

# ***Best Practices Guide on Adaptation to Climate Change for Vulnerable Sector Ecosystems***

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## Best Practices Guide on Adaptation to Climate Change for Vulnerable Sectors Ecosystems

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**ABBREVIATIONS**

MMAP	Ministry of Environment, Water and Forests
APM SB	Environmental Protection Agency Sibiu
KS	The Norwegian Association of Local and Regional Authorities
ULBS	Lucian Blaga University Sibiu
ANM	NATIONAL METEOROLOGICAL ADMINISTRATION

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## Introduction

This document was produced within the "Calea Verde spre Dezvoltare Durabilă – Greenway to Sustainable Development", financed by funds provided by Iceland, Liechtenstein and Norway through the European Economic Area Financial Mechanism 2009-2014 EEA, on the RO07 adaptation to climate change. The project promoter is the Environmental Protection Agency Sibiu and the following partners: the Norwegian Association of Local and Regional Authorities - KS, National Meteorological Administration, Municipality of Sibiu, Brasov City Hall, Tg. Mures City Hall and "Lucian Blaga" University of Sibiu. The project was carried out between January 2015 and October 2016. The overall objective of the project is to reduce human and ecosystem vulnerability to climate change and aims to develop a set of best practices on adaptation to climate change.

In this project, among other activities, there were created the Strategies and action plans on the adaptation to climate change in three municipalities in Romania: Sibiu, Brasov and Tg. Mures. Also, there were selected four important sectors of priority interest: transport, energy, infrastructure / construction / urban planning and ecosystems. The sectors were selected based on the Local Action Plans and Development Strategies in every county and are considered to have the greatest impact on people's lives, given that people use ways and means of transport, depend on energy and ecosystem and live in buildings.

This document is part of a series of guidelines documents created during the the project:

- Guidelines for the preparation of municipal development strategies for climate change adaptation
- Best practices guidelines on adaptation to climate change in the vulnerable sector Energy
- Best practices guidelines on adaptation to climate change in the vulnerable sector Transport
- Best practices guidelines on adaptation to climate change in the vulnerable sector infrastructure / construction / urban planning
- Best practices guidelines on adaptation to climate change in the vulnerable sector Ecosystems

The guide aims to present some methodological aspects, especially examples of best practices in the Ecosystems sector, referring to already drafted documents: the Strategies and Plans of Action on adaptation to climate change in the three municipalities and the guidelines for the preparation of developing strategies for climate change adaptation. This document is designed primarily for local governments, but also for other relevant actors in the Ecosystems sector at local or national level, including citizens.

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## 1. Summary of the methodology proposed in the guidelines

The methodology proposed in the guidelines closely follows the methodology proposed in the general guidelines for the preparation of municipal development strategies on adaptation to climate change, and it provides, in addition to common elements, specific tools for the Ecosystems sector.

The same as in the general guidelines, there are three main phases in developing a strategy for adaptation to climate change in the Ecosystems sector:

- ✓ **The initiation phase** or preparing the ground for drafting the document, which is designed for building the team that will manage the process, identifying the stakeholders and planning
- ✓ **The strategy and action plan drafting phase**, aimed at analyzing the main risks and vulnerabilities in the Ecosystems sector, setting goals and measures in this sector, defining, evaluating and selecting alternatives and making the Action Plan for the Ecosystems sector
- ✓ **The implementation phase** aimed at establishing the implementation and communication mechanism, as well as identifying the monitoring and evaluation indicators and the framework in which these activities will take place

## 2. Detailed steps taken in the process

### 2.1 Initiation phase

As mentioned above, this first phase is dedicated to creating the necessary framework for developing and implementing the strategy and action plan on adaptation to climate change in the vulnerable sector Ecosystems.

In the case of this vulnerable sector, the initiator may be the local public administration that can ensure the coordination and integration of knowledge and interests of the various actors in the Ecosystems sector and the involvement of all stakeholders at the local level. Therefore, at the administration level, a coordination team can be formed by people with competences and skills in the planning field (executive coordinator), the climate change and Ecosystems (sector experts), the financial and legal fields (support experts). If the locality already has strategies that target the Ecosystems sector (eg. integrated urban development strategy, socio-economic strategy etc.), we recommend the involvement of the same people. The departments / services / offices that may give the coordination team members are: strategy / development programs / European funds, environmental protection, transport / technical / public utilities, urban / regional planning / surveying, chief architect, economic, legal.

During the development of a strategy for adaptation to climate change in the Ecosystems sector, the representatives of relevant stakeholders (see proposal of partnership structures in the general Guidelines) should be involved as partners.

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The working group and the local advisory committee can include: the environmental protection agency, administrators / custodians of the protected natural areas, microenterprises and SMEs operating in the environment field, environmental NGOs, research and education institutions, and financial and credit institutions. The advisory committee can extend the list of stakeholders with actors from higher territorial levels such as: Ministry of Environment, Water and Forests, the National Agency of Meteorology, Ministry of Energy, Ministry of Education and Scientific Research, MFE, MDRAP, but also the general public. After identifying the stakeholders and the establishment of partnership structures, the activities of the drafting process will be mutually agreed, mentioning also the officers, deadlines and deliverables, using the Gantt chart tool.

## 2.2 Preparation phase

### 2.2.1 Analysis of the existing situation in the Ecosystems sector

The first step in this phase presents the existing situation in the Ecosystems sector, as well as the weather events that have affected the sector.

Example of indicators that can be collected and analyzed at this stage and the sources of information

Indicators	Sources of information
<ul style="list-style-type: none"> <li>- The surface of protected areas</li> <li>- Condition and vulnerabilities of habitats and ecosystems</li> <li>- Management of protected areas</li> </ul>	<ul style="list-style-type: none"> <li>- <i>Annual Report on the Environmental Conditions, APM</i></li> <li>- <i>Statistics and information provided by the management structures / custodians of protected areas</i></li> </ul>

After collecting and analyzing the data on the Ecosystems sector, we can draw conclusions on how this sector is or may be affected by climate change in the future, thus identifying the main challenges and assessing the risks and vulnerabilities of the sector.

#### Box 1. Challenges identified in the Biodiversity sector Strategy in the National Strategy of Romania on Climate Change 2013-2020

Biological diversity faces today one of the most complex phenomena: global warming.

The evolution of ecosystems can be strongly affected by climate change with a direct impact on them. Indirectly, the relationship between species can be affected, leading thus to new terms of reference in the ecosystem that is being created, especially related to the direct correlation between species and abiotic factors (temperature, humidity, moisture conditions, pH, CO<sub>2</sub> concentration, concentration of other gases, soil texture, etc.).

The impact of climate change on a territory involves the analysis of the impact on the ecosystems in that territory and the relationships between them, and this impact overlaps with the pressures already exerted on the habitat destruction and environmental pollution.

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Disruption of the environment has a powerful direct effect on the evolution of living beings, initially on their ability to adapt, and then on their ability to survive. It is likely that they act in extreme cases as an extinction factor to certain species from the food chains, with drastic consequences for the local biodiversity and an overall impact.

The effects of climate change can generate even the extinction of certain species that are represented by a single population or by very few populations, which live in ecological niches that are extremely narrow, on one hand, but also extremely vulnerable to the effects, on the other hand.

Extremely serious consequences occur not only on the biodiversity conservation, but indirectly on the survival capacity of the human civilization; it is known that biological diversity products and services underpin the survival of this civilization. Human civilization is part of the global ecological systems and the loss of their functional balance will affect directly the development of human civilization.

The project included such an analysis of the Ecosystems sector in the Municipality of Brasov, and the main risks, vulnerabilities and opportunities are presented below:

<b>Risks/Vulnerabilities</b>	<b>Opportunities/ Actions</b>
<ul style="list-style-type: none"> <li>- Some of the natural areas of particular value does not have the status of protected area</li> <li>- Lack of demarcation of observation areas and marked trails in protected areas</li> <li>- Lack of green bridges and passages for animals</li> <li>- Impairment of flower and fauna species that are not properly protected and preserved in situ and are subject to extreme weather events</li> <li>- Pollution / destruction of wetlands that are habitats for species of seabirds</li> <li>- The proliferation of invasive species</li> <li>- Changing the behavior of wildlife feeding and their penetration in urban areas</li> </ul>	<ul style="list-style-type: none"> <li>- The use of forests, including those with the status of protected area, for the purpose of spending time outdoors, especially in warm weather (in strict compliance with industry regulations)</li> <li>- Expansion of protected natural areas</li> <li>- Develop and implement management plans for the protected natural areas</li> <li>- Appropriate development of the watercourses meadows, for leisure activities and for their ecological reconstruction</li> </ul>

### 2.2.2 Assessing the risks of the Ecosystems sector

The following phase analyses the risks and prioritize them, based on the results obtained from the analysis, by estimating the impact (the weight of the affected target group – inhabitants, companies) of climate change on each risk and by considering the probability that a certain change might occur, using a scale from 1 to 5 and building a matrix (where 1 is a very low impact-probability, and 5 a very high impact-probability). After filling out the matrix, we obtain the points for each identified risk, and the score is calculated as a product between Impact\*Probability. A score that exceeds 15 points show a very high risk, between 8 and 12 points there is a high risk, between 3 and 6 points we have an average risk, and below 2 points, there is a low risk.

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In the case of Brasov Municipality, the risks identified in the matrix for the Biodiversity sector is as follows:

Hazard	Vulnerabilities	Risks	Effects	Probability	Impact	Total score
<b>Drought</b>	Reduced funding and staff for monitoring	Decreasing water resources	Endanger species	1	2	2
	Lacking funds for the implementation of the management plan	Vegetation fires	Endanger species	3	1	3
	Extreme sports	Migration of species in unprotected areas	Danger to conservation / disappearance	4	3	12
<b>Heat</b>	Extreme sports; uncontrolled tourism	Lifecycle of animals (bears, wild boar) damaged	Animal behavior change; damage	4	2	8
<b>Excess rainfall</b>		The emergence of invasive species (mosquitoes, slugs, snails)	Damage to local species + health	4	4	16

### 2.2.3 Developing the SWOT analysis and defining alternatives

The third stage in drafting the document for the adaptation to climate change is the construction of the SWOT matrix for the Ecosystems sector, i.e. identifying the internal and external factors that may be desirable or undesirable.

To make the transition to defining alternatives, in the case of pilot municipalities we used the SWOT analysis on chains, linking the threats and opportunities to the weaknesses and strengths identified for the analyzed sector and the fishbone diagrams (for details, see the overall Guidelines).

The SWOT analysis on chains for Brasov Municipality, Biodiversity sector:

<b>Identified risk</b>	<b>Animal behavioral changes in the city area</b>	
<b>Possible impact</b>	Negative impact on residents and tourists who come in contact with these animals	
<b>Weaknesses of the city</b>	<b>Natural threat</b>	<b>Strengths of the city</b>

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Expansion of the built up areas around the natural habitats of these species	<b>Rising temperatures in winter</b> <i>People / objects affected:</i> bears <i>Mechanism:</i> due to the increased temperatures in winter, the bears do not hibernate => they seek food near town	
The existence of tourism (especially of the uncontrolled - ex. motocross, ATV) near or within the habitat of these species		
Lack of information to residents and tourists regarding the interaction with these animals		
<b>Identified risk</b>	<b>Animals migrating outside protected areas</b>	
<b>Possible impact</b>	Endangering some protected species	
<b>Weaknesses of the city</b>	<b>Natural threat</b>	<b>Strengths of the city</b>
Lack of passages	<b>Drought (shortage of rainfall during the summer, in the context of high temperatures)</b> <i>People / objects affected:</i> frogs <i>Mechanism:</i> the drought reduces the water areas and the frogs are forced to move in search for a new habitat, becoming vulnerable	Natura 2000 Site with the possibility of funding certain interventions
Deficient mentalities		
The borders of Natura 2000 Sites are arbitrarily set		

<b>Identified risk</b>	<b>The emergence and development of invasive species</b>	
<b>Possible impact</b>	Imbalance of local habitats	
<b>Weaknesses of the city</b>	<b>Natural threat</b>	<b>Strengths of the city</b>
The lack of safeguards against invasive species	<b>Changes in annual temperatures</b> <i>People / objects affected:</i> indigenous species <i>Mechanism:</i> invasive species create competition against native species that are less adapted to climate change	
The lack of protection mechanisms for indigenous species		
<b>Identified risk</b>	<b>Destruction of vegetation</b>	
<b>Possible impact</b>	Damage of local habitats	
<b>Weaknesses of the city</b>	<b>Natural threat</b>	<b>Strengths of the city</b>
Significant pine tree weight in the total number of trees	<b>Drought (shortage of rainfall in the context of high temperatures in the summer)</b> <i>People / objects affected:</i> Pine trees	The existence of the nursery allows the substitution of affected trees

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	<i>Mechanism: droughts dries the trees</i>	
Recreational activities (especially uncontrolled - ex. barbecues) that create ignition sources near the forest	<b>Drought (shortage of rainfall in the context of high temperatures in the summer)</b> <i>People / objects affected: trees</i> <i>Mechanism: drought dries the trees, make them burn easily</i>	
Illegal exploitation of forest covered by arson		
Cleaning agricultural lands in nearby rural areas using fires		
Significant weight of old trees that do not face violent storms	<b>Violent storms</b> <i>People / objects affected: old trees</i> <i>Mechanism: storm uproots or break trees</i>	
Natura 2000 Site does not allow any type of intervention		
<b>Identified opportunity</b>	<b>Changes in the animal behavior in the city area</b>	
<b>Possible impact</b>	Positive impact on the reputation and attractiveness of the city as a tourist destination	
<b>Weaknesses of the city</b>	<b>Natural threat</b>	<b>Strengths of the city</b>
	<b>Rising temperatures in winter</b> <i>People / objects affected: bears</i> <i>Mechanism: due to the increased temperatures in winter, the bears do not hibernate =&gt; they seek food near town</i>	Intensive media exposure

#### 2.2.4 Setting the goals and measures related to the Ecosystems sector

Starting from the risks identified and selected as priorities, according to their hierarchy in earlier stages, we will define the objectives of the Ecosystems sector. These objectives should be SMART and will contain an action verb (eg. reduction / increase) and a noun (eg. transport / waiting time). These goals reflect the long-term impact of the strategy on the sector.

**Box 2. Objectives of the Biodiversity sector, according to the National Action Plan on Climate Change 2016-2020:**

Assessment of vulnerability of natural habitats and protected species of flora and fauna based on the monitoring system of the conservation status

Maintain and increase the resilience of the ecosystem

Increasing the capacity of biodiversity to adapt to climate change by promoting the

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adaptive management

Evaluation of the services provided by the ecosystems and implementing the ecosystem approach in decision-making process

Develop the knowledge and understanding of the role and contribution of biodiversity in adapting to climate change

Moreover, starting from the causes identified by the problem tree and the fishbone diagram, we will define the measures that detail the results to be obtained following the implementation of the strategy.

In the case of Brasov Municipality strategy on the adaptation to climate change for the Biodiversity sector, an overall objective was defined, together with two specific goals and four steps, as follows:

Overall objective	Specific objectives	Measures
<b>Reducing the area of ecosystems affected by climate change at least by 10% before 2020 and by 30% before 2050</b>	1. Preventing the damages to the life cycle of plants and animals during periods of extreme weather	1.1 Strengthening the institutional capacity of the custodians of protected areas
		1.2 Studies to evaluate the vulnerability of various ecosystems and species to climate change
		1.3 Forest management adapted to the area and to the climate change
	2. Preventing the appearance of invasive species in periods of excessive rain or heat	2.1 Removing invasive species

### 2.2.5 Evaluation and selection of alternatives (prioritization of measures in the Ecosystems sector)

Before evaluating and selecting the alternatives, we have to consider several decisions on the various intervention scenarios that can be addressed. We present below several types of scenarios, among which we will choose the most appropriate one during the discussions with the stakeholders.

Possible scenarios:

- ✓ Interventions by the public authorities / institutions
- ✓ Interventions by the citizens /civil society
- ✓ Interventions by the business sector
- ✓ **Mixed interventions** – the most complex, given the interventions undertaken by all categories of relevant actors in the city, thus ensuring their correlation and integration, and of course, a greater impact on the territory and the sector concerned.

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Options for approaching the adaptation:

- ✓ *Non-structural "soft" approaches* - designing and implementing policies and procedures, land use control, information dissemination, and economic incentives to reduce and prevent the vulnerability to disasters. (Human systems management)
- ✓ *Structural "green" approaches* - contribute to an increased resilience of ecosystems, aiming at the same time to halting the loss of biodiversity and the degradation of ecosystems and restoring the water cycle, using functions and services provided by ecosystems to achieve adaptation solutions that are more cost-effective and sometimes more feasible than relying solely on the grey infrastructure
- ✓ *"Grey" infrastructure approaches (hard projects)* - physical intervention (using engineering services) to create constructions and infrastructure that are essential for the socio-economic well-being of the society, making it more resilient to extreme events

We can have the following adaptation options:

- ✓ *No-regrets* – adaptation measures that worth being adopted (provide real social and economic benefits) regardless of future climate change. It includes measures which are justified (in terms of profitability) in the present climate conditions, and are justified for the future, if their adoption is consistent with the risks associated with the forecasted changes. They are suitable in the short term because there is a higher probability of being implemented (provide obvious and immediate benefits) and may provide the necessary experience for conducting future assessments of climate risks and adaptation measures: Actions aimed at strengthening the capacity of adaptation as part of a global adaptation strategy; Avoiding construction works in high-risk areas (eg. Floodplains); reducing the water supply network loss; Design / construction of properties and buildings to minimize the overheating in summer months; Reducing the consequences of floods by using waterproof materials (floors, walls); The introduction of multi-seasonal leisure facilities
- ✓ *Low-regrets (or limited regrets)* - adaptation measures for which the associated costs are relatively low and the benefits can be relatively high: Buildings with adjacent spaces to allow future changes (e.g. ventilation, drainage), consistent with the expected changes in temperature and precipitation; Restricting the type and degree of development in flood-prone areas; Promoting the creation and preservation of areas (roadsides, farmland, green areas, roofs) to support the biodiversity
- ✓ *Win-Win* - adaptation measures that lead to the desired result in terms of minimizing climate risks or potential exploitation opportunities, as well as other social, environmental or economic benefits. Win-win options are often associated with those measures or activities addressing the climate change impact, but also contribute to their mitigation or other social and environmental objectives. These types of measures include the primary ones taken for reasons other than climate risks, but also ensure the desired benefits of adaptation: flood management which helps the objectives of biodiversity support and

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habitat conservation; Improving the response and emergency planning capacity to deal with risks (including the climate-related ones); Improving the cooling capacity of buildings by increasing the solar shading level or adoption of less intensive cooling strategies in terms of energy; Green roofs and walls that have multiple benefits in terms of reducing the temperature of the building, rainwater drainage, extended green areas, and reducing the energy use for both heating and cooling

- ✓ *Flexible and adjustable management* – implementation of progressive adaptation options, and not taking one-time adaptation measures widely, thus allowing the avoidance of mistakes and adaptation to changes that occur over time in terms of knowledge, experience, technologies (eg. postponing the adoption of a measure / set of adaptation measures, provided that this decision is accompanied by a commitment to continue the adjustment, along with the monitoring and evaluation of risk development). Such a decision of deferral is taken when the climate risks are below a certain threshold or when resilience (regulations, institutional circumstances) is insufficient to allow such actions be initiated: Postponing the implementation of specific measures to adapt, while exploring other options and working with the appropriate administrative levels to achieve the necessary standards and regulations; Progressive development and investment in recreation consistent with the forecasted climate changes (eg. progressive investments in the development and promotion of multi-seasonal leisure activities).

The following criteria may be considered for prioritizing the measures whose achievement is scored with one point:

- ✓ C1. Relevance to large-scale strategies / complementary with other strategies
- ✓ C2. Several sectors targeted
- ✓ C3. Several risks addressed
- ✓ C4. Emergency (score points above 15 – high risk)
- ✓ C5. Implementation by the local government as the main lead
- ✓ C6. Impact on all three fields: economic, social, environmental
- ✓ C7. External financing options
- ✓ C8. Availability of resources for implementation (human resources, knowledge)
- ✓ C9. Socially accepted
- ✓ C10. The required legal framework exists

The example below presents the risk prioritization matrix for the Biodiversity sector in Brașov Municipality:

Proposed measure	SCORE POINTS										
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	TOTAL
<b>Strengthening the institutional capacity of protected area custodians</b>	1	1	1	1	0	1	1	1	1	1	9
<b>Assessment studies on various ecosystems and</b>	1	1	1	0	1	1	1	1	1	1	9

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<b>species' vulnerability to climate change effects</b>											
<b>Eradicating invasive species</b>	1	1	1	1	1	1	0	1	1	1	9
<b>Local forest management adapted to climate change</b>	1	1	1	1	1	1	0	1	1	1	9

### 2.2.6 Drafting the action plan

This stage identifies the actions necessary to achieve the objectives set in the strategy, while providing the information necessary for implementing the climate change adaptation strategy in the Ecosystem sector. There are several types of adaptation measures: information/educational/awareness actions, institutional action/institutional capacity building, investments, political / legislative actions. The data collected, together with the list of adaptation actions should be structured so that it can carry out a detailed plan showing concretely what should be done, by whom, by when and how to implement a successful adaptation strategy. This information will be presented in a table:

- ✓ measures / actions proposed,
- ✓ connection with the specific objectives of the Strategy,
- ✓ main leads and partners,
- ✓ proposed actions and necessary preparatory activities,
- ✓ expected results,
- ✓ deadlines
- ✓ estimated budget
- ✓ possible funding sources

The action plan below was drafted for the Biodiversity sector in Brașov City:

Proposed measure/action	Strategic Objective	Main lead / Partners	Brief presentation (proposed activities)	Expected result	Preparatory actions	Implementation deadline	Estimated budget	Funding source
<b>Strengthening the management capacity of protected area custodians</b>	Preventing damage to the life cycle of plants and animals during periods of extreme weather	Brașov Metropolitan Agency Local Forestry Authority Kronstadt RA Brașov	1. Training staff with responsibilities in the management of protected areas; 2. Allocation of funds by the UATs in the	No. persons trained: 6 No. of protected area management plans implemented		2016-2020	1.5 mil. Eur	Local budgets Other sources

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			Metropolitan Area for the management of protected areas	ented: 2				
<b>Assessment studies on various ecosystems and species' vulnerability to climate change</b>	Preventing damage to the life cycle of plants and animals during periods of extreme weather	Brașov Metropolitan Agency Local Forestry Authority Kronstadt RA Brașov  "Transilvania" University Research Institutes	1. Carrying out outsourced studies on ecosystems and species' vulnerability to climate change, in case of necessity; 2. Implementation of measures identified in these studies.	No. of studies implemented: 4		2016-2020	200 thousands Euro	Local budgets Other sources
<b>Eradication of invasive species</b>	Preventing the occurrence of invasive species during excess precipitation or heat periods	Brașov Metropolitan Agency DSP Brașov "Transilvania" University Research Institutes	1. Removal of allergy-causing plants.	No. of actions for invasive species eradication: 5	Local database	2016-2020	100 thousands Eur	Local budgets Other sources
<b>Tailored forest management adapted to climate change</b>	Preventing damage to the life cycle of plants and animals during periods of extreme weather	Brașov Metropolitan Agency Local Forestry Authority Kronstadt RA Brașov Faculty of Forestry within "Transilvania" University APM Brașov Research Institutes	1. Removal of fallen or infested trees; 2. Promotion of mixtures with mosaic patterns; 3. Reforestation with native species adapted to climate change.	Areas afforested with locally adapted species: 214 ha Areas with mixtures with mosaic patterns : 214 ha		2016-2020	200 thousands Eur	Local budgets Other sources

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Among potential funding sources for Ecosystem-related actions / projects, we mention: LIFE Programme, National Environment Fund, POIM 2014-2020, National Budget, Local budgets, POCA 2014-2020, POAT 2014-2020, HORIZON 2020 programme, national research programmes, SEE/INTERREG grants, private funds.

## 2.3. Implementation of the strategy / action plan

### 2.3.1 Establishing the implementation mechanism

The implementation of the strategy will be coordinated by the author of the Strategy on adaptation to climate change for the Ecosystem sector (coordination team within the City Hall), but this will be successful through the active involvement of all interested stakeholders, identified in the action plan as in charge with this.

For the successful implementation of the strategy, the following concrete actions should be carried out between 2016 and 2020 (at the monitoring stage in 2020, the City Hall and the proposed Monitoring Committee will review these actions in order to continue some of them by 2030, 2050, respectively):

- ✓ Local Council’s approval of the Strategy and Action Plan on adaptation to climate change in the Ecosystems vulnerable sector, by adopting decisions in this regard;
- ✓ Development, in collaboration with the relevant bodies (eg. OAR and RUR) and local stakeholders, and adoption by the Local Council of a regulation approving and implementing the local measures on adaptation to climate change, which become mandatory for all real estate developers until the next revision of PUG and RLU. If the process of reviewing the PUG and RLU will not be completed by that time, these measures will be included directly in the new versions of these urban planning documents;
- ✓ Correlation of the Strategy and Plan of Action on climate change adaptation of vulnerable ecosystems with all planning documents (urban, ecosystem-related) that already exist and / or will be further elaborated locally (eg. revision of the Regulation on the organization and functioning of public sanitation service in the sense of using de-icing solutions with less impact on the environment during periods of abundant snow and ice, in compliance with NTPA 002 and NTPA 001 regulations, with no negative effects onto the soil, vegetation and trees - recommendation made by the representatives of APM Sibiu);
- ✓ Dissemination of the Strategy and Action Plan on climate change adaptation of ecosystems vulnerable sector (in accordance with the proposed communication measures);
- ✓ Elaborarea Development of justifying / opportunity studies needed to implement the measures on adaptation to climate change in the Ecosystems sector proposed in the strategy and action plan (eg. Flood studies);
- ✓ Production of technical and economic documents related to the projects identified in the Action Plan;
- ✓ Identification, analysis and selection of the funding sources for the projects proposed for implementation;
- ✓ Identification of public and private partners to develop and implement projects;

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- ✓ Signing partnership agreements between the City Hall and the relevant actors at local, county and national levels for the development of the projects in the Action Plan;
- ✓ Identification and information of potential beneficiaries on the existing complementary funding sources, in order to increase the absorption of European funds;
- ✓ Annual budget planning by considering the resources needed to implement projects;
- ✓ Preparing the institutional and human resources for the successful implementation of the projects;
- ✓ Project implementation;
- ✓ Promotion of project results at national and international level (promotional materials, participation in international events, websites, etc.);
- ✓ Monitoring the progress of project implementation and the production of progress reports by the Monitoring Committee (City Hall, other public institutions with Ecosystem-related tasks, private companies, NGOs, universities etc.);
- ✓ Interim evaluation of the Strategy and Action Plan on adaptation to climate change in the Ecosystems sector;
- ✓ Assessment-based review of the Strategy and Action Plan on adaptation to climate change in the Ecosystems sector and corrective actions.

### 2.3.2 Communication and Dissemination Actions

In terms of the communication / dissemination of the strategy on Ecosystems' adaptation to climate change to the local stakeholders and the general public, following its approval by the Local Council, some concrete actions that could be envisaged for 2014-2020 are proposed below:

- Organizing a press conference and issuing a press release by the City Hall, on the City Council 's adoption of the Strategy and Action Plan on Ecosystems' adaptation to climate change;
- Promoting the Strategy and Action Plan on Ecosystems' adaptation to climate change in the virtual environment, through postings on the website and the Facebook page of the City Hall and the partner institutions involved in the development process;
- Organizing, under inter-institutional partnership, an annual international conference on the Ecosystem's adaptation to climate change, that brings together experts from academia and research, government, and practitioners from the public and private sectors active and interested in this field;
- Organizing professional training courses in the field of Ecosystem's adaptation to climate change addressing the education personnel, that will be later the vectors of communication with students;
- Developing promotional materials for the strategy and action plan on Ecosystem's adaptation to climate change, and a video presentation that will be promoted online, on websites and Facebook pages of the institutions involved.

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The video will also run at the premises of some institutions and in some public areas;

- Concluding partnership agreements with local opinion leaders (NGOs, representatives of the owners associations, family doctors and school head teachers, spiritual leaders, etc.) to carry out information, public awareness campaigns;
- Organization of competitions for ideas and concrete measures to adapt Ecosystems to climate change among different categories of local stakeholders (eg. students, retirees, housing associations, companies, etc.).

### 2.3.3 Monitoring & evaluation, review & improvement

This activity will identify a set of result and objective indicators to measure the progress in implementing the adaptation measures proposed in the action plan. The monitoring and evaluation clarify the aspects to be monitored and evaluated, considering the timetable for their implementation and helps to establish the tasks for carrying out these activities. The following aspects should be clarified through discussions with the stakeholders in the partnership structures: What needs to be monitored and evaluated, Time and frequency of monitoring, Who is responsible for the monitoring and evaluation, Provision of the resources and commitment of those involved in this process.

**Table 3. Result indicators proposed in the 2016-2020 Action Plan on Climate Change:**

National Assessment Program on Vulnerability of protected natural habitats and species to the climate change impact
Number of bodies responsible for assessing the vulnerability of protected natural habitats and species to the identified climate change effects
Structured network of volunteer observers of climate change effects on biodiversity and biodiversity changes
No. of methodologies / protocols produced to assess the vulnerability of protected natural habitats and species
No. of protected areas integrating the vulnerabilities of protected natural habitats and species
No. of strategies and action plans that integrate the adaptation to climate change (protected species and combating indigenous invasive species)
No. of plans / projects that take account of climate change impacts (environmental impact assessment)
No. of integrated management plans that take account of climate change impacts (biodiversity)
No. of plans that take account of climate change impacts (water resource management)
No. of trained decision-makers
No. of species whose conservation status has improved
Number of decision-making systems based on the collected monitoring data
Structure of management plans for protected natural habitats
Vulnerability assessment and adaptation strategy for SIC and APSA made
National strategy on domestic species control

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No. of managers/custodians applying the adaptive management principles
No. of rehabilitated ha or no. of habitats and species whose conservation has improved
No. of ha per habitat whose conservation has improved
No. of protected ha
No. of natural resources management systems based on the ecosystem approach
No. of universities that included the ecosystem approach in their curricula
No. of payment systems and natural solutions applied in business
No. of government entities included in intergovernmental platform for biodiversity and ecosystem services
Number of persons trained in the ecosystem approach for public authorities, natural resource managers, and managers/ custodians of protected natural areas
No. of protected areas ecosystem services have been assessed
No. of financed research studies
No. of technical and human capacities developed
No. of transfer of knowledge and exchange of experience cases
A permanent biodiversity center established

Monitoring activities will be carried out on the basis of the indicators proposed for this purpose. Thus, we can speak about at least two categories of indicators: result (short term) and objective (long term).

Result indicators:

- measure the progress of the actions and measures set
- indicate the results achieved at the end of each type of project
- are the main indicators used in the ongoing monitoring and evaluation of the Strategy and Action Plan

Objective indicators:

- measure the progress of the sectoral objectives set
- obtained after the completion of the strategic projects corresponding to each objective and used in the final evaluation of the Strategy and Action Plan implementation.

The indicators proposed for monitoring the implementation of the adaptation strategy on Biodiversity in Brașov City, are presented below:

Objective indicators (by sector)	Result indicators (by measure/project)
<b>Reducing the area of ecosystems damaged by climate change by minimum 10% by 2020, and 30% by 2050</b>	No. of trained people No. of protected area management plans implemented No. of research studies produced and implemented No. of invasive species eradication actions Areas afforested with locally adapted species Areas with mixtures with mosaic-patterns

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The monitoring of the Strategy and Action Plan implementation can be run according to the following timetable of activities:

- The monitoring the implementation of the strategy on Ecosystem adaptation to climate change, will be carried out in 2020, the year when the implementation of measures and actions provided in the strategy should end, be reviewed, in order to select the interventions proposed for 2030 or 2050 (the entire period covered by the vision). Basically, this monitoring action corresponds to a "stage" / interim strategy implementation assessment, given that it refers to three time horizons: short (2020), medium (2030) and long term (2050);
- The results of the proposed monitoring (2020) will be centralized in a monitoring report. The main purpose of the monitoring report is to highlight the status of the strategy and to propose recommendations for its effective implementation. It is recommended that the report has a simple structure, including an introduction (with information about the period covered by the monitoring report, the data sources used for assessing the progress in implementing the strategy, difficulties encountered), a section that describes the monitoring activities undertaken chronologically and synthetically, a chapter that provides the measures and actions that have been monitored, and recommendations to streamline the implementation of each measure and action, and a final section that provides a synthetic view of the overall report on the progress made in implementing the strategy for the period 2016-2020;
- The monitoring report will be discussed in the plenum of the City Council to review the progress in implementing the strategy on Ecosystems' adaptation to climate change and identify the recommendations for improving the implementation thereof;
- The City Hall, who will assume the strategic document by HCL, will have the task of documenting the values of the selected monitoring indicators indicators, based on secondary sources: statistical data provided by the National Institute of Statistics (eg. TEMPO Online database), own data, transport operators, other institutions etc. as well as from the Annual Implementation / Progress Reports of the Operational Programmes for 2014-2020, drawn up by the Management Authorities / Intermediary Organisms (based on SMIS data), given that some of the priority projects of strategy's portfolio are proposed for funding from the Operational Programmes;
- If the information made available by the existing sources is insufficient to reflect the progress of the strategy implementation, monitoring questionnaires may be applied at the organizations that implement projects relevant to the strategy (see the people in charge / partners in the action plan);
- To ensure the representation of the stakeholders at local level, the continuity of the planning process and the success of the monitoring, we recommend, as mentioned above, the setting up of a Monitoring Committee of the strategy, to carry out the interim monitoring activities (eg. yearly or every two years) and to provide direct support to the City Hall representatives (eg. documenting the indicators for monitoring, establishing measures to streamline the implementation, identifying new projects, partners, funding sources, etc.) in the monitoring process which will be implemented by 2020;

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### 3. Best practices of Ecosystem adaptation

Project title	Climate change adapted management of Koros-Maros National Park
<b>Brief presentation</b>	Koros-Maros National Park is located in south-eastern Hungary and was established in 1997 to protect birds. Located in the region containing the Koros river arms, it has a variety of habitats including unforested grasslands, wooded pastures and swamps, meadows and groves with a tremendous value.
<b>Challenges</b>	Changes in annual temperature and precipitation in Hungary. Forecasts indicate the occurrence of new threats in Koros-Maros National Park area. These changes will have various impacts on the park’s habitats and biodiversity, such as: dry steppes and marshes during periods of low rainfall, while heavy rains change their salinity, low precipitation affects the hydrophilic vegetation, reduced water levels in wetlands in summer threatens the composition of species, decreased groundwater may lead to the disappearance of wetlands and growth of weeds, water deficit may prevent regeneration of tree and shrub species.
<b>Solutions</b>	The water regime maintenance solves the water supply and excess water issues due to neglected works, thus avoiding too high water levels in spring or summer by directing the water through canals straight into ponds Protecting against invasive species by cutting or harvesting of exotic species, prohibiting fires, introduction of grazing sheep or cattle in some areas (including the selection of species and grazing time), avoiding over-grazing in wetlands, mowing, prohibition of exotic fish species in waters. Conservation and restoration of river habitats and their connection with other adjacent terrestrial habitats Monitoring the water quality in canals that represent water sources in drought years. The Area Management Plan adapted to climate change includes general recommendations and specific management strategies and measures, restrictions, obstacles, indicators and methods for involving stakeholders
<b>Stakeholder participation</b>	The coordinator was the National Park board The key stakeholders were the representatives of the local, regional and national nature conservation agencies, the regional water management authority, tourism associations and research institutes . The promotion of results and raise of awareness level included press releases and newspaper articles, workshops, and participation of target groups in fairs and exhibitions at the park information centers. The active involvement of stakeholders, including the

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	integration of their interests and needs in the management plans adapted to the climate change, increase the likelihood that the proposed adaptation and mitigation measures might be achieved
<b>Legal aspects</b>	Policy recommendations were made, which may be useful in national and European law, particularly the Water Framework Directive and Natura 2000 framework (Habitats Directive, Birds Directive)

<b>Project title</b>	<b>Habitat restoration and management in Ebro Delta coastal lagoons</b>
<b>Brief presentation</b>	Alfacada and Tancada coastal lagoons are located in ECRO Delta Natural Park. They are vulnerable to climate change, particularly the sea level rise and sediment deficit due to river regularization, leading to coastal erosion and compaction. Local management practices have also affected the natural habitats and species, causing reductions in wetlands and changes in salinity and water quality.
<b>Challenges</b>	Alfacada lagoon is vulnerable to climate change and sediment deficit, because the area nearby the river withdraws quickly. The saline marshes near Tancada lagoon were affected by intensive aquaculture and require major works to restore the protected area to its natural state and recover its connection with the Alfaca bay by removing dams
<b>Solutions</b>	The main adaptation measure for increasing the resilience to rising sea level, is to restore the hydrological connectivity between the lagoon and the sea, so that sediment inputs into lagoons grow during sea storms. Among the measures implemented to cope with rising sea levels and habitat degradation, we mention: improving the hydrological network of Alfaca lagoon by cleaning the canals crossing the lagoon and building a new direct channel which connects the lagoon with the river; improving the hydrological connections of salt marshes, which were separated and isolated by dams; naturalization of rice fields in the coastal lagoon and former aquaculture facilities in the salt marsh; creating small islands as nesting areas for seabirds; limiting the access to certain areas to reduce the impact of predators and humans; repopulation with the European pond turtle.
<b>Stakeholder participation</b>	The main institutional partners: Government of Cataluna and Spain and the city councils of both cities where the lagoons are located (Amposta and Sant Jaume d'Enveja). Other stakeholders have been informed and consulted through meetings, but did not participate actively
<b>Legal aspects</b>	The main supporting legislative framework was the Habitat Directive

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Project title	CALCHA – An integrated analysis system for forestfire protection
<b>Brief presentation</b>	Summers are warmer, drier and longer, and climate change forecasts suggest an increase in the frequency and severity of forest fires. One factor that increases the vulnerability is the inadequate hazard management planning. Recent fires have shown serious shortcomings in coordination, order issues, inadequate management and allocation of resources. Often, the information is not updated or inadequate, leading to inefficient decisions
<b>Challenges</b>	A major step in the hazard management is the preparation phase directly linked with reduced risk. The hazard assessment, good planning, appropriate management strategies and cooperation are vital elements upon which the CALCHAS project relied.
<b>Solutions</b>	Development and implementation of an efficient integrated analysis system for forestfire protection. It uses a forest fire simulation tool capable to estimate the evolution of the fire by using, as input data, the fire ignition risk, real-time meteorological data, vegetation in the area and spatial information. Weather stations were installed in the two pilot sites (Troodos, Cyprus and Grammos, Greece), which are more vulnerable to fire. This fire simulator is then used to forecast the fire development and support their management.
<b>Stakeholder participation</b>	Local authorities, like fire stations, civil protection, local communities and citizens were involved in the dissemination of results to handle the threats caused by forest fires
<b>Legal aspects</b>	-

Project title	Elimination of polders in the border region for flood and nature protection: Hedwige and Prosper Polders
<b>Brief presentation</b>	The project is part of the Belgian Sigma Plan (as an exception, it also covers the Netherlands): an integrated plan to strengthen the quay dams and walls, and open the floodplains to protect the land along the estuary of the Scheldt and the upstream basin against flood. The outer defensive walls of Hertogin-Hedwige and Prosper Polders will be removed, opening these areas to tides. The process involves moving dams inland. This will provide space for water during tides, reducing the risk of flooding and restoring a natural estuary area.
<b>Challenges</b>	The emergence of storms in the North Sea has increased substantially since the 50s, and the sea level is

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	<p>forecasted to rise further in the coming decades. These storms threaten the town of Antwerp (Belgium) mainly due to the narrowing of Scheldt estuary that generates high water levels. Opening the two polders will reduce the water level at Antwerp and upstream, and will enhance the safety of the urban and industrial areas.</p>
<b>Solutions</b>	<p>The new natural area and the increased flood protection will be achieved by moving the protective dams inside, and exposing the currently protected polders to tides. The new dams of 10.2 m height above the sea level built inside will provide flood protection for the lower inland surfaces.</p> <p>A natural area of 465 ha will develop on the territory of the two polders. To promote the creation of this natural area, a system of creeks has been dug in the polder. Related works such as filling in the drainage system and removal of other infrastructure related to drainage, road infrastructure and the existing vegetation, partially swamps, have also been made. Following these changes, natural processes will begin in more natural conditions. Swamps will contribute to the self-cleaning capacity of the estuary; in addition, wetlands are an important silica source for diatom algae as basic food sources. Creating a new natural inter-tidal area is expected to bring new leisure opportunities. The design includes the construction of a natural pavilion and eco-lodge and a number of trails for walking or biking, lookout points, information signs, benches and parking for visitors.</p>
<b>Stakeholder participation</b>	<p>Many owners of agricultural land, farmers and residents of the polders opposed this project</p>
<b>Legal aspects</b>	<p>Treaty between Flanders and the Dutch national government on the development of the Scheldt Estuary Development Plan. Habitats Directive and Natura 2000</p>

<b>Project title</b>	<p><b>Saltmarsh recreation by managed realignment, Hesketh Out Marsh, UK</b></p>
<b>Brief presentation</b>	<p>Hesketh Out Marsh is the biggest managed realignment project in the UK, and is one of the country's most important estuary habitats for birdlife. The original saltmarsh was isolated from the estuary in 1980 by the creation of an outer wall, and was used for growing crops. With the sea level rising, it was necessary to create stronger sea defences. By a process known as “managed realignment”, seawater has been let back in to flood the land, re-creating saltmarsh and providing space for nature. At the same time, the new saltmarsh</p>

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	acts as a buffer, soaking up some of the energy of the sea before it reaches the stronger, new sea defences.
<b>Challenges</b>	With the climate changing and the sea level rising, the Royal Society for the Protection of Birds and the Environment Agency recognised the need to plan for the future and create stronger sea defences against flooding
<b>Solutions</b>	Identifying a more natural way of dealing with coastal flooding, through what is called "managed realignment" – using land as a place to store floodwater. In the past, this land might have been drained for farming. But allowing floodwater back on to the land returns it to salt marsh or mudflats. These can then absorb the impacts of higher sea levels and increased storm surges resulting from climate change. The Royal Society for the Protection of Birds bought half of the land at Hesketh Out Marsh, to turn into a nature reserve. Since then, they have been working with the Environment Agency and other organisations to create salt marshes, creeks and lagoons. After first upgrading the original embankment inland, the Environment Agency then removed sections of an earlier privately built embankment. This allowed high tides back on to the nature reserve to re-create 168 hectares of salt marsh habitat.
<b>Stakeholder participation</b>	The initiators were the Royal Society for the Protection of Birds and the Environment Agency Lancaster City Council funded and developed the Action Plan to renew the rural area of Lancaster and other partner organisations
<b>Legal aspects</b>	Conservation Regulations, relating to the Special Protection Areas Town & Country Planning Regulations The Water Framework Directive The Shoreline Management Plan The Ribble Coast & Wetlands Regional Park initiative The Biodiversity Action Plans for saltmarsh and saline lagoons

## Conclusions and recommendations

The principles underlying the development of a good strategy for adaptation to climate change:

- ✓ involving the relevant stakeholders
- ✓ understanding the risks and barriers
- ✓ defining smart objectives and results and communicating them

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- ✓ managing the climate and non-climate risk in a balanced approach, integrating the adaptation measures into existing programs and policies (taking into account the context provided by the general development objectives)
- ✓ focusing on priority climate risk management actions, sector focus
- ✓ addressing the prioritized risks associated with current climate variability and extremes
- ✓ using a flexible management to cope with uncertainties
- ✓ recognizing the importance of no-regret / low-regret and win-win adaptation options in terms of cost effectiveness and multiple benefits
- ✓ ongoing review of the effectiveness of adaptation decisions by monitoring and re-evaluation of risk
- ✓ ongoing process, and the documents to be reviewed and updated to take into account the new developments in the field (science, research, technology)
- ✓ effective communication and awareness

We present below some specific conclusions and recommendations for the Ecosystems sector:

- ✓ we recommend measures that enable the conservation and enhancement of the ecosystem (habitats, ecological corridors, etc.), in line with the principles of adaptation to climate change, and monitor them carefully, especially in the context of the increasing anthropogenic pressures they face
- ✓ adaptation to climate change requires joint efforts of individuals, businesses, industries and authorities affected by the climate change impacts, which means that we must ensure the involvement of all relevant actors in both the drafting and implementation of the strategy and in its communication process
- ✓ among these actors, a major role is played by the administration and the parks custodians, which have detailed knowledge in the field and direct connections with landowners or those who use the land in the managed area, as they can point various vulnerabilities, risks and opportunities for the adaptation to climate change in the Ecosystems sector
- ✓ the relevant actors in the Ecosystem sector should integrate the awareness, management and adaptation to climate change in their planning process on the short and long term
- ✓ the Romanian National Strategy on Climate Change 2013-2020 specifies the following actions, as recommendations and adaptation measures to be taken:
  - creating a national system to monitor endangered species, developed with public and private support, through national programs and with the participation of civil society, as a result of research activities;
  - evaluation of the monitoring system, in order to determine the evolution of the climate change impact and to identify the opportunities to modify it;
  - extending the use of monitoring data by extrapolating the results obtained using mathematical simulation;
  - developing special management plans of natural habitats in order to prevent and limiting the degradation process of these habitats as a result of the climate change impact;

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- reducing the additional pressure that affects the vulnerable species;
- reducing the farming activities in the areas directly affected and implementing adequate measures to protect natural and semi-natural habitats present near agricultural areas, including the identification of compensatory measures necessary for the survival of the affected population;
- reducing the impact generated by industrial activities on the groundwater and air quality, by isolating them using green belts;
- expanding forested areas by rehabilitation of deserted areas and by creating other favorable areas;
- undertaking studies to assess the vulnerability of various ecosystems / species to climate change (restoring the meadows along rivers, flood plains and wetlands);
- (better) protection / creating new areas with natural resources;
- connecting the conservation areas in order to improve the options for migrating species - ecological corridors;
- using a nature oriented management;
- improving the ecological conditions of aquatic and littoral areas.

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For further details on the drafting and implementing methodology and the tools used, should also refer to the Guidelines for developing municipal strategies for climate change adaptation.

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The project develops between January 2015 – April 2017. The overall objective of this project is to reduce the vulnerability of humans and of the ecosystem to the climate change and envisages to create a best practices set on the adaptation to climate change.

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For the period 2009-2014, €1.79 billion has been set aside under the Grants. Norway contribution is approximately 97% of the total funds. The grants are available for NGOs, research and academic institutions and the public and private sector from 16 EU Member States, from Central and South Europe. There is a deep cooperation with the donor states entities and the activities can be implemented before 2016.

The key support fields are the environmental protection and climate change, research grants and scholarships, civil society, healthcare and children, gender equality, justice and cultural heritage.

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