

THE SELECTION OF TECHNOLOGIES IN THE WATER MANAGEMENT SECTOR IN BOSNIA AND HERZEGOVINA FOR THE REDUCTION OF GHG EMISSIONS BY USING BACKCASTING AND THE ASSESSMENT METHODS FOR TECHNOLOGY NEEDS

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In Bosnia and Herzegovina, climate change is increasingly considered to be the matter of key strategic importance, especially by local authorities and the academic community. The State development vision is that by 2025 Bosnia and Herzegovina (B&H) will be a sustainable and progressive 'green economy'. The implementation of measures for the reduction of greenhouse gases emission is an optimal opportunity and a chance to start a technological transition with international professional and financial help. In B&H, through consultative activities, seven priority sectors for the adaptation to climate changes were identified: agriculture, biodiversity and vulnerable ecosystems, energy (hydro-energy), forestry, public health, tourism and water resources/water management. Water management and agriculture are considered as main priorities that have a significant impact on other sectors. Having in mind its descriptive character and the characteristic of the problem solving at the very beginning, the backcasting approach is much more convenient for solving long-term problems and for offering long-term sustainable solutions. The aim of this paper is the identification of optimal technologies in the water management sector using the backcasting approach which can be applied in B&H, and their analysis through the TNAAssess software to evaluate their acceptability and the possibilities of their use in B&H.

Keywords: Backcasting, water management, technology assessment

Introduction

In Bosnia and Herzegovina (B&H), climate change is increasingly considered to be the matter of key strategic importance, especially by local authorities and the academic community. The state development vision is that by 2025, B&H will be a sustainable and progressive "green economy" [1,2]. When B&H joins the European Union (EU), as a member state it will have low emissions, high quality of life for all, preserved natural ecosystems, a sustainable management of natural resources and a high level of resistance to climate change. Increased levels of energy efficiency, the increased use of a renewable energy and improved energy and transport infrastructure and services will lead to attracting the international investment, job creation and business entrepreneurship in the economy based on the efficient use of resources. Negative impacts of climate change will be minimized by reducing the level of sensitivity and exploiting climate change opportunities [1,2]. Unlike many other environmental issues, the impact of climate change is not geographically related to their causes. Thus, although B&H is among the countries with the lowest greenhouse gas emissions per capita in Europe (five tons of equivalent carbon dioxide per capita per year, about

half of the EU average value), climate change has already been observed [2]. B&H is particularly vulnerable to climate change due to its geographical position, the economic importance of the agriculture and forestry sector, as well as its limited capacity to adapt to climate change.

The implementation of measures for the reduction of emission greenhouse gases (GHG) is the optimal opportunity and chance to start a technological transition, with international professional and financial help. However, the problem meets many barriers: from ignorance and distrust to inadequate legal regulations. It is therefore appropriate and necessary to demonstrate technology transfer in B&H with all their aspects: technical, economic, environmental, market, legal and social. After the beginning of implementation of a certain technology, it is very important to establish monitoring, to track results and resolve all difficulties with introducing new projects [1,2]. The use of renewable energy sources and the implementation of energy efficiency measures in the energy dependence of the state and the improvements in the quality of the environment, as well as the increase of the competitiveness of B&H's economy. With properly designed programs, these measures will re-

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sult in the development of the whole economy. In the last few years, more companies in B&H have directed their activities to the field of the production of equipment and systems for the use of a renewable energy source.

In B&H, through consultative activities, seven priority sectors for adaptation to climate changes were identified [1]: agriculture, biodiversity and vulnerable ecosystems, energy (hydro-energy), forestry, public health, tourism and water resources/water management. Water management and agriculture are considered as main priorities that have a significant impact on other sectors.

The backcasting approach started in the early 1970s and was originally developed as an alternative to traditional forecasting and planning methods [3]. The focus was on the analysis of energy planning policies, and later for examining sustainable solutions in the future, while stakeholder involvement and achievement goals through the implementation of action plans became a significant part of this approach at the beginning of the 21st century. This enables such approach to be used at the level of organizations, local communities, the region, the industry and other spheres of the social development, as well as at the state level and globally [4]. However, the backcasting approach is not the only approach that uses descriptive or desirable visions of the future, but it is also possible to recognize it in other approaches that combine descriptive scenarios with the stakeholder involvement [5]. In this way, the backcasting approach can be viewed as a philosophical concept, both as a study and as an approach, both as a methodology and as an interactive process between participants, as an analysis, and as a specific retrograde step (from the desired future) in the whole planning process [4]. All this means that backcasting is used to determine whether it is a conceptual or holistic model, a level of sociological and intercultural processes, a level of the overall approach and methodologies that contain multiple steps, methods and instruments, as well as the level of specific steps, methods and instruments within such approaches and methodology.

Also, although this approach is described as a phase (step by step) and in some way linear, it certainly is not. It is possible to repeat individual cycles, and there is a mutual influence of the two phases (steps) that accompany each other [5]. Furthermore, the backcasting process has a dynamic nature, which means that at one time there may be a change in the main actors. Backcasting is normative in nature and problem-oriented, multidisciplinary and involves the participation of all stakeholders, which makes it even transdisciplinary. Interested stakeholders are very important, not only because of their specific content-related knowledge, but also for obtaining the consent for the results obtained and the implementation of the proposed activities [6].

Having in mind its descriptive character and problem solving at the very beginning, the backcasting approach is much more convenient for solving long-term problems and offering long-term sustainable solutions. Therefore, it is better to consider backcasting as an approach rather than a method. Furthermore, backcasting studies should provide

decision-makers and the public with an entirely acceptable and interesting picture of the future of the whole society on which an opinion should be formed for quality decision making [7]. Therefore, the scenarios of the project (in our case, water management scenarios) using the backcasting approach should provide a wide description of the solutions that should be considered for the adoption of final options of different future [5]. It has been confirmed that the backcasting approach is particularly promising in cases of complex problems, the need for radical changes, in cases where dominant trends are part of the problem and external influences that cannot be sufficiently addressed in the current market. Sustainable development issues clearly combine all the above-mentioned features, and then it is clear why the application of backcasting approaches from the initial energy sector has spread to all sectors of sustainable development [8]. What we refer to as backcasting in the modern world is the so-called participatory backcasting approach. It requires the participation of all stakeholders in the planning process, as already stated at the very beginning of this paper.

Although most literary approaches show certain deviations in the applied methods, the method of involving stakeholders and the number of steps, it is possible to generalize and group them into a single methodological framework for participatory backcasting approach consisting of five stages (steps) [9]:

1. Orientation towards the strategic problem;
2. Developing sustainable vision of the future or scenarios;
3. Backcasting;
4. Development, analysis and defining of all activities with the development of an action plan;
5. Including the results and generating later activities and implementations.

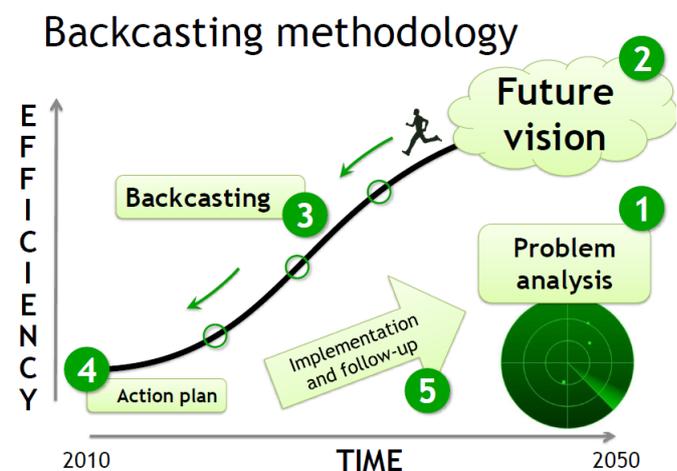


Figure 1. Steps in backcasting

A wide range of methods and tools is necessary when using a participatory backcasting approach, and can be divided into four groups of actors which together constitute the basic backbone of the necessary tools in the

process. Participatory tools and methods make the first group [10]. This includes all the tools and methods that are useful for the active involvement of the actors and the achievement of an appropriate interaction between them. This includes the specific tools needed to organize and run the workshop, the creative tools and tools needed by the actors in certain backcasting activities, as well as the tools needed to develop a participatory vision and develop scenarios. The second group consists of the tools and methods needed for creation. This is not just about creating scenarios, but also about developing and embedding details of all system elements and creating process tools. The third group consists of analytical methods and tools. This does not only apply to the assessment of scenarios and studies, such as the economic analysis or the environmental impact analysis, but includes the methods for the process analysis and assessment, the identification of actors and their analysis and the analysis of their impact. Since the backcasting approach also requires the effective management and coordination in communication, these methods, tools and skills are the fourth group. This includes the methods and skills necessary for effective communication, networking among actors and management of that network. It must be emphasized that each stage of the backcasting approach generally requires some of the methods and tools listed, while some specific methods and tools are used in some specific phases of the process [11].

Efforts have recently been made to integrate the issue of climate change into sectorial policies, strategies and plans. The first, second and third national communications on climate change have been drafted and submitted to the UNFCCC Secretariat and represent important documents for understanding and monitoring the phenomenon of climate change in B&H. In addition, the Strategy for Adaptation to Climate Change and Low-Sustainable Development has been developed and adopted in B&H, and the First and Second Biennial Reports on the Greenhouse Gas Emission of B&H have been prepared.

The EU Energy and Climate Package adopted in December 2008 emphasizes the need to reduce greenhouse gas emissions (GHG emissions) and increase the share of low-carbon or non-carbon energy technologies in the economic and energy systems of member states and countries that are in the process of accession. The EU Roadmap sets the ambitious goal of reducing GHG emissions by 80-95% by 2050 and estimates that the investments are needed to achieve this goal of around 270 billion € per year (i.e. about 1.5% of GDP). At the same time, the estimated benefits of the emission reduction measures are very significant and greatly compensate (or even exceed) the necessary investments. Fuel cost savings are therefore estimated at € 175-320 billion per year, while other significant benefits include new jobs in innovative industries, greater competitiveness through the development and transfer of low-emission technologies, improved conditions for maintaining the health of

the population (e.g. through the better-quality air due to the transition to traffic with low carbon emissions) and so on. [1].

B&H does not have a specially built infrastructure for identifying needs, collecting the information on available technologies, or a specific incentive system. There are no special privileges for the transfer of technologies in B&H, and only the legal possibility that foreign investments in the form of a founder's role are exempt from customs duty and value added tax, technology (knowledge and equipment) is exempted from customs duties and taxes if it is recorded as the founding foreign investor. Limitations due to the lack of incentives should be considered when technology transfer models are being developed [2].

Climate change scenarios for participation and air temperature will have a negative impact on the current system of water management in B&H. Although there are available information on water levels, and this information is used for the determination of total water availability, the available data on hydrological resources are very limited. In accordance with this, there were no estimations on climate change impacts on these systems on the state level. Forecasted changes in participation and its spatial distribution (scope and seasonal) in combination with the temperature increase and evaporation rate, will probably lead to the increase of the number of extremes (floods and droughts). Also, water shortage will happen more frequently during the summer period, especially in the Adriatic Sea and Herzegovina area. The climate change adaptation is currently limited due to the shortage of reliable data. This should be in focus for future planning in this sector.

The Technology Needs Assessment (TNA) process can fit very well into the context of B&H, as it can play a significant role in the process of harmonizing domestic legislation with EU legislation and practice in the field of climate change and contributing to the fulfillment of obligations under the UNFCCC. The timing and future implementation of this document coincides with the growing importance at the global level of transfer of technologies and the growth of global funds for the issue of climate change, an opportunity that B&H should not miss. In addition, the results of this process can also serve as input data for the development of other strategic development documents.

The aim of this paper is to identify the optimal technologies in the water management sector using backcasting approach that can be applied in B&H and their analysis through the TNAssess process evaluates the acceptability and the possibilities of their use in B&H.

Experimental methods

The TNA Handbook [12] foresees that the process takes place in five basic steps (shown in Figure 2), which are realized in a participatory way, through workshops involving all relevant stakeholders. Based on these recommendations, when preparing the assessment of technological development needs for mitigation of climate

change and the adaptation to climate change in B&H, all planned steps were implemented through a series of activities of the broader and wider TNA team, the engagement of technical experts for technology identification,

cost estimation and the emission reduction, and through the organization of workshops and several consultative and working meetings during the implementation of the technology assessment.

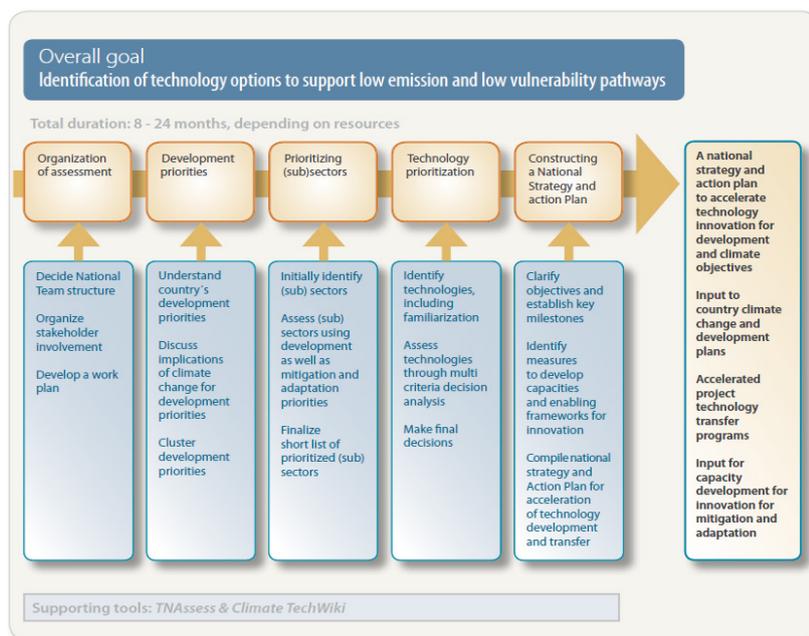


Figure 2. Steps in conducting TNA

Source: Handbook for conducting Technology Needs Assessment for Climate Change, UNDP 2010

Based on the identification of technology for priority sub-sectors, done based on Chapters 5 and Annex 7 of the TNA Manual [12], a description technology on the site ClimateTechWiki and Climate-ADAPT, UNEP DTIE-UNEP DTU manuals and other available sources, the author in cooperation with relevant stakeholders:

- Identified possible technological options for priority sub-sectors and formed a long list of available technology;
- Made a recommendation on which the available technology / measure is applicable and suitable for conditions in B&H so forming a shorter technology list;
- Collected data on technological options / measures with shorter lists in the shape given by TNAssess software thus creating info pages for each individual technology;
- Estimated costs (capital, operational and other) for the application for a submitted technological option; for sub-sectors reduction emission the costs are estimated in detail while for adaptation technologies / measures, constituent elements cost and estimated categories are only identified - from low to very high.

Collected information about individual technological options from shorter lists are presented at workshops for the introduction with technologies with the aim to provide the participants with a backcasting process at the TNA workshop, the active participation and all collected infor-

mation included in the prioritization. Workshops are also an opportunity to verify a technology list with participants that are in the position to suggest complementation and/or abbreviation of the proposed list, i.e. corrections of the offered information.

After finishing the identification process, the information about the selected technologies was entered into the multi-criteria TNAssess software in the appropriate categories. Thus, these processed and categorized data on technologies served as a base for the next step in the process - determining a priority option that will mostly contribute to the achievement of climate and development goals in the country.

Results and discussion

Collected information about individual technological options from shorter lists were presented at workshops for the introduction to technologies, with the aim to provide the participants with a backcasting process at the TNA workshop, the active participation and all collected information included in the prioritization. Workshops were also an opportunity to verify a technology list with participants who were in position to suggest complementation and/or abbreviation of the proposed list, i.e. corrections of the offered information.

After finishing the identification process, the information about the selected technologies was entered into the multi-criteria TNAssess software in the appropriate

categories. Thus, these processed and categorized data on technologies served as a base for the next step in the process – determination of the priority option that will mostly contribute to the achievement of climate and development goals in the country. Technologies for the emissions reduction and Technologies/measures for the climate change adaptation for water management sector are given in the Table that follows.

Table 1. Selected technologies for the emissions reduction and the adaptation in the water management sector

Technologies for the emissions reduction and Technologies/measures for the climate change adaptation
1. Maintenance of river banks
2. Flood warning
3. Flood protection measures/ embankments
4. Losses reduction
5. Measures for reducing a specific use of water (industry, irrigation, etc.)
6. Irrigation
7. High dam construction
8. Sustainable use of ground waters
9. Improvement of monitoring and other measures related to droughts
10. Waste water treatment

Based on the previous knowledge, the information provided through the TNA process and discussions at the workshop, workshop participants should assign points to all options in categories of technologies in which there was a sufficient number for TNAAssess prioritization to be implemented (three or more).

Points should be assigned for every of the selected criteria on the scale from 0 to 100, in a way that the score of 0 points does not mean that by the application of these technologies would not be achieved any benefits but to make a contribution of the concrete technology was the lowest in the relationship with the others options in the group (rating of 100 points would mean the biggest contribution). For assigned ratings, workshop participants were supposed to give appropriate explanations, too. The results for assigned ratings and weights for each technology and criteria are given in Tables 2 and 3. Based on these points and the weight assigned, the average grade for each criterion is calculated, and such results are included in the software. The software generates total benefits from the application of technology and allows their graphical and tabular overview.

Table 2. Results for sector: Water management

No.	Technology	Contribution to the reduction of GHG / Contribution to the reduction in sensitivity	Contribution to the environmental protection	Contribution to the economic development	Contribution to the social development
1.	Maintenance of river banks	50	20	20	40
2.	Flood warning	30	30	30	80
3.	Flood protection measures/ embankments	80	40	70	20
4.	Losses reduction	55	55	40	50
5.	Measures for reducing specific use of water (industry, irrigation, etc.)	70	90	50	30
6.	Irrigation	90	50	90	70
7.	High dam construction	100	0	100	90
8.	Sustainable use of ground waters	60	80	80	100
9.	Improvement of monitoring and other measures related to droughts	20	100	60	60
10.	Waste water treatment	80	60	60	80

Table 3. Results of giving weight to the criteria

<u>Weight to improvement</u>			
Criteria	The least desirable option	The most desirable option	Weight
GHG reduction/ Sensitivity	9	7	100
Environmental	7	8	60
Economic	1	7	80
Social	10	3	70

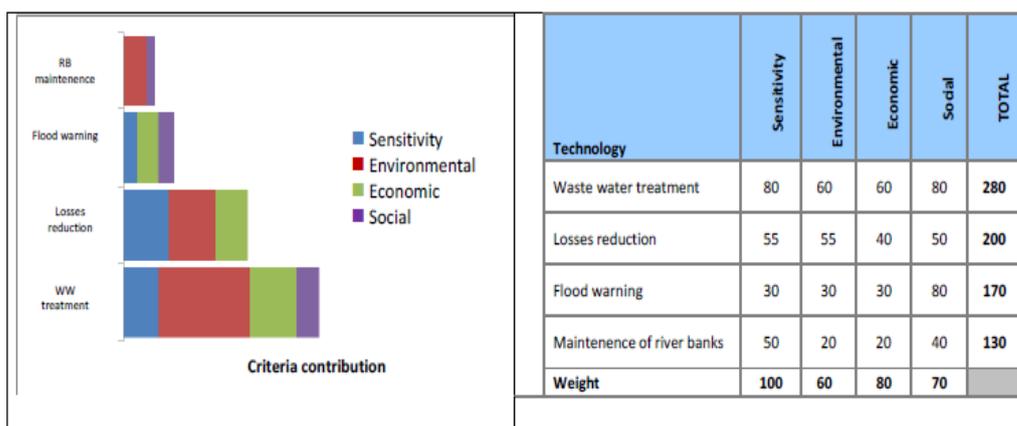


Figure 3. Chart with the contribution to overall benefits of prioritized technologies and the Table with weight points

Interpretation: The chart on the left side of Figure 3 shows the cumulative development and climate benefits for each prioritized technology in this sector, based on assigned points and weights. The Table on the chart above shows the same results as number values. The results show that first two prioritized technologies/measures are waste water treatment (280 points) and losses reduction in water supply systems (200 points). Different colors show how each criterion contributes to total benefits. For example, total benefits from waste water treatments are mostly originated from the sensitivity and social criteria, while environmental and economic criteria are lower but also significant. The losses reduction in water supply systems has almost three identical criteria: sensitivity, environmental and social, which equally contribute to total benefits. In the water management sector, the sensitivity criteria is evaluated as the most important and assigned with 100.

Sensitivity analysis

The chart with sensitivity analysis illustrates consistency (robustness) of the most desirable rating techno-

logical option in relationship with the changes in weight criteria. The name of the most desirable options from prioritization is stated at the top. Thus, all the criteria and colors are listed (or empty fields) that highlighted how robust rating on the most desirable option in relationship with the increase (to right pages) or with the decrease (on left pages) in the assigned weight. Tags have the following meanings:

- Empty field: None changes in the cumulative weight would not change most desirable option.
- Red color: Cumulative weight should be changed for 5 percent points or less to change the most desirable option.
- Yellow color: Cumulative weight should be changed for 5 to 15 points to change the most desirable option.
- Green color: Cumulative weight should be changed for more than 15 points to change the most desirable option

In the case that the increase or decrease of the criteria weight led to the change of the most desirable options, the new most desirable option is displayed next to colored fields.

Charts with green or empty fields show that the results of concrete ratings are robust, since even not significant changes in points or weights would not change the most desirable option in a relevant category.

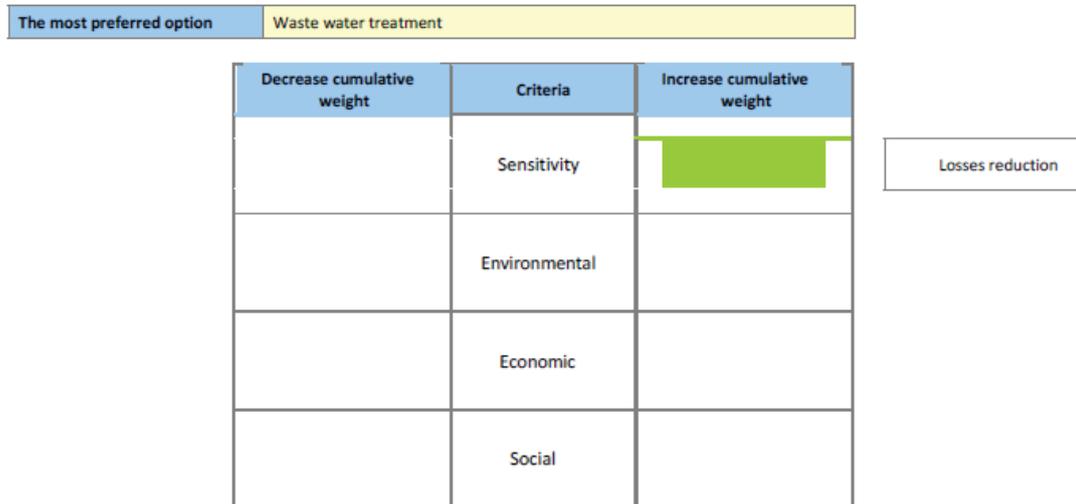


Figure 4. Chart with sensitivity analysis

Interpretation: From the chart above it can be seen that with the weight increase for 15 points for the sensitivity criteria, the reduction of losses will become the most preferred option. For other criteria, any change in the weight score will not lead to the change of the most preferred option. According to TNA assess MCDA (Multi-criteria decision analyses) guidelines, the decision that the waste water treatment is the most preferred option can be considered as robust, having in mind that even significant decrease/increase in the assigned weight would not change the results of prioritization. This is illustrated with green color or empty fields for each criterion on the chart above.

Conclusions

Experiences with applying backcasting in the process of developing a sustainable development scenario using the TNA Handbook and other available tools can be summarized in the following way:

- Backcasting and TNA methodology are a solid framework for systematic implementation of processes with a clear link between different steps in the process;
- Regarding the contribution to overall benefits of prioritized technologies, the waste water treatment has been calculated as the optimal technology aiming to achieve sustainable development;
- In working conditions with a broad spectrum of social actors, the methodology proposed by the TNA Handbook is not always easy to follow;
- The application of the TNA methodology in B&H has made it difficult to obscure the uncertainties and lack of

information that were particularly expressed in the sub-sector for mitigation, which made it impossible to quantify certain elements, and made the evaluation of benefits less accurate;

- The introduction of multi-criteria decision analysis (MCDA) in the process of evaluation of technologies gave a new quality to the overall process and offered a possible model for further consideration of sustainable development options of the country;
- It is proven that backcasting and TNA methodology can be efficiently used for the selection of technologies in the water management sector aiming to provide adequate information and analyses to decision makers;
- The tools and sources of information recommended by the Manual (such as the ClimateTechWiki database and the TNAssess software) have facilitated the process, especially in terms of emission reduction technologies; at the same time, the need to improve information and technical solutions to support the process has been identified;
- A flexible approach and adaptation of individual guidelines from the Manual to local conditions, process participants and the available time and information is required.

The realization of the development, climate and EU integration goals is possible if politics that favor emission and energy intensive projects and solutions will be modified and support redirects on new technologies that contribute to achieving objectives of sustainable development and enhance total benefits.

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Izvod

SELEKCIJA TEHNOLOGIJA U SEKTORU UPRAVLJANJA VODAMA U BOSNI I HERCEGOVINI U CILJU SMANJENJA GHG EMISIJA PRIMJENOM BACKCASTINGA PRISTUPA I PROCJENE TEHNOLOŠKIH POTREBA

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U Bosni i Hercegovini (BiH), klimatske promjene se sve više smatraju pitanjem od ključnog strateškog značaja, naročito od strane domaćih vlasti i akademske zajednice. Vizija razvoja države je da do 2025. godine BiH bude održiva i napredna 'zelena ekonomija'. Provođenje mjera smanjenja emisija gasova staklene bašte je zaista prava prilika i šansa da se, uz međunarodnu stručnu i finansijsku pomoć, pokrene tehnološka tranzicija. U BiH, kroz konsultativne aktivnosti je identifikovano sedam prioriternih sektora za prilagođavanje klimatskim promjenama: poljoprivreda, biodiverzitet i osjetljivi ekosistemi, energija (hidroenergija), šumarstvo, zdravlje ljudi, turizam, vodni resursi/vodoprivreda. Vodoprivreda i poljoprivreda se smatraju glavnim prioritetima koji, u manjoj ili većoj mjeri, utiču na ostale sektore. "Backcasting" pristup, imajući u vidu njegov opisni karakter i osobinu rješavanja problema u samom začetku, mnogo pogodniji je za rješavanje dugoročnih problema i nuđenje dugoročnih održivih rješenja. Cilj ovog rada je u sektoru upravljanja vodama primjenom backcasting pristupa identifikuje optimalne tehnologije koje se mogu primijeniti u BiH i njihovom analizom kroz TNA assess proces, ocijeni njihovu prihvatljivost i mogućnosti njihove upotrebe u BiH.

Ključne reči: Backcasting, upravljanje vodama, ocjena tehnologija