and implementation of the Hazard Analysis and Critical Control Point (HACCP), enhancement of the vector-borne

disease monitoring system, more accurate meteorological observations and projections to ensure timely high precautionary measures in high-risk periods and an air pollution alert system. Some of the measures proposed are early flood alert system, pollen monitoring; analysis of the costs and benefits of adaptation measures in the health sector related to climate change.

- Analyses show that in **tourism** sector the impact that climate change can have on businesses is insufficiently considered, and is insufficiently addressed in the national development plans. The following adaptation measures are recommended: research (site specific studies, vulnerability assessment and action plans), informing the tourism stakeholders regarding the risks, training and awareness raising in the climate change sector and preparing for risk management.
- Climate change undoubtedly has significant impact on **cultural heritage**. There is very little relevant data in this sector and very little research has been done, but the Report[19] produced within the project "Adaptation to Climate Change in the Western Balkans" prepared by the German Institute for Cultural Heritage, in cooperation with all relevant national institutions (supported by the German Society for International Cooperation - GIZ and the UNDP) shall be mentioned. This report, through an analysis performed on three selected locations in Macedonia, presents assessment of the risks of impacts expected from climate change and provides recommendations for protection of the cultural heritage from climate change, emphasizing the need for development a National Climate Change Adaptation Action Plan in the sector cultural heritage. Key recommendations include vulnerability assessment of the built and archaeological cultural heritage, damage monitoring program, identification of tools and climate change adaptation measures for the key categories. The document emphasizes the need for additional research and prevention activities, stresses the vulnerability and irreversibility of the buildings, sites and landscapes that may occur as result of climate change and recommends urgent action to reduce the extent of damage, i.e. the cost of repairing damage. As aspects that rise concerns about the impact of climate change on the immovable heritage are the impacts of rains, floods and soil saturation with water; extreme weather events, as well as high winds; abrupt changes in temperature and increased humidity; changes in ecosystems, etc.
- **Socio-economic** status is one of the key factors that determine how effectively the local community, i.e. the population, can prepare to deal with climate change impacts. Socio-economic vulnerability is highly dependent on local conditions and therefore it is crucial to have a detailed profile of the area to be assessed. Unfortunately, even in this sector, the unavailability of data for more precise analysis must be noted.

  According to the vulnerability assessment and adaptation measures presented in the document "Disaster Risk Reduction and Climate Change"[20] which specifically analyzes the Southeast Region and its 10 municipalities, Valandovo is rated as a medium-level

[19] Protection of cultural heritage and climate change, vulnerability evaluation and recommendations for adaptation, 2013, http://www.unfccc.org.mk/content/Documents/ADAPTATION/Cultural%20Heritage_final_MK%20so%20CIP.pdf

[20] Disaster Risk Reduction and Climate Change, 2014 http://www.unfccc.org.mk/content/Documents/ADAPTATION/new_Disaster%20risk_final_EN%20so%20CIP.pdf

municipality with a SoVI -0.438 index, where the index of social vulnerability in the region takes into account 14 factors: socio-economic status, gender, ethnicity, age, households, employment, occupation, family structure, education, population growth, access to medical services, populations with special needs and social dependence. In this document, municipalities are ranked according to the values of the calculated social vulnerability indices for each municipality. The limiting factors related to the problems of data comparability due to the application of different data classifications are also provided, and most importantly, due to the lack of data at lower administrative/territorial level for household incomes and employment. Selected categories of population (elderly, children, etc.) and the municipalities are assessed according to the level of social vulnerability.

PLAN OF MEASURE AND ACTIVITIES FOR ПЛАН НА МЕРКИ И АКТИВНОСТИ FOR CO_2 EMMISSIONS REDUCTION UNTIL 2030

Table 32: Overview of EE measures for reduction of the CO_2 emissions

Activity	Responsible institution	Period of implementation	Implementation expenses (MKD)	Assessment for 2030			Comments
				Energy savings (MWh/a)	Production from renewable sources of energy (MWh/a)	Reduction of the GHG emissions (tCO2/a)	
Buildings sector							
Reconstruction of the buildings' envelope (placement of thermal façade, replacement of the carpentry, placement of roof thermal insulation)	Municipality of Valandovo	2020-2030	528,701,600	15,601		3,320	
Installation of solar collectors for preparation of hot water as well as support to the heating	Municipality of Valandovo	2020-2030	5,950,800	378.92		84.56	
Replacement of the existing lamps with energy efficient lamps	Municipality of Valandovo	2020-2030	7,543680	618		459	

Activity	Responsible institution	Period of implementation	Implementation expenses (MKD)	Assessment for 2030			Comments
				Energy savings (MWh/a)	Production from renewable sources of energy (MWh/a)	Reduction of the GHG emissions (tCO2/a)	
Sector public lighting							
Complete program for revitalization of the street lighting	Municipality of Valandovo	2020	20,340,000	464		424.6	
Sector transport							
Supply of environmentally friendly vehicles (vehicles with reduced GHG emission) that use LPG	Municipality of Valandovo	2020-2030	1,580,000	4.3		1.1	
Introduction of a system for energy management for the vehicles owned by the municipality	Municipality of Valandovo	2020-2030	600,000	1		0.249	
Construction of cycling trails and support of the utilization of bicycles and procurement of public bicycles	Municipality of Valandovo	2020-2030	1,000,000	25		6.2	
Promotional, informative and education measures and activities	Општина Валандово	2020-2030	60,000	25		6.2	
Сектор вода							
Set of measures for the water sector	PCE Communal Service	2020-2030	1,000,000	424		388	

SOURCES OF FINANCING OF THE PROPOSED MEASURES AND ACTIVITIES FOR REDUCTION OF THE CO_2 EMMISSIONS

The access to appropriate sources of funding is an essential prerequisite for the realization of projects and activities in line with this Action Plan.

Funding and co-financing of projects (individually or through combination) should be provided through the municipal budget and with funding from the following domestic and international sources of funding:

- Funds from the budget of the Republic of Macedonia - Development part, allocations for the regional development program and programs for the development of individual sectorial policies of the ministries / agencies
- International financial institutions
- Pre-accession assistance (IPA II 2014 – 2020)
- Support of other international donors
- Funds from public-private partnership
- Donations and sponsorships.

Budget of the Republic of North Macedonia 2020 – 2022 – Development part

1. **Sub-programme REGIONAL DEVELOPMENT** http://brr.gov.mk

   Main goal: development of contemporary and modern infrastructure and stimulation of the economic through implementation of projects for development of: planning regions (70%); areas with specific development needs (20%); and villages (10%)

   Beneficiaries:

   - Local self-government units
   - Councils for development of the planning regions

2. **Sub-program FINANCIAL SUPPORT FOR RURAL DEVELOPMENT** (http://www.ipardpa.gov.mk)

   Main goal: improving the quality of life in rural areas. The projects will focus on: rural infrastructure investment and rural tourism development for local road infrastructure, water supply and sewage systems, homes for children & youth, homes of culture etc.

   Beneficiaries: Local self-government units

3. **Sub-program CONSTRUCTION OF PRIMARY SCHOOLS** (http://www.mon.gov.mk)

Main goal: Improving the infrastructure of primary schools by building new ones, taking into account the reforms in the field of primary education, the full implementation of the nine-year curriculum and the fulfillment of appropriate conditions for the smooth realization of the education..

Beneficiaries: Local self-government units

4. **Sub-program RECONSTRUCTION OF PRIMARY SCHOOLS** (http://www.mon.gov.mk)

   Main goal: Reconstruction of the existing network of primary schools in order to improve the conditions for education, creating equal opportunities to attend classes for all primary school students.

   Beneficiaries: Local self-government units

5. **Sub-program CONSTRUCTION OF SPORT HALLS WITHIN THE PRIMARY** (http://www.mon.gov.mk)

   Main goal: Construction of school sport halls within the primary schools and creation of conditions for realization of education and activities in sports in order greater attention to the health of future young generations.

   Beneficiaries: Local self-government units

6. **Sub-program CONSTRUCTION OF SECONDARY SCHOOLS (**http://www.mon.gov.mk)

   Main goal: Improvement of the secondary school infrastructure through construction of new schools, taking into consideration the reforms in the activity of secondary education in order to meet the appropriate conditions for realization of the program and implementation of compulsory secondary education through creation of equal opportunities for all secondary school students in this activity.

   Beneficiaries: Local self-government units

7. **Sub-program RECONSTRUCTION OF SECONDARY SCHOOLS** (http://www.mon.gov.mk)

   Main goal: Reconstruction of the existing network of secondary schools in the Republic of Macedonia in order to improve the conditions for realization of the program and implementation of the compulsory secondary education.

   Beneficiaries: Local self-government units

8. **Sub-program CONSTRUCTION, EQUIPMENT AND MAINTENANCE OF CHILDREN'S PROTECTION FACILITIES** (http://www.mtsp.gov.mk)

   Main goal: Reconstruction and renovation of the existing kindergartens in accordance with the program for investing in the existing kindergartens, as well as equipping the newly constructed kindergartens

Beneficiaries: Local self-government units

9. **Sub-program SPORTS FACILITIES** (http://www.ams.gov.mk/)

   Main goal: Realization of capital investments in sports infrastructure. The accompanying investment costs (for preparation of project documentation, project supervision, electricity connection, etc.) are included in the amount of planned funds.

   Beneficiaries: Local self-government units

Funds from international financial institutions

1. **Sub-program MUNICIPAL SERVICES IMPROVEMENT PROJECT** (https://www.finance.gov.mk)

   Main goal**:** Construction and reconstruction of infrastructure investment projects in the areas of water supply and wastewater, solid waste management and other investments in municipal services that have the potential to generate revenue ie make savings or which are of high priority for municipalities. The projects will be financially supported by a World Bank loan and a grant from the European Union to improve rural infrastructure.

   Beneficiaries:

   - Local self-government units
   - Public enterprises founded by the municipalities

2. **Sub-program SOCIAL SERVICES IMPROVEMENT PROJECT** (http://www.mtsp.gov.mk)

   Main goal: Improving the quality and increasing the access to social services for vulnerable groups of citizens, the elderly, persons with disabilities and others. Grants will be awarded for immediate social service projects, individual or family support, home care, personal assistance, day care, temporary care, small group homes, day care centers and supported living services and other innovative community services. Municipalities that express interest to receive a grant for the development of social services will be provided with direct support for the preparation of application documents, including project proposals by an expert engaged in the Project.

   Beneficiaries: Local self-government units

3. **Sub-program PROJECT FOR RECONSTRUCTION OF WATERSUPPLY AND WAST WATER TREATMENT** (http://www.mtc.gov.mk/)

   Main goal: Construction and reconstruction of water supply and sewage systems, financed by a loan from the European Investment Bank (EIB), as one of the most important preconditions for ensuring contemporary standard of living for the population. Funds are allocated to municipalities in the form of a grant, which significantly contributes to improving the living conditions of the population..

   Beneficiaries: Local self-government units

4. **Sub-program PROJECT FOR ENERGY EFFICIENCY IN THE PUBLIC SECTOR** (https://www.finance.gov.mk)

   Main goal: The project will include implementation of measures by municipalities to improve the energy efficiency of public buildings on their territory. The projects will be financially supported by the World Bank.

   Beneficiaries: Local self-government units

5. **Sub-program PROJECT FOR CONSTRUCTION AND REHABILITATION OF LOCAL ROAD INFRASTRUCTURE (**https://www.finance.gov.mk)

   Main goal: The project will include implementation of projects by municipalities to improve local road infrastructure. The projects will be financially supported by the World Bank

   Beneficiaries: Local self-government units

European Union – pre-accession assistance (IPA)

The Instrument for Pre-Accession Assistance, or simply IPA, is a funding mechanism of the EU. The EU Instrument for Pre-accession assistance is unique in addressing the objective of preparing candidate countries and potential candidates for Union membership. The funds build up the capacities of the countries throughout the accession process, resulting in progressive, positive developments in the region.

Since 2007 the Instrument for Pre-accession Assistance actively promotes territorial cooperation, for example through cross-border programmes, transnational and inter-regional cooperation programmes and macro-regional strategies.

The North Macedonia, as a candidate country for EU membership, has funds under the EU Pre-Accession Assistance (IPA) Instrument currently available through IPA 2014 - 2020 Financial Perspective (IPA 2).[21]

1. **INTERREG IPA CBC BULGARIA - NORTH MACEDONIA PROGRAMME 2014 – 2020** (www.ipa-cbc-007.eu)

   Cross border region:

   - In Bulgaria: Districts of Blagoevgrad and Kyustendil
   - In North Macedonia: North East, South East, and East regions

   Total budget:: 19.461.690 €

   Priority axis 1: Protecting the environment, promoting climate change adaptation and mitigation, risk prevention and management;

[21] On 14 June 2018, the EU Commission published its legislative proposal for a regulation establishing the Instrument for Pre-accession Assistance (IPA) III 2021-2027. This instrument is part of a set of proposed instruments for EU external action under Heading 6 'Neighbourhood and the World' in the next Multiannual Financial Framework for the period 2021-2027. IPA III aims to help the transformation process in the Western Balkans in the next period; implement robust economic reform programmes; and renew the focus on reforms necessary for future membership

Types of recipients:

- Local and regional authorities and their associations
- Regional structures of central public authorities
- Regional and sectorial development agencies, non-government, non-profit organisations
- Research, education and training institutions
- Social institutions
- Any association of the above

2. **INTERREG IPA CBC GREECE - NORTH MACEDONIA PROGRAMME 2014 – 2020** (http://www.ipa-cbc-programme.eu/)

Cross border region:

- Greece: regions of Thessaloniki, Kilkis, Edessa, Florina and Pella
- North Macedonia: Vardar, Pelagonia, Southeast and Southwest region

Total budget: 45.000.000 €

Priority axis 2: Protection of Environment - Transportation that focuses on the improvement of public infrastructure and reduction of isolation by improved access to transport, information and communication networks and services. It promotes sustainable management, treatment and recycling of waste as well as supports sustainable management of protected areas, ecosystems and biodiversity and addresses prevention, mitigation and management of natural disasters, risks and hazards..

Корисници: Локални власти

3. **INTERREG BALKAN-MEDITERRANEAN** PROGRAMME **2014-2020** (http://www.interreg-balkanmed.eu/)

Cross border region: Bulgaria, Cyprus, Greece, Albania, North Macedonia

Total budget: 39.727.654 €

Priority axis 2: Environment focuses on the development and implementation of common strategies and approaches will foster for the protection and sustainable use of natural/cultural heritage and will accordingly strengthen resources' management efficiency and climate change resilience.

Types of recipients:

- Local, regional and national authorities
- Environmental and development agencies
- Protected/ designated areas' management organisations and bodies

- Non-governmental and Civil Society organisations
- Umbrella organisations of SMEs

4. **IPA RURAL DEVELOPMENT PROGRAMME 2014 – 2020**
(http://www.ipardpa.gov.mk)

   Measure: INVESTMENTS IN RURAL PUBLIC INFRASTRUCTURE

   Main goal: To support economic, social and territorial development, with a view to a smart, sustainable and inclusive growth through the development of physical capital in the country.

   Specific goals:

   - to provide infrastructure needed for the development of rural areas;
   - to contribute towards the improvement of living standards for rural population;
   - to support public investments necessary to achieve development and environmental aims;
   - to increase the attractiveness of rural areas for local and outside investors.

   Types of recipients: Local administrative units (LAU 1 – Municipalities) defined according to the Law on territorial organisation of local self-governments

Support from other international donors

1. **MUNICIPAL SERVICES IMPROVEMENT PROJECT (MSIP) 2019-2021**

   Goals: The project provide the financial resources that less-developed municipalities need to undertake necessary preparatory work (infrastructure designs, urbanization plans, feasibility studies) for development projects that are eligible for EU, state or donor funding, either through direct grants or low-interest loans.

   Beneficiaries: local authorities

Funds from public-private partnership

One of the key policy directions of the PPP concept is the desire to improve the country's national infrastructure and support public services, without burdening public funds and without the need for tax increases.

According to the Law on Local Self-Government, the municipality may delegate the performance of public interest activities that are of local importance to other legal or natural persons, based on a contract for performance of public interest activities, in accordance with the law. The Law on Energy regulates, inter alia, the manner and procedure for determining and fulfilling the obligations to provide public service in the electricity, natural gas and thermal energy markets and the manner and conditions for encouraging the use of renewable energy sources. The Law on Concessions

and Public Private Partnership regulates more precisely the issues related to the establishment of public-private partnership between the local government and the private sector.

In that direction, the opportunities for concluding public-private partnerships with energy service companies [ESCO] could be used as a source of funding for the realization of this Action Plan to improve energy efficiency and the utilization of renewable energy sources on the territory of the municipality

Funds on basis of donations and sponsorships

According to the Law on the Financing of Local Self-Government Units, the revenues from donations are identified as one of the sources of funding of the municipalities

The Law on Donations and Sponsorship in public activities regulates more precisely the issues of giving and receiving of donations and sponsorships by which the donor and the recipient can request tax incentives, the purpose of the giving and receiving, the donors and the recipients, the subject, the use, the tax incentives. recording and control of the donations and sponsorships in public activities.

MONITORING CONTROL AND REPORTING

Monitoring, control and reporting on the results of the Sustainable Energy and Climate Change Action Plan for the Municipality of Valandovo is a very complex and difficult process that requires participation of all stakeholders, including municipal administration bodies, public enterprises, citizens, stakeholders and persons involved in the implementation process. The cities/municipalities that are signatories of the Covenant of Mayors, after the adoption of the Action Plan, are obliged to prepare a Report on the results of the Action Plan every two years and submit it to the European Commission. The report must contain a detailed description of the measures implemented, the activities and a list of results achieved, with a CO_2 emission control inventory for the reporting period.

With this Action Plan, a reference CO_2 Inventory for 2018 has been produced. The comparison of the CO_2 reference and control Inventory will show a real reduction in CO_2 emissions and hence the successful implementation of the Action Plan.

The process of monitoring and control of the implementation of the Action Plan is currently based on the recommendations made by the European Commission. The Joint Research Center of the European Commission is preparing an official manual for this area and following the adoption of this document, the methodology for monitoring and control of the implementation of the Action Plan will be adjusted to the already defined reporting procedures.

The European Commission makes recommendations on how to monitor, control and report on the preparation of the CO2 emission control inventory. If the production of the control inventory for objective reasons is not possible within the suggested time intervals, then the recommendation is to alternate every two years:

- CO_2 Emission Inventory Status Report
- Implementation Report with CO_2 Inventory.

The above provides continuous reporting and analysis of the measures implemented every two years of preparation and adoption of the Action Plan. The CO_2 Inventory Report will contain information on the measures that have been undertaken, their impact on energy consumption and CO_2 emissions, overall activities, energy savings achieved, and analysis of the implementation of the Action Plan, including corrective and preventive measures if necessary.

In addition to the information provided in the status report, the implementation report will also contain information on CO_2 inventory. Each of these reports will analyze the level of implementation of the Action Plan, and if the implementation of these measures is objectively impossible or the results of the measures that have been implemented are different than expected, the report will include proposed corrective actions.

Moreover, it is also suggested to conduct internal monitoring in the form of regular annual report to the Municipality of Valandovo. It should be prepared in the form of a status report without the CO_2 emissions inventory included.

It is recommended to regularly inform the citizens of the Municipality of Valandovo on the implementation of the Action Plan. The activities will be carried out through presentation of some of the implemented projects, which will ensure more active citizen participation and promotion of responsible and rational use of energy in the municipality.

The monitoring, control and reporting on the results of the implementation of the Action Plan require:

1. Establishment of organizational structure, supervision and working bodies for the implementation of the Action Plan;
2. Establishment of an information system for monitoring of the energy consumption in the municipality;
3. Creation of a single register of buildings and consumers;
4. Establishment of an information and education center,

Establishment of organizational structure, supervisory and working bodies for the implementation of the Action Plan

Successful implementation of the Action Plan requires careful planning of the organizational structure, supervision and working bodies to create a coherent implementation team. Therefore, it is necessary that the municipality sets up a working group on energy efficiency, sustainable development and climate change

As a head of the working group, it is necessary to appoint an energy management coordinator or expert who will manage the activities of the group and prepare reports on the implementation of the Action Plan.

The working group will monitor the implementation of the Action Plan, establish a database and continuously record the energy consumption for the proposed sectors that have significant share of total energy consumption. In addition, the working group will participate in:

- Temporary and financial control on the implementation of the proposed measures
- Developing control inventory of CO_2 emission
- Monitoring of RES projects
- Collaboration with public enterprises and other parties in the data collection
- Cooperation with citizens, information and education center and NGOs for conducting trainings
- Other tasks related to the implementation of the Action Plan.

CONCLUSIONS

Implementation of the proposed energy efficiency measures presented in this Action Plan would significantly reduce CO_2 emissions at municipal level. By sector, CO_2 emission reduction is distributed as follows:

Table 33: Overview of the CO_2 emissions reduction per sectors

Sector	Sub-sector	Share of the emissions reduction (%)	Total reduction of the emissions per sectors (%)
Sector buildings	Municipal buildings	51 %	19.5 %
	Tertiary sector buildings	63,3 %	
	Residential buildings	18 %	
Sector public lighting		68.3 %	68.3 %
Sector transport	Municipal transport	5.2 %	0.07 %
	Private an commercial transport	0.06 %	
Sector water		80 %	80 %

The most significant difference is evident in the transport sector where the proposed measures cannot be adequately formulated and monitored since the measures are subject to private and commercial vehicles. At the same time, without full involvement of the institutions in the creation of sustainable transport policies and the introduction of different types of subsidies, emission reductions in this sector are impossible.

The largest share (in %) of CO_2 emissions reduction is evident with the implementation of the set of measures for the water sector, and the implementation of the Complete program for revitalization of the public lighting, which leads to CO_2 emissions reduction of more then 68%. The following table presentss the CO_2 emissions for the reference year 2018 and the estimations for 2030 following the implementation of the proposed EE measures.

Table 34: Overview of the CO_2 emissions per sectors for 2018 and 2030

Sector	Емисија на CO_2 во 2018та (tCO_2/a)	Емисија на CO_2 во 2030та (tCO_2/a)
Buildings	19,846	15,985.4
Public lighting	622	197.4
Transport	21,106	21,092.3
Water	485	97
Total	**42,059**	**37,372.1**

The total reduction of the CO_2 emissions after the implementation of all proposed measure for energy efficiency would be equal to 4,686.9 tCO_2 11.11%.

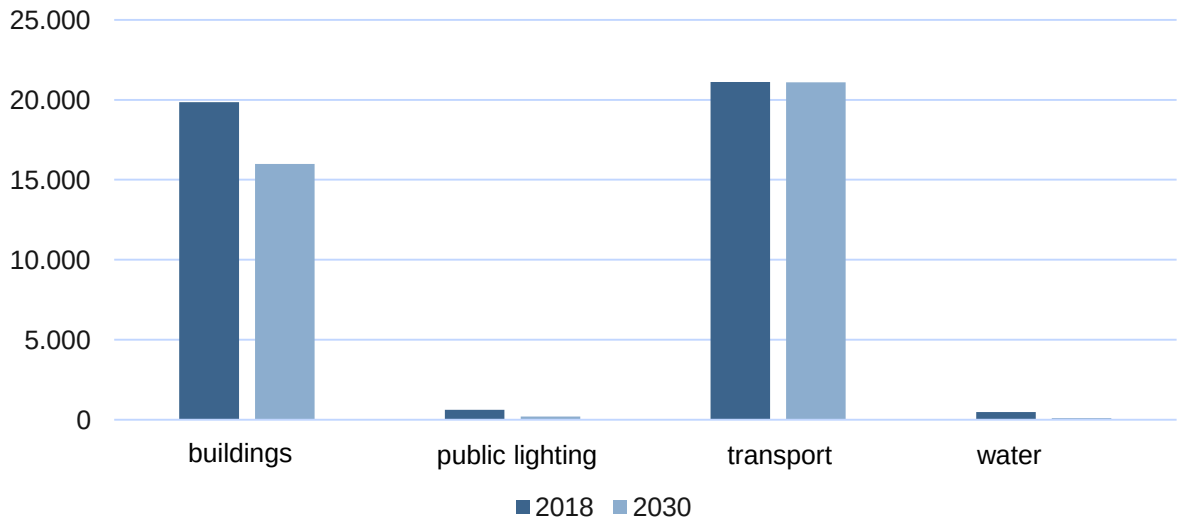

Figure 19: Overview of the CO_2 emissions per sectors for 2018 and 2030

In the process of implementation of the Action Plan, it is necessary to have constant coordination by the competent institution for the implementation of the projects and carrying out of the proposed measures.

During the implementation of the project activities, monitoring of the following parameters is necessary:

- Status of implementation of the measures (at what stage of implementation they are)

- Dynamics of spending the foreseen funds
- Percentage of reduction of greenhouse gas emissions in relation to the status of implementation of the measure.

The future steps needed for policies and activities creation for next period towards achieving the goals set can be formulated based on the monitoring of the implementation of proposed measures and the results achieved.

APPENDIX I QUESTIONAIRRE FOR COLLECTION OF DATA ON CONSUMPTION AND COSTS OF ENERGY IN BUILDINGS SECTOR

The following table can be used for collection of data in the buildings sector. Data collection is being performed for the past three years, if data exist. To be indicated also the sub-sector where specific building belongs (for example: educational building, residential building, healthcare protection, etc.)

Table 35: Proposed table for energy consumption and costs

Sector	No. of users	Total area	Грејна површина	Електрична енергија		Огревно дрво		Екстра лесно масло за горење		Дрвени пелети		Other _____	
		m^2	m2	[kWh/a]	[МКД/a]	[m^3/a]	[МКД/a]	[l/a]	[МКД/a]	[t/a]	[МКД/a]	[____/a]	[МКД/a]
2018													
2017													
2016													