Best Practices Guide on Adaptation to Climate Change for Vulnerable Sector Energy

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MINISTERUL MEDIULUI, APELOR ȘI PĂDURILOR

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Activity	Activity 2.2.1 Developing 5 guides on adaptation to climate change in Region 7 Center: 1 guide on the preparation of municipal development strategies, 4 guides for the selected vulnerable sectors: transport, energy, infrastructure/constructions/urban planning, ecosystems
Sub-Activity	2.2.1.2. Developing 4 best practices guides on adaptation to climate change for the vulnerable sectors: 'transport', 'energy', 'infrastructure/constructions/urban planning', 'ecosystems'
Reporting date	10.10.2016
Status	Final
Lead organization	SC AVENSA CONSULTING SRL
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Green Path towards Sustainable Development
"Project funded under the Financial Mechanism of the European Economic Area (EEA) 2009-2014" Contract nr. 95/08.01.2015

Title	Best Pactices Guide on Adaptation to Climate Change for the Vulnerable Sector Energy
Author	SC AVENSA CONSULTING SRL
Production date	10.05.2016
Date of the last revision	10.10.2016
Topic	Deliverable under service contract no. 34/14.10.2015
Status	☐ Draft ☒ Final
Published	December 2016
Type	Font Verdana
Description	Summary of the report: This document introduces the methodology and examples of best practices on climate change adaptation in the vulnerable sector Energy
Contributors	APM SIBIU, KS/ SC AVENSA CONSULTING SRL
Reviewed by	APM SIBIU / SC AVENSA CONSULTING SRL
Format	Doc
Source	Project Green Path towards Sustainable Development
Copyright	☐ Restricted ☒ Public
Identification	Best Pactices Guide on Adaptation to Climate Change for the Vulnerable Sector Energy
Language	RO/ENG
Link	SC AVENSA CONSULTING SRL
Duration	According to the assumed Gantt chart

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ACRONYMS

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

Version	Date	Author	Tasks
0.1	10.05.2016	SC AVENSA CONSULTING SRL	The first draft of the activity
0.2	16.07.2016	SC AVENSA CONSULTING SRL	Revision of the first draft
0.3	02.09.2016	SC AVENSA CONSULTING SRL	The second draft with revisions
0.4	05.09.2016	SC AVENSA CONSULTING SRL	The third draft with revisions
0.5	10.10.2016	SC AVENSA CONSULTING SRL	Final version

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Introduction

This document was produced within the project 'Green Path towards Sustainable Development', funded by a grant provided by Iceland, Liechtenstein and Norway under the Financial Mechanism of the European Economic Area (EEA) 2009-2014 – Adaptation to Climate Change. The promoter of the project is the the Environmental Protection Agency Sibiu and the the partners are the Norwegian Association of Local and Regional Authorities – KS, National Administration of Meteorology, Sibiu City Hall, Brasov City Hall, Tg. Mureș City Hall and "Lucian Blaga" University of Sibiu. The project was implemented in the period January 2015 – October 2016. The general objective of the project is to reduce human and ecosystem vulnerability to climate change and it aims at developing a set of best practices on adaptation to climate change.

Within this project, besides other activities, were developed Strategies and Action Plans on adaptation to climate change in three municipalities in Romania: Sibiu, Brașov and Tg. Mureș. Furthermore, four important and high priority sectors were identified: transport, energy, infrastructure/constructions/urban planning and ecosystems. These sectors were selected on the basis of the Local Action Plans and Development Strategies in each county and it is considered that they have the most significant impact on people's life given these inhabitants use means and routes of transport and they depend on energy and ecosystems and live in buildings.

This document is part of a series of guidelines developed within the project as it follows:

- Guide for developing municipal strategies for adaptation to climate change
- Best pactices guide on adaptation to climate change for the vulnerable sector Energy
- Best pactices guide on adaptation to climate change for the vulnerable sector Transport
- Best pactices guide on adaptation to climate change for the vulnerable sector Infrastructure / constructions / urban planning
- Best pactices guide on adaptation to climate change for the vulnerable sector Ecosystems

This guide aims at introducing a series of methodological aspects, especially examples of best practices in the sector Energy, referring to the documents that have been already developed: Strategies and Action Plans on adaptation to climate change in the three municipalities and Guidelines for developing municipal strategies for climate change adaptation. This document is intended primarily for local public administration and also for other stakeholders in the sector Energy at local and national level, including citizens.

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1. Overview of the methodology proposed in the guide

The methodology proposed in this guide observes closely the methodology proposed in the General guidelines for developing municipal strategies on adaptation to climate change, and it provides, in addition to common elements, details concerning specific instruments in the sector Energy.
As in the general guidelines, there are three main phases in developing a strategy for adaptation to climate change in the sector Energy:

- ✓ **Initiation Phase** or initial preparation for drafting the document that consists in building the team who will manage the process and in identifying the stakeholders and are planned the activities.
- ✓ **Preparation Phase** – developing the strategy and the action plan. This stage aims at analyzing the most serious risks and vulnerabilities in the sector Energy, setting the objectives and measures related to this sector, defining, evaluating and selecting alternatives and elaborating the Action Plan for the Sector Energy.
- ✓ **Implementation Phase** aims at establishing the implementation and communication mechanism, as well as identifying the monitoring and evaluation indicators and the framework for these activities.

2. Description of the steps taken in the process

2.1 Initiation Phase

As stated above, this first stage is aimed at establishing the necessary framework for the development and implementation of the strategy and the action plan on adaptation to climate change in the vulnerable sector Energy.
In the case of this vulnerable sector the promoter may be the local public administration that can ensure coordination and the integration of the knowledge and interests of the actors in the sector of Energy and the involvement of all stakeholders at local level. Therefore, at the level of the administration, can be built a coordination team consisting of persons with specialized knowledge and expertise in the field of planning (the executive coordinator), of climate change and energy (sectoral experts), in the financial and legal domains (non key experts). In case strategies for the sector Energy have been elaborated in the locality (e.g. integrated urban development strategy, socio-economic strategy, action plan for sustainable energy) it is recommended to involve the same persons. The departments/services/offices from which the members of the management team may come from are: stragegies/ development programs

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/European funds, technical/public utilities, environmental protection, urban/town and country planning/land register, chief architect, economic, legal.

During the development of a strategy for adaptation to climate change in the sector Energy representatives of the relevant stakeholders should be involved, as partners, taking into account the two components of this sector: energy suppliers and energy consumers (please see the proposal for partnerships in the General Guidelines). In the working group and the local advisory committee can be included: local electricity and district heating suppliers, regional operators in water supply and wastewater management, public sanitation companies, public transport companies, environmental protection agencies, representatives of industry, clusters and energy agencies, NGO's in the field of energy and environment, local homeowners' associations, research and education institutions and financial and banking and financial institutions. In the case of the advisory committee this list of stakeholders can be supplemented with actors from higher territorial levels such as: ANRE (Romanian Regulatory Authority for Energy), Ministry of Energy, MFE (Ministry of European Funds), MDRAP (Ministry of Regional Development and Public Administration) and the general public.

After identifying the stakeholders and establishing the partnership structures, will be established, by mutual agreement, the activities that will be undertaken in the process of development, mentioning the officers, deadlines and the expected results, the instrument that will be used being the GANTT chart.

2.2 Preparation phase

2.2.1 Analysis of the existing situation in the sector Energy

The first step in this stage aims at presenting the existing situation in the sector Energy (information that cen be considered concern the total housing stock and the structure of this stock, the energy efficiency rating, energy consumption in buildings), as well as weather events that have affected the sector.
Example of indicators that can be collected and analyzed in this stage and the information sources

Indicators	*Information sources*
- Energy (electricity, heating, cogeneration) demand and supply; the structure of production and consumption - Energy networks infrastructure - Energy consumption in public buildings - Energy consumption in residential buildings - Energy consumption in the economic sector - Energy consumption in the public lighting system - Energy consumption in the public transport system - The price of energy - Works to increase energy efficiency	- The 2011 Population and Housing Census, INS (National Insitute of Statistics) - Romanian Regulatory Authority for Energy - Statistical data and information provided by specialized operators - Action Plan for Sustainable Energy

After collecting and analyzing the data concerning the sector Energy,we can draw conclusions regarding the way this sector is or could be affected in the future by

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climate change, thus identifying the main challenges and assessing the sectoral risks and vulnerabilities.
For example, within the Romanian National Climate Change Strategy 2013-2020 were identified the following challenges in the sector of energy at the level of Romania:

- decline in the demand for electricity for heating in winter, as a result of global average temperature increase;
- increase in the consumption of electricity necessary for the operation of air conditioners and cooling appliances during hot weather;
- changes in the seasonal demand for electricity, which will be lower in winter and higher in summer;
- reduction of the hydroelectric power production due to decreasing water resources (the decrease in the water resources also affects the functioning of the cooling systems of nuclear power plants)

Box 1. Risks identified by the International Energy Agency in the energy sector caused by the impact of climate change
Extreme weather events (storms, forest fires, landslides, floods and extreme temperatures) - affect energy production and distribution infrastructure, cause outages and affect infrastructure that depends on the energy supply. The risk to energy infrastructure will grow as the frequency and intensity of certain types of extreme weather events increase.
Changes in water availability - will exacerbate existing challenges in energy production. Reduced water availability and a rising demand for water from a growing population will constrain hydropower, bioenergy (particularly biofuel production) and some solar power systems as well as the operation of thermal power plants (fossil fuel and nuclear), which require water for cooling. Water in excess – in the form of increased flooding, extreme rainfall and tempests – poses other challenges to the energy infrastructure.
Unusual seasonal temperatures - can change energy demand patterns. For example, higher summer temperatures increase electricity demands for cooling, and the corresponding higher peak loads may require additional generation capacity, while warmer winters will reduce heating energy demand.
Alternate freezing and thawing - may result in damage to pipelines and other energy infrastructures.
Rising sea levels - will affect coastal and off-shore energy infrastructure. The greatest concern is storm surge as more water is transported by winds, tides and waves. Greater storm surges and coastal erosion pose risks to existing and future infrastructure.

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An analysis of this type for the sector Energy was conducted under the project for the municipality of Tg. Mureș. The biggest risks and vulnerabilities are presented below:

Risks/Vulnerabilities	***Opportunities / actions***
- The rising of the costs of residential heating caused by the closing down of district heating systems and mounting natural gas-powered residential heating systems - High percentage of houses that have not been insulated (also generate CO2 emissions) and are built of materials that are not energy-efficient, covered with roofing frameworks. - The increase in the consumption of electricity and natural gas in public buildings and a low percentage of public buildings that have been been included in energy efficiency improvement programs. - A significant part of the electricity distribution and communications networks consists of overhead lines and this causes disruptions in the availability of electricity and communication services during some extreme weather events (e.g. tempests) - Disruptions in the supply or decrease of pressure of the natural gas transported through pipelines in winter - Increase in the costs of electricity consumed by the public lighting system due to its low energy efficiency - Increase in the price of energy in dry years caused by the decrease in the percentage of the hydropower at the expense of thermal energy (more costly)	- Re-establisment, rehabilitation and modernisation of the infrastructure of the district heating system, including production and heating distribution - Valorisation of renewable energy resources by developing solar and wind farms - Increasing efficiency of the energy consumption and reducing costs in supplying dwellings, public buildings, industrial facilities, public lighting, public transport - Rehabilitation and modernization of the natural gas distribution networks - Modernization of the electrivity distribution networks - Installing and building hydroelectric power plants - Extending the buried counduit systems to relocate overhead lines used in electricity supply and communications, etc.

2.2.2 Risk evaluation in the sector Energy

During the next phase, based on the results obtained, is conducted a risk evaluation and prioritization, by estimating the impact (the share within the target group affected – 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 designing a matrix (where 1 is low impact–probability and 5 is high–high probability). After having completed the matrix, is obtained the score for each identified risk as the product of multiplying Impact*Probability. A score above 15 points indicates a very high risk level, between 8 and 12 points the risk is high, between 3 and 6 points there is an average risk and below 2 points the risk is extremely low.

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In the case of the Muncipality of Tg. Mureș, the matrix for the risks identified in the sector Energy and telecommunications is presented below:

Hazard	Vulnerabilities	Risks	Effects	Probability	Impact	Total score
Rising temperatures	Unrehabilitated dwellings	Increase in the number of air conditioners	Increase in costs; Increase in energy consumption	5	2	10
Extreme temperatures (frost)	Increase in the number of residential heating systems	Gas pressure drop	Decrease in the quality of life	1	2	2
Climate change	Old network sections; Low power consumption	Low profitability on certain sections/networks	Increase in prices; Financial difficulties for those who cannot afford	5	2	10
Drought	Decrease in the hydroelectric power production	Change of the energy basket (increase in price)	Affecting industrial and residential consumers	5	2	10
Tempests / Freezing rain	High percentage of overhead distribution lines; High dependence on energy	Power lines collapse	Power outages; Public lighting outages	5	3	15

2.2.3 Conducting SWOT analysis and defining alternatives

The third stage in dfrafting the document for the adaptation to climate change consists in creating a SWOT matrix for the sector Energy, namely identifying external and internal factors which may be desirable or undesirable. In order to make the transition to defining alternatives, in the case of pilot municipalities was used the value chain SWOT analysis, connecting the threats and the opportunities to strengths and weaknesses identified for the analysed sector and the fishbone diagram (for further details please see the General Guide).
The value chain SWOT analysis for the Municipality of Tg. Mureș for the sector Energy and Telecommunications.

Identified risk	**Increase in the number of air conditioners**	
Potential impact	Overloading the electricity distribution network, power outages	
Weaknesses of the city	**Natural threat**	**Strenghts of the city**
Unrehabilitated apartments	**Rising temperatures +**	

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and public buildings	**intense heat** *Affected persons / objects*: electricity distribution networks *Action mechanism*: high temperatures lead to an increase in electricity consumption (e.g. for air conditioners) thus casing peak loads in the distribution network	
Lack of information concerning the effects of air conditioners for citizens		
Dependence on urban confort		
Affordability and availability of air conditioners		
Old electricity distribution networks with low capacity at peak loads		
Identified risk	**Lower gas pressure**	
Potential impact	Frozen gas pipes, damage, decrease in the quality of life	
Weaknesses of the city	**Natural threat**	**Strenghts of the city**
Obsolete distribution network	**Extremely low temperatures** *Affected persons / objects*: Inhabitants and businesses in the area *Action mechanism*: low temperatures increase gas consumption in heating systems which leads to lower pressure – and, in extreme situations, to interruptions of malfunctioning of the heating systems	The gas main is sized to sustain the operation at full capacity of Azomureș Chemical Plant, gas supply being thus available for Tîrgu Mureș
A significant share of the population has residential gas-powered heating systems		
Identified risk	**Low profitability of electricity and gas distribution in certain areas and of the extension of networks to some areas**	
Potential impact	Some consumers will be disconnected / will not be connected	
Weaknesses of the city	**Natural threat**	**Strenghts of the city**
Gas and electricity theft	**Higher temperatures in winter** Affected persons / objects: utilities companies and citizens *Action mechanism*: the increase of temperatures in winter lowers the providers' profitability; cumulated with energy theft and failure to pay invoices, it can lead to drastic measures (increases in the price, disconnection, stopping the expansion of networks, etc.)	
Poverty in certain areas		
Identified risk	**Increase in the prices for electricity**	
Potential impact	Higher costs for businesses	

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Weaknesses of the city	Natural threat	Strenghts of the city
The complete dependence on the national energy system	**Drought at national level** *Affected persons / objects:* businesses in the municipality *Action mechanism*: drought at national level reduces the production of cheap energy (hydro) and increases the price per kWh	
Identified risk	**Cable and pole collapse**	
Potential impact	Power outages, damage to home and industrial electric equipment, interruptions of public lighting, safety issues in transport	
Weaknesses of the city	**Natural threat**	**Strenghts of the city**
50% of the network of the network consists of overhead lines	**Tempests + freezing rain** *Affected persons / objects*: electricity distribution networks *Action mechanism*: wind can cause the break of cables and poles	New cables should be installed in underground counduits
Dependence on consumption and high sensitivity to electricity supply		Prompt troubleshooting as compared to other localities
Troubleshooting takes too much time - max. 72 h		Obligation to install cables in underground conduits
Identified opportunity	**Increase in the renewable energy potential (solar power)**	
Potential impact	Increase in local production of solar energy	
Weaknesses of the city	**Natural opportunity**	**Strenghts of the city**
This destination was not taken into account for the necessary land at the time of the development of the authorization documentation	**Increasing numbers of sunny days** *Advantaged persons:* solar power producers *Action mechanism:* increasing numbers of sunny days increases the potential renewable power production	The existence of spaces available for solar farms (Azomureș pit, roofs, etc.)

2.2.4 Setting the objectives and the measures related to the energy sector

Starting from the risks identified and selected as priorities during the prioritization process in the previous stages, will be defined the objectives of the sector Energy. These objectives will be SMART and will contain an action verb (e.g. reduce/increase) and a noun (e.g. consumption, emissions, production). These objectives will reflect the long-term impact of the strategy on the sector.

Box 2. Objectives for the sector Energy according to the Romanian National Climate Change Strategy 2013-2020
Reducing the intensity of carbon in energy supply
Improving energy efficiency at end users, mainly in buildings and industrial

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facilities.
Approaching accessibility of energy for economically vulnerable groups.

Moreover, on the basis of the causes identified using the issue tree and the fishbone diagram measures will be defined to detail the results that will be obtained following the implementation of the strategy. In box 3 is presented an example of adaptation measures proposed by the International Energy Agency.

Box 3. Adaptive practices proposed by the International Energy Agency	
Types of measures	Measures and actions
Management and technical measures	- Pruning and managing trees near transmission and distribution (T&D) lines - Placing T&D networks underground - Installing pumping back-up systems to allow for water pumping when water levels are low - Manufacturing non-wooden or reinforced poles - Modifying the siting of infrastructure during renovations or while planning new developments - Undertaking load forecasting using climate information - Modelling climate impacts on existing and planned assets in collaboration with meteorological services - Assessing hydrological data and simulating situations for hydropower planning - Demand-side management may be critical for handling disruptions of electricity from hydropower - To address water scarcity, upstream energy companies are recycling water when possible: some companies use municipal waste water, brackish water or sea water instead of scarce fresh water. There are also attempts to conduct waterless hydraulic fracturing (e.g. with propane or CO2).
Technological and structural measures	- Fortifying coastal, off-shore and flood-prone infrastructure against flooding and sea level rises - Designing wind turbines to better manage high wind speeds - Modifying pipeline materials to withstand extreme weather events and temperature fluctuations - The use of improved technologies that enhance the energy and water-use efficiency of energy processes. - New technologies to reduce water consumption and enhance water re-use. - Thermal power plants are introducing improved cooling systems. Recirculating cooling systems are less vulnerable to modifications in water availability than once-through cooling systems - Air-cooled (or "dry cooling") systems help to reduce evaporative losses and do not use water in the process, but they require extra energy (in the order of 5%-7%) and

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	may not be suitable for retrofitting existing plants. - Micronetworks and distributed generation - Underground water storages have ensure water availability for critical uses during emergency situations caused by extremely low water levels (e.g. the aquifer storage and recovery (ASR)).
Training and education	- Training emergency response teams is imperative for a fast and proper response in the case of a disaster, and also for quick repair and restoration actions - Training for data management, modelling and forecasting to intergrate climate forecasts into energy system planning - These activities should be organised in co-operation with government-led capacity-building programmes
Recovery, resourcefulness, robustness	- Businesses can develop logistical and back-up plans to provide for a rapid recovery from supply interruptions - Purchasing emergency response vehicles, training teams for specific recovery actions and developing recovery strategies - Using new management practices using smart meters and automated switching devices that allow for much quicker recovery times from disruptions.

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In the case of the strategy of the Municipality of Tg. Mureș for adaptation to climate change for the sector Energy and telecommunication have been defined a general objective, two specific objectives and 3 priority measures, as it follows:

General objective	Specific objectives	Measures
Reducing the duration of power disruptions during extreme weather events by at least 20% until 2020 and by 50% until 2050	1. Reducing energy consuption	1.1 Increasing the share of telecommunications and power distribution underground networks
	2. Reducing the number of collapsed cables and poles during tempests / heavy rainfall	2.1 Ensuring a proper sizing of the electricity distribution network for peak loads.
		2.2 Improving troubleshooting capacity of the electricity providers (staff, quick response machinery)

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

To prioritize the measures several criteria should be considered and for each criterion is given one point. The criteria might be:

- ✓ C1. It is relevant to the strategies at higher levels / it complements other strategies
- ✓ C2. It targets more sectors
- ✓ C3. Addresses more risks

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- ✓ C4. It is considered urgent (the risk score is higher than 15 – high risk)
- ✓ C5. It can be implemented by the local authorities as lead organizations
- ✓ C6. It produces effects in all the three domains: economic, social and environmental
- ✓ C7. It could be funded from external sources
- ✓ C8. There are resources available for its implementation (staff, expertise)
- ✓ C9. It is socially accepted
- ✓ C10. The legislation needed for its implementation is already available.

The risk prioritization matrix for the sector Energy and telecommunications in the Municipality of Tg. Mureș is presented below:

Proposed measure	SCORE ALLOTTED										
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	TOTAL
Increasing the share of telecommunications and power distribution underground networks	1	1	1	1	1	1	1	1	1	1	10
Ensuring a proper sizing of the electricity distribution network for peak loads	1	1	1	1	1	1	1	1	0	1	9
Improving troubleshooting capacity of the electricity providers (staff, quick response machinery)	1	1	1	1	0	1	1	1	1	1	9

2.2.6 Developing the Action Plan

This stage identifies the actions that are necessary to accomplish the objectives set in the strategy, while providing the information needed for the implementating the strategy of adaptation to climate change in the sector Energy. These adaptive actions can be of several types: informative / educational / awareness actions, institutional / institutional capacity enhancement actions, investments, political / legislative actions. The data collected, together with the list of adaptive actions, will be structured so as to allow the production of a detailed plan that establishes concretely what should be done, who has to do those actions, deadlines and methods to implement successfully the adaptation strategy. Thus, for each sector will be drafted a table containing the following information:

- ✓ measures/actions proposed,
- ✓ the connection with the specific objectives of the Strategy,
- ✓ lead organizations and partners,
- ✓ proposed actions and necessary preparatory actions,

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- ✓ expected results,
- ✓ deadlines
- ✓ estimated budget
- ✓ potential funding sources

The action plan for the sector Energy and telecommunications for the Municipality of Tg. Mureș is presented below:

Proposed measure /action	Objective in the Strategy	Main lead / Partners	Brief presentation (proposed activities)	Expected result	Preparatory actions	Implementation deadline	Estimated budget	Funding source
Ensuring the proper sizing of the distribution network	Reducing energy consumption	The Technical Department for Urban Planning Utilities providers Private owners	1. Resizing indoor distribution networks in individual dwellings and public buildings; 2. Replacing cables and transformers to ensure the proper sizing at the level of the municipality	No. of dwellings with resized network: 4.000	Local recommendations for increasing the percentage of resized networks according to the ANRE norms in the situation of the authorization of electrical networks	2016-2020	EUR 11 million	Private funds, Funds of the distribution operators
Increasing the share of underground power distribution and telecommunications networks	Reducing the number of collapsed cables and poles during tempests / heavy rainfall	The Technical Department for Urban Planning Public Domain Administration Specialized providers Contractors	1. Coordinating the works for tranfering cables in buried conduits as agreed between the municipality and providers; 2. Extinding the buried conduit systems and a proper	Length of underground conduits installed: 15 km		2016-2020	EUR 22,000,000	ROP 2014-2020 Norwegian Funds, The local budget

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			sizing for the later increase in the number of providers.					
Improving troubleshooting capacity of the electricity providers (staff, quick response machinery)	Reducing the number of collapsed cables and poles during tempests / heavy rainfall	Specialized providers (ELECTRICA TRANSILVANIA SUD) Techinical Departament	1. Equiping the electricity providers with proper equipments for troubleshooting; 2. Recruitment of additional staff for quick response operations.	No. of purchased quick response equipments: 2		2016-2020	EUR 880,000	Own funds

Potential funding sources for the actions / projects in the field of Energy: POIM 2014-2020 (Operational Programme Large Infrascture), ROP 2014-2020, Own funds of the distribution operators, Local budgets, POCA 2014-2020 (Operational Programme Administrative Capacity), POAT 2014-2020 (Operational Programme Technical Assistance), the consumers by their contribution for green certificates for cogeneration paid according to the invoices for electricity, Norway 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 Energy sector (the Coordination team within the City Hall), but to ensure the successful accomplishment of this stage all the stakeholders, identified in the action plan as being in charge with this, should involve actively.

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

- ✓ Approval by a decision of the Local Council of the Strategy and Action Plan on adaptation to climate change in the vulnerable sector Energy;
- ✓ Development, in collaboration with the relevant bodies (eg. OAR and RUR) and local stakeholders and adoption by the Local Council of regulations for approving and implementing the local measures on adaptation to climate

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change, which become mandatory for all real estate developers until the next revision of PUG (General Urban Plan) and RLU (City Urban Regulations). If the process of reviewing the PUG and RLU is 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 sector Energy with all planning documents (urban, energy-related) that already exist and / or will be further elaborated locally;
- ✓ Dissemination of the Strategy and Action Plan on climate change adaptation for the vulnerable sector Energy (according to the proposed communication measures);
- ✓ Development of project rationales / advisability studies needed to implement the measures on adaptation to climate change in the sector Energy proposed in the strategy and action plan (eg. Flood studies);
- ✓ Developing 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;
- ✓ 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;
- ✓ Multi-annual budget planning by considering the resources needed to implement projects;
- ✓ Preparing the institutional framework 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 attributions in the sector Energy, private companies, NGOs, universities, etc.);
- ✓ Interim evaluation of the Strategy and Action Plan on adaptation to climate change in the vulnerable sector Energy;
- ✓ Asssesment-based review of the Strategy and Action Plan on adaptation to climate change in the vulnerable sector Energy and corrective actions.

2.3.2 Communication and Dissemination Actions

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As regards communication/dissemination of the strategy on adaptation to climate changes for the vulnerable sector Energy among the local stakeholders and the general public, after its approval by the Local Council, some concrete actions for 2014-2020 are proposed below:

- Organizing a press conference and issuing a press release by the City Hall, on the adoption by the Local Council of the Strategy and Action Plan for the adaptation to climate change for the vulnerable sector Energy;
- Promoting the Strategy and Action Plan for the adaptation to climate change for the vulnerable sector Energy in the virtual environment, through online posts on the website and the Facebook page of the City Hall and of the partner institutions involved in the development process;
- Organizing, under inter-institutional partnership, an annual international conference on the adaptation to climate change for the vulnerable sector Energy, that brings together experts from academia and research, government and also professionals from the public and private sectors who hae attributions and are interested in this field;
- Providing professional training courses in the field the adaptation to climate change for the vulnerable sector Energy, targeting teaching the teaching staff who will act later as vectors of communication with students;
- Developing promotional materials for the strategy and action plan the adaptation to climate change for the vulnerable sector Energy, mainly a video presentation that will be promoted online, on the websites and Facebook pages of the institutions involved. The video will also run on the premises of some institutions and in some public areas;
- Concluding partnership agreements with local opinion leaders (NGOs, representatives of the homeowners' associations, GP's and school head teachers, spiritual leaders, etc.) to carry out information and awareness actions for the general public;
- Organizing competitions for ideas and concrete measures for adaptation to climate change for the vulnerable sector Energy among different categories of local stakeholders (eg. students, retired persons, homeowners' associations, companies, etc.).

2.3.3 Monitoring & evaluation, review & improvement

During this activity will be established a set of result and performance indicators to measure the progress in implementing the adaptation measures proposed in the action plan. The monitoring and evaluation framework ensures the clarification of the aspects to be monitored and evaluated, considering the schedule for their implementation and helps to assign the responsabilities in carrying out these activities. The following aspects should be clarified through discussions with the stakeholders in the partnership structures: What should 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.

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Box 4. Result indicators proposed in the National Climate Change Strategy 2013-2020:
Reduction of CO2 emissions
Distribution companies that will have implemented smart distribution systems by 2020
Installed capacity of renewable energy (wind, solar, biomass, biogas) and cogeneration
Increase of the integration capacity of renewable resources
Energy saving for supply, energy transport and distribution
Energy saving in the industrial sector
Energy saving in the housing sector
Energy saving in the public buildings and services sector
Reduction of the primary energy consumption
Reduction of energy intensity at the level of the industry
Reduction of the average households' energy consumption in
Reduction of losses in district heating networks – transport and distribution
Improvement of energy efficiency in public buildings
Energy saving in public lighting
Identification of the vulnerable consumers

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

Performance indicators:

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

The indicators proposed for monitoring the implementation of the adaptation strategy in the sector Energy and telecommunications for the Municipality of Tg. Mureș are presented below:

Performance indicators (at sectoral level)	**Result indicators (for measures/projects)**

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Reducing the duration of power disruptions during extreme weather events by at least 20% until 2020 and by 50% until 2050	• No. of dwellings with resized electricity distribution network • Length of the underground conduits installed • No. of purchased quick response equipments

The monitoring of the implementation of the strategy will be conducted according to the following timetable of activities:

- Monitoring activities of the implementation of the strategy for adaptation to climate change in the vulnerable sector Energy, will be conducted in 2020, the year when the implementation of measures and actions provided in the strategy should be completed and 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 assessment of the implementation of the strategy, taking into account that it refers to three time horizons: short (2020), medium (2030) and long term (2050);
- The results of the proposed monitoring action (2020) will be centralized in a Monitoring report. The main purpose of the Monitoring report is to highlight the status of the implementation of the strategy and to propose recommendations for optimizing its 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 chronologically and synthetically the monitoring activities conducted, a chapter that presents the measures and actions that have been monitored, and recommendations to optimize the implementation of each measure and action, and a final section that provides a synthetic overview of the 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 for adaptation to climate change in the vulnerable sector Energy and identify the recommendations for optimizing the implementation thereof;
- The City Hall, who will assume the strategic document by HCL (decision), will be assigned to document the values of the selected monitoring indicators, based on secondary sources: statistical data provided by the National Institute of Statistics (eg. TEMPO Online database), own data, utilities 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

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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 the setting up of a Monitoring Committee for the Strategy,to conduct the interim monitoring activities (eg. yearly or every two years) and to support directly the representatives of the City Hall (eg. documenting the values of the monitoring indicators, establishing measures for the optimization of the implementation, identifying new projects, partners, funding sources, etc.) in the monitoring process which shall be implemented by 2020;

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3. Best Practices in Adaptation in the Sector Energy

Title of the project	Climate resilient retrofit of a Rotterdam building
Brief description	The renovation was carried out for an old office building (the 1940's) that was renovated and made available for commercial functions on the ground floor and flexible office spaces at the other floors. The most important climate adaptation and mitigation measure implemented is the energy-efficient cooling and heating system – an Aquifer Thermal Energy Storage (ATES) system that supplies the building with heat and cold. In summer, heat will be absorbed and stored in a ground water aquifer, this stored heat can be used in winter to heat the building. During the summer period cold water from another part of the aquifer is pumped up to cool the building. In this way the infrastructure is associated with climate adaptation (being prepared for increased cooling needs in summer in a sustainable way) and mitigation of effects on climate (reduced emissions of carbon dioxide). The additional heat that is needed comes from district heating (excess heat from nearby industry). The rooftop garden is a further implemented adaptation measure dampening the effect of more frequent heavy rainfall. In addition, it is an attractive recreational green space with special attention for birds, bats and insects. The project was funded exclusively from private funds.
Challenges	Increased cooling needs in summer as a consequence of higher temperatures. Protecting the interior of the building from excess heat. Creating synergies between adaptation and mitigation solutions. Improving energy efficiency and saving energy consumption.
Solutions	The use of ATES for cooling in summer and heating in winter. For heating in winter, ATES contributes to 30-50% of the heat and has enabled an overall CO2 reduction of 11.4% with respect to district heating alone. When only the heating/cooling system is considered, the CO2 reduction is 45%. The rooftop garden serves as rain water buffer and, in addition, it is an attractive recreational area for the employees and it serves as a habitat for insects, birds and bats. To reduce heat losses were used triple glazed windows. To facilitate an optimal use of day light were installed transparent facades and an atrium. Moreover, to reduce the use of artificial lighting were installed sensors for daylight and sensors for presence. In the renovation process were used insulating materials.

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Stakeholder participation	The rehabilitation process was initiated by the company Joulz (the field of activity being gas and electricity infrastructure), the main tenant in the building, which remarked the potential of the building to become a sustainable one. Other key actors involved: LSI Project Investment (the owner of the building) that commissioned the renovation, Gemeente Rotterdam required a commercial use of the ground floor.
Legal aspects	There is a municipal requirement that the ground floor contributes to the public space and is not used as an office. The renovation can be integrated in the Eurocode for buildings (Commission Recommendation on Eurocodes 200/887/EC) as well as in the urban development planning (Directive 2010/31/EU on the energy performance of buildings)

Title of the project	**Seawater keeps Copenhagen buildings cool**
Brief description	Establishing a district cooling station having an installed capacity of approximately 15 MW that is based on three different principles of cooling thus making it very flexible and energy-efficient. The district cooling plant utilises seawater from the Port of Copenhagen in periods where the seawater is sufficiently cold, as well as surplus heat from power plants to produce environmentally-friendly cooling. Finally, the plant also uses compressors running on electricity.
Challenges	As summers are becoming longer and hotter, the need for cooling in buildings where people live or work (shopping centres, hotels, banks and offices, hospitals, kindergardens) will be greater in future. Many buildings have their own cooling systems that run on CFC gases which, like CO2, contribute to global warming. Furthermore, they use large amounts of electricity and water.
Solutions	Connecting buildings to a district cooling system. District cooling works on the same principles as district heating. Chilled water is produced centrally in district cooling plants and then it is supplied to end consumers through a network of pipes. As effects that were measured we can mention the reduction of emissions of CO2 by 66% annually, respectively by 62% for SO2 and NO.
Stakeholder participation	The promoter of the project was the company Copenhagen Energy, owned by the City of Copenhagen, that established the first district cooling plant in Denmark, in the buildings of a former nulcear power station. The users of the system: Danish banks Danske and

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	Sydbank, Magasin department store and the media group Egmont
Legal aspects	Adoption of the District Cooling Act in 2008, enabled Danish municipalities that fully or partly own district heating companies to establish and run district cooling systems.

Title of the project	**Adapting to reduced euipment thermal ratings**
Brief description	Utilities companies in UK admit that climate change causes thermal de-rating (decrease in the transmission and distribution capacity of the electricity system when temperatures rise above a certain level) it has been estimated that there will be a decrease by 4-9% for overhead distribution lines and by up to 3% for overhead distribution lines. Similar effects are expected in southern Canada. BC Transmission Corporation supports the research and development of dynamic (real-time) thermal-rating systems. The main benefit is that these systems can help to prevent power outages during periods of peak loads and conditions close to maximum operating temperatures by leveraging unused capacity within a power system.
Challenges	High temperatures pose a significant challenge for many of the power lines that distribute electricity to households and companies. Power lines sag as they heat up, due to two main factors: warmer temperatures and increased amounts of energy transmitted through the lines. Due higher temperatures, some lines would likely hang below the minimum distance from the ground required by law. Failure to adapt transmission and distribution lines to increased temperatures may be a source of disruptions and revenue loss. What is more, the risk of overloads and power outages can increase when temperatures rise and more people use air conditioners and fans.
Solutions	Increasing the height of poles (and the use of wood poles) overhead line support structures facilitates maintaining a certain distance above the ground and working at hotter operation temperatures. Installing conductors with hotter operating limits or novel 'low-sag' conductor material. Using dynamic thermal rating (relying on real time data about weather doncidtions and/or the state of conductors) that can improve both the transport capacity and the efficiency of the network, Adopting improved design standards for new distribution equipment.

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Stakeholder participation	The promoters were BC Transmission Corporation (Canada) Hydro Tasmania (Australia) National Grid (UK) – the work group for adaptation to climate change Western Power Distribution (U.K.)
Legal aspects	By law, power lines must hang a minimum distance above the ground. Electric distribution companies operate distribution lines and equipment, and manage minimum clearance requirements on the basis of thermal ratings, which are estimates of the total capacity of an electrical component to carry current at a point in time. Adopting regulations that provide the obligation to report on climate change adaptation.

Title of the project	**Storm Hardening in a Climate Change Context**
Brief description	In 2012, New York City suffered serious damage due to Huricane Sandy. The storm spurred the city to adopt a strategic approach to climate change resilience. In 2013, the city convened an expert panel to update the city-level climate change projections and a panel on climate change to advise and provide the work group with technical data and information. The panel on climate change had to present updated climate change projections for the 2020s and 2050s. The Mayor's office also published a municipal-resilience plan calling for 250 initiatives worth a total of US$15 billion. To facilitate the implementation of the plan it was established a department within the City Hall for service-restoration and resilience. These actions supported the gas and electricity company ConEdison in promoting and making decisions on climate change resilience in order to harden critical facilities.
Challenges	Increased storm and tropical-cyclone intensity Sea-level rise and coastal flooding Rising temperatures and numbers of hot days
Solutions	Developing strategies for improving the resilience of critical infrastructure to climate change impacts. Monitoring equipment and technology Design and operation standards, guidelines, tools and maintenance schedules Protection and equipment relocation, flood walls and barriers, water pumps, modernization and using alternative materials, burying some overhead distribution equipment. These solutions increased resilience to issues caused by climate and reduced the time needed to restore services after disasters caused by climate.
Stakeholder	New York City

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participation	Climate Change Adaptation Force New York Panel on Climate Change (experts in: climate chane, ocean sciences, urban planning, civil engineering, law and risk management) ConEdison utilities company
Legal aspects	Local Law 42, establishing the Panel on Climate Change as a permanent body required to meet twice a year to review recent scientific data on climate change and their potential implications for the City. It also stipulates that new climate change projections are to be prepared within one year of the publication of new data by the Intergovernmental Panel on Climate Change.

Title of the project	**Awareness campaigns for behavioural change**
Brief description	The Commission's strategy has been to address the scepticism of the population and convince them that individual actions are worthwhile and can lead to big contributions to reduce climate change. To reach this goal the EU heavily invested in tools such as advertising, website, exhibitions, media relations, events, and schools programmes both at European and national levels. As media and communication chanels were used television, internet, newspapers, and, in addition, were developed several tools to increase decision makers' awareness.
Challenges	Not all stakeholders are aware and informed about their vulnerability and the measures they can take to pro-actively adapt to climate change. Although awareness raising is often considered to be important at the first stages of the adaptation process, research shows that levels of awareness fluctuate through time under the influence of external variables. Therefore, raising awareness is not only important at the first stages of the process but is integral throughout the process to maintain and increase the general level of awareness.
Solutions	Large climate change awareness raising campaigns are often a mixture of mitigation, energy efficiency, and sustainability measures rather than adaptation measures. The EU financed national awareness campaigns in its Member States. Additional effort was made for implementing awareness campaigns in Poland, the Czech Republic, Hungary, Romania and Bulgaria. Development of new tools to raise awareness (tools on the UKCIP website) decision makers' awareness (for example 'Keep it Cool', 'Ludo' and 'Clim-ATIC' board games). The aim of these campaigns is to change behaviours on long term. Ways of communication during the campaigns: dissemination of printed materials, organisation of public meetings and

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	training, professional consultation, communication and information through social and mass-media, using informal networks for information dissemination. Campaigns can be combined with the establishment of community self-protection teams that promote self-reliance among residents and businesses to minimize the risk to personal safety and property damage (e.g. during a flood event).
Stakeholder participation	Involvement of all relevant actors that are confronted by the impacts of climate change (individuals, companies, industries, government authorities) that were involved in the development of adaptation to climate change strategy, includingd NGO's.
Legal aspects	The adoption in 2013 of the EU adaptation strategy. Awareness rasing and mainstreaming of adaptation are considered as important elements of this strategy.

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Conclusions and recommendations

The principles underlying the development of an efficient strategy for adaptation to climate chage:

- ✓ involving the relevant stakeholders
- ✓ understanding risks and impediments
- ✓ defining SMART objectives and expected results and communicating them
- ✓ managing climate-related and non-climate-relates risks 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 the management of priority climate-related risks, sectoral focusing
- ✓ addressing the prioritized risks associated with current climate variability and extremes
- ✓ implementing a flexible management to properly address uncertainties
- ✓ recognizing the importance of no-regret/low-regret and win-win adaptation options in terms of cost effectiveness and multiple benefits
- ✓ continuous reviewing of the effectiveness of adaptation decisions by monitoring and re-evaluation of risks
- ✓ continuous process that consists in reviewing and updating documents so that they consider the new development in the field (science, research, technologies)
- ✓ effective communication and awareness

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

- ✓ the most topical measures to be taken in the sector of energy aim at increasing energy efficiency in buildings and using renewable energy sources to supply them with energy, stimulating connection to district heating systems and increasing their energy efficiency, including through promoting cogeneration, defining relevant and accessible indicators for monitoring and evaluating strategies for adaptation to climate change in the residential and housing sector, etc.
- ✓ in the energy sector should be identified and evaluated the way how the impact of climate change affects energy supply and distribution, how it can alter the demand for energy and what damage it causes to the energy infrastructure
- ✓ electrical power and fuel supply system should strengthen their resilience to extreme weather events and the increase of pressure on water resources
- ✓ the business environment is a key actor in planning and implementing measures to strengthen resilience to climatic effects and adaptation practicess

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- ✓ local and national public administration authorities should encourage actions that strengthen resilience and have a key role in their
- ✓
- ✓ implementation as far as the response to emergency situations and the management of their own energy assets are concerned
- ✓ Local authorities may make use of four tools that can contribute to reducing fossil fuels consumption, to the increase of energy-efficiency and increasing the production of energy from renewable sources:
  - Awareness campaigns aimed at changing the population's energy consumption habits
  - Regulations that govern activities in urban areas and the energy systems in buildings
  - Regulations concerning taxes which can provide incentives for those who adopt measures to reduce energy consumption
  - Measures aimed at minimizing energy consumption in activities of the local authority
- ✓ Adaptation to climate change requires joint effort of individuals, companies, industries, authorities affected by the impact of climate change which means that we must ensure the involvement of all the relevant actors and environmental NGO's both in developing and implementing the strategy and in its communication because they know better their 'beneficiaries', they have better knowledge of their expectations and find the best way to communicate with them, thus giving more credibility to the awareness campaigns.
- ✓ to ensure a successful collaboration between the energy industry and local authorities it is necessary to have a clear common picture of the risk assessment mechanisms and of the adaptation to climate change solutions
- ✓ many businesses have to integrate awareness of aspects, management and adaptation to climate change in their internal lon and short term planning process
- ✓ energy services companies should develop strategies to adapt to climate change that consider the customer engagement, formulating policies and identification of incentives, the trans-sectoral cooperation for new technologies, forecasting water resources availability and ensuring access to them under agreements and partnerships, taking into account risks (investments in risk management) and capacity for innovation to address climate change (innovative business models), the increase in the level of involvement in the community to include risks associated with climate change.

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For further details on the methodology for development and implementation and the tools used, please refer to Planning for adaptation to climate change – Guidelines for Muncipalities.

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The *"Calea Verde spre Dezvoltare Durabilă – Greenway to Sustainable Development"* project, with a total eligible value of EUR 4,628,535, benefits from a grant amounting EUR 3,934,254.75 from Island, Liechtenstein and Norway through the EEA Grants 2009 – 2014 and a co-funding of EUR 694,280.25, provided by the Ministry of Environment, Water and Forest, within the RO07 Programme for the Adaptation to Climate Change.

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.

The EEA Grants and Norway Grants represent the contribution of Iceland, Liechtenstein and Norway to reducing economic and social disparities and to strengthening bilateral relations with the beneficiary European countries. The three countries have a close cooperation with the EU by the European Economic Area (EEA) Agreement.

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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