

The National Climate Change Adaptation Strategy for the Transport Sector in Bulgaria – Review of Data Collection Procedures, Emergency Situations, Institutional Capacity

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Abstract: *The National Climate Change Adaptation Strategy for the "Transport" sector until 2030 was developed in the period 2017 – 2019. After 4 years in the conditions of several overlapping crises, the recommendations contained in the document on main adaptation measures relating to institutional capacity building have not started. This is observed against the background of activity from a number of countries that are looking for models to assess the sensitivity of the transport infrastructure to climate events and, from there, measures to achieve sustainability and adaptability in the medium term. The article analyzes the problems of backwardness in Bulgaria and offers recommendations for increasing the participation of all interested participants in the transport sector.*

Keywords: *TRANSPORT SECTOR, INSTITUTIONAL CAPACITY, EMERGENCIES, RESILIENCE AND ADAPTABILITY, ADAPTATION MEASURES, STAKEHOLDERS, CRISIS AND RISK MANAGEMENT*

1. Introduction

In the last few decades, the phenomenon of global warming and related climate changes has become one of the most pressing challenges facing the modern world. The countries of the European Union, understanding the seriousness and long-term consequences of this process, are engaged in the development and implementation of complex strategies and measures to mitigate the negative effects. However, these efforts are not limited to just one or two areas; they require far-reaching changes in energy, industry, agriculture, and transport.

Carbon emissions and greenhouse gases continue to increase, creating conditions for faster warming and adverse climate events such as drought, floods, and widespread extreme weather events. Such problems require even more active adaptation and decisive action in critical sectors of the economy.

Bulgaria, as a member of the European Union, is committed to adopting and implementing similar measures. The goal is to prepare the infrastructure and society for the new climate conditions and to minimize the risks of future climate catastrophes.

In this context, adaptation and resilience become key concepts that must be integrated into every aspect of management and planning. This includes not only technological innovation but also social and cultural changes that support a more sustainable and adaptive way of life. Thus, in the conditions of rapid and irreversible climate changes, the task of adaptation and sustainability becomes increasingly urgent and complex.

The transport sector is a key industry element in terms of economic stability. Its degree of significance for the national economy of Bulgaria requires a serious development of risk prevention actions and countermeasures against its damaging components.

The request for the sustainability of the sector must necessarily include the vulnerabilities that arise from climate risks [1, 2, 3].

The first more serious steps were finalized at the beginning of 2019. Then, with a clear awareness of these challenges, with the help of experts from the World Bank, Bulgaria developed a "National Climate Change Adaptation Strategy (NCCAS) and Action Plan" [1]. The strategy sets the direction for future efforts, including an analysis of the impact of climate change on key sectors of the economy, including the Transport sector. It offers basic recommendations for overcoming barriers to adaptation, which must be implemented in the 11 years from October 2019 (the document was adopted by decision No. 621 of the Council of Ministers) until the end of 2030.

A Climate Change Adaptation Report (CCAR) has also been developed for the strategy for each sector [2]. In both types of documents, basic principles are indicated from which climate adaptation measures can be derived. Through their application, the

aim is to prevent vulnerabilities in terms of risk factors and to reduce the effects of events occurring within the "Transport" sector.

Adaptation in the context of climate change is a global set of processes, actions, or measures that societal systems adopt to cope with the pressures of climate change. The ultimate goal is to reduce their vulnerability and increase the ability of economies to withstand the impacts of climate change, i.e., to build working mechanisms to achieve such an ability in both reactive (in response to the manifested changes) and proactive (preliminary, in anticipation of the changes) form.

2. National Climate Change Adaptation Strategy status 5 years after admission

Despite the relatively high-quality and applicable adaptation policies in both documents [1, 2], already five years after their adoption, we are faced with the reality of delays and lack of active implementation of the proposed measures in many sectors, including transport.

This article is aimed at analyzing the implementation of the "National Climate Change Adaptation Strategy and Action Plan – Transport Sector" (NCCAST). Let's look at some of the reasons that led to the inactive implementation of the strategy, as well as the potential risks and losses facing Bulgaria's transport sector.

2.1 Crisis events at national and global levels concerning the backwardness of [1, 2]

The level of development of the transport infrastructure is different within the EU member states. In Bulgaria, construction and modernization are at a stage where significant investments will be needed in the long term.

Given this, in the conditions of the complicated international situation from 2020 until now, the packages of activities for implementing the strategy and its maintenance are of increased sensitivity to the consequences of these alternating events. This applies even more strongly to the creation of opportunities to implement the principles of sustainable development for the sector, and as a result, their implementation has literally been pushed back far in time.

To date, three continuous groups of crisis events in a short period have led to severe shocks in the transport construction sector (especially in the road construction sector). The series of collapses started in early 2020 with the COVID-19 pandemic, and from 2021 until now, instability of a political and economic nature has significantly damaged and devalued the positive image and funding of transport infrastructure. After February 2022, the financial turmoil that arose from the situation in Ukraine further reduced the opportunities for modern sector development.

As a result, the focus on an overall efficient and environmentally friendly transport infrastructure has shifted to "piecemeal" project implementation approaches.

In this situation, there was a vacuum in the sectoral policies of the requests to start activities according to the recommendations that the document on adaptation to climate change (ACC) [2] set at the end of 2019.

This halts the activities that should ensure the adaptability and resilience of the Transport sector. In terms of evaluating and guiding documents, [1] and [2] remained the only ones guiding adaptation measures for the transport sector of Bulgaria between 2019 and 2023. This negatively affected all the main measures for building adaptive capacity, mainly in the direction of a lack of commitment to rework the systems, documents, and methods for assessment and response in emergency situations.

2.2 Reasons for the lag and non-implementation of the strategy's recommendations

The reasons for the lag and/or complete non-implementation of the recommendations of the strategy should be sought in the accumulated deficiencies and ambiguities in the management of the transport sector. In Bulgaria, the institutions and the legal framework, which are responsible for ensuring all elements of the efficiency of the "Transport" sector, organize their activities within the framework of limited managerial autonomy.

The lack of commitment and the degradation of the understanding of the importance of transport as an economic and social subject for the development of the state and society at the national level makes it impossible to build an institutional capacity that would provide the essential part of infrastructure construction for our national economy.

This outlines the unfavorable trend that policies aimed at construction and maintenance will continue to be constrained within sectoral fragmentation and financial redistribution of resources from year to year. This makes the sector extremely susceptible to negative economic and political conditions caused by crises. Respectively, this literally stops the optimization and development of the sector in terms of technology, competitiveness, and sustainability. The latter continues to be evident in this calendar year as well when the established state of NCCAST remains unchanged compared to the 2019 base year.

3. General assessment of the recommendations and main adaptation measures proposed in the strategy.

Concerning the recommendations and the main packages of measures that are contained in the national documents for climate change adaptation (CCA) in the transport sector [1, 2], attention can be paid to the following essential points:

The positive side is the relatively in-depth study of the problems in the sector and the formation of corresponding recommendations, the implementation of which can set a perspective for real adaptability and synchronization of activities. Respectively, this should presuppose the implementation and operation of transport infrastructure in our country, which is the carrier of a safer and better service in the medium and long-term time frame.

Two large groups of activities to be optimized should be noted as weaknesses:

1) There is a need to expand the scope of the elements under the CCA compared to those proposed so far in [2].

Referring to Appendix 1 (table 23) from [2], an analysis and recommendations are prepared for increasing and refining the scope of the CCA, to be presented after the end of the project "Impact of climate change on the transport infrastructure in Bulgaria – conceptual approach for assessment of the potential impact on achieving sustainability and safety of elements of the transport sector" (funded by the Research, Consultancy and Design Centre – RCDC at the University of Architecture, Civil Engineering and Geodesy). The aim is to specify the vulnerability of transport

infrastructure to climate change, as well as adaptation measures (databases, regulatory documents, responsibilities of institutions) from an engineering-technical point of view.

2) Removal of recommendations on adaptability, which, in terms of their verification in standards and normative documents, cannot be fulfilled.

The reasons are diverse, but the main one is the lack of institutional capacity to build a unified system of legal and by-law documents with a common level of action. This is currently completely unfeasible due to the high level of fragmentation in implementing these processes at the national level.

For example, fragmentation is when multiple institutions are responsible for compiling and promulgating documentation that actually concerns the preparation of a single investment project.

Another point is that entirely independent technical (expert) committees are entrusted with preparing norms, regulations, and standards that ensure the parts of a project task. A big problem in synchronizing these different documents is the lack of instructions obliging individual instances to bring their legal acts to a single common system. This is also the reason why many of the adaptation measures are inapplicable, as recommended in [2], and hence, the principles of CCA cannot be introduced to them.

4. Recommendations for timely building of institutional capacity to CCA

In [4], it is stated that adaptive capacity develops when institutions enable actors to prepare for climate risks, changes, and effects and acquire adaptability to this complex process. Therefore, if we are looking for an application in the direction of process management, implementing this measure requires a change in the structures and activities that each national structure concerning the "Transport" sector performs.

For this to happen, targeted action at national and regional levels is needed to improve the status of several key elements. Optimizing them will provide opportunities to define institutionality regarding adaptation to climate change for the transport service. The most important of them are the following:

- **Formation of sub-sectors with direct commitments to implement CCA practices.**

This does not mean inflating the administration, but training and qualifications of the participants in the process of building adaptive capacity. In [2], it is stated that the need for training should be assessed. This is absolutely necessary at this stage of the backwardness, on the one hand, to start the processes of introduction of CCA, on the other hand, in order to use the accumulated foreign experience to speed up the work.

To learn from what has been achieved at the international level, the expertise provided by the scientometric sources and their authors should also be included. This makes the participation of scientific and educational institutions necessary, and they participate in the process of building adaptive capacity.

- **Revision of regulations and administrative-management documentation for regulation of the sector.**

With this, to initiate responsibilities and obligations under the CCA and to optimize the practices with which measures are worked on, such as data collection, processing of regulatory documents, etc. Without prescribing written procedures and the ways of their implementation, the practical implementation of the measures will again be transferred in a reduced volume and scope to the contractors in the investment process or to the traditional maintenance and operation procedures. Under such conditions, we are working at the moment, and the result is that, in practice, we do not have global working policies for the introduction of adaptive capacity.

- **The responsible units under CCA should prioritize programs to compensate for the delay, according to [1, 2].**

The compilation of available literature regarding the administration of the process is essential to its organization.

Therefore, within the responsibilities of the institution concerned, schedules of activities must be planned, and this must be tied to relevant deadlines for implementation. Competency programming will show how to compensate for the three initial missing parameters – a high degree of missing data, lack of researched and selected climate models, and lack of forecast modeling for risk assessment.

- **To eliminate inter-institutional problems by introducing the principle of joint actions.**

The authors of [4] reached similar conclusions that the lack of connectivity is the cause of unsystematic and isolated actions on adaptation measures, and in our country, the de facto results remain buffered within the governing body and its subdivisions. Reformulating the interaction between institutions in the sector will filter the barriers that result from individual administration.

The first step is within the framework of the peculiarities of the structure of the Bulgarian legislation. Because at the national level, the scope and obligations of the institutional management of the "Transport" sector are set, and therefore, the connection will be confirmed with normative acts.

Secondly, for the individual institutions to work together, the process will need a high degree of digitization. Digital approaches will most quickly and at scale provide universally accessible portals and hubs of connectivity where information is fed from all sides. At the same time, the received data will be available to all connected users of the system in real-time. This will make it possible in practice for the governing bodies to coordinate the activities for which they are responsible in a timely and regular manner. The result should be a management model where the same element of transport infrastructure can simultaneously be serviced when a problem occurs (both at the level of documentation and at the level of on-site activities by all responding parties).

- **In [2], an adaptive element "Increasing awareness" is proposed.**

Emphasis is placed there on surveying, compilation of primary general documents, analyses, and others. This practically does not complement the plans and order in which the individual institutions act but only illustrates their level of awareness.

It would be more effective to carry out work on solving specific tasks by measures such as:

- 1) drawing up documentation that indicates algorithms for drawing up the projects in the various stages, taking into account the possibility of adaptation,
- 2) implementation of maintenance and operation activities, which are already linked to adaptive activity indicators,
- 3) carrying out activities in emergencies that have real-time information, the possibility of early disclosure, and the responsible institutions coordinating their activities at the same time in the stages of the emergency.

That is, "awareness" should be understood as the practical application of specific adaptive parameters, not their theoretical knowledge within a given agency, ministry, municipality, or other governing body. This will expand users and participants who wish to receive a more sustainable service and increased CCA protection.

It should also be mentioned here the BG-ALERT system [5], which is intended for the distribution of messages to warn the population in case of dangerous events (disasters, emergencies, and others posing a threat to life, health, or property) through the networks of mobile operators to citizens' end devices (mobile

phones, tablets, and some smartwatches)1. This system is designed to provide timely information to citizens if there is danger to them in the event of a disaster.

In the context of climate change, the BG-ALERT system can be advantageous. Climate change may lead to an increase in the frequency and intensity of extreme weather events such as floods, droughts, and storms. In such cases, BG-ALERT can provide timely information to citizens about emerging dangers and give instructions for action that can help reduce damage and protect people's lives and property.

5. Example of connectivity between institutions

Within the framework of the scientific project "Impact of climate change on the transport infrastructure in Bulgaria – conceptual approach to assess the potential impact on achieving sustainability and safety of elements of the transport sector," an example of an approach is being prepared, how the connectivity between institutions and their databases, will affect maintenance, operation, crisis management and at the same time will not require a significant financial resource.

The example is in the scope of:

- Ministry of Regional Development and Public Works [6];
- Ministry of Transport and Communications [7];
- Road Infrastructure Agency [8];
- National Railway Infrastructure Company [9];
- Ministry of the Interior [10];
- and other institutions that need to coordinate their procedures concerning the CCA.

The task is related to establishing the affected objects of the road network, for which prevention of geological risk is required, which can be provoked by occurring climatic events [11, 12].

The selection was made for landslide geological hazards from the database of the national register of landslides in Bulgaria [13]. The selected road sections are within the scope of the "Pernik" Geoprotection [14].

The aim is to show that, using the available data, with joint efforts, the institutions can join a portal that receives information from the available but is specifically related to the landslide processes concerning roads and the corresponding measures of prevention and removal of the effects.

The field survey results and survey conclusions are detailed in [15]. Establishing effective communication and coordination between various institutions and agencies is critical to overcoming the challenges facing the country with changing climate conditions. Centralized collection and analysis of data on geological and climate risks can help to better understand and manage the potential dangers they pose to the transport network. The example of the landslide geological hazard and the coordination between different institutions illustrates how, by joining efforts and optimizing the available resources, the sustainability and safety of the transport infrastructure can be improved without significant financial investment. This highlights the opportunity to achieve greater efficiency and accountability in crisis management, as well as to create a safer and more sustainable transport system in the long term.

6. Conclusions

The delay to date and lack of active implementation of the proposed measures in the NCCAS requires catching up on all elements of sustainable transport infrastructure modeling at an accelerated pace to expect the fulfillment of commitments (even in partial volume) by the 2030 deadline year.

When we talk about adaptation in a specific sector like transport, it should at least start with optimization, complementing, and reworking in three main directions:

- **Planning and strategy for managing the investment process in design and construction** – process management, regulatory documents, standards, and interconnection of all elements of the projects, which should lead to a sustainable "Transport" sector under the CCA;

- **Research and innovation** – development of new technologies and practices and digitization of processes that help transport infrastructure to function effectively under changing climate conditions [16, 17]. Here, we should simultaneously focus on climate parameter prediction modeling combined with products that allow simulations of the mutual influence of transport infrastructure and the occurring climate event.

Research and innovation should also include modernization with materials and methods at every level of the investment project and the operational life to increase sustainability and reduce the sector's sensitivity to climate change.

Last but not least, the first two recommendations must be supported by sufficiently publicized studies and scientometric results concerning CCA.

- **Risk assessment and prevention** – development of crisis management plans. There is a need for institutional connectivity, unity in actions related to crises resulting from climatic events, development of early warning systems, real-time observations, implementation of intelligent management systems, and other practices to improve connectivity with CCA.

Launching actions on the specified groups is a request for a start-up package, which a comprehensive institutional approach to climate adaptation must secure. Without a unified approach to CCA management, an adequate institutional capacity cannot be built, and the asymmetry in the measures implemented with separate isolated efforts at the national and regional level will remain the only form of adaptation of the transport and especially the road infrastructure.

- **Institutional connectivity at all stages of the transport object's life cycle.**

Coordination of activities at a given stage and on a given adaptation measure will allow simultaneous updating of all processes. On the other hand, it will significantly enhance risk management regarding climate change.

The elucidated challenges and propositions underline the exigency of a consolidated, well-coordinated approach to bolster the resilience and sustainability of Bulgaria's transport infrastructure amidst the unfolding climate metamorphosis. The delay in enacting the measures envisaged in the NCCAS manifests a clear call for an accelerated impetus toward achieving a sustainable transport paradigm by 2030. This necessitates a holistic, multi-faceted strategy encompassing meticulous planning, fostering innovation, and ensuring robust risk management frameworks. Central to this endeavor is the cultivation of an institutional synergy that transcends the silos of individual agencies, enabling a conducive milieu for knowledge sharing, technological advancement, and strategic alignment with the overarching climate adaptation goals. The linchpins of this strategy – planning, research, risk assessment, and institutional connectivity – mustn't be seen as isolated tenets but as interwoven threads of a larger structure that is the climate-resilient transport infrastructure. Moreover, the infusion of digital technologies and intelligent management systems, aligned with a thorough understanding and anticipation of climate-induced risks, could significantly amplify the efficacy and responsiveness of the transport sector to climatic exigencies. This endeavor not only propels Bulgaria towards fulfilling its climate adaptation commitments but also sets a precedent of proactive, integrated, and informed action that could be emblematic of broader regional or even global climate adaptation initiatives in the transport sector.

Acknowledgments

The authors express their gratitude to RCDC of UACEG for the financial support of the scientific project "Influence of climate change on the transport infrastructure in Bulgaria – a conceptual approach to assess the potential impact on the achievement of sustainability and safety of elements of the transport sector."

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