URBAN CLIMATE ADAPTATION IN BULGARIA

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Gabriela Arabadzhieva

Minor Thesis Research LUP-80424, 24 ECTS

Registration Number: 890815017040

Supervisors: Gerrit-Jan Carsjens and Sanda Lenzholzer

Wageningen University and Research Centre

Land Use Planning Group

Droevendaalsesteeg 3a Building 100 6703 AA Wageningen

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Abstract:

Climate change is considered the most important issue of the 21st century. Facing its harmful consequences by working towards a more adaptive living environment, is an important and challenging task for both scientists and policy makers. Urban climate adaptation is increasingly becoming a “hot topic” for urban planners and designers, as well as for the local and national governments. In the past years there is a trend, showing that cities are aiming to adapt their urban environment to climate change. They are also trying to face the effects and consequences of the changing urban micro-climate. The main aim of this research is to show the state of the art solutions for urban adaptation policies and practices applied in Bulgaria. The country, with its south-eastern geographical position is also affected by climate change. In the last decades, large, highly populated Bulgarian cities with densely built-up areas and active traffic are experiencing the urban heat island effect (Maneva et al., 2012). Therefore, this study will make an inventory of the current status of the urban climate adaptation in Bulgaria.

Key words: adaptation, climate change, urban heat, awareness, urban adaptation

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1. Introduction

1.1. Problem description

Climate change is considered the most important issue of the 21st century. Facing its harmful consequences by working towards a more adaptive living environment, is an important and challenging task for both scientists and policy makers. It is important to evaluate the effects of climate change on a global, but also on a local level. Urban climate adaptation is increasingly becoming a "hot topic" for urban planners and designers, as well as for the local and national governments. In the past years there is a trend, showing that cities are aiming to adapt their urban environment to climate change. They are also trying to face the effects and consequences of the changing urban micro-climate. To face those risks in a most efficient way, local authorities need well developed climate adaptation policies, in order to make their cities more resilient and to reduce the harmful effects of the raising temperatures for their citizens (Henstra and McBean, 2009; Prasad et al., 2009; Henstra, 2012).

Nowadays, urban areas with their raising population are the most affected by global warming. The temperature increase in the cities, affects the health and the thermal comfort of their inhabitants. According to European Environmental Agency (EEA), climate change is increasingly causing serious problems to cities such as heat waves, floods and droughts (EEA, 2012). This is a prerequisite for cities to make their urban environment more adaptive to these threats, in order to ensure the good quality of life of the citizens (EEA, 2012). Figure 1, shows the possible effects of climate change on human health. The Urban Heat Island effect (UHI) has very harmful consequences on the well-being of local population, especially to the most vulnerable age groups such as elderly and children (Wilby, 2008). Therefore, it is important that local and national authorities develop a well-functioning system of mitigation and adaptation measures to improve the living conditions in urban areas.

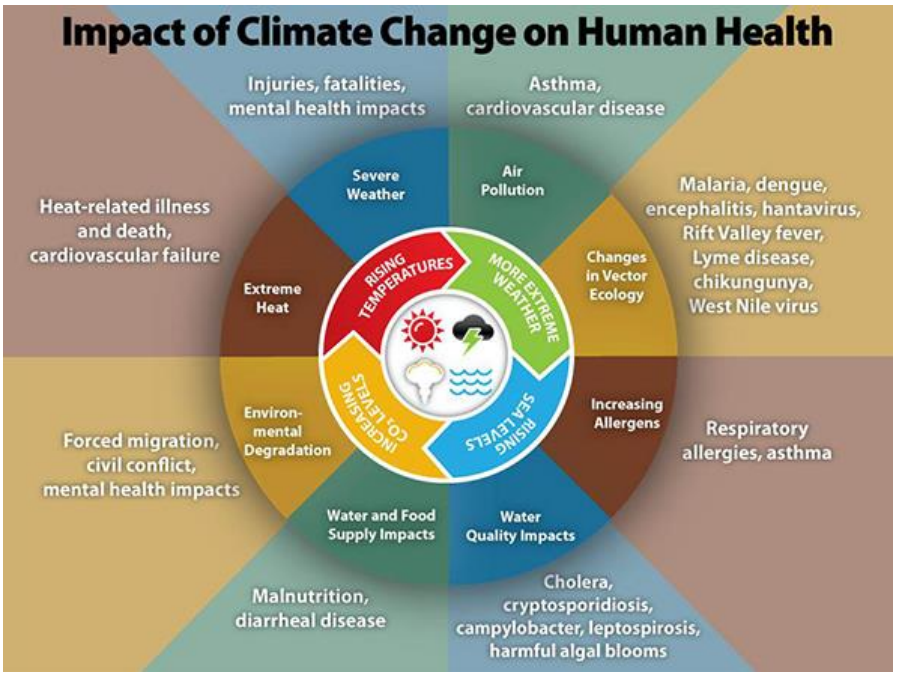

FIGURE 1 WHAT INDUCES THE UHI EFFECT, **SOURCE: HTTP://WWW.CDC.GOV/CLIMATEANDHEALTH/EFFECTS/DEFAULT.HTM**

Bulgaria, with its south-eastern geographical position is also affected by climate change. These effects are even more sensible on a local level. In the last decades, large, highly populated Bulgarian cities with densely built-up areas and active traffic are experiencing the urban heat island effect (Maneva *et al.*, 2012). Therefore, they need sound and efficient laws and measures to adapt to the changing climate. This research will focus on the urban adaptation measures that the cities in Bulgaria are developing. It will study how urban environment is adapting to raising temperatures. Furthermore, it will try to go more in depth into the measures and strategies implemented in the country and what are the effects of their implementation.

1.2. Research Objective

This research is a part of a world-wide study on urban adaptation. Similar studies were already conducted in the Netherlands and China. The main aim of this research is to show the state of the art solutions for urban adaptation policies and practices applied in Bulgaria. This case-study was chosen, because it represents a good example of an Easter European country which is in the initial phase of building climate adaptation. Thereby, examples will be given with several Bulgarian cities, for example the capital city – Sofia, as well as several other larger and smaller cities. This research will help in establishing the level of awareness on climate change and quality of the communication process between the local population, urban planners, climate scientists and policy makers. Furthermore, it will establish the availability of instruments needed to build adaptation, as well as their degree of implementation.

As a part of a larger study, the analysis will be based on a set of pre-made interview questions, used for all countries within the project.

The main objective of this research is to make an inventory of the current status of the urban climate adaptation in Bulgaria. It will aim to identify the climate adaptation measures applied in different cities in the country. It will examine the actions of local and national authorities to reduce the effects of this

phenomena and the measures they are taking towards achieving climate adaptation. Thus, it will elaborate on its connection to urban heat and its influence on urban climate adaptation.

1.3. Research questions

Main research question

What is the current situation with urban climate adaptation Bulgarian cities?

Sub-questions

1. What are the current issues with awareness and communication between different actors (i.e. Scientists, local authorities, governmental actors and local population) regarding urban adaptation in Bulgaria?
2. What instruments are used by the local and national authorities to achieve urban adaptation and how are they implemented on an urban level?

1.4. Thesis outline

This thesis will be organized in six main chapters. Chapter two presents a literature review of the theoretical concepts relevant for this study. In this second chapter, I present the origin of climate change and urban heat. Firstly, I explain the concepts of climate change and urban heat island (UHI). Furthermore, I present the main factors that induce the UHI effect. Then I present the concept of climate adaptation and its implementation on EU/national and urban level. In chapter three, I discuss my case study and the methodology that I used to collect my data. In chapters four and five I present the analysis and the discussion of my findings. Furthermore, in the discussion I make a link of my results to the existing literature. In the last chapter, I draw some conclusions about the state of the art of urban climate adaptation in Bulgaria. Thus, I present the limitations of my research. Finally, I give some scientific and social recommendations.

2. Theoretical framework

The theoretical framework within this thesis will briefly describe the theories about climate change, urban heat and climate adaptation, similar to that of previous studies in this project. It will provide information about the elements of the urban climate and will explain in what way they are affected by the changing climate in the cities. It will show how climate adaptation is applied on a city level. Finally, in relation to the second objective of this document, the theoretical framework will elaborate more on urban fabric and on its specifics in the Bulgarian cities. It will explain how it influences urban heat and its role in urban climate adaptation.

Climate change

Climate change is a global process that affects Earth`s climate on global and on a local level. This research will concentrate on the effects of climate change on an urban scale. Climate change is natural process for our planet, however nowadays its speed increases dramatically due to the anthropogenic activities, such as industrial production, transportation, but also deforestation. Normally, the average climate of the planet changes over a longer time period, where simultaneously the frequency and intensity of extreme weather events, such as heat waves and floods increases (EEA, 2012). On a city level, scientists consider that climate

change will have severe effects. Increasing urban temperatures, along with heavy transportation and poor Building insulation lead to considerably higher Urban Energy Budget (UEB) (EEA, 2012; Oke, 1982; Wilby, 2008). They also create conditions for the occurrence of more frequent and longer heat waves, and a higher amount of hot days in a year, where the Sothern European countries are most affected (EEA, 2012; Oke, 1982; Wilby 2008).

Urban heat

The changing global climate has more heightened effect on an urban scale. The increasing population of cites and the large amount of motor vehicles contribute for an even larger temperature increase on a local level. Scientist have noticed that these factors, along with the densely built-up central urban areas lead to the so called Urban Heat Island Effect (UHI). This phenomenon is defined by Stathopoulou et al. (2005) as "the excess warmth of the urban atmosphere compared to the non-urbanized rural surroundings". These territories can reach a temperature difference from up to 10°C. Figure 2, explains the mechanism and the origin of UHI effect.

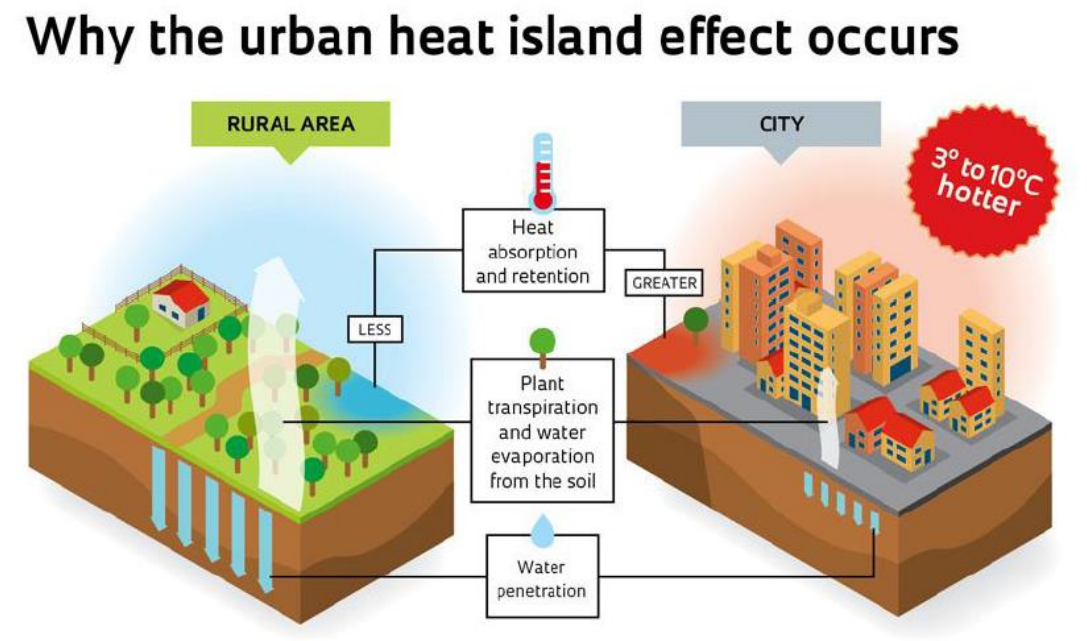

FIGURE 2 WHAT INDUCES THE UHI EFFECT, SOURCE: WWW.REVISTAPESQUISA.FAPESP.BR, 2016

Main factors that induce urban heat island

The occurrence of the UHI effect is due to a variety of factors such as buildings reflectivity features (albedo) (Stathopoulou, 2005). Furthermore, UHI intensity is affected by factors as urban design, urban fabric, the types of surfaces within the city (pervious/impervious), building insulation, sky view factor, land surface temperature and building materials (Rizwan, 2008; Mitraka et al., 2014).

Climate adaptation on an EU/national level

With the changing global climate making highly populated urban areas climate proof and adaptive to the climatic conditions is very important. Climate adaptation is a complex process including various actions from both policy makers and urban planners. From a policy perspective it requires big changes in current laws and regulations, such as building standards and design, planning urban geometry and the amount of green areas (EEA, 2012). Thus, in a long term urban adaptation requires tailor-made legislation and financial incentives, for instance the Multi-annual Financial Framework of the EU covering the program period 2014-2020. The framework provides that 20% of the budget for the period to "support both climate mitigation and adaptation" (EEA, 2012). However, EEA (2012) argues that most actions emphasize more on mitigation rather than making cities more adaptive to climate change.

Climate adaptation on an urban level

Climate adaptation on an urban level varies within the different regions of Europe. Furthermore, in order for it to be effective, it needs sound and systematic planning for which multiple approaches were developed (EEA, 2012; Smit *et al*., 2002). A good example for such an approach is developed by the city authorities of London. Because of its densely built city centre and the type of its urban fabric, London is considered to be highly vulnerable to climate change (CLC, 2015). In order to make their city more adaptive to the increasing urban temperatures and to reduce the effects of urban heat, in 2010 City of London Corporation (CLC) created a strategy to the city more adaptive to the changing climate (CLC, 2015; CLC, 2010). The document was called "Climate change adaptation strategy" (LCCAS) and it was originally initiated by the Mayor of London within the Greater London Authority (GLA), who did not manage to implement his idea because of lack of finances (GLA, 2011; CLC, 2015; CLC, 2010). The LCCAS, therefore, was created within a broader collaboration of public and private actors that included GLA and City of London (GLA, 2011). The main aim of the document was to make London Metropolitan area more sustainable and able to adapt to the threats of climate change (GLA, 2011; CLC, 2010). According to GLA (2011), the city is facing a serious impact of urban heat due to its growing population and the way the city scape is changing to accommodate their needs of living space. According to available research, London`s population is facing a phenomena called "fuel poverty", that occurs because of the poor building insulation which increases the energy bills and it is a prerequisite for a more intensive use of heating or air conditioning (Marmet Review Team, 2011; Heath, 2011). The LCCAS, along with several other national and municipal programs is meant to be used as tool overcome such problems, to increase the energy efficiency of the city and to improve the quality of life of the local population.

Such good examples for urban adaptation can be given in multiple Western European cities, such as London, Malmö and Rotterdam. Nowadays, with the expansion of the EU on the East, good urban adaptation practices could be also given with some Eastern European cities such as Bratislava in Slovakia and Thessaloniki in Greece. This trend shows the increasing importance of urban climate adaptation.

3. Methodology and case study selection

This section presents the methodology that has been used for data collection and data analysis. Furthermore, it introduces the selected case-study of Bulgaria.

3.1. The case of Bulgaria

The case-study that has been used in this thesis is Bulgaria. The country was chosen, because it represents an interesting case of what is the degree of climate change adaptation within a country from Eastern Europe. Furthermore, it is interesting with its transitional geographical location, the diversity of its landscape that reflects on the urban climatology, as well as with its urban diversity.

Bulgaria is situated in the south-eastern part of Europe, at the Balkan Peninsula (Georgiev, 1991; Vekilsa, 1991; Ivanov, 1998). Therefore, the country experiences the influence of two main climatic zones, namely the moderate continental climate and the Mediterranean climate, as well as the transitional climate occurring between the two zones (Georgiev, 1991; Vekilska, 1991; BAN, 1991). This geographic location is a prerequisite for a larger amount of solar radiation over a period of over 8 months (Vekilska, 1991, BAN, 1991). Since Bulgaria is situated in the southern part of the European continent, it is experiencing a relatively higher level of solar radiation, with an average amount of around 4460 hours per year (BAN, 1991). The highest amount of solar radiation is estimated to be in the summer months between June and August, and the lowest is in December (Georgiev, 1991; Vekilska, 1991, BAN, 1991). However, this factor is directly affected by some specific atmospheric events, such as air pollution and amount of cloud coverage (Vekilska, 1991). Therefore, it is considered that the regions with a higher degree of air pollution, such as big cities like the capital Sofia, experience a lower amount of solar radiation (Georgiev, 1991).

The anthropogenic factors also have an influence on the climate of the country, especially on the local microclimates. For instance, the population growth, the built-up density, the urban geometry and the urban fabric have a significant influence on the temperature change in the central urban areas (Maneva *et al*., 2012). In the city centre of Sofia, it was observed that the air temperature is a few degrees higher than in the periphery of the city (Georgiev, 1991; Maneva *et al*., 2012). This is an example of the "Urban Heat Island" (UHI) which in Sofia is caused by factors like the higher built-up density, the higher amount of vehicles in the city area and the disturbed air circulation due to the complex city geometry (Georgiev, 1991; Maneva *et al*., 2012). Nowadays, this phenomenon is increasingly observed not only in the large Bulgarian cities, but it starts occurring also in smaller scale cities, such as Dobrich. This is due to a variety of factors like the increase of the Urban Energy Budget (UEB) due to poor building insulation and the increasing urban population.

National data shows that from the end of the 20th century, the climate in Bulgaria is becoming warmer and the winters are less severe (Maneva *et al*., 2012). It was measured that the mean annual temperature for 2011 was 0,4°C higher than the normal limit (Maneva *et al*., 2012). It was observed that there were longer periods of drought and the frequency of extreme weather events was higher (Maneva *et al*., 2012). Furthermore, the temperature amplitude between the annual minimum and maximum had decreased (Maneva *et al*., 2012). Based on this data, different meteorological models predict that the mean air temperatures in Bulgaria would increase with 2° to 5°C until the end of the century (Maneva *et al*., 2012). According to the available climate data, scientists expect that due to climate change, the country will be

more threatened by the occurrence of heat waves, in combination with a higher humidity and a higher degree of urban air pollution (Maneva *et al*., 2012).

Currently, according to the national Spatial planning law, issues in 2009, there are minimal requirements regarding the amount and the positioning of urban green areas within the Bulgarian cities (Maneva *et al*., 2012). The law covers the minimum requirements regarding urbanization processes, however highly urbanized Bulgarian cities nowadays need an innovative and more flexible approach for urban adaptation (Maneva *et al*., 2012). Another problem that occurs, is that there is a tendency of creating closed urban structures within the suburban areas which have a high percentage of green areas and environmental friendly materials, but usually they are private properties with a restricted access for the broader local population (Maneva *et al*., 2012).

Bulgaria is taking measures to increase it adaptive capacity on a national level, by developing a National Adaptation strategy, managed by the Ministry of Environment and Water (EEA, 2015). The strategy is developed by Minister of Environment and Water, in collaboration with the National Expert Council on Climate Change (EEA, 2015). According to EEA, 2015 "…all the collected and evaluated information will give grounds for the development of specific measures which should present the overall appearance of the strategic actions that reduce the vulnerability of the country from the effects of climate change.". Furthermore, Bulgaria is a member of the Kyoto protocol and as a part of the European Union (EU), the country is obliged to reduce its GHG emissions with at least 50% by 2020 (Maneva *et al*., 2012; EEA, 2015). According to national evaluations, in 2009 Bulgaria has achieved around 52,2% decrease of its carbon emissions comparing to the year the country joined the Kyoto protocol in 2002 (Maneva *et al*., 2012; Darov 2006).

3.2. Data collection methods

Literature review

The first step that has been taken in the process of collect data, was a short literature review on the main concepts discussed within this research, namely climate change, urban heat and climate adaptation. The sources that have been researched were primary sources, such as scientific articles, governmental strategies and laws, and relevant online sources.

Expert interviews

The second phase of this research consisted of 10 in-depth, semi-structured interviews. This method was chosen, because it allows the researcher to gain more depth into the points of view of different actors from a qualitative perspective. Hence, the interviews are considered to be an effective tool of data collection which also allows the researcher to gain a broader perspective on the research area, by simultaneously decreasing the chance of the so called "researcher bias" (Brikci & Green, 2007). The interviews were based on an already prepared list of questions (see Annex 1). The questionnaire consisted of two types of questions. The first part of the questionnaire (Awareness and Communication) consisted of a mix of questions based on a Likert scale and open-ended questions. The second part (Instruments and Implementation), was based on open-ended questions. Since the interviews were semi-structured there was an opportunity to ask additional questions, and thereby, to acquire some additional information on some of the questions.

To achieve the main objective of this research, the target group consisted of a broad range of both public and private actors. From the target group of public actors, six interviews were conducted. Among the actors that have been interviewed, there were two scientists of the Bulgarian Academy of Science (BAN) from which one was a climate expert and the other expert in climate and bio Modelling. The rest four interviewees were experts from Dobrich Municipality: an expert from the municipal Environmental Protection agency, the director of the "Centre Nature and Animals Conservation", the Chief Architect of the Municipality and the Municipal Secretary. From the private actors, interviews were conducted with two urban planners, one from the capital Sofia and one from Varna city. One of the interviews was with an agronomist and landscape designer from Varna and one sustainability expert from the city Byala Slatina.

The interviewees were approached both by phone and by e-mail. The actual interviews were conducted via phone and Skype, due to the large distance to the researched country. The interviews were held in Bulgarian for an easier communication with the interviewees and in order to avoid miscommunication. No record was made, since the interviewees refused to be recorded, instead, the additional information was written down on paper. After conducting the interviews, the data was translated from Bulgarian to English. Later it was summarized in one overview document and each question was analysed accordingly.

3.3. Data analysis

The data was further analysed, based on the main topics (Awareness, Communication, Instruments and Implementation) of the standard questionnaire to achieve a good clarity and structure of the analysis. The questions, based on the Likert scale were analysed using Excel and they were converted in to graphs for a better visual representation. The open ended questions were analysed, based on the answers that interviewees gave. Furthermore, to present a better picture of climate adaptation a bridge was made between the acquired data and the existing literature.

4. Results

This chapter will present the results of the conducted in-depth, semi-structured interviews. The results will be presented according to the structure of the questionnaire which was used to acquire the data. The categories that will be analyzed as follows: a) awareness; b) communication; c) instruments and d) implementation (see Annex2).

A) Analysis of the data in terms of Awareness

Q1. What is the sense of urgency to adapt the urban environment to climate change amongst the following groups in the future in your city?

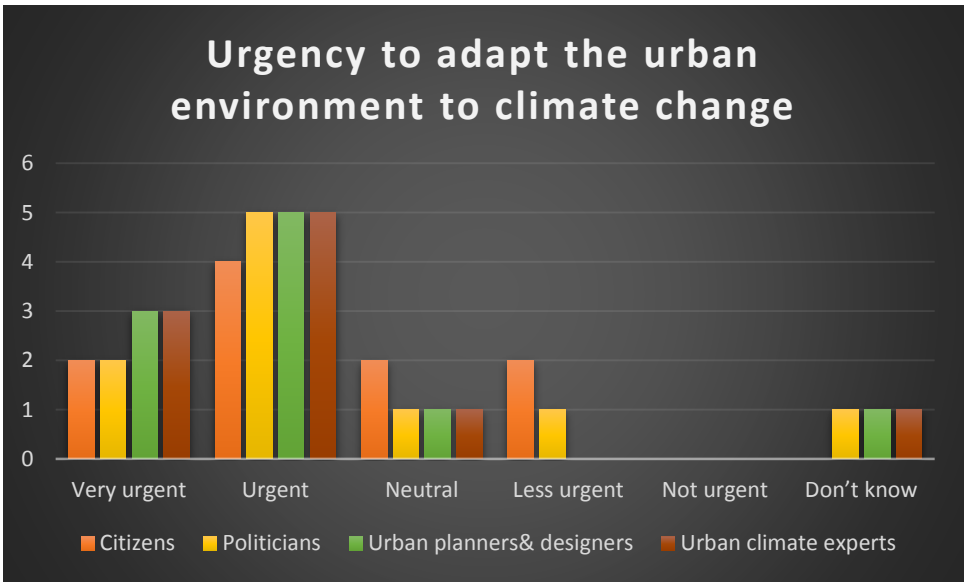

FIGURE 3 SENSE OF URGENCY TO ADAPT THE URBAN ENVIRONMENT TO CLIMATE CHANGE

Figure 3, shows that the majority of the interviewees recognized the urgency of the need of climate adaptation on their cities. The interviewed stakeholders estimate that almost for all groups, (namely citizens, politicians, urban planners and designers, and urban climate experts) urban climate adaptation is an urgent to a very urgent matter. However, five out of ten interviewees stated that because of the low awareness some of the groups might have a neutral attitude to urban adaptation or to feel it as a less urgent matter. People from the municipality stated that citizens and politicians are the least informed about urban climate change.

Q2. In case the sense of urgency is low, what is needed to make those groups feel more urgent about adapting the urban environment?

The majority, six out of ten, the interviewees stated that the main measure that is needed in case the sense of urgency of the stakeholders is low, is raising awareness campaigns. They consider that those campaigns would help informing people on the urgency of adapting urban environments to climate change. For the separate categories of stakeholders, five of the experts think that citizens should be better informed about the anticipated consequences of the lacking implementation of adaptation measures in the urban environment. These consequences include overheating of downtown city areas and soil disruption of urban green spaces.

Others consider that politicians should be made aware, in order to make changes in legislation and create more effective instruments for urban adaptation such as building systems for early warning and measures for reducing the greenhouse gas emissions. According to one municipality representative "In Bulgaria, there is no governmental institution that is interested in protecting the environment and mitigating the effects of these changes in the urban environment."

Regarding the groups of urban planners and designers and urban climate experts, one interviewee stated that to raise the sense of urgency on urban climate adaptation, they should have a "realistic judgment about the problems of the settlements and they should create a program to overcome those problems."

Q3. How aware are the groups of the following two urban climate phenomena?

Urban Heat Island

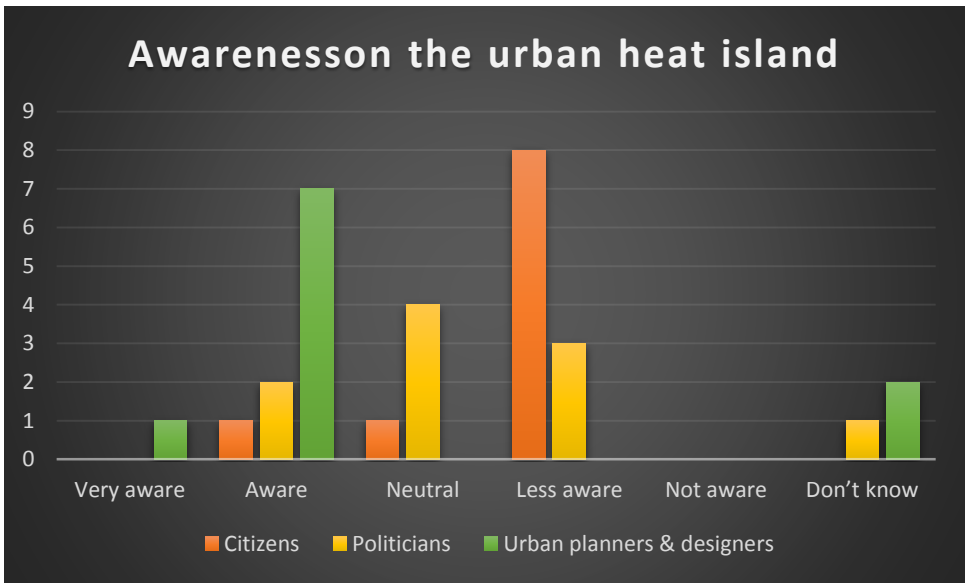

FIGURE 4 AWARENESS ON THE URBAN HEAT ISLAND IN BULGARIAN CITIES

Figure 4, shows the interviewee awareness on urban heat island (UHI). The figure shows that urban planners and designers are considered to be the most aware of this phenomenon compared to other groups. Regarding the politicians, the respondents stated that they are not certain to what extent this group is aware of the problem. Three interviewees stated that politicians are less aware of UHI, four were neutral and one did not know. Only two, stated that according to them politicians are aware of the urban heat island effect.

On the other hand, most of the interviewees, eight out of ten, estimated that in Bulgaria, the citizens are the group which is the least aware of the UHI effect. However, there was one interviewee who stated that citizens are aware of urban heat.

Wind Discomfort

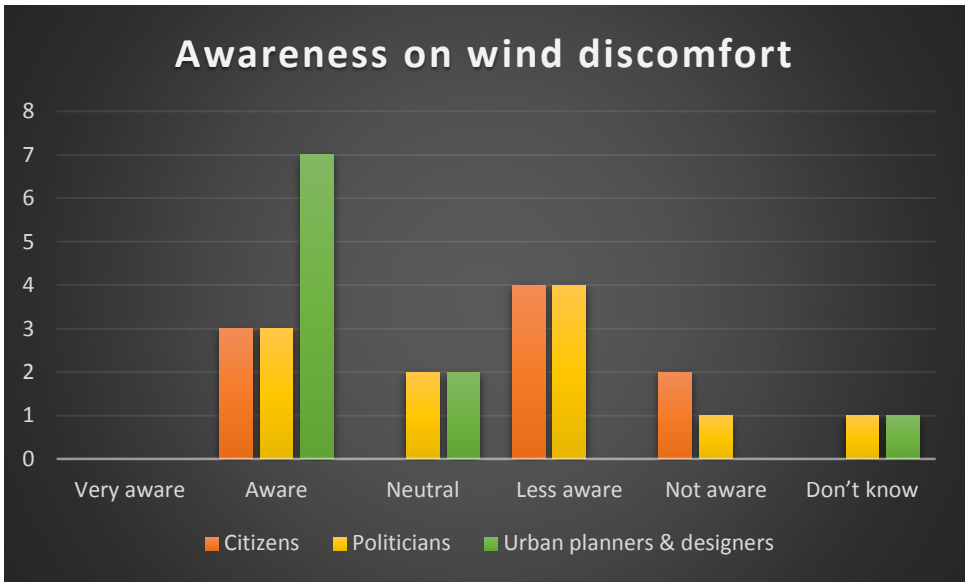

FIGURE 5 AWARENESS ON WIND DISCOMFORT

The awareness on wind discomfort is presented in Figure 5. According to the data presented on the graph, this phenomena is again more related to the knowledge of urban planners and designers. Though, the opinions on the awareness of the politicians regarding wind discomfort differ. Three of the municipality representatives consider that politicians are aware of the problem, another four was not sure, but most, five out of ten, considered that politicians are less to not aware of the problem. Regarding citizens, most interviewees stated that their awareness on wind discomfort is low to non-existent. However, three of the respondents, mainly in the municipality of Dobrich, stated that citizens are aware of the problem, because it is something that they experience in their daily lives in their city.

Q4. In case awareness is low, what is needed to increase the awareness among those groups of two urban climate phenomena mentioned in question 3?

In this case, interviewees are unanimous that for all groups the most important tool to increase awareness are large media campaigns and education. Specialist consider also that there should be a strong collaboration between science and policy to create and develop strategies create "Innovative solutions and measures to build a supportive infrastructure and capacity to mitigate the effects of climate change."

Q5. How aware are the groups of following four urban climate adaptation measures?

City design (e.g. street orientation, adapting to wind and solar orientation of building and streets)

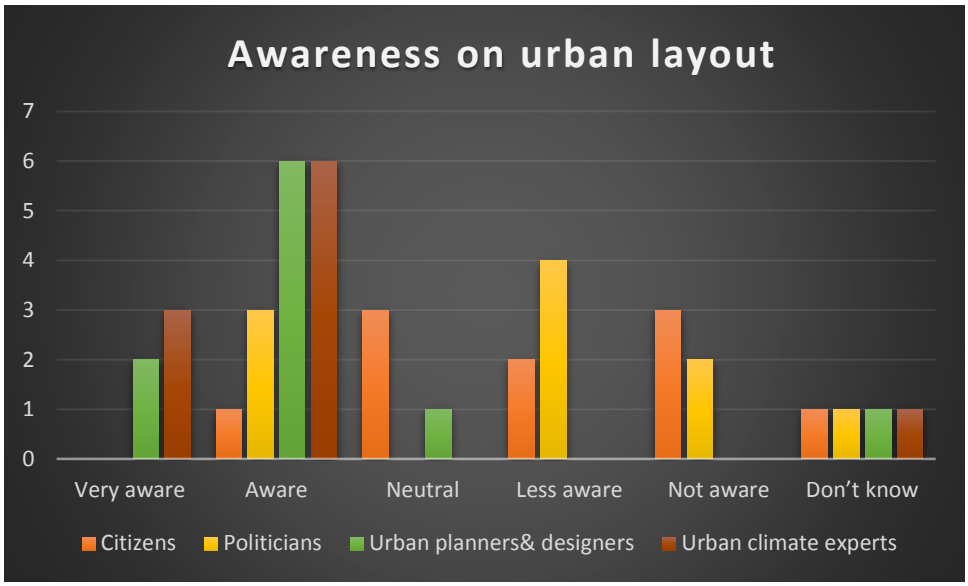

FIGURE 6 AWARENESS ON URBAN LAYOUT FEATURES

Figure 6, shows the rate of awareness of the studied groups, on the features of urban layout. According to the interviewees, the urban planners and designers, and the urban climate experts are the most aware of the city design as a tool to shape urban climate. On the other hand, six of the experts consider that the politicians are less aware or even not aware at all. Only three municipality representatives think that the politicians are aware that the city design could be a measure for urban climate adaptation. However, nine out of ten interviewees stated that the group of the citizens is less to not aware of this measure. Figure 4, shows the rate of awareness of city design for the different groups.

Urban vegetation (e.g. green roofs, urban forestry)

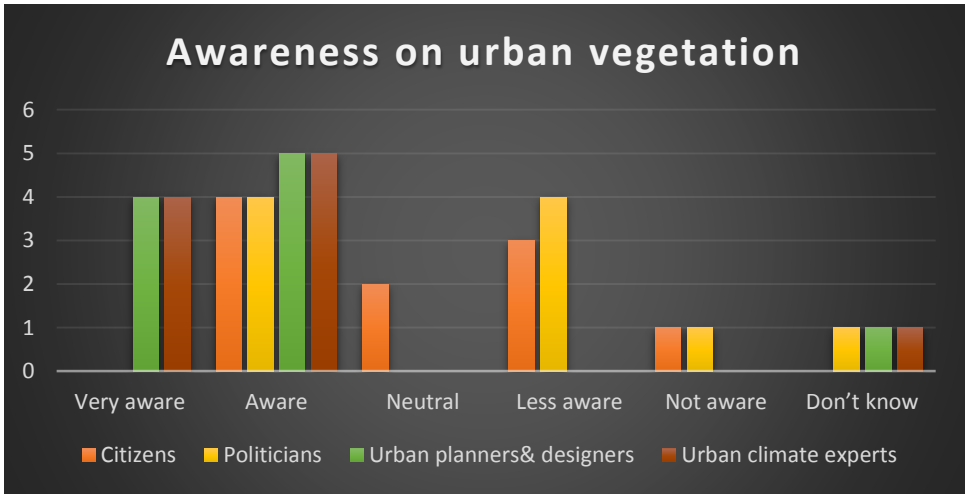

FIGURE 7 AWARENESS OF URBAN VEGETATION

Another climate adaptation measure is urban greening. Figure 7 shows that according to the interviewees almost all groups are aware to very aware about this measure. For the groups of urban planners and designers and the urban climate experts, the awareness of the role of urban green in making cities climate proof is high. For the group of the politicians, most, six of ten, respondents consider that the awareness on urban

forestry is low. On the other hand, opinions differ regarding the group of the citizens. Almost half (four) of the interviewees stated that the citizens are more or less aware of the effects of urban green to reduce urban heat. Five of the respondents, stated that citizens are not aware of the effects of green spaces in the cities.

Use of materials (e.g. low albedo and longer cooling time-lag materials)

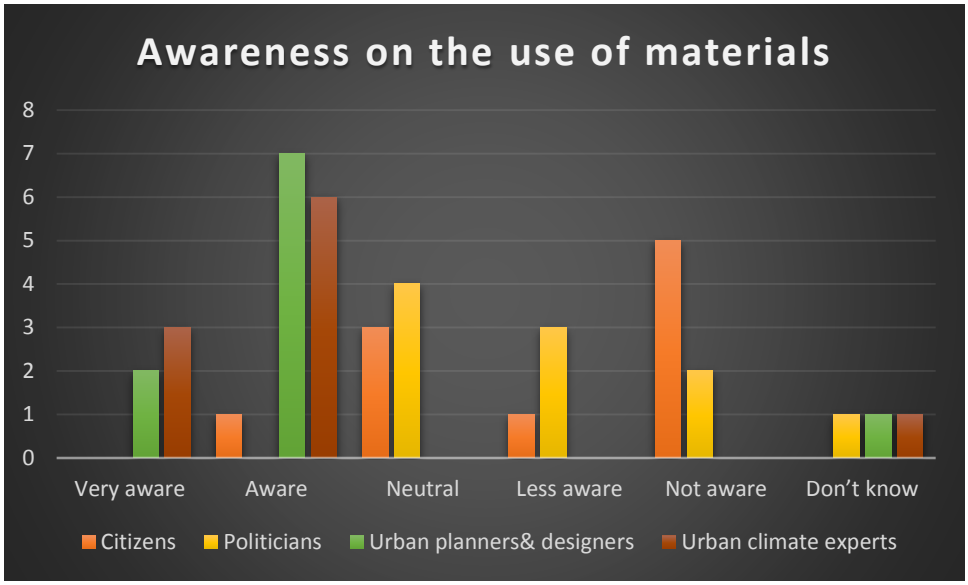

FIGURE 8 AWARENESS ON THE USE OF MATERIALS

Using materials with cooling properties or/ and low albedo is another measure for achieving urban climate adaptation. The use of materials to increase energy efficiency is also considered in the field of expertise of mainly urban planners, designers and urban climate experts. Both groups were considered by the respondents the most aware the types of materials that can be used for increasing urban adaptation in Bulgaria. All interviewees were not completely aware to what extent the local politicians are familiar with this climate adaptation measure. Citizens were the group which almost all, nine of ten, respondents considered as less to not aware about the effects of different building materials. One stated that people often are more interested in the price of materials rather than by their additional qualities.

Anthropogenic heat (e.g. less air conditioners)

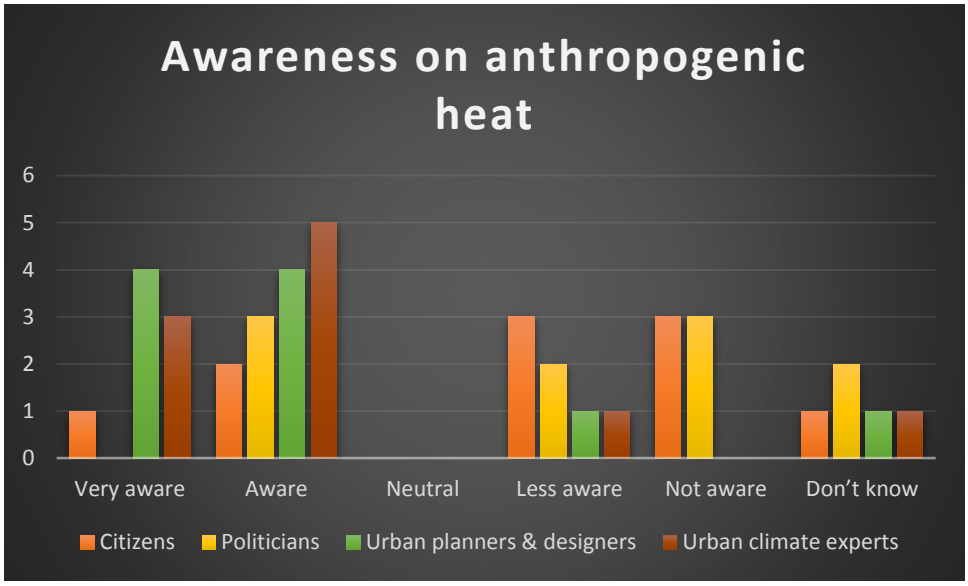

FIGURE 9 AWARENESS ON ANTHROPOGENIC HEAT

Anthropogenic heat is a problem most studied groups are aware of. However, prevention and adaptation are considered mainly a responsibility of the scientists and climate experts. Politicians and citizens are mostly seen as less to not aware of the problem. However two of the interviewed municipal experts from the municipality of Dobrich, along with one of the urban planner from Sofia stated that citizens have sufficient knowledge on anthropogenic heat since they experience urban heat island effect, especially down town in big and mid-size cities such as Sofia and Dobrich.

Q6. In case awareness is low, what is needed to increase the awareness among those groups of four urban climate adaptation measures mentioned in question 5?

The most effective method to increase awareness in this case are massive targeted media campaigns, publications, educational material and large open forums that would help the public understand the effects of climate change and its implications on their living environment.

B) Communication

Q1. Which roles do citizens, politicians, planners and designers and urban climate experts have in the process of planning, designing and implementing urban climate adaptation measures?

According to the interviewees, different stakeholder groups have following roles:

Citizens have a fundamental role in implementing climate adaptation measures, because they are the primary user of urban resources such as parks, gardens and recreation areas. They play the role of an external observer and they are able to express opinions and demands for more climate sound decisions in urban planning.

Politicians have an important role in steering and creating new policies, instruments and incentives for better urban climate adaptation measures.

Urban planners and designers have a role in planning, developing and implementing innovative climate adaptation measures. Their role is important, because they have the technical knowledge and the technical training, but also higher awareness about the good practices in urban adaptation.

Urban climate experts have a key role in urban adaptation because of their scientific expertise and their ability to assess and develop scientifically sound strategies to increase the adaptive capacity.

Q2. What are the relationships between these actors in the communication strategies?

The connection between citizens and politicians all interviewees defined as weak to non-existent.

The connections of citizens with urban planners and designers and urban climate experts was also defined as very weak and almost non-existent.

The communication between politicians and urban planners and designers and urban climate experts is defined as existent, but very weak and inefficient.

Q3. What is the role of communication to support the planning, design and implementation of adaptation measures?

The role of communication to support the planning, design and implementation of adaptation measures was defined as very important and even crucial by all interviewees. Furthermore, it helps to create fast solutions to make cities in affected regions more resilient and adaptive to changes in local climate. Good communication would also maintain the links between different stakeholders for better connections and efficiency. Interviewees also stated that a better communication will raise societal awareness. Moreover, according to one of the municipality representatives getting the public involved into the process of urban adaptation would grant their support and participation in the process of adapting the urban environment to the climate. Thus, a good communication process would grant a better understanding and better implementation of technical and scientific requirements by involving more climate experts and urban planners.

Q4. Are there formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures? If yes, can you please name them?

No formal guidelines or policies were found that drive the use of communication in the planning, design and implementation of adaptation measures. Almost all interviewees stated that they are not sure if such policies or guidelines exist on both national and local level.

Q5. What are the strengths and weaknesses of the communication process?

Strengths:

As strengths of the communication process interviewees see firstly that if many parties are involved in the process of sharing knowledge and experience, this would make the communication faster and the solutions would be reached for a less amount of time. Secondly, if all stakeholders are unanimous in their opinions that would prevent misunderstandings.

Weaknesses:

Interviewees stated that they see many weaknesses in the communication process. First of all, they name the high rate of miscommunication on all levels. Secondly, they mention the lack of money. Furthermore,

new information is processed very slowly, because of heavy administrative procedures and long unproductive discussions. Another weakness is the general lack of communication between the different governmental and non-governmental actors. Lastly, interviewees see as a weakness that that communication process misses a subject.

Q6. Is there need to improve the communication process? If yes, how to improve?

All interviewees are unanimous that there is an urgent need of improvement of the communication process at all levels. Such improvements, according to them could be accomplished by better developed awareness strategies of both scientists and policy makers. Thus, more frequent meetings and conferences could be a useful tool to improve communication.

A) Instruments

Q1. Are there legally binding instruments (e.g. zoning plans) used to implement urban climate adaptation measures? If yes, please explain how they work?

In Bulgaria, urban adaptation to climate change is mainly a responsibility of the Ministry of Environment and Water and the municipalities. The main instrument that has been mentioned by three of the interviewees, are the municipal plans for overall spatial planning which is not legally binding. Still, those plans are made mainly for bigger cities and they are mostly missing for small towns and villages. Additionally, most of the interviewees, seven of ten, were not familiar with any legally binding instruments for urban climate adaptation.

Q2. What are the strengths and weaknesses of the legally binding instruments used?

For the instrument that exists, no concrete strengths were stated. However, two of the three respondents who mentioned this instrument, stated that its weakness is that it is very poorly implemented and it is legally binding features.

Q3 and Q4. Are there certain chances / potentials missed when using the legally binding mentioned instruments (e.g. coupling with other instruments)?; Are there other policy instruments used to implement urban climate adaptation measures?

Within those two questions, the interviewees did not have any knowledge, so they could not provide any relevant data.

Q5 and Q6. What are the strengths and weaknesses of the other policy instruments used?; Are there certain chances/ potentials missed when using other policy instruments (e.g. coupling with other policies)?

The same statement applies for those two questions and for Q3 and Q4. All interviewees stated that they do not have any knowledge on the questions asked.

D) Implementation

Q1. Which concrete urban climate adaptation measures/ interventions are currently implemented or have been implemented in your city?

Only one municipal expert from the Bureau for Environmental Protection with Dobrich municipality gave an answer to this question. According to her "The city of Dobrich is aiming to create a system that will ensure that during the warmer months of the year there will be a proper irrigation of the roads and the green

areas to cool them down and reduce dust in the air." The other example given by this expert was about increasing the energy efficiency of Dobrich municipality, but it is not applicable since it concerns urban mitigation and not adaptation. Another municipal representative from the same municipality stated that there are some measures that were implemented, however he is not familiar with them. The rest of the interviewees were not aware of any urban climate adaptation measures implemented in their cities.

Q2. What are the strengths and weaknesses of these mentioned urban climate measures/ interventions?

The expert from the Environmental Protection Bureau stated also some strengths and weaknesses of the implemented urban adaptation measures.

Strengths:

As a strength of the implementation process interviewees see firstly the improved energy performance of buildings by introducing a package of energy efficiency measures. They state that there is also a possibility of utilization of renewable energy. Furthermore, the increase of the energy efficiency of the municipality is also seen as a strength, along with the increased awareness of the role of local government as a model of intelligent energy behavior. Lastly, interviewees see as a strength the process of making local population more active towards climate adaptation.

Weaknesses:

Regarding weaknesses, first is the inefficiently used potential of renewable energy. Another weakness is the insufficient financing of EE (energy efficiency) / RES (relative energy sources) activities. Furthermore, interviewees see as a weakness the lack of government incentives for small and medium enterprises for the use of renewable energy. Lastly, the difficult access to the installed renewable power grid, because electricity providing companies make the process of installation too complex with too many administrative procedures.

Q3. And Q4. Are there conflicts between aesthetics and these mentioned urban climate adaptation measures?; Are there conflicts between urban functions and these mentioned urban climate adaptation measures?

Interviewees did not have sufficient data on those two topics. However, regarding aesthetics a few of them stated that currently, there is a conflict between the implemented urban adaptation measures and the aesthetic look of the neighborhoods where they were applied.

Q5. Are there certain chances/ potentials (e.g. coupling with other interventions / 'no regret' measures) missed when implementing these mentioned urban climate adaptation measures?

There are certain possible chances and potentials that were missed when implementing the above mentioned measures. However, most interviewees were not certain what they could be. They stated that some additional measures might be further implemented to make Bulgarian cities more climate proof.

5. Discussion

This chapter will present a discussion of the findings made during the process of data collection and analysis. It will follow the structure of the questionnaire used to retrieve the data. It will elaborate on first on the process of awareness on urban climate adaptation, secondly, on the communication process of the different groups subject of this study, thirdly, on the instruments used to achieve urban adaptation, and lastly on the process of implementation of those instruments.

A) Awareness

Q1. What is the sense of urgency to adapt the urban environment to climate change amongst the following groups in the future in your city?

Raising awareness of the need of cities to adapt to climate change is an important tool in achieving greater efficiency in the process of urban climate adaptation. Therefore, there is a need to "create understanding" of what is climate change and to "gain support from climate change adaptation policy" (EEA, 2012). However this is considered very difficult. According to Swart et al. (2009), to achieve a better understanding, one must communicate the problem to a wider audience and make them aware of its implications. The majority of the interviewees recognized the urgency of the need of climate adaptation in their cities. However, despite its urgency, the awareness on the topic is still very low. This in line with Moser and Dilling (2007), who state that a big obstacle for community involvement is that the available information is mostly not accessible or not relevant for non-experts. Therefore, in Bulgaria it is needed that local and national governing bodies take urgent measures to raise awareness, especially among politicians and citizens, since they are outside of the scientific community.

Q2. In case the sense of urgency is low, what is needed to make those groups feel more urgent about adapting the urban environment?

The perception of a lower urgency for urban adaptation requires more and better structured awareness campaigns. Since the general opinion is that politicians, urban planners and designers and the urban climate experts should be made most aware of climate change problems, they are also seen as the main actors that need to take action towards building urban adaptation. In Bulgarian cities, it is often the case that those key stakeholders neglect the urgency of the problem and thereby the importance of taking action. This is in line with, Mehrotra *et al.* (2009, p. 11), who discuss that the role of governing stakeholders in urban adaptation is ". . . the ability and willingness of the city's key stakeholders to cope with the adverse impacts of climate change and depends on the awareness, capacity, and willingness of the change agents". In this case, by "key stakeholders" the author envisages politicians, urban planners, scientists, local population and the private sector (Carter et al., 2015; Mehrotra et al., 2009). However, according to the acquired data, in Bulgaria the importance of citizens in the adaptation process is not highly recognized, regardless that they are considered an important stakeholder when building adaptive capacity.

Q3. How aware are the groups of the following two urban climate phenomena?

Urban heat island (UHI)

Despite that people start increasingly noticing the effects of urban heat island (UHI) in big cities, especially in the capital city of Sofia, most interviewees stated that citizens are less aware of this phenomenon. This lack of awareness of citizens, originates from the fact that according to the derived data, none of the

interviewees, neither the municipality representatives, nor the experts, noted the importance of local population in making cities more adaptive to climate change.

However, nowadays the interest towards urban climate change in Bulgaria is increasing, especially in big cities, such as the capital Sofia. According to the report for 2012 of the Executive Environment Agency (EEA) by the Ministry of Environment, in 2012 in Bulgaria the average annual temperature was exceeding the norm with values from around 1,3°C to 0,3°C (EEA, 2012). Due to the increasing urban temperatures, in combination with the old buildings and the anthropogenic heat, local population starts experiencing UHI more and more. This increases the need of more research and the urge for implementing some new adaptation measures, both in terms of legislative instruments and technical measures.

Wind discomfort

Another element of urban environment is wind discomfort. According to the interviews, wind discomfort is more noticeable than UHI effect. People in Dobrich, a middle-sized municipality in the North-East of Bulgaria, were experiencing this phenomenon more than those in Sofia. This is due to the fact that the city is situated in the plains and there is no physical barrier to stop the winds coming from the North. The city has no high buildings which could stop the wind or create urban canyons. On the contrary, Sofia has a different kind of urban design which creates conditions for wind alternations. The city centre of Sofia consists of a mixture of small, narrow streets and wide open spaces and boulevards. The main winds in the city are coming from the west and south-west (Stefanov et al., 2011). Furthermore, these winds tend to slow down or change direction abruptly when they reach an obstacle such as buildings and narrow streets which is the case in Sofia. It occurs that the wind speed is higher in the peripheral neighborhoods which are not so densely built and it slows down until it reaches down town.

In the case of wind discomfort urban planners are also considered the most aware of the problem, whereas citizens and politicians are seen as less aware or not aware.

Q4. In case awareness is low, what is needed to increase the awareness among those groups of two urban climate phenomena mentioned in question 3?

In order to increase public awareness, one of the most efficient tools that could be used are the mass media campaigns. In Bulgaria, such campaigns are not widely used, therefore awareness on climate change and climate adaptation is rather low. Therefore, on a local and national levels, there is a need of organizing such campaigns that would reach to people and improve their perception of climate change implications. Thus they could improve the understanding of the concept of climate adaptation. Thereby, with a higher degree of awareness scientists, policy makers and urban planners could create a stronger collaboration towards building adaptive capacity on a local level. A good example for such campaign is the cities of Toronto and Halifax in Canada. Local governments and policy makers have created a climate adaptation plan. Thus they made the public aware

Q5. How aware are the groups of following four urban climate adaptation measures?

Raising awareness of the different studied groups on the components of urban environment consists and the measures that can be taken to make them more adaptive is an important factor when building urban adaptation. There are several important measures that can be taken in the process of making a city more adaptive, namely adapting city design, increasing urban vegetation, decreasing anthropogenic heat and using the correct materials.

Building layout

Building layout is an important feature of climate adaptation. A well designed building layout could help reducing the urban heat island effect and risk of severe consequences for the population in case of a heat wave. Thus, it is a prerequisite for a better urban ventilation, since it does not breach the wind patterns of cities (EEA, 2012). A good example is the city of Stuttgart. Local government in the city has created a climate planning strategy to grant a better urban management towards diminishing the UHI effect (EEA, 2012). According to the strategy the build-up areas in Stuttgart have been designed in such a way that they exploit "the natural wind patterns and dense vegetation" help in reducing extreme heat in the city (Baumüller and Verband Region Stuttgart, 2008). Thus, the city uses the beneficial effects of the cool air from the surrounding hills by creating wide open spaces that create "ventilation corridors" that help in aerating "the city`s street infrastructure" (Baumüller and Verband Region Stuttgart, 2008). In Bulgaria, such an effect could be reached by a better collaboration between urban planners and designers, urban climate experts and local authorities. They could collaborate better in building an urban layout that would reduce the risk of overheating on case of a heat wave. Thus, that would grant a better adaptive capacity of the urban areas in the country.

Urban vegetation

In connection with the previous section, urban vegetation is also an important feature of urban design. For instance, restoring urban green, by building more parks and gardens as well as artificial and natural water bodies, which would help reducing the heat stress over cities. Such areas are called "park cool islands" and they help in developing a cooling effect for cities, thus they are beneficial for a better street ventilation with a cooler air (Lenzholzer, 2015). Furthermore a combination between plants and water bodies, gives an even better cooling effect, because water also has the quality of absorbing solar radiation (Lenzholzer, 2015; GLA, 2011). A good example for combining artificial water bodies with a green area is Central park in New York. In Bulgaria such city designing practices are also possible, however the awareness on their features is rather low. Therefore, in order to increase public awareness, urban planners and designers work closely with municipal officials and climate experts which are the groups that are most aware of how to develop such projects. Thus, regardless that interviewees did not mention examples, they are good examples for such good practices. For instance, the municipality of Dobrich developed and implemented a project for restoring the city park and the adjacent artificial lake, and creating more green areas around the city.

Use of materials

The use of proper materials to increase energy efficiency is also important for building more adaptive cities. In Bulgaria, urban planners and designers work closely with the Spatial planning law and the municipal experts who make the regulations for the types of materials that can be used for construction in urban areas. However, the law does not say anything explicitly about the use of materials of their cooling features. Furthermore, urban planners are more aware of the quality and energy efficiency features of the materials offered on the market. However, citizens mostly don`t know the properties of the materials that they are using. They are mainly guided by the price of the material rather than it`s features.

Anthropogenic heat

Anthropogenic heat is one of the most significant problems that Bulgarian cities are facing. This is partly due to the fact that in Bulgaria most people still prefer using their private vehicles to travel within the cities

instead of using public transportation. Furthermore, people are not quite aware of how could they contribute to reducing urban heat. This is very clearly visible from the interview data, where people were mostly referring to simple mitigation measures such as CO2 reduction. Whereas, an adaptation measure to reduce urban heat would be using cooler materials in construction and reparation of buildings, improving building insulation by also implementing non-regret measures such as green roofs and green walls.

Q6. In case awareness is low, what is needed to increase the awareness among those groups of four urban climate adaptation measures mentioned in question 5?

Since in Bulgaria the awareness on the urban adaptation measures is rather low, it is important that on a local level, there are campaigns to introduce the implications on climate change. Municipalities are seen as one of the most important actors in climate governance, since they are responsible to implement the measures locally. However, that could not be achieved without the support of the local population and local businesses (Uittenbroek, 2014). Therefore, the analysis shows that media campaigns are seen as an efficient measure to raise awareness. Another useful tool would be also learning by organizing public forums and fairs. This is in line with the research of Schort et al. (2015), who established that in order to increase awareness and understanding is providing visual materials such as presentations and posters. Such an approach would be beneficial for Bulgarian cities, because it would help people to gain more knowledge and get a better understanding of the effects of climate change on the urban environment and the possible adaptation measures that could be implemented.

B) Communication

Besides awareness, a good communication process is crucial for building a good adaptive capacity.

Q1. Which roles do citizens, politicians, planners and designers and urban climate experts have in the process of planning, designing and implementing urban climate adaptation measures?

Private actors such as citizens and businesses play an important role in implementing any adaptation measures in the cities, because they benefit directly from their potential qualities. However, the communication between them and local governing bodies is almost not existent. This is probably due to the more hierarchical governance structure and top-down approach in urban governance.

An inefficient communication, though, is an obstacle in the process of implementation of any adaptation measures. Thus, in Bulgaria there is no clearly defined policy regarding environmental protection which reflects on the social thinking of the people in urban environments. The lack of adequate measures and strategic documents is a gap in the political organization of the environmental protection in Bulgaria. The existing laws are not legally binding, which entails their neglect. In Bulgaria it is mostly the case that changes in law are made without taking into account people`s opinion. This shows a general lack of communication between city planners and local policy makers which results in a lower efficiency when implementing adaptation measures.

In Bulgaria, urban climate scientists are the main group which generates empirical and statistical data that helps decision-making process of other groups like urban planners and designers. Building an efficient communication would help local policy makers in creating more efficient laws and guidance for environmental protection and climate adaptation. However, the way of communication and framing the problem also has a big impact on people`s behavior towards climate adaptation. According to the literature, top-down communication strategy “especially when it depends on a framing of the problem not shared by

the public, is at best insufficient for changing behaviour" (Owens, 2000; O`Neill & Hulme, 2009). Therefore, there is a need to change into a more society-oriented model such as the "civic model" described by Owens (2000). This model is oriented towards a more "multi-directional engagement approaches", because that would not simply provide people with information about climate change, but it would also increase their motivation to be more active (Owens, 2000; O`Neill & Hulme, 2009). In Bulgaria, such an approach is applicable, thus, if correctly used it would give good results in starting to change people`s behaviour towards climate adaptation.

Q2. What are the relationships between these actors in the communication strategies?

Overall, the analysis shows that communication relations between all studied groups as weak to non-existent. Poor communication is likely to be due to lack of trust in governing bodies. In Bulgaria, it is not a practice that local authorities and policy makers present their decisions to the public or make them a subject of discussion. Similar is the case with urban planners and designers. In other countries, however, it is a practice to ask public opinion when implementing a new local policy or plan. A Canadian study shows that for the cities of Toronto and Halifax, local authorities, supported by climate scientists created a Climate change adaptation program (Henstra, 2012). However, before getting to the phase of implementation, the Municipality presented the plan and its expected outcomes to the citizens. Thereby, they made them aware of the implications of climate change and what actions they intend to take to make Toronto more climate proof.

Using such communication strategy in Bulgaria would be very beneficial in a long therm. It would create trust and improve the relations between local authorities, planners, scientists and local communities. This would be a good fundament to build upon when creating and implementing measures and strategies for urban adaptation. Thus it would improve knowledge exchange on an expert level.

Q3. What is the role of communication to support the planning, design and implementation of adaptation measures?

Efficient communication is an important tool for developing and implementing adaptation measures. Thus, it is a good tool to improve the process of exchanging knowledge and good practices. Therefore, planners, designers and urban climatologists in Bulgaria need to have good communication which would determine the quality and the degree of efficiency of the adaptation measures they are creating. For planning, design and implementation, it is also important to build trust in citizens which would grant a higher degree of support is needed for developing a certain measure.

In Bulgaria, however, such communication is rather weak partly due to complicated information exchange on different levels and the limited financial means for raising awareness. Yet, it is possible to improve communication in simpler and rather inexpensive ways. For instance organizing Municipality open days where local climate experts and volunteers engaged could answer questions and explain to people about the effects of climate change and the benefits of climate adaptation for their cities.

Q4. Are there formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures? If yes, can you please name them?

On a national and local level they are no formal guidelines or policies that drive the use of communication of planning and implementation of adaptation measures. According to the interviews, they are some programs on a national level, such as the "National program for energy efficiency", sponsored by the EU.

However, this is not a legally binding document and it does not explicitly provide any guidelines for communicating urban adaptation. The interview answers also show that people also do not have a clear understanding of how communication strategies could influence the adaptation process.

Q5. What are the strengths and weaknesses of the communication process?

According to the analysis, the communication process in Bulgaria displays many weaknesses than strengths. This is mostly due to an inefficient communication at all levels, as well as the lack of any formal guideline that could facilitate the process. However, potentially if communication improves, there would be an opportunity to build upon a more efficient system for knowledge exchange. Potentially, it would prevent miscommunication and would allow stakeholders at all levels to have a faster and more efficient dialogue.

As already stated earlier, weaknesses prevail in the communication in Bulgaria. The general miscommunication on all levels, combined with the lack of money for raising awareness, causes many difficulties in the process of information exchange between policy, practice and society. On a national level, Bulgarian government does not invest enough means in awareness. Most of the projects related to climate change are mainly funded by EU programs for sustainable development. However, most projects are still focused more on mitigation, such as the project for energy efficiency, part of the EU Energy efficiency program Horizon 2020.

Q6. Is there need to improve the communication process? If yes, how to improve?

Currently, there is an urgent need of improvements in the communication process in Bulgaria. At its current state it is not possible to build adaptation, because firstly there is no clear view of the meaning of the concept itself. Additionally, there is no clear division of the roles and functions of main actors that could contribute in the adaptation process. There is a big variety of options to improve the communication process. However, the first step is to establish clear outlines on which institutions and organizations dealing with environmental protection and climate change adaptation could base their further work.

C) Instruments

In order to achieve urban adaptation, it is important to have quality instruments that would allow an easier implementation of any measures adopted by local and national institutions. In Bulgaria, such instruments exist, however, they are not well known for the public. This might be due to the fact that most of those instruments are quite new, dating from the years 2012 to 2015, for instance "The third national plan for limiting climate change 2013-2020" dating from 2012. Thus, their focus is not specifically focused on climate adaptation, but rather on climate mitigation. Moreover, they are not specifically focused on adaptation, nor have any legally binding features. Therefore, this could have an impact on the quality of the adaptation process by putting more focus on climate mitigation. Thus, there is a general confusion between mitigation and adaptation. Furthermore, according to the collected data not many people are familiar with any legally binding instruments concerning climate adaptation besides the municipal plans for spatial planning. Thereby, there arises a possibility that people are aware of some concrete instruments, but they did not mention them.

Being an EU country, Bulgaria is obliged to comply with its environmental policy. Therefore, Bulgarian legislation does contain national laws and regulations concerning climate change. The "Law of limiting climate change" in Bulgaria was adopted in 2014, in accordance with the decision № 406/2009/EO of the European parliament from 2009 n Member States' efforts to reduce their emissions Greenhouse gases

necessary for the implementation of the Community's commitments to reduce emissions greenhouse gas emissions by 2020 (ZOIK, 2014). However this law is not legally binding on a local, but rather on a national level towards the EU. On a national level, this law along with Third National Climate Change Action Plan (2013-2020), build Bulgaria's National adaptation policy. However, none of the interviewees had any knowledge on these national instruments which might be due to the fact that they are very new and not well known for the wider public. The National Climate Change Action Plan was mentioned only by an expert form the Ministry of Environment and Water, who however, did not agree on an interview.

D) Implementation

The low awareness on urban adaptation, combined with poor communication between public and private actors are a prerequisite for the lack of implementation of any measures for urban adaptation. The only concrete example that was given within the interview process, it was still focusing on a mitigation measure, namely it described the aim of the municipality to achieve energy efficiency and reduce CO2 emissions until 2020. This is another example that in Bulgaria, people are still often confusing the concepts mitigation and adaptation. Therefore, it can be considered that the implementation of any adaptation measures in Bulgarian cities is still very difficult. Overall, the analysis showed that people are aware that there are some instruments to tackle urban heat, but none of them was aware of their implementation.

Another major issue in implementing climate adaptation measures is the lack of financing and governmental incentives for developing public and private adaptation projects, such as the installation of green roofs and solar panels. According to Mees, *et al.* (2013) "green roofs represent a short-term no-regrets climate adaptation measure". Regardless, of their good potential for implementing such installations, most Bulgarian municipalities lack implementation. This is due to the high prices of the materials and the difficult installation process. This creates a major problem, since by not utilizing their good potential cities are facing an increasing threat of overheating during the summer and increased energy use during the winter. With the changing climate, the summers are becoming more hot and dry and heat waves are a more frequently occurring phenomena. Therefore, by implementing green structures in Bulgarian cities could reduce the UHI effect and they would improve their urban energy budget. A good example are the cities Basel, Chicago, Rotterdam, London and Stuttgart that have adopted green roof policies. The city of Chicago, for instance has adopted a green roof policy in 2001 as a part of its Climate change action plan, aiming to achieve both a better storm water retention and to reduce heat stress (Mees et al., 2013; CCAP, 2008). Their implementation was facilitated by a special municipal regulation that obliges all new municipality funded buildings to build a green roof. Thus, this was further facilitated by some "indirect financial incentives" (Mees et al. 2013, CGPP, 2010).

Another major issue regarding the urban adaptation measures are their aesthetics and functionality. Interviewees did not have sufficient knowledge regarding the aesthetics and the functionality of climate adaptation measures. Few of them referred to building insulation as an adaptation measure, whereas according to the literature insulation is a measure for mitigation rather than adaptation. However, regarding building insulation it can be argued that there is indeed an interference, because insulation is still privately implemented, property owners have the liberty to decide upon the outlook of their houses. Thus, there are no legally binding documents that explicitly oblige owners to comply with a certain style of building. Studies show also that there is a direct correlation between colors and temperature perception (Lenzholzer, 2015). Therefore, aesthetics matter when it comes to thermal comfort. However, this does not have any implication on urban adaptive capacity. On the other hand, the problem of functionality is also a bit disregarded. Analysis shows that often people neglect the functional features of a building which mostly interferes with

their living comfort. Therefore aesthetics and functionality are important factors, because they interfere with quality of the living environment of the citizens.

In fact, in Bulgaria because of the general lack of implementation of any adaptation measures, a lot of chances and potentials have been missed. However, this not an insulated case. According to several authors, despite the increasing number of cities that are starting to adapt to climate change, "the planning and implementation of climate adaptation remains slow" (Uittenbroek, 2014; Reckien et al. 2014; Carter 2011). Most interviewees did not have enough knowledge to elaborate further on this question. This shows, that the lack of awareness prevents people of taking any concrete measures towards urban adaptation. Thereby, a lot of chances to implement no regret measures are missed. For instance, restoring urban green areas could be easily implemented with a wide public support if there would be a good campaign to organize and stimulate people.

6. Conclusions

This chapter presents the main conclusions of this research, based on the findings discussed in the previous chapters. Thus it concludes with some social and scientific recommendations for Bulgaria.

Conclusions on the state of the art of climate adaptation in Bulgaria

Conclusions on awareness

Raising awareness on climate change is one of the most important tools in building urban adaptation. The analysis showed that in Bulgaria the degree of awareness and its implications on cities is still very low. Overall, people recognize that adaptation to climate change is an urgent matter. However, they have a very little knowledge on the implications of changing local microclimate and the measures that could be taken. Generally, local citizens are not aware of what is urban adaptation and why is it so important for their cities in a long term. They also do not have a clear view of how they are contributing to the problem and what can they do to reduce their own impact on their living environment. This arises the question, what is needed to improve the degree of awareness among local societies.

Conclusions on Communication

Acquired data showed that experts and municipality representatives in Bulgaria recognize that a good communication process is crucial for urban climate adaptation. However, the communication process in Bulgaria is still very slow and ineffective at all levels. Therefore, currently this causes a great deal of misunderstanding and confusion of the whole concept of climate adaptation. Urban planners and designers are rarely taking any initiative to organize campaigns or events aiming to present such knowledge. From the governmental institutions, the Ministry of Environment and water, are launching and promoting campaigns for urban sustainability, funded by the EU. However, in the documents explaining these campaigns it is often the case that the concepts of climate mitigation and adaptation are explained in a way that makes public confusing the two concepts. Therefore, it is often the case that bad communication is cause of misunderstanding between science, policy and local society.

Conclusions on Instruments:

The analysis showed that Bulgaria lacks any concrete instruments for climate adaptation. There seem to be not many laws and legally binding acts within the national legislation concerning climate change. The main instrument mentioned were the municipal plans for overall spatial planning. However, urban adaptation is still rather outside of their scope. Thus, an important finding was that in Bulgaria urban planners and designers are still not completely aware of the difference between mitigation and adaptation instruments. Furthermore, Bulgarian urban policies appear to be much more focused on climate mitigation by improving energy efficiency and CO_2 reduction. Climate adaptation, on the other hand is still not well translated in national and regional policies.

Conclusions on Implementation

Bulgaria has a big potential to develop urban climate adaptation. Being a part of the EU allows the country to apply for funding and develop good adaptation projects. Despite the good potential, such measures are either poorly or not implemented at all. The lack of concrete measures and instruments on urban adaptation, determined the lack of their implementation. The data showed that in Bulgaria they are still no climate

adaptation measures that have been implemented. Implementation of such measures still seems vague for most people. Therefore, it can be concluded that until any measures are implemented, people need to understand the concept of adaptation and its importance for their living environment.

Limitations of the study

Despite the importance of the topic, there were some difficulties encountered during the process of data collection. Due to the high degree of political uncertainty in Bulgaria, it was difficult to reach and interview important ministry or municipal experts. For instance, e-mail interview requests were sent to some ministry experts, scientists, university professors in the field of climatology, GIS mapping and urban planning. However, the response rate was very low.

In the initial phase of the data collection, a contact was made with a representative of the Ministry of Environment and Water (MOEW), who agreed on an interview and provided some useful information used in this document. However, when contacted further to set up a date for an interview, she stopped all communication and did not give a further reply. The same issue was encountered with a university professor, expert on urban planning.

Further, in the sections instruments and implementation it is often the case that the interviewees stated that they are not aware on the matter. This, however, is based on the answers of a small group of experts and municipality representatives.

Recording the interviews was also not a possibility, since all interviewees refused to be recorded and preferred to keep their anonymity. Therefore, the interviews needed to be written down by hand.

Another difficulty was encountered with the availability of information and data about the adaptation strategies and measures. It was rather difficult to find up to date data on climate adaptation, because the information sources were limited and difficult to find online. On the other hand, the actors that could provide such data were not authorized and/or not willing to provide it. These potential difficulties might, therefore, reflect on the depth and quality of the research analysis.

Societal recommendations

According to the findings, there is a need of well-structured information campaigns and public forums that would help people to get familiar with the concept of climate adaptation. Therefore, the development of understandable and good quality awareness campaigns consistent with the social group their targeting, such as politicians, citizens and/or scientists, would be a great benefit in the process of increasing the adaptive capacity of Bulgarian cities.

Municipalities can invest more in implementing structures as green walls which could help decreasing urban heat island (UHI) effect. From a societal point of view, it is important to start building knowledge and climate responsibility from an early age. Therefore, education on climate responsibility and sustainability should start at schools. Teachers, for instance, could organize special classes where they teach children how to keep safe the environment. This way, young generations will grow up with a sustainable way of thinking.

For building adaptation, it is also needed to have a good communication process. Bulgaria needs a more structured and well developed system for communication between policy makers, urban planners, scientists and local societies. This would improve the degree of trust of the population which would allow a smoother

implementation of urban adaptation. It would also improve the exchange of good practices on a national and international levels.

Furthermore, Bulgaria needs to develop well-structured and efficient instruments on climate adaptation. They need to be tailor-made for the specific climate change problems that Bulgarian cities are likely to or are currently experiencing. Therefore, climate scientists, urban planners and policy makers need to work together to design plans and laws that would help their cities to adapt easier to the changing microclimates. A good plan would be to develop local policies taking into account the regional specifics of the municipalities. Thus, the potential place-specific issues that might have an implication on the local adaptation strategies.

Finally, to enhance and develop the potential of Bulgarian cities to become more adaptive to climate change, local authorities need to work closely with scientists and urban planners. They also need to include and educate local citizens, because they are the main users of the urban space. If they are properly informed on the effects of climate change on their living environment, they could have a great positive impact on building adaptive capacity in their cities.

Potential topics for further research

Further studies might explore the policy mechanisms of urban adaptation and their effects on local societies. Furthermore, they could study from a societal point of view, what is the reason why the process if implementation of urban adaptation is very low in both developed and developing countries. Another interesting topic would be to go more in depth in the relation between urban climate adaptation and the types of urban fabric in cities. Thereby, to study to whet extent does urban fabric influence process of adaptation? The problem of lacking implementation of adaptation measures, is also a topic that needs more research. Lastly, a further research might go more in depth in the mechanisms of urban adaptation in different countries. Thus, what are their strengths and weaknesses and how could they be improved.

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Annex 1

Urban Climate Adaptation Interview Questions

General Information

1. Name:
2. City:
3. Position: □ Politician □Urban planners/ designer □Urban climate expert □ Other,____
4. Organization:
5. Email:

Awareness

1. What is the sense of urgency to adapt the urban environment to climate change amongst the following groups in the future in your city?

Groups	Very urgent	Urgent	Neutral	Less urgent	Not urgent	Don't know
Citizens						
Politicians						
Urban planners& designers						
Urban climate experts						

7. In case the sense of urgency is low, what is needed to make those groups feel more urgent about adapting the urban environment?

Groups	Measures to sense of urgency
Citizens	
Politicians	
Urban planners& designers	
Urban climate experts	

2. How aware are the groups of the following two urban climate phenomena?

- Urban Heat Island

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens						
Politicians						
Urban planners & designers						

- Wind Discomfort

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens						
Politicians						
Urban planners & designers						

3. In case awareness is low, what is needed to increase the awareness among those groups of two urban climate phenomena mentioned in question 3?

Groups	Measures to increase awareness
Citizens	
Politicians	
Urban planners& designers	

8. How aware are the groups of following four urban climate adaptation measures?
   - City design (e.g. street orientation, adapting to wind and solar orientation of building and streets)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens						
Politicians						
Urban planners& designers						
Urban climate experts						

   - Urban vegetation (e.g. green roofs, urban forestry)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens						

Politicians						
Urban planners& designers						
Urban climate experts						

- Use of materials (e.g. low albedo and longer cooling time-lag materials)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens						
Politicians						
Urban planners& designers						
Urban climate experts						

- Anthropogenic heat (e.g. less air conditioners)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens						
Politicians						
Urban planners & designers						
Urban climate experts						

4. In case awareness is low, what is needed to increase the awareness among those groups of four urban climate adaptation measures mentioned in question 5?

Groups	Measures to increase awareness
Citizens	
Politicians	
Urban planners & designers	

Planning and design processes for implementation

Communication

1. Which roles do citizens, politicians, planners and designers and urban climate experts have in the process of planning, designing and implementing urban climate adaptation measures?
   Citizens:
   Politicians:
   Urban planners and designers:
   Urban climate experts:
2. What are the relationships between these actors in the communication strategies?
   Citizens/ Politicians
   Citizens/ Urban planners and designers
   Citizens/ Urban climate experts
   Politicians/ Urban planners and designers
   Politicians/ Urban climate experts
   Urban planners and designers / urban climate experts
3. What is the role of communication to support the planning, design and implementation of adaptation measures?
4. Are there formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures?
   If yes, can you please name them?
5. What are the strengths and weaknesses of the communication process?
6. Is there need to improve the communication process?

If yes, how to improve ?

Instruments

1. Are there legally binding instruments (e.g. zoning plans) used to implement urban climate adaptation measures?

If yes, please explain how they work?

2. What are the strengths and weaknesses of the legally binding instruments used?
3. Are there certain chances / potentials missed when using the legally binding mentioned instruments (e.g. coupling with other instruments)?
4. Are there other policy instruments used to implement urban climate adaptation measures?

If yes, please explain how they work?

5. What are the strengths and weaknesses of the other policy instruments used?
6. Are there certain chances/ potentials missed when using other policy instruments (e.g. coupling with other policies)?

Implementation

1. Which concrete urban climate adaptation measures/ interventions are currently implementing or have

been implemented in your city?

2. What are the strengths and weaknesses of these mentioned urban climate measures/ interventions?

4. Are there conflicts between aesthetics and these mentioned urban climate adaptation measures?
5. Are there conflicts between urban functions and these mentioned urban climate adaptation measures?
6. Are there certain chances/ potentials (e.g. coupling with other interventions / 'no regret' measures) missed when implementing these mentioned urban climate adaptation measures?

Thank you for answering the questions in this questionnaire. Do you have any other remarks regarding the urban climate adaptation process or the content of the questionnaire?

Annex 2

Urban Climate Adaptation Interview Questions

2014/7/14

General Information

Name:

City: Dobrich, Sofia, Byala Slatina

Position:

□- 2 Urban planners;

○ - 2 Scientists from Bulgarian Academy of science (BAN);

∞ - Expert "Environmental protection";

§ - Architect;

¤ - Municipal secretary;

◊ - Director OP "Centre of Nature conservation";

● - Sustainability expert

◌ - Agronomist

Organization:

Email:

Awareness

1. What is the sense of urgency to adapt the urban environment to climate change amongst the following groups in the future in your city?

Groups	Very urgent	Urgent	Neutral	Less urgent	Not urgent	Don't know
Citizens	○○	●◊§∞	□◌	□¤		
Politicians	○○	◊§¤∞◌	□	□		●
Urban planners& designers	○○◌	□□◊§¤	∞			●
Urban climate experts	○○◌	□□◊§¤	∞			●

2. In case the sense of urgency is low, what is needed to make those groups feel more urgent about adapting the urban environment?

Groups	Measures to sense of urgency
Citizens	◌ Awareness campaigns. ∞ Information regarding the anticipated consequences of the lack of implementation of the adaptation measures of the urban environment to climate change. ○ Urgent measures ¤ Energy efficiency and insurance § Building insulation; Waste separation. People should use less cars,

	only if they need to. Not aware □ Overheating of the central city parts and disruption of soil structure of parks and others. □ Awareness of the consequences from the climate change ●Raising awareness
Politicians	∞ Awareness and initiative. ○ Urgent measures ¤ Changes in legislation, building systems for early warning and measures for reducing the greenhouse gas emissions § Politicians have to plan feasible measures and control against the violations of law offenders that cause harm to rivers, dams, the sea or even to ◊ Reducing the harmful emissions into the air; stop deforestation; reducing water pollution; install filters to the factories that produce CO2 emissions □ In Bulgaria, there is no governmental institution that is interested in protecting the environment and mitigating the effects of these changes in the urban environment. □ Strong public opinion ● Public pressure
Urban planners& designers	∞ Governmental support and funding. ○ Urgent measures ¤ Increasing the urban water bodies and the green spaces § Urban planners should execute quality planning of the urban environment and thereby also create more space for bicycle lines. □ N/A □The lack of adequate measures and decisions by the governing institutions in the field of natural resource management in the municipality of Velingrad. ● Don`t know
Urban climate experts	∞ Governmental support and funding. ○ Urgent measures ¤ The lack of safety belts with plants § They should have a realistic judgment about the problems of the settlements and they should create a program to overcome those problems. □ N/A □ Providing daily information - statistics and empirical data - the basis for research and development in favor of the decision and major issues of climate protection and dealing with problems in the big cities.

	● Don`t know

3. How aware are the groups of the following two urban climate phenomena?

- Urban Heat Island

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens		◊	§	●□□○¤ ○∞○		
Politicians		◊∞	□○§○	□¤○		●
Urban planners & designers	§	□□◊○¤ ∞○				●○

- Wind Discomfort

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens		◊§○		●□○¤ ∞	□○	
Politicians		◊○∞	○§	□¤○	□	●
Urban planners & designers		□◊○§¤○ ∞	□○			●

4. In case awareness is low, what is needed to increase the awareness among those groups of two urban climate phenomena mentioned in question 3?

Groups	Measures to increase awareness
Citizens	○ Awareness education the climate phenomenon ∞Awareness campaigns, forums, meetings, publication of informative materials in the media and others. ○ Media campaigns ¤ Awareness campaigns § For all groups, there should be a popularization of the threats and measures to limit their effects. They should be though in the schools. ○ Targeted media policies ◊ This theme is highly discussed in all media. □ Tendentious measures to inform citizens of climate change. □ Media coverage ●Publications in media
Politicians	○ Involvement in current problems of urban climate change; conferences and sharing problems and knowledge with other policy makers; more openness. ∞Work closely with the scientists.

	○ Media campaigns ¤ Public discussions § Furthermore, they should be popularized in the media and vie exhibitions in public and corporative environment. ○ Targeted media policies □ Development of strategies and policies on the conservation of natural resources and the public awareness for climate characteristics and changes on a national, regional and a global scale. □ Media coverage
Urban planners& designers	○ Take the initiative to explain arise awareness amongst citizens and local policy makers. ∞Work closely with the scientists. ○ Media campaigns ¤ Specialized seminars and conferences ○ Targeted media policies □ Innovative solutions and measures to build a supportive infrastructure and capacity to mitigate the effects of climate change.

5. How aware are the groups of following four urban climate adaptation measures?

- City design (e.g. street orientation, adapting to wind and solar orientation of building and streets)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens		○	□◊§	□∞	○¤○	●
Politicians		◊○		□□§○	○x	●
Urban planners& designers	◊○	□□○§¤∞○	□			●
Urban climate experts	◊¤○	□□○§∞○				●

- Urban vegetation (e.g. green roofs, urban forestry)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens		●□◊○	§∞	□¤○	○	
Politicians		◊¤○∞		□□§○	○	●
Urban planners& designers	□◊¤○	□○§∞○				●
Urban climate experts	□◊¤○	□○§∞○				●

- Use of materials (e.g. low albedo and longer cooling time-lag materials)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens		□	●◊○	x	□○§¤○	
Politicians			□◊¤○	□□○	○§	●
Urban planners& designers	◊○	□□○§¤○				●
Urban climate experts	□◊○	□□○§¤○				●

- Anthropogenic heat (e.g. less air conditioners)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens	□	●◊		§○∞	□○○	¤
Politicians		□◊		□○∞	○§○	●¤
Urban planners & designers	□□◊§	○○∞○		¤		●
Urban climate experts	□□◊	○§○∞○		¤		●

6. In case awareness is low, what is needed to increase the awareness among those groups of four urban climate adaptation measures mentioned in question 5?

Groups	Measures to increase awareness
Citizens	○Awareness campaigns. ∞Awareness campaigns, forums, meetings, publication of informative materials in the media and others. ○ Information campaigns ¤ Massive awareness campaign ○ Targeted media campaigns □ Media coverage; Open lectures;
Politicians	○ Conferences and ∞Awareness campaigns, forums, meetings, publication of informative materials in the media and others. ○ Information campaigns ¤ Group consultations and a referendum ○ Targeted media policies □ Media coverage; Debates;
Urban planners & designers	○ Communication and share knowledge with others involved in the field of urban planning and design. ∞Awareness campaigns, forums, meetings, publication of informative materials in the media and others. ○ Information campaigns ¤ Conferences and seminars § Conducting seminars and trainings for designing buildings with a

	low energy demand. But, mostly adapting the existing buildings to the necessary norms. I think montaging isolation panels on the building facades is not very efficient, since after a certain amount of time it might cause problems, mainly due to external factors such as strong winds and low quality of montaging. ○ Targeted media policies

Planning and design processes for implementation

Communication

1. Which roles do citizens, politicians, planners and designers and urban climate experts have in the process of planning, designing and implementing urban climate adaptation measures?

Citizens:

○ Important role in civil society

¤ External observers with monitoring functions

§ The most difficult task is to create a civic consciousness, which in my opinion is a matter of years of education.

○ None

□ Citizens have a fundamental role because they are the primary user of urban resources - parks, gardens, recreation and more. Local NGOs can organize monthly care of the cleaning and maintenance of the above recreation.

□ neutral role

● They can voice demands for more climate conscious decisions in the urban planning

Politicians:

○ Important role in steering

¤ Policy making and legislative functions

§ Unfortunately, politicians in Bulgaria area product of party deals. According to the legislation, the experts should have a leading role. All changes in law are made without asking the people working according to them, but they are modified to serve private interests and lobbies.

○ Neutral

□ In Bulgaria there is no clearly defined policy regarding environmental protection which reflects on the social thinking of the people in urban environments. The lack of adequate measures and strategic documents is a gap in the political organization of the environmental protection in Bulgaria. An achievement in recent years is the regulation of the National Ecological Network "Natura 2000" and the Protected areas law, but this is not enough to achieve efficiency and effectiveness in management towards the process of adaptation to the effects of climate change in urban environments.

□ Important

● Decision making, budgeting

Urban planners and designers:

○ Important role in the design

¤ Professional opinions

§ Expert training, a higher awareness about the good practices and more conferences.

○ Important

□ They are key players in the development of innovative ideas and allowing for the implementation of

policies and strategies developed by political circles.

□ Key role

● Planning, implementation, technical execution

Urban climate experts:

∞ Adaptation to climate change is a process of adjustment to current or future weather conditions and their effect in order to reduce adverse or to utilize opportunities arising from them.

Over the past decade the fight against climate change has become one of the main priorities in the world and a major factor in combating climate change is setting high goals for reducing emissions of carbon dioxide. Each of us has a role to play - from individuals to businesses, large organizations and government, we all have a responsibility to work together to achieve these goals and make effective use of energy.

○ Important role in planning

¤ Professional opinions and application of the measures.

○ Important

◊ In normal countries they are governmental structures that deal with exactly this problem and give instructions to every new building that is under construction about the materials that they can use to reduce energy consumption, about the types of the plants they could use around the fence of the building, etc. Unfortunately, in Bulgaria, this is still missing.

□ These are the people responsible for consulting and development of scientifically - justified developments accompanied by empirical and statistical data that helps decision-making and keeping efficient and effective policies in the field of environmental protection and mitigation of climate change in the urban environment.

□ Key role

● Expert opinion, assessments, consultancy, knowledge capacities

2. What are the relationships between these actors in the communication strategies?

Citizens/ Politicians :

◌ No;

∞ Indirect relation;

○ Negative;

¤ Weak;

§ None;

○ Non-Essential

◊ Weak;

□ Weak. The connection is permanently impaired 26 years. The lack of trust in political figures and institutions in respect of citizens determines the low efficiency and effectiveness in dealing with problems in the urban environment;

□ Almost none;

● None.

Citizens/ Urban planners and designers:

◌ No,

∞ Direct relation,

○ Neutral,

¤ Weak,
§ Only by creating of individual projects (weak),
○ None,
◊ Weak,
□ Direct/weak,
□ Almost none,
● Weak

Citizens/ Urban climate experts:

◌ no,
∞Indirect relation,
○ Weak,
¤ Non-existent,
§ None,
○ None,
◊ Weak,
□ Direct/weak,
□ Almost none,
● Weak

Politicians/ Urban planners and designers:

◌ Yes,
Project making and implementation,
∞ Direct relation,
○ N/A
¤ Expert,
§ None,
○ Neutral,
◊ Weak,
□ Indirect,
● Relatively not strong

Politicians/ Urban climate experts:

◌ Yes,
Knowledge generation,
∞ Direct relation,
○ N/A
¤ None,
§ Neutral,
○ neutral
◊ Weak,
□ Direct,
□ Relatively not strong,
● Weak

Urban planners and designers / urban climate experts:

◌ Yes,

Sharing experience and knowledge,

∞ Direct relation,

○ N/A

¤ Expert,

§ None,

○ Scientific,

◊ Weak,

□ Direct,

□ Strong,

● Relatively strong

3. What is the role of communication to support the planning, design and implementation of adaptation measures?

◌ Very important in order to find fast solutions to make cities in affected regions more resistant to changes in local climate.

∞ An important role of communication in support of the planning, design and implementation of adaptation measures Urban to climate change, because for their successful implementation an effort is necessary at all levels - individuals, businesses, organizations, local authorities and government.

○ Significant

¤ The role of communication is important to maintain the links between different stakeholders to keep a good communication and for a greater efficiency.

§ I think it would be very beneficial in any case.

○ Neutral

◊ N/A

□ Communication is the most important - role in solving any problem. Maintaining good communication is a symbol of efficiency and effectiveness, and most - already responsibility to achieve - a good result.

Spread of awareness among the less acknowledged groups

Crucial role; communication between all stakeholders at early stages benefits every project, especially project of big importance for a certain community (citizens) – like adapting the urban environment to the climate; Getting the community involved at an early stage and incorporating opinions promises bigger support and engagement from their side; Involving climate experts and urban planners at early stage communication – guarantees that the technical and scientific requirements are taken into consideration;

4. Are there formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures?

◌ Yes, there are many programs mainly sponsored by EU (sanirane)

∞ After adopting the new legislative package on climate and energy in 2008, the European Commission launched the initiative "Covenant of Mayors", in order to support and assist local authorities in implementing policies for sustainable energy. In fact, local authorities play a key role in limiting the effects of climate change, especially taking into account that 80% of energy consumption and CO2 emissions associated with activities conducted in urban settings. As a local authority, the municipality

defines local sustainable energy policy defines priorities in its development and creates conditions for the implementation of local energy initiatives. Dobrich has the potential for use of renewable energy and an opportunity to promote the implementation of energy efficiency measures. The share of this energy can provide significant part of total final energy consumption in households and businesses.

○ Not aware

¤ I am not aware of any.

§ I am not aware.

○ Not, as far as I know

◊ I am not aware.

□ They are no such documents.

□ I am not aware of any.

● Don`t know

5. What are the strengths and weaknesses of the communication process?

◌ **Strengths** – vast circle of parties involved in the sharing knowledge and experience and due to this communication faster solutions are reached for a limited time. Communication between government officials and municipality in terms of reducing urban heat by insolating old buildings to reduce their energy budged and consumption. **Weaknesses** – miscommunication, lack of money, slow processing the information, slow process of implementation.

∞ There is a general lack of communication between the different governmental and non-governmental actors.

○ Communication process misses a subject.

¤ The maintenance of a good communication process would help to keep a better efficiency, but in Bulgaria this process is very difficult, because of the heavy administrative procedures.

§ This process is almost missing.

○ I am not aware.

◊ N/A

□ Major problem in Bulgaria is the lack of communication at all levels.

□ I am not aware of any.

● Strength: Having all stakeholders on the same page; avoids misunderstandings; Weakness: Lengthy discussions and incorporating everyone's wishes can slow down the progress

6. Is there need to improve the communication process?

If yes, how to improve?

◌ Yes, there is always a need for improvement in every aspect of the processing. Improved agenda, and more frequent meetings and conferences for better information exchange and reporting the level of improvement.

∞ Yes, there is an urgent need of improving the communication. This can be done for instance by launching more awareness campaigns and make more forums and conferences where municipality representatives, climate experts and citizens can meet and exchange knowledge.

○ Yes, there is an urgent need.

¤ There is a great need for an improved communication, to achieve a better awareness and a higher

efficiency of the adaptation projects.

§ Definitely yes. The sense of the communication process is on one hand is to know the nature of the problems, on the other to have feasible solutions.

○ More media campaigns.

◊ I am not aware.

□ The options are many. But first you have to start with the distribution of responsibilities and specific objectives and tasks of each institution / organization dealing with environmental protection and mitigation of climate change.

□ Yes

● Not aware

Instruments

1. Are there legally binding instruments (e.g. zoning plans) used to implement urban climate adaptation measures?

   ◌ Yes, there is but only in the big cities such as Sofia, Varna, Plovdiv and Bourgas. Still these instruments are missing in the small towns and villages.

   ∞ I am not familiar with such instruments.

   ○ I am not aware of any.

   ¤ Plans for urban zoning exist. They are tied to the development plans of municipalities and controlled by the municipal councils. The most active urban zoning is in major cities within the country such as Sofia, Plovdiv and Varna.

   § There is such a part in the Overall Spatial Planning Plan of the Municiplaity.

   ○ I am not aware of such instruments.

   ◊ I am not aware.

   □ **No available instruments!**

   □ I am not aware of any.

   ● I am not aware of any

   If yes, please explain how they work?

2. What are the strengths and weaknesses of the legally binding instruments used?

◌ N/A

∞ N/A

○ The important strength is that they exist, and the weakness is that they are poorly implemented. There is a need of legal regulation

¤ Not aware

§ I am not aware of any.

○ Not aware

◊ I am not aware.

□ N/A

□ I am not aware of any.

● I am not aware of any

3. Are there certain chances / potentials missed when using the legally binding mentioned instruments

(e.g. coupling with other instruments)?

◌ N/A

∞ N/A

○ Not aware.

¤ Not aware, but they exist

§ N/A

○ Probably they are

◊ Not aware

□ I am not aware.

□ N/A

● I am not aware of any.

4. Are there other policy instruments used to implement urban climate adaptation measures?

◌ Not aware.

∞ N/A

○ N/A

¤ Not aware

§ N/A

○ N/A

◊ Not aware

□ I am not aware

□ I am not aware of any.

● I am not aware of any

If yes, please explain how they work?

5. What are the strengths and weaknesses of the other policy instruments used?

◌ Not aware.

∞ Not aware

○ Not aware

¤ Not aware

§ Not aware

○ Not aware

◊ I am not aware.

□ N/A

□ I am not aware of any.

● I am not aware of any

6. Are there certain chances/ potentials missed when using other policy instruments (e.g. coupling with other policies)?

◌ N/A

∞ Not aware.

○ Not aware of any

¤ Not aware

§ Not aware

○ Not aware

◊ I am not aware.

□ N/A

□ I am not aware of any.

● I am not aware of any

Implementation

1. Which concrete urban climate adaptation measures/ interventions are currently implementing or have been implemented in your city?

◌ N/A

∞ The city of Dobrich has implemented several energy efficiency measures such as gasification of the industrial sector, of some municipal buildings, and increasing rate of domestic gasification. They are some campaigns and initiatives to change the behavior of the public towards a more sustainable energy consumption. The overall objective of the municipality for 2020 is to achieve at least a 25% reduction in carbon emissions; 25% reduction in energy consumption; 20% share of renewable energy in overall energy consumption. Dobrich is aiming to create a system that will ensure that during the warmer months of the year there will be a proper irrigation of the roads and the green areas to cool them down and reduce dust in the air.

○ I am not aware of any

¤ In our city they are successfully implemented energy efficiency measures.

§ Not aware

◊ Not aware

○ I am not aware.

□ **No specific measures applied.**

□ I am not aware of any.

● I am not aware of any

2. What are the strengths and weaknesses of these mentioned urban climate measures/ interventions?

◌ N/A

∞ *Strengths:* Gas industry, municipal buildings, increasing household gas; Improved energy performance of buildings by introducing a package of energy efficiency measures; Used possibilities for utilization of renewable energy; Implemented pilot and demonstration projects for energy efficiency; Awareness of the role of local government as a model of intelligent energy behavior; Active civil society.

Weaknesses: General trend of significant growth in the consumption of electricity, respectively the share of greenhouse gas emissions into the atmosphere; Inefficiently used potential of renewable energy; Insufficient financing of EE(energy efficiency) / RES (relative energy sources) activities; Lack of government incentives for small and medium enterprises in the use of renewable energy; Obstacles to the accession of installed renewable power to the grid - burdensome procedures by the electricity transmission company; Sharply increasing the share of private automobiles in favor of public transport, respectively increased emissions.

○ I am not aware of any

¤ The strengths are that they increase the energy efficiency of the municipality. I am not aware of the weaknesses so far, because the measures are rather new and there is no data.

§ Not aware

○ Not aware

□ **N/A**

□ I am not aware of any.

● I am not aware of any

3. Are there conflicts between aesthetics and these mentioned urban climate adaptation measures?

○ N/A

∞ Yes, some of them are in a conflict with the overall cityscape.

○ Yes

¤For the moment there is, since the renovation of buildings is carried out individually by the owners, but there is no law or regulation regarding the appearance of the buildings.

§ Not aware

○ Yes, there is

◊ I am not aware.

□ **N/A**

□ I am not aware of any.

● I am not aware of any

4. Are there conflicts between urban functions and these mentioned urban climate adaptation measures?

○ N/A

∞ I am not aware of any.

○ To certain extent, yes

¤ Not to my knowledge.

§ Not aware

○ Yes, for the existing ones there is.

◊ I am not aware.

□ **N/A**

□ I am not aware of any.

● I am not aware of any

5. Are there certain chances/ potentials (e.g. coupling with other interventions / 'no regret' measures) missed when implementing these mentioned urban climate adaptation measures?

○ N/A

∞ Probably, but I am not aware.

○ Yes

¤ Yes, it is possible to implement additional measures such as better landscaping or implementation of green roofs on buildings that are suitable for such installations.

§ High prices for electricity, increasing the prices of the natural gas are forcing people with low income to use coal for heating. The tree belts along the fields were illegally cut, same refers to the forests. There is a need for restoration of the green spaces not only in the cities, but also in general.

○ I am absolutely sure that they are.

◊ Probably

□ **N/A**

□ I am not aware of any.

● I am not aware of any

Thank you for answering the questions in this questionnaire. Do you have any other remarks regarding the urban climate adaptation process or the content of the questionnaire?

Annex 3

Table of interviewees

Interviewee	Sector
Agronomist	Private sector
Municipal expert "Environmental protection"	Public Sector
Scientist 1 – Bulgarian Academy of Science (BAN)	Public Sector
Scientist 2 – Bulgarian Academy of Science (BAN)	Public Sector
Municipal secretary	Public Sector
Municipal Chief Architect	Public Sector
Municipal expert, director of OP "Centre for Nature conservation"	Public Sector
Urban planner 1 - Sofia	Private sector
Urban planner 2 - Varna	Private sector
Sustainability expert	Private sector