PLANNING FOR ADAPTATION TO CLIMATE CHANGE

GUIDELINES FOR MUNICIPALITIES

act

Adapting to Climate change in Time

LIFE08 ENV/IT/000436

With the contribution of the LIFE financial instruments of the European Community

ACT – Adapting to Climate change in Time
is a project funded by the European Commission within the LIFE program on Environmental Policy and Governance. This program was created to contribute to the implementation, update and development of policy and legislation in the environmental policy area, thereby contributing to the efforts towards sustainable development.

PROJECT PARTNERS

Municipality of Ancona

Municipality of Bullas

Municipality of Patras

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

FORUM of Adriatic and Ionian CITIES

ACKNOWLEDGEMENTS

Guidelines coordination
F. Giordano, A. Capriolo, R. A. Mascolo (ISPRA).

Authors and contributors by chapter

Chapter 1: Get started

Authors: F. Giordano, A. Capriolo, R. A. Mascolo (ISPRA).

Chapter 2: Review the available knowledge and establish a baseline

Authors: F. Giordano, R. A. Mascolo, A. Capriolo (ISPRA).

Contributors: F. Desiato, A. Toreti, G. Fioravanti, P. Fraschetti, W. Perconti (ISPRA).

ACT Experiences: 1) A. Capriolo, F. Giordano, R.A. Mascolo (ISPRA); 2) F. Giordano, R. A. Mascolo (ISPRA); 3) P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert (Municipality of Bullas); 4) F. Desiato, A. Toreti, G. Fioravanti, P. Fraschetti, W. Perconti (ISPRA).

Chapter 3: Assess vulnerability and risk

Author: F. Giordano (ISPRA).

ACT Experiences: 5) G. Finocchiaro, A. Capriolo (ISPRA); 6) A. Capriolo, C. Mastrofrancesco (ISPRA); 7) J. Tuscano, F. De Maio, S. Rieti, L. Sinisi, A. Capriolo (ISPRA); 8) C. Cacace, A. Giovagnoli (IsCR), R. Gaddi, M. Cusano, P. Bonanni (ISPRA); 9) D. Spizzichino, A. Capriolo (ISPRA); 10) C. Piccini (ISPRA); 11) S. Mandrone, C. Vicini (ISPRA); 12) M. Di Leginio (ISPRA); 13) P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert (Municipality of Bullas).

Chapter 4: Develop the Adaptation Plan

Authors: F. Giordano, A. Capriolo (ISPRA).

ACT Experiences: 14) P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert (Municipality of Bullas); 15) M. Cardinaletti, Project Manager for Sustainable Development, Consultant for the Municipality of Ancona; 16) P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert (Municipality of Bullas)..

Chapter 5: Design the implementation of actions

Author: A. Capriolo (ISPRA).

Chapter 6: Monitor, evaluate and update the Adaptation Plan

Authors: F. Giordano, R. A. Mascolo, A. Capriolo (ISPRA).

ACT Experiences: 17) P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert (Municipality of Bullas); M. Cardinaletti, Project Manager for Sustainable Development, Consultant for the Municipality of Ancona.

Chapter 7: Engage stakeholders

Authors: A. Laghi, M. Bigi (Indica srl).

ACT Experiences: 18) M. Cardinaletti, Project Manager for Sustainable Development, Consultant for the Municipality of Ancona.

Chapter 8: Mainstream adaptation

Author: R. A. Mascolo (ISPRA).

Chapter 9: Communicate and raise awareness

Author: R. A. Mascolo (ISPRA).
ACT Experiences: 19) P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert (Municipality of Bullas); 20) Forum of Adriatic and Ionian Cities.

Expert reviewers

D. Gaudioso (ISPRA), P. Pelizzaro (Kyoto Club), S. Venturini (CMCC).

Graphic design and artwork

Valentina Barsotti, Matteo Stefanelli (AzzeroCO_2).

Photos

Photos on page 25,51,71, 127, 149,168,175 kindly provided by F. Iozzoli and P. Orlandi (ISPRA)

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PREFACE

These "***Guidelines for Municipalities"*** are the result of the activity carried out within the Action 7 – *Evaluation of project results* of the LIFE ACT Project (Adapting to Climate change in Time Project - LIFE08 ENV/IT/000436). The document was prepared by the Institute for Environmental Protection and Research (ISPRA, Italy), in cooperation with the local partners of the project: the Municipality of Ancona (Italy), the Municipality of Bullas (Spain) and the Municipality of Patras (Greece).

The Guidelines are based on the experience gained during the project (2010-2013) and is intended to provide mayors and other city officials with a practical guidance on how to respond to the challenges of climate change adaptation in their cities. For this purpose, the document proposes a comprehensive methodology aimed at driving the process to design, implement and monitor a Local Adaptation Plan (LAP), by providing basic theoretical information on key climate adaptation issues that are relevant to cities, examples of successful experiences gained within the project and good practices from other European experiences. The approach proposed is not intended to provide a prescriptive format to users - there is no one approach that best suits all - but it rather aims at providing to local administrators the key features for the development of LAPs through a practical approach.

Developing a climate change adaptation "strategy" or a "plan" is a different issue, even if sometimes these terms are used interchangeably. Despite the lack of official definitions of the two terms, it is nevertheless possible to draw some relevant elements that characterise respectively the two concepts (ISPRA, 2011).

In general a **strategy** can be considered as the foundation stone, an early-stage level of policy making, to be prepared before the implementation of adaptation measures. Therefore, it represents a generally non-binding document, that could be designed and adopted at various levels (e.g. continental, transnational, national, regional and local level) in order to: i. define the strategic vision of an administration, its adaptation principles, goals and objectives, its overarching direction; ii. assess vulnerability and risk posed by climate change; iii. involve relevant stakeholders and decision-makers; iv. raise awareness; v. provide recommendations and guidelines to build and/or strengthen the adaptive capacity in various sectors and reduce the costs for society, etc. The strategy can therefore be seen as a medium-long term process that ascertain the needs for action.

A **plan** is developed after the adoption of the strategy with the aim of promoting its concrete application and implementation and laying down future steps for its further implementation. The plan is therefore a short-term document (e.g. 5 years), including a number of specific adaptation actions that are prioritised and linked to the risks and vulnerability previously identified. A plan should therefore identify the financial resources allocated as well as the actors responsible for the implementation of the actions. For its implementation, the plan will require the "signing up" of a wide number of community stakeholders who will have the authority to implement the adaptation actions so that it may be more difficult to adopt compared to a strategy.

While identifying the main steps towards the definition of a LAP (Chapters 4 to 6), these Guidelines draw up at the same time the key elements for designing a strategy

(Chapters 1 to 3). Chapters 7 to 9 illustrate relevant activities that should be carried out during the whole adaptation process.

For this reason, even if this document is designed for driving the process towards the adoption of a LAP, the first part could be useful for those administrations willing to prepare just a Local Adaptation Strategy (LAS).

Significant barriers should be faced by decision makers while implementing climate action plans. The types of barriers varies over the different stages of the process. Local governments and government entities may need additional training for their staff and increased budgets or might be concerned about a deficient support from leadership, lack of quality downscaled climate models, and uncertain returns from investments.

More in general, problems may occur when there is a lack of communication, transparency and coordination between the different scales and sectors, in case authority and responsibility are not clearly defined, and when financial constraints might limit certain scales ability to take effective adaptation actions.

The LIFE ACT project, as a major barrier, mainly experienced the lack of scientific knowledge and expertise at the level of local municipalities to perform model simulations rather than impact assessment. This critical issue has been in this case balanced and overcome by technical support provided by ISPRA, although it is not reasonable to assume that this effort, in terms of financial and particularly skilled human resources dedicated to scientific analysis and evaluations, can be replicated each time a municipality starts an adaptation policy cycle.

When quantitative data or technical capacity are unavailable at local level, there is probably just one “facilitator” that can foster similar processes efficiently: a policy framework at national or regional level (e.g.: a National or a Regional Adaptation Strategy) that provides the necessary terms of reference for future climate projections and impact assessment in a format that might result as useful as possible at different areas.

At the same time, the coherence of the LAP with respect to the National/Regional (where existing) and even European policies in place should be ensured to avoid potential conflicts. EU regulations are also subject to change, which offers the potential for greater incorporation of climate change adaptation in a number of directives. However, at the local level, also amendment of the local policies (e.g. spatial development plans) could be considered in order to comply with high-level adaptation strategy framework.

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INTRODUCTION

Why these guidelines?

Many physical evidences lead to the fact that climate change is already occurring as a result of the greenhouse gases accumulated in the atmosphere to date during the last century. Furthermore, many of the changes projected through the 21st century will be likely driven by present-day greenhouse gas concentrations. For this reason, the reduction of greenhouse gas emissions plays a critical role in determining if climate change will affect natural resources and societies in the future and in which way.

However, governments at the various levels cannot wait for global greenhouse gas emissions to be reduced before taking actions in order to cope with climate change.

Climate change effects represent already a serious challenge for almost all the cities around the world: they threaten to increase vulnerabilities, reduce the availability of natural resources and weaken ecosystems functioning, limit citizens security, decrease business, hinder social and economic development, and much more.

Thus, adapting to climate change and building resilience is increasingly becoming a high priority for cities. Besides mitigation initiatives, to which municipalities have been committed since many years[1], cities may play today a larger role in adaptation and focus on strengthening their capacity to assess vulnerability to climate change impacts and to identify corresponding plans and investments to increase their resilience.

In Europe, cities are already experiencing the impacts of climate change and expect to be increasingly affected in the future. Results from a survey conducted among the European cities within the EU Project – Adaptation strategies for European cities[2] – demonstrate that 81% (out of 196 responses) have already experienced periods of hot weather and heat waves and expect this to be the main impact they will have to face over the next 30 years, while 71% expect to be increasingly affected by water scarcity.

Among the surveyed cities:

- around 24% have already adopted an adaptation strategy, even though half of those are still in the very early stages;
- 14% have an adaptation strategy because they are legally obliged to have one;
- 34% have publicly committed to develop an adaptation strategy voluntarily;
- 8% have not started thinking of or working on adaptation.

Today cities cannot state being unaware about climate change, however uncertainties on the scale, timing and consequences of climate change, lack of information, knowledge and expertise, insufficient guidance and tools at local level may represent some of the barriers to adaptation.

[1] For further details: http://www.eumayors.eu/actions
[2] For further details: http://eucities-adapt.eu/cms/

With these guidelines, the Partners of the project ACT would like to give their contribution to fill this gap, by making their experience available to other communities as well as illustrating strengths and weaknesses identified during their local adaptation process. This document is addressed to all the local authorities that are interested in starting a process towards adaptation to climate change, and in particular to those located in the Mediterranean area that could be characterized by similar vulnerabilities compared to those identified in the areas investigated during the project.

Main approach and purpose

These Guidelines are NOT intended to provide a complete overview of the existing approaches to adaptation, NOR to suggest some approaches as better than others. Adaptation is a very complex issue, bringing together several disciplines and the international discussion on specific issues (e.g. vulnerability and risk, adaptation monitoring and indicators, etc.) is still very active. As a matter of fact, the literature contains a wide range of possible theoretical definitions (e.g. vulnerability, risk, etc.) and methodological approaches (e.g. vulnerability assessment, risk assessment, etc.) and there is no one approach that suits all. For this reason, it is up to the communities to choose what works best for their needs: some communities may decide to implement the whole adaptation policy cycle, other communities may prefer to skip a step altogether, or develop a simplified version, or undertake just a risk or vulnerability assessment. The choice will depend on several factors, such as for example the availability of financial resources, technical skills, data, etc.

These Guidelines are therefore intended to assist local communities in formulating Local Adaptation Plans (LAPs) or implementing some steps of it, by providing useful theoretical elements together with practical examples taken from the experience gained by the Partners within the ACT Project. In order to make the guidelines as much accessible as possible also to less experts and beginners in the field of climate change, in some cases simplifications of concepts and approaches have been preferred.

Structure of the Guidelines

The structure of these Guidelines (Figure 1) is built on the basis of the commonly known features of the adaptation policy cycle, with particular attention to the process proposed within the Adaptation Support Tool of the Climate-Adapt Platform[3]. Not less important for this purpose has been the preparation of the state of the art review carried out at the beginning of the ACT Project (ISPRA, Life ACT Project - 2011).

[3] For further details: http://climate-adapt.eea.europa.eu/web/guest/adaptation-support-tool/step-1

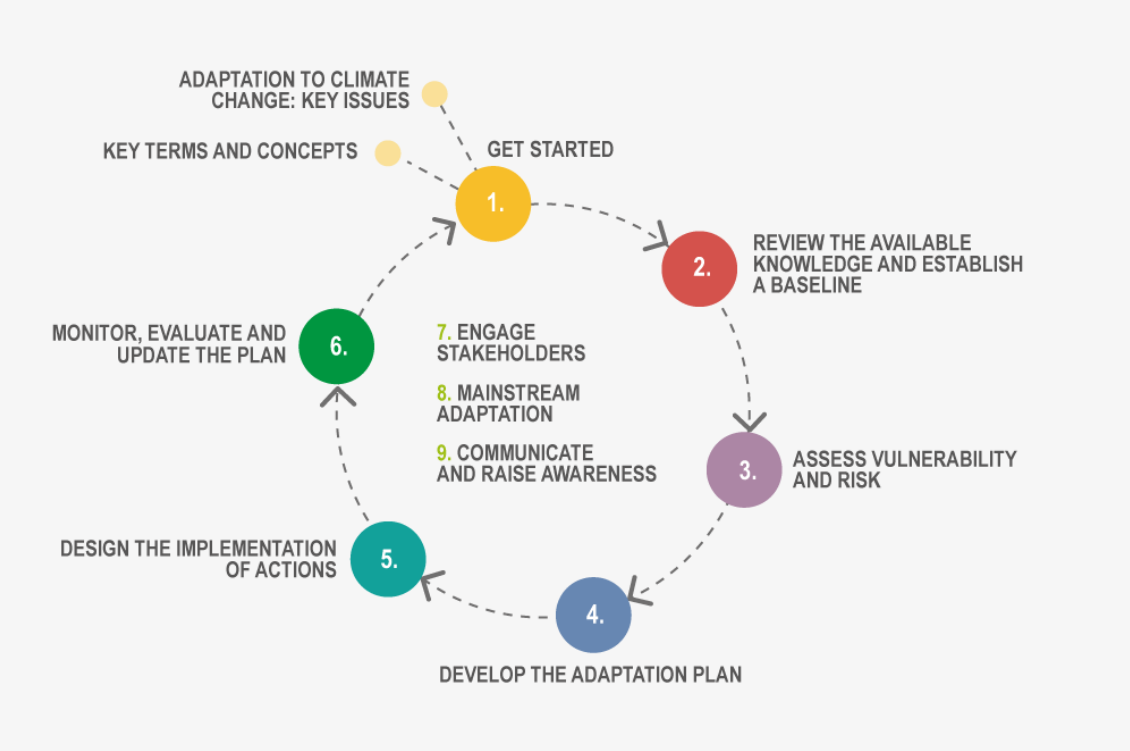

Figure 1 - Structure of the Guidelines for the Local Adaptation Plans (LAPs).

Key terms and concepts and *Adaptation to climate change: key issues* are introductory sessions to the Guidelines. Furthermore, nine chapters describe step-by-step the whole adaptation process for the preparation of the LAPs. Finally, Annex 1 provides an Adaptation Actions Database including a list of the adaptation actions of the three LAPS developed within the Project.

For each chapter there is a box containing **key messages**, as well as basic **theoretical concepts** that are useful for the understanding of the contents and **practical examples** (e.g. methodologies, approaches, indicators, etc.) taken from the ACT Project. In some cases when examples from the ACT Project were not available, practical examples selected among different initiatives in European cities were included on the basis of specific criteria:

- their nature, in order to make easier the understanding of specific concepts;
- relevance of the source (e.g. EU projects, international organizations, etc.);
- local scale, as this is the scale of the target users of the guidelines. However, examples at local scale are few and are not always sufficiently descriptive in order to clearly illustrate certain approaches. There are examples at different spatial scales and when possible also at local scale.

At the end of each chapter a **check list** allows to verify if the suggested steps have been implemented.

Key terms and concepts

The following section provides official definitions of the key terms and concepts frequently used in these guidelines and adopted for operational use within the framework of the Project ACT. It is very important to have a common understanding of definitions and concepts that are widely used in the field of adaptation. Some terms are often not officially defined by the United Nations Framework Convention on Climate Change (UNFCCC[4]) or by the Intergovernmental Panel on Climate Change (IPCC[5]), and this may lead sometimes to misleading interpretations.

The "*Key terms and concepts*" section of these guidelines therefore aims to collect and provide a list of the most relevant key terms and concepts selected from reports and documents of the most authoritative sources in this field: Intergovernmental Panel on Climate Change, United Nations Framework Convention on Climate Change, other UN Agencies (e.g. UNDP[6], UNEP[7], UNISDR[8]), European Environment Agency[9], ICLEI[10], Organisation for Economic Co-operation and Development[11].

Furthermore, the CLIMATE-ADAPT glossary could be an important source for this purpose (*http://climate-adapt.eea.europa.eu/glossary*).

The key terms are presented in alphabetic order and for each term the related specific source is provided without editing from the original sources.

Adaptation (IPCC, 2007) - Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

anticipatory adaptation – adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.

autonomous adaptation – adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.

planned adaptation – adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Adaptation costs (IPCC, 2007) - Costs of planning, preparing for, facilitating, and implementing adaptation measures, including transition costs.

Adaptive capacity (IPCC, 2007) - The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

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[4] For further details: http://unfccc.int/2860.php
[5] For further details: http://www.ipcc.ch/
[6] For further details: http://www.undp.org/content/undp/en/home.html
[7] For further details: http://www.unep.org/
[8] For further details: http://www.unisdr.org/
[9] For further details: http://www.eea.europa.eu/it
[10] For further details: http://www.iclei-europe.org/
[11] For further details: http://www.oecd.org/

Adaptation indicators (EEA, 2008) - A measure of progress towards the implementation of adaptation measures (process-based) or a measure of effectiveness of adaptation policies and activities in general.

Adaptation Strategy (UNDP, 2005) - Refers to a broad plan of action that is implemented through policies and measures. A climate change adaptation strategy for a country refers to a general plan of action for addressing the impacts of climate change, including climate variability and extremes. It may include a mix of policies and measures, selected to meet the overarching objective of reducing the country's vulnerability. See the Chapter 1. "Prepare the ground" for a further discussion of this concept.

Baseline/reference (IPCC, 2007) - The baseline (or reference) is the state against which change is measured. It might be a 'current baseline', in which case it represents observable, present-day conditions. It might also be a 'future baseline', which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines.

Building adaptive capacity (Ribeiro et al, 2008) - Building adaptive capacity involves creating the information and conditions (regulatory, institutional, managerial) that are needed before adaptation actions can be undertaken.

Capacity building (IPCC, 2007) - In the context of climate change, capacity building is developing the technical skills and institutional capabilities in developing countries and economies in transition to enable their participation in all aspects of adaptation to, mitigation of, and research on climate change, and in the implementation of the Kyoto Mechanisms, etc.

Clearinghouse (Ribeiro et al, 2008) - The Clearinghouse is a central agency or entity for collecting and giving out information. A Data Clearinghouse is an organization or an organisational framework that acquires, maintains, and distributes data or provides information services about data for many different data users. Such an organization may also integrate the data, generate the data, or perform other types of data processing functions.

Climate change (IPCC, 2007) - Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines 'climate change' as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. See also climate variability.

Climate model – GCM and RCM (IPCC, 2007) - A numerical representation of the climate system based on the physical, chemical, and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. The climate system can be represented by models of varying complexity (e.g., for any one component or combination of components a hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical, or biological processes are explicitly represented, or the level at which empirical parameterizations are involved. Coupled atmosphere/ocean/sea-ice General Circulation Models (AOGCMs) provide a comprehensive representation of the climate system.

More complex models include active chemistry and biology. Climate models are applied, as a research tool, to study and simulate the climate, but also for operational purposes, including monthly, seasonal, and interannual climate predictions.

Climate projection (IPCC, 2007) - The calculated response of the climate system to emissions or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based on simulations by climate models. Climate projections are distinguished from climate predictions, in that the former critically depend on the emissions/concentration/radiative forcing scenario used, and therefore on highly uncertain assumptions of future socio-economic and technological development.

Climate resilient community (Snover et al, 2007) - One that takes proactive steps to prepare for (e.g., reduce the vulnerabilities and risks associated with) climate change impacts.

Climate scenario (IPCC, 2007) - A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships and assumptions of radiative forcing, typically constructed for explicit use as input to climate change impact models. A 'climate change scenario' is the difference between a climate scenario and the current climate.

Climate variability (IPCC, 2007) - Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also climate change.

Desertification (IPCC, 2007) - Land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Further, the United Nations Convention to Combat Desertification (UNCCD) defines land degradation as a reduction or loss in arid, semi-arid, and dry sub-humid areas of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including those arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation.

Disaster (UNISDR, PreventionWeb) - A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disaster risk reduction (UNISDR, PreventionWeb) - The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Drought (IPCC, 2007) - The phenomenon that exists when precipitation is significantly below normal recorded levels, causing serious hydrological imbalances that often adversely affect land resources and production systems.

Early warning (UNISDR, PreventionWeb) - The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals,

communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

Emissions scenario (IPCC, 2007) - A plausible representation of the future development of emissions of substances that are potentially radiatively active (e.g., greenhouse gases, aerosols), based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socio-economic development, technological change) and their key relationships. In 1992, the IPCC presented a set of emissions scenarios that were used as a basis for the climate projections in the Second Assessment Report. These emissions scenarios are referred to as the IS92 scenarios. In the IPCC Special Report on Emissions Scenarios (SRES) (Nakićenović et al., 2000), new emissions scenarios – the so-called SRES scenarios – were published.

Extreme weather event (IPCC, 2007) - An event that is rare within its statistical reference distribution at a particular place. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called 'extreme weather' may vary from place to place. Extreme weather events may typically include floods and droughts.

Exposure (IPCC, 2001) - It is the nature and degree to which a system is exposed to significant climatic variations.

Hazards (UNDP, 2004) - A physically defined climate event with the potential to cause harm, such as heavy rainfall, drought, flood, storm and long-term change in mean climatic variables such as temperature.

(Climate change) Impacts (IPCC, 2007) - The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts:

potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation.

residual impacts: the impacts of climate change that would occur after adaptation. See also aggregate impacts, market impacts, and non-market impacts.

(Climate change) Impact assessment (IPCC, 2007) - The practice of identifying and evaluating, in monetary and/or non-monetary terms, the effects of climate change on natural and human systems.

(Climate change) impact indicators (EEA, 2012b) - Main purpose of climate change impacts indicators is to understand consequences of climate change and determining vulnerability to climate change.

Implementation tools (Snover et al, 2007) - The authorities and/or avenues over which your government has control or influence in policy, planning and infrastructure, in order to take your preparedness actions successfully.

Indicators (EEA website) - Observed value representative of a phenomenon to study. In general, indicators quantify information by aggregating different and multiple data. The resulting information is therefore synthesised. In short, indicators simplify information that can help to reveal complex phenomena.

Mainstreaming (UNDP, 2005) - Mainstreaming refers to the integration of adaptation objectives, strategies, policies, measures or operations such that they become part of

the national and regional development policies, processes and budgets at all levels and stages. It seems that “mainstreaming” is used interchangeably with “integration”.

Maladaptation (IPCC, 2001) - Any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead.

Mitigation (IPCC, 2007) - An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

No regrets policy (IPCC, 2007) - A policy that would generate net social and/or economic benefits irrespective of whether or not anthropogenic climate change occurs.

Preparedeness (UNISDR, PreventionWeb) - The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Resilience (IPCC, 2007) - The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

Risk (UNDP, 2004) - The combination of the probability of an event and its consequences (UNISDR, 2009). This definition is consistent with that used in ISO/IEC Guide 73. Some climate change glossaries consider vulnerability a part of risk, for example the UNDP guidance defines climate related risk as the result of the interaction of physically defined hazards with the properties of the exposed systems, e.g., their sensitivity or (social) vulnerability. Risk can also be considered as the combination of an event, its likelihood, and its consequences, e.g., risk equals the probability of climate hazard multiplied by a given system’s vulnerability.

Scenario (IPCC, 2007) - A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from *projections,* but are often based on additional information from other sources, sometimes combined with a “narrative storyline”.

Sector (Snover et al, 2007) - A general term used to describe any resource, ecological system, species, management area, activity, or other area of interest that may be affected by climate change. General examples include forests (a resource), wetlands (an ecological system), salmon (a species), water supply (management area), agriculture (an activity), or human health.

Sensitivity (IPCC, 2007) - Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).

System (Snover et al, 2007) - Refer to the built, natural, and human networks that provide important services or activities within a community or region. Built systems can refer to networks of facilities, buildings, and transportation infrastructure such as roads and bridges. Natural systems can refer to ecological networks of fish, wildlife, and natural resources like water. Human systems can refer to networks of public health clinics, courts, and government.

SRES (IPCC, 2007) - The storylines and associated population, GDP and emissions scenarios associated with the Special Report on Emissions Scenarios (SRES) (Nakićenović et al., 2000), and the resulting climate change and sea-level rise scenarios. Four families of socio-economic scenario (A1, A2, B1 and B2) represent different world futures in two distinct dimensions: a focus on economic versus environmental concerns, and global versus regional development patterns.

- The **A1** storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B).
- The **A2** storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines.
- The **B1** storyline and scenario family describes a convergent world with the same global population that peaks in midcentury and declines thereafter, as in the A1 storyline, but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.
- The **B2** storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

Statistical downscaling (UNFCCC) - Downscaling is a method for obtaining high-resolution climate or climate change information from relatively coarse-resolution Global Climate Models (GCMs). Typically, GCMs have a resolution of 150-300 km by 150-300 km. Many impacts models require information at scales of 50 km or less, so some method is needed to estimate the smaller-scale information.

Statistical downscaling first derives statistical relationships between observed small-scale (often station level) variables and larger (GCM) scale variables, using either analogue methods (circulation typing), regression analysis, or neural network methods. Future values of the large-scale variables obtained from GCM projections of future climate are then used to drive the statistical relationships and so estimate the smaller-scale details of future climate.

Stakeholder (IPCC, 2007) - A person or an organisation that has a legitimate interest in a project or entity, or would be affected by a particular action or policy.

Uncertainty (IPCC, 2007) - An expression of the degree to which a value (e.g., the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g., a range of values calculated by various models) or by qualitative statements (e.g., reflecting the judgement of a team of experts).

Vulnerability (IPCC, 2007) - Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Vulnerability indicators (Ribeiro et al, 2008) - An observable variable that provides some indication of the possible future harm a system of interest is facing.

Adaptation to climate change: key issues

What is adaptation to climate change?

Adaptation to climate change is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Climate change increases temperatures and modifies precipitation patterns, resulting in a wide variety of consequences such as sea level rise, melting of glaciers, reduction/loss of terrestrial and marine biodiversity, increase in the risk of coastal erosion and in the occurrence and severity of weather-related disasters, decrease in water resources availability and many others. These changes will likely affect also a number of socio-economic sectors such as agriculture, forests, fisheries and aquaculture, energy, infrastructure, tourism and health.

Two types of responses are required in order to address climate change: **mitigation** and **adaptation**. The first one deals with the causes of climate change and therefore aims at reducing greenhouse gas emissions (GHGs), while the second one deals with the unavoidable consequences and aims at reducing the vulnerability to climate change (EC, 2009).

Figure 2 illustrates the conceptual diagram describing the different approaches used by mitigation and adaptation: while the first one focuses on the strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks, the second one aims to reduce the vulnerability of systems to climate change by reducing

the potential impacts, or by increasing adaptive capacity. The figure illustrates also the interrelations existing between climate change impacts, adaptive capacity and vulnerability.

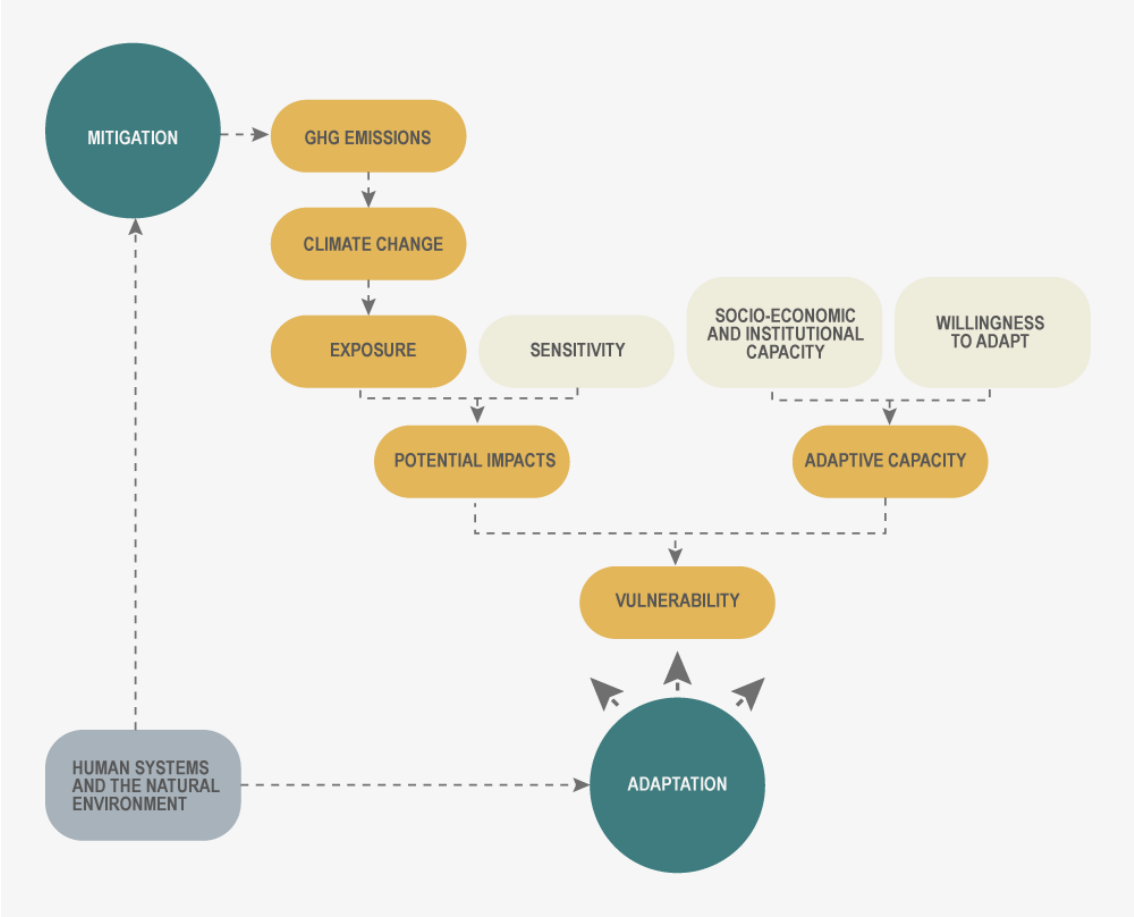

Figure 2 - Conceptual diagram for climate change impacts, vulnerability and adaptation (EEA Report, N 4/2008 (Ch.6. Adaptation to climate change; Figure from Isoard, Grothmann and Zebisch (2008)).

As defined by the Intergovernmental Panel on Climate Change adaptation to climate change is “the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

- anticipatory adaptation – adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
- autonomous adaptation – adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- planned adaptation – adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state”.

Depending on the timing, in addition to being anticipatory, adaptation may be also reactive, when it occurs after the initial impacts of climate change become evident. In

natural systems adaptation is reactive by nature, while in human systems it can be both reactive as well as anticipatory.

In other words, adaptation consists of actions altering our behaviour to respond to current and future impacts and vulnerabilities and is addressed to anticipate and protect against the adverse effects of climate change, to prevent or minimise the damages it can cause, as well as take advantage of any benefits.

Adaptation is a cross-cutting issue since it aims at enhancing resilience to climate change impacts which affect several economic sectors in Europe, such as water management, agriculture, forestry, health, energy, transport, tourism, fisheries, as well as natural resources and the ecosystems based services (EEA, 2008).

Early action will save on damage costs later: the earlier we implement adaptation responses, the less it will cost to address climate change in the future and the better equipped we will be in order to cope with challenges coming from climate change - "*for every 1€ spent in disaster prevention, we save 4-7€ in disaster*" (EC, 2013).

Adaptation policy design requires considerations in time-horizon ("when"), spatial ("where") and decision-level ("how") terms: in fact, there is a need to assess the location of current and future impacts; to identify people, resources, sectors at risk; to gather information about the timeframe of impacts; to define and implement appropriate adaptation actions at appropriate levels of decision-making (EEA, 2013).

Why do we need to adapt?

There are many reasons why we need already to adapt: climate is already changing; climate change impacts are already occurring even more quickly than predicted; near-term significant reduction of GHGs is unlikely; climate change impacts will occur long after the GHGs are stabilized; without action, the impacts of climate change will increase rapidly and some changes will be irreversible; delaying action will only exacerbates the - economic, environmental, social – costs; early action will allow to take full advantage of the opportunities arising from climate change.

There are many reasons why we need already to adapt to climate change.

Climate is already changing. As the IPCC states in its Fourth Assessment Report on Climate Change (IPCC, 2007a) " leading to very high confidence that the global average net effect of human activities since 1750 has been one of warming " and also "..warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level ". An increasing amount of physical evidences demonstrates that warming of climate system is already occurring as a likely consequence of the greenhouse gases accumulation in the atmosphere to date.

Climate change impacts are already occurring even more quickly than predicted. As the IPCC states in its Fourth Assessment Report on Climate Change (IPCC, 2007b)

"observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate change, particularly temperature increases" and "a global assessment of data since 1970 has shown it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems". Climate change impacts are already occurring and are being experienced even more quickly than predicted. The severity of impacts varies by region. In Europe, the most vulnerable regions are Southern Europe, the Mediterranean Basin, Outermost regions and the Arctic. Furthermore, mountain areas in particular the Alps, islands, coastal and urban areas and densely populated floodplains are facing particular problems (EC, 2009).

Short-term significant reduction of GHGs is unlikely. Approximately, 75% of CO_2 emissions to the atmosphere over the past 20 years are due to fossil fuel burning (IPCC, 2001a). Our global economic system is strictly dependent upon fossil fuels and it seems that the time required in order to adopt new technologies and convert fossil fuels use into a global clean energy economy is significant. For these reasons, any significant reduction in GHGs emissions appear to be unlikely to occur soon enough to avoid many of the projected climate change impacts (Snover et al, 2007).

Climate change impacts will occur long after the GHGs are stabilized. Even in the case that the world governments will succeed soon in reducing dramatically GHGs emissions, our planet will take time to recover from the GHGs already emitted in the atmosphere. In fact, GHGs remain in the atmosphere for tens to thousands of years before breaking down, thus continuing to trap energy and cause warming. Furthermore, due to the "lag time" of the Earth's atmosphere and oceans to warm, a new equilibrium of these systems and the whole planet, will be reached in hundreds of years.

A further climate change is therefore inevitable, regardless of the success of emissions reduction efforts. In fact, many of the changes projected for the middle of the 21st century will be due to the present-day GHG concentrations. Therefore, reducing GHGs will limit the occurrence and the severity of long term impacts, but will not prevent from the short-term effects (Snover et al, 2007).

Gas	Lifetime
Carbon dioxide (CO_2)	5 to 200 years
Methane (CH_4)	12 years
Nitrous Oxide (N_2O)	114 years
Sulfur Hexafluoride (SF_6)	3.200 years
Carbon Tetrafluoride (CF_4)	50.000 years

Table 1 - Greenhouse gases lifetimes: average amount of time an emitted gas will spend in the atmosphere before being chemically broken down, absorbed into the ocean, or removed from the atmosphere (Snover A. K. et al, 2007).

Without action, the impacts of climate change will increase rapidly and some changes will be irreversible. Both global and regional climate models project for the coming decades an increase in temperatures, a decrease in precipitation and an increase in

the frequency and intensity of extreme climate events. Without taking an immediate action, climate change will likely lead to some irreversible losses, in terms of species, habitat, ecosystems, and many other natural resources, with relevant consequences also on our societies and economies. It is therefore urgent to act in order to avoid these losses.

Delaying action will only exacerbates the - economic, environmental, social - costs. It has been demonstrated that costs of taking immediate action to address climate change, both in term of mitigation and adaptation, will be much lower than the costs of inaction over the medium to long-term (EC, 2009; Stern, 2006). Planning in time may therefore help reduce the costs, while also allowing to take full advantages of the opportunities arising from climate change – e.g. the possibility to cultivate new varieties or the ability to generate new business opportunities.

Who needs to adapt?

Adaptation is needed at all levels of administration, from the local up to the international level. Cities, in particular, should be central in the process of adaptation to climate change.

Adaptation is needed at all levels of administration, from the local level up to the international one. Even if climate change is a global issue, communities, regions and states will experience climate change impacts to different degrees and in different ways. The ability to cope and adapt to climate change will depend on the varying severity and nature of climate impacts between regions and will vary across populations, economic sectors and regions in Europe.

If mitigation is a global concern, adaptation is undoubtedly a local issue.

Nobody and nothing will be spared; no person, people or nation. Individuals, organizations and governments will have therefore to identify their own best solutions if they would like to succeed under a changing climate (EC, 2009).

Different vulnerable systems at different geographic levels will require different approaches: adaptation options have to be tailor-made to the specific geographic area considered in terms of vulnerable landscape types (e.g. coastal areas, wetlands and rivers, mountains and glaciers, the Mediterranean, etc.) and sectors involved. While higher levels of governments can and must provide funding and support for adaptation, local, regional and state governments have the responsibility to plan proactively and implement adaptation, by tailoring adaptation strategies to their specific context.

Cities increasingly take the centre stage in worldwide development, both politically, economically, culturally, and ecologically. In environmental terms some of the challenges are brought about by issues related to the rate and magnitude of a changing climate, the potential for non-linear changes and the long-time horizons. Scientific knowledge and understanding of these issues are limited by substantial uncertainties and fundamental limits to predictability, which complicates planned adaptation. The fact that knowledge of future climate is not yet complete represents

itself a new challenge. Cities are therefore central in the process of adaptation to climate change for several reasons, as follows[12].

Cities are highly vulnerable to climate change. Around three quarters of Europe's population live in urban areas (EEA, 2012a). Cities are at the same time economic centres, thus driving the vast majority of the energy use and contributing to global GHGs emissions, and the places where a highly concentrated population will be vulnerable to the effects of climate change, due to sea level rise, storm surges, flooding, heatwaves, etc. Vulnerability is thus a context-specific issue, that shapes the way in which people can respond to the impacts to climate change.

Climate change impacts are manifested locally. While climate change is commonly perceived as a global issue, leading to the increase in the global temperature, its effects have a local dimension thus affecting local livelihood, economic activities, health risk, and many other environmental, social and economic systems. Thus a global problem is translated into local phenomena on the basis of various environmental, social and economic factors (Snover et al, 2007). Climate change will interact with existing urban problems, thus worsening some problems and/or creating new ones (Ecologic Institute et al, 2010).

The city administration is closest to the population. The closest administrative body to citizens is the city administration which has the responsibility of several areas related to adaptation. Therefore local administration can facilitate the participation of different actors and people that at individual level are involved in promoting solutions.

The main benefits of adaptation are at local level. Unlike mitigation, adaptation action is focused at local level and its benefits are perceived directly at local level (Snover et al, 2007).

[12] See Johnson and Breil, 2012.

1.
GET STARTED

This chapter is intended to guide the reader during the initial steps towards adaptation to climate change, from the organizational and technical side to the political commitment of policy makers. The real success of an adaptation strategy or plan will strongly depend on the proper setup of the various aspects involved (e.g. organizational, technical, political, financial, etc.). In fact, a climate change adaptation plan is only likely to be successful if it is developed by a cross-departmental team.

Furthermore, in order to launch and implement an effective climate change adaptation process political backing and early and long-term commitment from policy makers should be guaranteed at local level, by involving the most senior officers in the local authority, such as the Mayor and the high-level politicians. A key approach for this purpose is to actively involve them as much as possible in preparing the Plan and not just keep them informed.

Before starting it is important to take the right initial decisions in order to pave the way to the further future steps (e.g. adaptation plan or adaptation and mitigation plan? top-down or bottom-up approach?) and build the critical foundation on which the later stages of the adaptation effort will be based. Last but not least is the financial aspect. Developing ways to pragmatically raise financial capital for urban adaptation is essential for effective adaptation resource mobilization and allocation from both a public and private sector point of view.

1.1 Secure the organizational and technical management

A climate change adaptation process is likely to be successful if it is developed by a cross-departmental team. Establishing an interdisciplinary team and identifying a leader represents the first step in order to secure an appropriate organizational and technical management.

A climate change adaptation process is likely to be successful if it is developed by a cross-departmental team. In some cases, an inter-departmental working group on climate change may already be active at local level but in the most cases a clear leadership on this issue may be lacking since adaptation is new to local policies. In any case, establishing an interdisciplinary team and identifying a leader will be the first step in order to secure an appropriate organizational and technical management.

The ideal **team leader** will be selected among public officials, or their advisors, and will be required to:

- communicate well with colleagues from other departments;
- involve stakeholders;
- build and maintain the political support for adaptation;
- collect information and data;
- draft documents and have a good knowledge of the organization's responsibilities and competencies;
- set goals, objectives and targets,

and many other activities.

Briefly, the team leader will act as a general focal point with overall responsibility for coordination and communication (Snover et al, 2007). In cases of lack of a clear leadership on this issue, leaders outside the administration may also be engaged in order to validate the internal effort. For example, they could be already committed to other environmental issues and be willing to expand their focus to include climate change adaptation.Planning for the impacts of climate change will mean being able to manage many natural resources and human systems.

One or two people may not be sufficient to accomplish the adaptation objectives. Defining a climate change **adaptation team** with representatives from across a number of policy areas will be therefore vital in order to oversee, coordinate and advocate for adaptation efforts.

The team composition will vary in number and background of the members and will depend on several factors, such as the specific impacts likely to occur in the area, the services, infrastructure and policies that will be affected, the way how the local government intends to involve other administrations, engage stakeholders, and raise awareness of the citizenship. At least one representative from each sector which is likely to be affected by climate change may be identified (Table 2).

EXPERTISES POTENTIALLY NEEDED FOR AN ADAPTATION TEAM	
Climate science	Energy
Water resources	Fisheries and aquaculture
Terrestrial and marine biodiversity	Public health
Soil degradation and desertification	Emergency management
Forestry	Sustainable development
Flooding	Urban planning
Landslide	Infrastructure and transportation
Coastal and marine environment	Cultural heritage
Agriculture	Insurance
Tourism	Economics of climate change

Table 2 - Examples of expertises that may be included in an adaptation team (Adapted from Snover et al, 2007).

Experts from different field such as vulnerability and adaptation assessments, climate science, as well as individuals with experience in environmental, social and economic issues will have the appropriate skills and characteristics to be part of the adaptation team.

The primary responsibility of the adaptation team will be to guide the local authority through the whole adaptation process: vulnerability and risk assessment, identification of adaptation priorities, definition of the adaptation objectives and goals, development of the plan are some examples of the activities that the team will have to carry out.

In order to establish a common language and understanding among team members, it will be useful that the team members share their knowledge on what is currently known about climate change, which the major projected impacts are, which national, regional and local policy framework are in force and the way how to develop the adaptation process (Snover et al, 2007).

The number of the team's members may change over time on the basis of specific requirements (Ribeiro et al, 2008). Between a step and an other a periodical check could be useful in order to verify whether the team is still appropriate for its purpose or if additional members may be needed. A clear **team mandate** will help give legitimacy and authority to the work that it will carry out (Example 1).

EXAMPLE 1

DEVELOPING A TEAM MANDATE

The City of [ ] Adaptation Team was created by [ ] to research, draft and implement our community's Adaptation Plan. The Team is led by [Team Leader Name] the [Team Leader Title] for

the City of [...].
Our purpose is to collect information on climate change impacts and offer expert advice to Council on the most credible and economically viable options for adapting to climate change through the creation and implementation of our community's adaptation plan.
Team members must commit to monthly meetings for a minimum of [Time] hours each in addition to project specific tasks to be determined by the group. The Adaptation Team, on behalf of the community at large, has committed to an ongoing process of monitoring and review for the duration of the project (approximately two years).

Source: ICLEI, Workbook for Municipal Climate Adaptation.

ACT EXPERIENCE 1

CAPACITY BUILDING OF LOCAL ACTORS

(A. Capriolo, F. Giordano, R. A. Mascolo - ISPRA, Life ACT Project 2010).

Figure 3 - Capacity building activities during the LIFE ACT Project.

In order to overcome the initial barrier due to lack of a common language and understanding of climate change, a capacity building activity among the partners (local authorities) of the Life ACT Project have been performed in order to create a common and shared knowledge basis. For this purpose four thematic workshops have been organized during the initial phase of the project:

1. *Climate change scenarios and downscaling* (time series analysis and current climate trends estimates, global and regional climate models scenarios, downscaling, projections of relative sea-level rise);
2. *Assessment to climate change impacts and local vulnerabilities* (natural risk, coastal environment, biodiversity, health, soil, infrastructure, historical and cultural heritage, agriculture and forestry, fisheries, tourism, economic impact);
3. *Definition of adaptation strategies* (European and Member States level framework, overview of regional/local guidelines, strategies and plans);
4. *Definition of actions and adaptation plans* (Case studies: Spanish National Adaptation Plan and Climate change strategy of the Murcia Region).

Based on the methodological framework provided during the workshops and the knowledge gained by the partners, participants have been split into three working groups and have been asked to run through again the assessment process illustrated during the workshops. Discussion among the participants have thus focused on the main threats posed by climate change to communities, the vulnerability of communities to climate change, the options that communities have to adapt to climate change.

1.2 Ensure political interest and commitment

Gaining political backing and securing early and long-term commitment from policy makers at local level is extremely important for launching an effective climate change adaptation process. Time spent in building political support can be extremely valuable in helping achieving the adaptation objectives.

Several factors can motivate adaptation to climate change and encourage to undertake adaptation actions, such as for example:

- the exposure to a recent extreme weather event (e.g. flood, heatwaves);
- the need to protect economic well-being or to enhance public safety in the face of weather-related impacts;
- a requirement from the government;
- the willing to progress on adaptation, after mitigation;
- the foresight in identifying positive opportunities and gaining an "early mover" advantage (*http://www.ukcip.org.uk/essentials/adaptation/good-adaptation*)

In general, the decision to adapt is driven by a mix of climate- and non-climate-related factors. Exogenous drivers could be represented by national and regional adaptation policies, while endogenous drivers could be related to the vulnerability of key economic sectors or the political will, awareness and commitment of the local administration, etc. (Swart et al, 2009).

Since adaptation is a new issue in many countries, regions, sectors and organizations, the start of adaptation process is not easy and very much depends on skilled and motivated individuals with a sufficient leadership to drive such processes (Prutsch et al, 2010). However, without political acceptance and backing to the adaptation Plan, its implementation may never take place due to consequent inaction.

Gaining political backing and secure early and long-term commitment from policy makers at local level is therefore extremely important for launching an effective climate change adaptation process. The commitment should involve possibly the most senior officers in the local authority: the mayor and the high-level politicians.

These people should not only be informed but also actively involved as much as possible in preparing the plan. As a general rule, it can be stated that time spent in building political support can be extremely valuable in helping achieving adaptation objectives.

However, decision makers at various levels are not always adequately aware about climate change and its impacts and adaptation needs. For this reason, it could be useful to establish a **clear message** describing relevant issues such as, for example, the changes that have already been observed and the future risks associated to climate change, illustrating the potential impacts that may affect the community and explaining the need for policy makers to take responsibility in building society and ecosystems long-term capacity to adapt to climate change (Prutsch et al, 2010). For

example, the availability of a Local Climate Profile for this purpose could prove to be an effective tool for organisations and a catalyst to further awareness and action (http://www.ukcip.org.uk/lclip/). Given the complexity of the issue, the message should be scientifically sound but simple and easy to understand in order to maximize the communication effort. Fact sheets or presentations concerning climate change and its impacts may be available online and could be adapted for specific purposes, such as meetings, brochures, websites, etc. (Snover et al, 2007).

1.3 Establish a vision and guiding principles

A vision can be considered as a statement that expresses where a community would like to be in the future and should be established through a participatory process.

USEFUL QUESTIONS

- ✓ *What am I trying to accomplish with my climate change adaptation plan?*
- ✓ *What does a well adapted community look like to me?*

Establishing a **common and shared vision** is a way for the community to integrate the adaptation objectives and principles into the wider vision of the community and may help to set specific adaptation goals and objectives in a successive step.

A vision can be considered as a statement that expresses where a community would like to be in the future and should be established through a participatory process. Within an adaptation planning process, a clear vision can help to establish what an adaptive community looks like. A vision statement also could represent a call to action and could be a catalyst to inspire change.

It is important to take into account that "*adapting to climate change is not about making the community "climate proof", but rather making it climate resilient"*. In this sense, the community will take proactive steps to prepare for projected climate change impacts (e.g. reduce the vulnerabilities and risks associated with).

A common and shared set of guiding principles for resilience could be useful in order to achieve this vision (Example 2).

EXAMPLE 2

RECOMMENDED GUIDING PRINCIPLES (GP) FOR ACHIEVING A CLIMATE RESILIENT COMMUNITY
GP 1: increase public awareness of climate change and its projected impacts on the community
GP 2: increase your technical capacity to prepare for climate change impacts
GP 3: mainstream information about climate change vulnerabilities, risks, and adaptation into planning, policy, and investment decisions
GP 4: increase the adaptive capacity of built, natural, and human systems in the community
GP 5: strengthen community partnership that reduce vulnerability and risk to climate change impacts
Source: Snover et al, 2007.

1.4 Take the first decisions

Before starting an adaptation process appropriate decisions should be taken in order to pave the way to the further future steps (e.g. should I prepare an adaptation plan or and adaptation and mitigation plan? should I adopt a top-down or a bottom-up approach?) and build the critical foundation on which the later stages of the adaptation effort will be based.

1.4.1 Adaptation vs Adaptation and Mitigation Plan

There is high confidence that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change (IPCC, 2007c).

USEFUL QUESTIONS

- ✓ *Would I keep adaptation and mitigation as separate process?*
- ✓ *Which are the synergies and conflicts between adaptation and mitigation?*
- ✓ *Would I integrate adaptation and mitigation actions?*

One of the first relevant decisions to take will concern whether to prepare an integrated adaptation and mitigation plan or to keep the two issues in separate approaches. Cities contribute significantly to greenhouse gas emissions and are also at high risk due to climate change as they are the place where human population concentrates with its economic, social and cultural activities. For this reason, urban planning represents an important mean both for mitigation and adaptation, with the potential of linking the two. Nevertheless, when thinking about climate change local governments think first to mitigation and then, eventually, to adaptation which is the other half of the issue. Local governments could make their efforts more effective by considering actions that will provide benefits for achieving both types of objectives.

As the IPCC Fourth Assessment notes: “There is high confidence that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change”.

Therefore, three possible approaches can be taken when starting to plan for adaptation:

1) local governments that still have to start their climate action planning could develop a single plan combining both mitigation and adaptation actions;
2) local governments that have already carried out their emissions inventory could make a local impact assessment before selecting the mitigation actions in order to address both types of goals;
3) local governments that are already working to develop a mitigation plan could commit themselves in adaptation planning as the second phase of their climate protection policy. Adaptation actions could maximize co-benefits and in some cases reveal that mitigation actions may work against adaptation goals. In this second situation those actions should be avoided.

The European Commission intends to continue to promote urban adaptation strategies, through three specific actions: action 1) encourage all Member States to adopt comprehensive adaptation strategies; action 2) provide LIFE funding to support capacity building and step up adaptation action in Europe (2013-2020); action 3) introduce adaptation in the Covenant of mayors framework (2013-2014), (EC, 2013b).

1.4.2 Planning and policy horizons

For successful adaptation strategies and plans, planning and policy horizons and their time scales must be acknowledged.

USEFUL QUESTIONS

- ✓ *Is climate change likely to occur with this planning horizon?*
- ✓ *How soon are impacts likely to arise (or have they already arisen)?*
- ✓ *For how long are impacts likely to endure? (UNDP, 2004).*

For successful adaptation strategies and plans, planning and policy horizons must be acknowledged. While **planning horizons** relate to the lifetime of decision-making associated with a particular activity, **policy horizons** are referred to the period of time over which a particular policy is planned to be implemented. Therefore, the two time scales could be different.

As illustrated in the Table 3, an infrastructure (e.g. dam, waste water system, etc.) could have a lifetime of many decades (30-50 years), but the policy horizon governing the operation of that infrastructure may be shorter.

Area	Time scale (years)
Water infrastructure	30-200
Land-use planning	>100
Coastline and flood defences	>50
Building and housing	30-150
Transportation infrastructure	30-200
Urbanism	>100
Energy production	20-70

Table 3 - Areas with long planning horizons (Adapted from UNDP, 2004).

In general, natural resources policies are implemented over periods of 5-10 years and are reviewed or updated over time but are expected to manage resources over a much longer planning horizon.

Time scales of climate change projections are clearly beyond society's time frame for making decisions about the future: as an example, municipalities have annual or biannual budgets and have not therefore the capacity to plan and implement adaptation strategies over long time scales. Furthermore, people who are required to make economic sacrifices today - without having benefits directly – may lack the incentives to implement long-term adaptation strategies.

Planning in areas with short horizons will require short-term, no regrets type strategies in order to manage the problem of uncertainty in climate change adaptation, thus avoiding making irreversible or wrong decisions for the future. However, not all topics affected by climate change will be manageable within a short planning horizon and sometimes areas with long planning horizons are the ones most in need of immediate actions. Thus, ignoring strategic objectives in favour of exclusively short-term management may lead to incremental changes resulting in irreversible outcomes.

1.4.3 Top-down and bottom-up approaches

Top-down frameworks are designed to help understand the potential long-term impacts of climate change - using global models - whereas bottom-up frameworks are intended to focus on adaptation primarily at local level.

USEFUL QUESTIONS

- ✓ *What are the key long-term impacts of climate change?*
- ✓ *How adaptation can reduce the negative effects of climate change?*
- ✓ *What can a community do in order to adapt to climate change?*
- ✓ *How to better develop and apply adaptation policies?*

At the time of preparing the ground for an adaptation process, two different approaches must be taken into consideration: the "*top-down*" and the "*bottom-up*" approaches. The most common way of thinking about the difference between the two approaches is that **top-down** frameworks are mainly designed to help understand the potential long-term impacts of climate change (using global models), whereas **bottom-up** frameworks are more focused on adaptation primarily at local level (UNFCCC, Resource guide for preparing the National Communications of non-Annex I Parties).

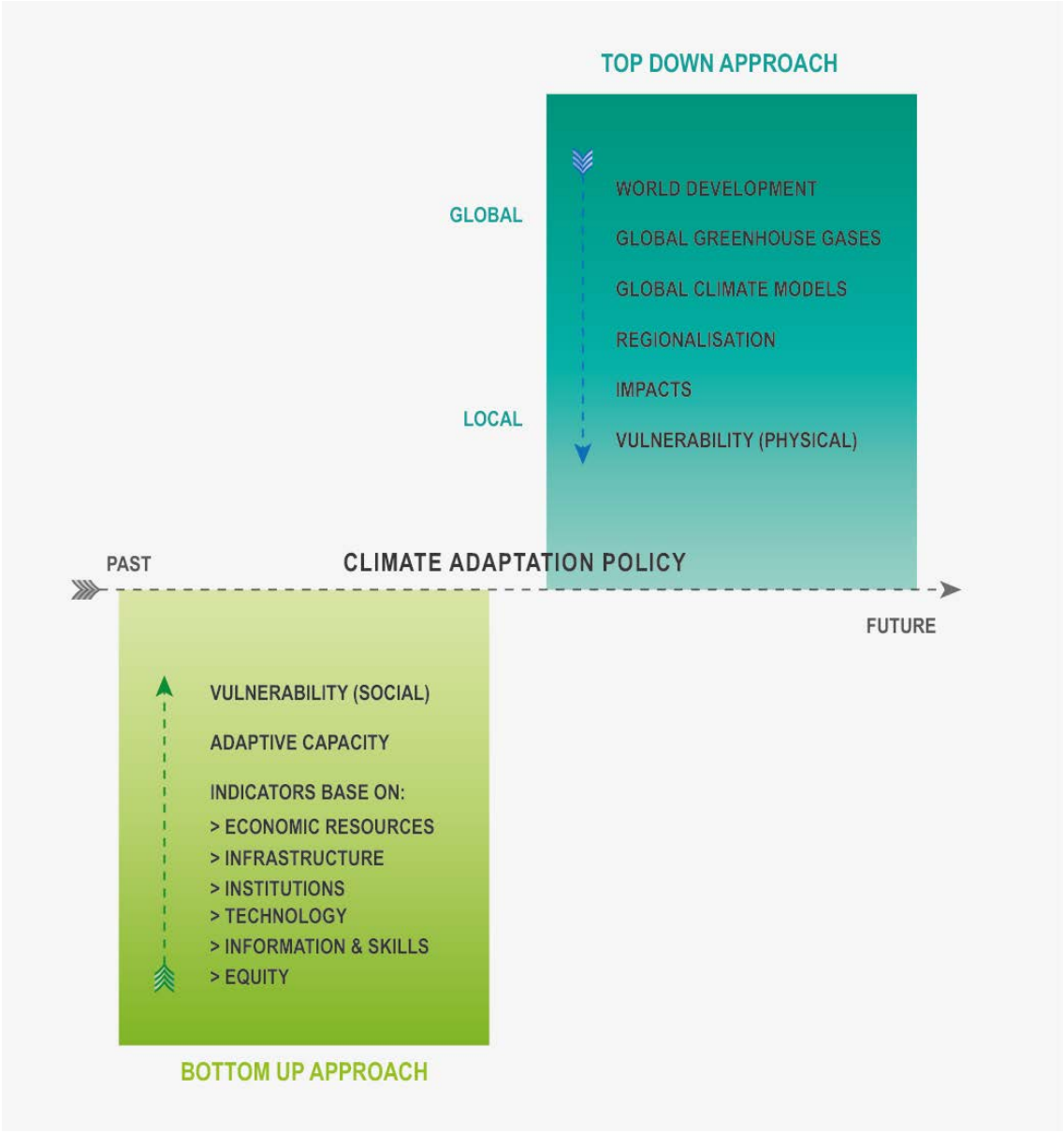

Figure 4 - Top-down and bottom-up approaches used to inform climate adaptation policy (Swart et al, 2009).

The two approaches are not contradictory but complementary, and they clearly have different characteristics as well as strengths and weaknesses (Table 4 and 5).

TOP-DOWN APPROACH	
Relevant questions	• *What are the key long-term impacts of climate change?* • *How adaptation can reduce the negative effects of climate change?*

Spatial domain	From general (global) to particular (vulnerability-physical).
Conceptual approach	The approach is guided by science, which identifies the future climate change and its impacts and derives the consequences in terms of physical vulnerability. Vulnerability is therefore intended here as a result of climate change.
Type of goal	Actions to reduce impacts and risks under future climate.
Scenarios	Climate scenarios are the fundamental basis for the assessment of climate change impacts. Socio-economic scenarios are the fundamental basis for the assessment of the economic value and the social cost of damages to people and assets caused by climate change. The estimate of probability of impacts would be very useful in this context.
Method and tools	Modelling the impacts of climate change to the highest degree of precision possible, which certainly requires probabilities, and then devising adaptation strategies to reduce exposure to the increased hazard. Methods and tools such as downscaling, sectoral impact models.
Type and scale of the unit of analysis	It is concerned with physical or natural exposure units (e.g. watersheds, ecosystems, irrigation projects, buildings, etc).
Timescale and planning horizons	It has traditionally focused on the mid- and long-term horizon (e.g. 2050s or 2080s), which leads to a mismatch of information requirements. Planning horizons are also important because if the exposure unit being considered has a long planning horizon (e.g. dams, bridges or roads), then estimates of likelihood of climate change could help strategic adaptation decision-making, especially to prevent irreversible damages.
Adaptation options	Adaptation options are based on the results of scenarios. However, it could happen the climate change will not be as it has been predicted, and so the adaptation measures could reveal to be inadequate. In fact, in this case vulnerability has been only based on climate factors. Adaptation measures will take into account only climate change and will need to be added or introduced into development plans and programs.
Development status of the area	Most developed countries are perceived as being more resilient (less vulnerable) to climate variability and change than developing countries are. Because of this perception, it is easy to understand why prediction-oriented studies have been largely preferred to vulnerability-based studies in developed countries.
Type of adaptation that would benefit of this approach	In case of anticipatory, planned and strategic adaptation, which is usually undertaken by public decision-makers, probabilities of climate change could potentially be very helpful.

Table 4 - The top-down approach (Dessai, 2004; Ferrara and Farruggia, 2007).

BOTTOM-UP APPROACH	
Relevant questions	• *What can a country or a community do in order to adapt to climate change*? • *How to better develop and apply adaptation policies*?
Spatial domain	From particular to general.
Conceptual approach	Vulnerability is the starting point. Current vulnerability is due to various factors and is independent of climate change. But climate change could further modify it. As a consequence, vulnerability should be faced from different perspectives, in which climate change is included. Starting from the local dimension, the approach allows the identification of local deficiencies also in terms of technical, organizational and institutional skills and provides useful information on how to improve the adaptive capacity.
Type of goal	Actions to reduce vulnerability
Scenarios	Socio-economic scenarios
Method and tools	It combines the current and future vulnerability to climate change assessment to non-climatic factors, intensively involving key stakeholders. Vulnerability indicators.
Type and scale of the unit of analysis	It is addressed to social exposure units such as households, communities, or in some cases small nations or all nations. The focus is more centred on the social and economic well-being of society.
Timescale and planning horizons	It mainly focuses on the past and present conditions to inform policy-making today and in the short-medium term. Many social exposure units have short planning horizons or turnover times and these do not require probabilities of climate change; for example, governmental, institutional or business policy mostly focus on the short term.
Adaptation options	Dynamic planning policies are required in order to integrate current policies with changes that climate will produce on environmental and socio-economic assets. Adaptation options mainly aim at modifying existing policies aiming at reducing vulnerability in order to take into account climate change.
Development status of the area	As numerous developing countries are presently vulnerable to climate variability, it makes more sense to look at the processes that create this vulnerability rather than make predictions of the (long-term) future. There is also some evidence that some developed country decision-makers have not found climate change scenarios useful for planning. Instead they have used past drought conditions as worst-case scenarios for planning.
Type of adaptation that would benefit of this approach	Autonomous, responsive, instantaneous adaptations undertaken mainly by private decision-makers (e.g. behavioural changes), are a different type of adaptation that will also take place under a changing climate. This sort of adaptation would probably not benefit from probabilities of climate change because it is based on experiencing climate hazards and responding to them, rather than planning in advance based on probabilistic information. These adaptations refer mainly to human and managed ecological systems. It is

	also clear that probabilities will be irrelevant for adaptation in unmanaged ecological systems.

Table 5 - The bottom-up approach (Dessai, 2004; Ferrara and Farruggia, 2007).

Elements of top-down and bottom-up approaches are increasingly combined together, as well as local knowledge and scientific knowledge; reducing vulnerability and addressing impacts; specific responses and managing uncertainty (IPCC, 2007b). Anyway, since many adaptation actions are already taking place autonomously at the local level, a bottom-up approach could be considered more adequate for designing a city adaptation strategy and/or plan.

1.5 Secure financial resources

Developing ways to raise financial capital for urban adaptation is essential for effective adaptation resource mobilization and allocation from both a public and private sector point of view.

The World Bank recently released a report estimating that up to 80 percent of the expected $80-100 billion per annum of climate change adaptation costs will be borne by urban regions (World Bank, 2010). These estimates highlight the extent to which the urban dimension of adaptation may easily account for the largest share of long-term climate change adaptation cost.

Developing ways to more pragmatically raise financial capital for urban adaptation is essential for effective adaptation resource mobilization and allocation from both a public and private sector point of view.

Adaptation and resilience will initially add a further dimension of complexity into already complex urban development projects, where the primary risk management focus has been reducing liabilities and ensuring short-term financial returns to developers and builders. Introducing resilience as a new performance requirement into the conventional process of upgrading specific urban districts and service systems involves the addition of measures that have not historically been associated with ways of creating new property value or revenue streams. Cities can begin to consider how adaptation investments can improve their economic performance and attractiveness to outside investors, by increasing the reliability of their infrastructures.

Most of the market-based value in an urban area is primarily found in its real estate. This attractiveness, or performance, of an area is reflected in the amount and variety of private investment in local property development in decisions of companies to locate an office or retail outlet in an area and in the cost of capital for municipal development corporations and public utility companies that are developing that area.

The level of value of an individual property asset is directly a function of the performance of the location. That is the attractiveness and reliability of the location for residential, retail, and other commercial activities and the revenue streams they produce. Basic utilities, such as water and energy services, offer additional revenue streams that can attract private investment for upgrading activities. Basic infrastructure, such as a drainage system, a road system, or a retention wall, underpins local value, but does not generally provide a direct investment opportunity. In other words, the ability of adaptation or resilience projects to attract private investment is generally linked to the integration of these non-revenue producing projects with a broader upgrading or re-development strategy for an area. This effective mainstreaming of green performance criteria into urban product design, becomes a way to increase property value and secure higher rents and profit margins in these rents. 'Building green' is a way to optimize return on assets by reducing operating costs and by offering higher quality living spaces and work environments.

On the basis of different risk-reward profiles and performance of these resilience measures in reducing risks (within the context of different types of conventional urban re-development or upgrading projects) specific financing instruments could be designed to create diversified, scaled options for direct or integrated investments (Table 6). The instruments could each be tailored to a targeted class of measures that share a similar risk-reward profile. The instruments might take the form of portfolio-based loans, catastrophe bonds, re-insurance, securitization, or other structured finance instruments. In this way, much larger private capital flows could be sourced for adaptation and other kinds of disaster risk reduction.

Sample Investors	Benefit from direct investment	Benefit from other, integrated investments
International Adaptation Fund	Upgraded storm water drainage and retention system. Reduced flood risk and damage	Permeable surfacing reduces size/cost of upgrade. Street & BRT contribute to planned drainage pattern
Local Roads Department (Municipality)	Upgraded street & sidewalk grades. Permeable surfacing. A greener more user friendly streetscape	Reduced manteinance cost due to reduced flood risk. Reduced traffic congestion/increased emergency access due to separated bus lane
Local Property Developer	Community center (cum emergency shelter) in new commercial/retail building.	Increased development height allowance in exchange for center. Increased property value and shopping trips due to reduced congestion & risk.
Regional Transportation Department (Sub-national Government)	Separated, above-grade BRT Water retention, wall abutting residential area	Reduced planning cost / increased routing efficiency due to community permission in exchange for retention wall

Table 6 - Efficiency and performance synergies from integrated upgrading (ICLEI, 2011).

There are multiple types of investment, ranging from investment in development institutions, in specific measures and fixed assets, and in local capacity building and technical support. Each type of investment reflects a different "investment proposition", as described in the left column of Table 7, and seeks a different kind of performance

outcome. To secure finance, the project proponents must prepare robust performance propositions for prospective investors, in the form of business plans, investment prospectuses, contracts, or capacity-building proposals. Different types of financial instruments are available or must be created to structure the finance for the different performance propositions this results in the use of a mix of financial instruments for each project. In this way, specific instruments tend to be used for financing specific kinds of project deliverables. It is this matching between instruments and measures/deliverables that provides the opportunity, for investment recruitment purposes, to create portfolios of similar measures across multiple cities and projects.

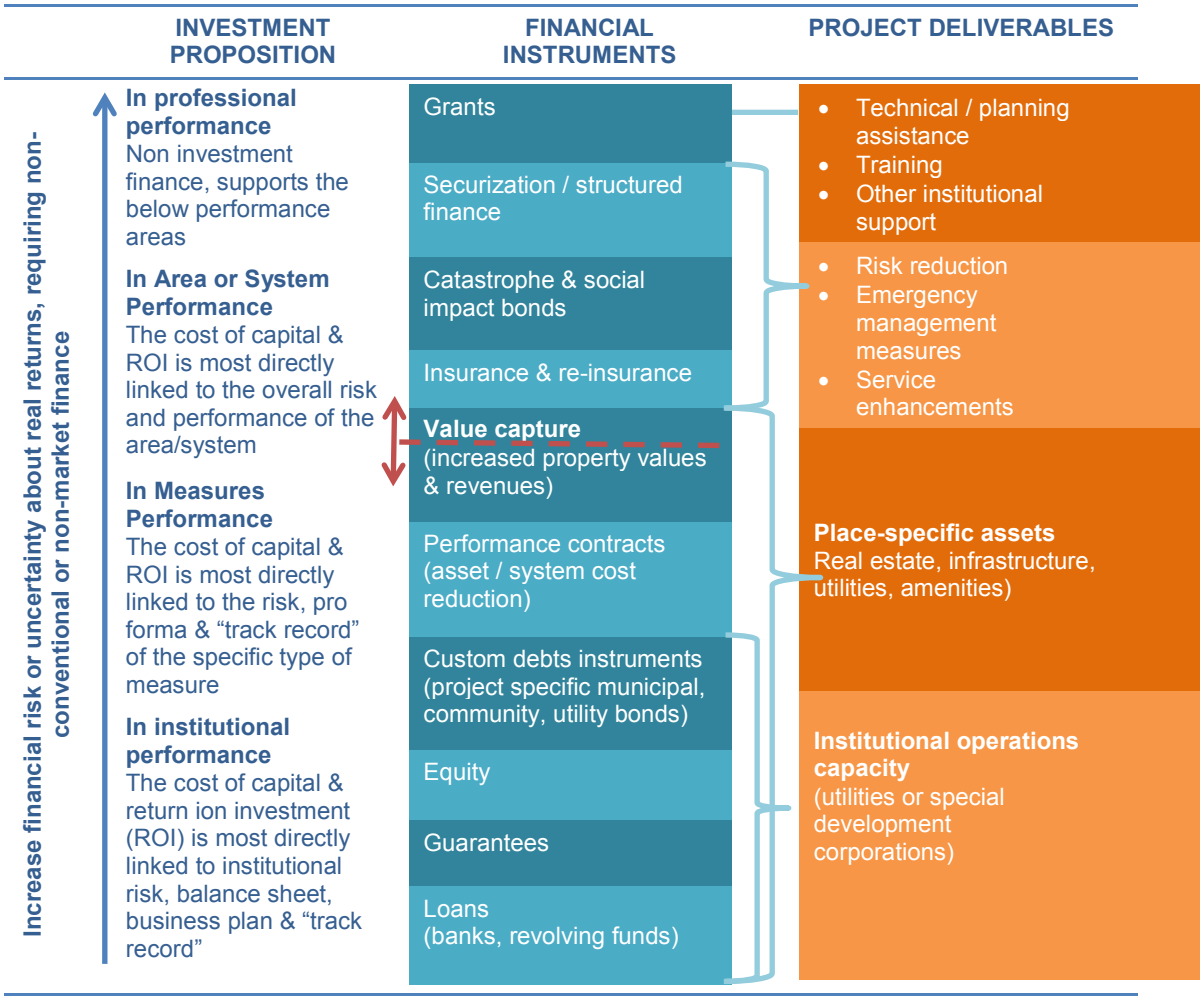

Table 7 - Investment structuring for complex urban upgrading projects (ICLEI, 2011).

Some of the most recent financial innovations include the creative use of land leases, land-swaps, 'bonusing' incentives, value capture schemes, tax-increment debt financing, revolving loan funds, property assessed clean energy financing, and project guarantees.The expansion of water supply, e.g. through building reservoirs could likely be financed through the provision of conventional development loans to national governments, or through the issuance of special bonds by local governments or utilities that are guaranteed by future revenues or otherwise by the local government. Measures to reduce risks to the distribution network e.g. upgrading pipes could be written into the above bond, or financed through a performance-based instrument or

contract that pays part of the revenues or savings associated with reduced water losses via leakages and illegal connections to the investor or contractor performing the specific distribution upgrade. Upfront funding for the demand-side management program could be budgeted through existing utility or local government assessments, as a strategy for reducing the necessity of new supply infrastructure and its associated debt. Catastrophic risk could be addressed through a catastrophe bond, catastrophe insurance, or other securitization instruments; or through structured finance that pools and thereby further spreads risk in scores of cities. The creation of this kind of local institutional capacity is essential for international development banks and special climate funds to be able to leverage their limited resources to respond to rapidly emerging risks and to develop quality project portfolios. Supporting the development of such institutions, particularly in high vulnerability urban regions, may be the most important capacity-building investment that the adaptation funds can make. International/multilateral adaptation funds could finance project planning, financial structuring services, and the establishment of necessary monitoring, preventive maintenance, and emergency management systems. As suggested in the Table 8, to the extent that addressing priority risks requires non-conventional project interventions from a financing perspective, the level of required financial innovation will be greater.

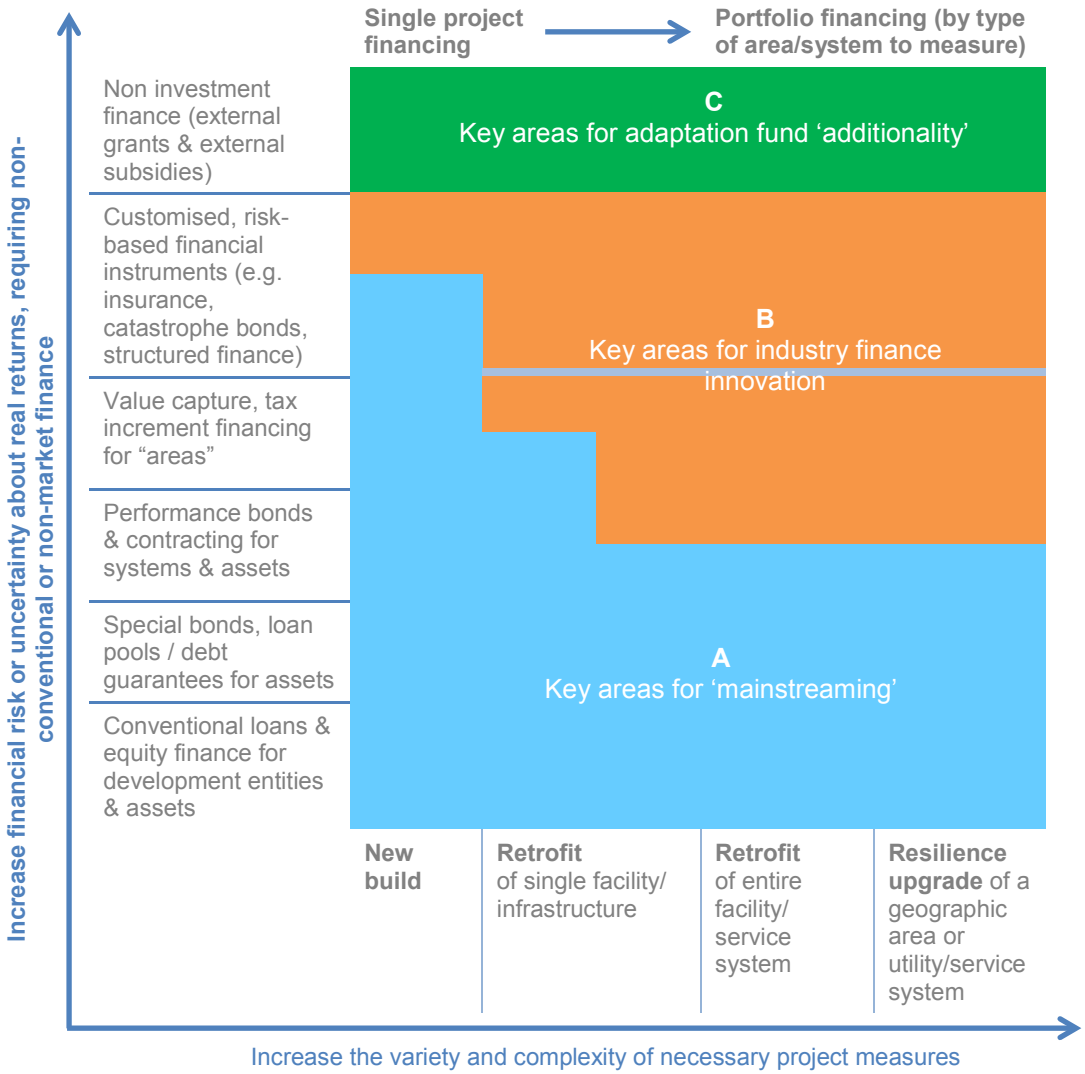

Table 8 - Increase in the variety and complexity of necessary project measures (ICLEI, 2011).

The scale of adaptation finance needs for a city depends on the city's particular circumstances that drive the nature of specific adaptation activities[13]. Cities can benefit from pursuing projects that support a joint mitigation and adaptation agenda, but these funds are limited and can be expected to meet only a portion of cities' total financing needs.

1.5.1 Financial tools

1.5.1.1 Municipal and National Finance

Most dedicated global funding for adaptation currently flows through national channels, primarily based on priorities set in nationally-adopted climate frameworks, such as National Adaptation Programmes of Action (NAPAs) (UNFCCCa 2011). In order for cities to access more funding, they have to be recognized as important potential partners and implementers of adaptation projects. In practice, it proves extremely difficult for municipalities to access this and other international funding schemes for adaptation. This has led groups of cities and local government networks to advocate for greater recognition and funding in international climate change frameworks.

International funding sources in Europe[14] or from multilateral and bilateral agencies[15] will still likely be insufficient to cover all the adaptation needs of cities, so developing competency in securing funds for local-level adaptation will be therefore critical for city officials, as a city's own investment and operating budget will be more and more essential. Although cities often have to make difficult choices among competing priorities, they can often build resilience to climate change impacts by investing in already-needed basic services and infrastructure.

In industrialized countries, potential funds allocated for adaptation at the municipal level depend more on national or local budgets. Funds generated by a government agency from service payments, taxes, fees and charges can be designed with specific policy objectives and used to fund adaptation investments, such as improvements in infrastructure.

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[13] Climate Finance Options (http://www.climatefinanceoptions.org), an informational website sponsored by the World Bank and UNDP, and the Adaptation Learning Mechanism website (http://www.adaptationlearning.net), both contain project-level information that may be useful for this purpose (Climate Finance Options 2011; Adaptation Learning Mechanism 2011.

[14] The LIFE+ Programme, The Cohesion funds,The European Regional Development Fund (ERDF), The European Social Fund (ESF), The European Agricultural Rural Development Fund, The European Maritime and Fisheries Fund (EMFF).

[15] These sources can be used to fund activities ranging from capacity building and technical assistance, to municipal infrastructure. Examples of sources include the following: Global Environment Facility (GEF), the GEF Small Grants Programme (SGP), Climate Investment Funds (CIFs), the Strategic Climate Fund (SCF), which supports the Pilot Program for Climate Resilience (PPCR), the Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF), the Adaptation Fund (AF), the Global Facility for Disaster Reduction and Recovery (GFDRR), the Multilateral Development Banks (MDBs), the Millennium Development Goal Achievement Fund

1.5.1.2 Catastrophe bonds

Catastrophe bonds were first developed by insurers in the early 1990s in response to the increasing strength of hurricanes striking highly urbanized southern Florida, causing losses significantly above the levels that insurers were willing to bear. In effect, the first catastrophe bonds were an alternative to re-insurance. Re-insurance passes risk on to the re-insurance company, which diversifies its risk through issuance and control of a managed pool of re-insurance policies. A catastrophe bond instead passes the insurer's extreme risks on to a variety of private investors who are willing to assume the risk of loosing all of their investment principal (in the instance of a defined catastrophic condition) in exchange for the opportunity to earn substantial interest on their investment.

EXAMPLE 3

CASE STUDIES

Following the introduction of catastrophe bonds by the insurance industry, governments began issuing their own catastrophe bonds to cover losses from extreme national crises. For instance, in 2006 Mexico issued catastrophe bonds to establish a pool of funds for responding and recovering from major earthquakes. In 2009, the World Bank established a Multi-Catastrophe or "MultiCat" Program to help governments structure "coverage" against multiple kinds of catastrophe risk, or to pool the risks of multiple governments through issuance of a special bond. Mexico was the first government to issue a bond to cover extreme losses due to earthquake, flooding, and tropical storms. In effect, the World Bank issued a bond whose proceeds would be used to cover the Mexican natural disaster fund in the instance of extreme losses.

A major innovation in the MultiCat approach is the pooling of different kinds of risks or of risks across a number of countries. A further innovation might be to use the catastrophe bond instrument to cover a portfolio of specific kinds of catastrophic risk across a large number of cities. The portfolio approach might be even more attractive if the proceeds could be used, in part, to finance risk reduction measures in these cities that establish predictable reductions of the risks covered by the bond. This could be called an 'active' use of a catastrophe bond. An actively structured catastrophe bond would use part of the proceeds from sales of the bond to implement reliable measures that actively reduce risks that are covered by the bond.
The measures would have to be able to produce reliable risk reduction effects at predictable range of cost. By using proceeds from the bond to reduce the risk, the interest payments demanded by investors could also be reduced, and the issuer of the bond could maintain a balance of funds to generate its own financial returns and to cover future claims against the bond.

Source: ICLEI, 2011.

1.5.1.3 Market-based Financing

Market-based financing offers significant opportunities for investments in cities, including for adaptation. This section describes some of these instruments, which often involve the private sector. The private sector may be an important source of adaptation funding for both private assets and public infrastructure, as observed in the World Development Report 2010. City engagement with the private sector on adaptation could involve the following:

- Value capture where privately-held infrastructure that provides public services (for example, transportation, electric power networks, water systems, and solid

waste) and private properties that can be leveraged to improve adaptive capacity (for example, downtown buildings that could be renovated with green roofs to minimize the urban heat island effect)
- Insurance
- Securitization and structured finance
- Micro-finance

Value capture instruments

The existence of local tax assessment authority over geographic areas may offer a unique opportunity for financing comprehensive, place-centred resilience upgrades. Local governments have widely used value capture mechanisms and borrowing against future tax revenues, such as tax-increment financing, to incentivize if not finance investments in blighted areas e.g. areas with high private investment risk. Value capture mechanisms use special district-level taxes and community improvement fees to capture part of the value created for private owners and developers as a result of local government investments.

In principle, the same mechanisms used to capture the value created for private owners through public investment in transport or drainage could be applied to public investments to reduce disaster or insurance risks to private land owners. Tax-increment financing is a form of value capture based on tax revenues in order to finance investments in deteriorated or high-risk areas. In principle, if it can be established that climate or disaster risks are directly lowering property values, then value capture mechanisms should in principle be available to finance the measures to reduce these risks, and thereby increase those values.

Insurance and re-insurance

Insurance and other risk management instruments serve important functions for cities and countries when disasters strike, covering the risks of high severity, low-frequency events for individuals, public institutions, and private entities.

Insurance provides an important instrument for reducing the extent of possible losses of those who invest and hold assets in a city or urban infrastructure system. In this sense, insurance is a very important financial instrument when seeking to mobilize additional capital for any kind of city-building. Consider, for instance, a resilience upgrading project in which some of the area's required risk reduction measures can be 'mainstreamed' into conventional projects, other measures can be financed via special risk-based financial instruments like catastrophe bonds, but where there are still no reliable, economic measures available for reducing other catastrophic risks. The prospective investors, whether in the conventional projects or in the special risk reduction measures, may not be willing to invest if there is still an outstanding catastrophic risk that cannot be mitigated in the area. Insurance provides investors a way to manage those extreme risks, thereby making their other investments attractive.

Re-insurance further spreads the risk of major losses by sharing parts of the insurers' risk portfolio with the secondary insurer. Re-insurance allows an insurer who holds thousands of policies to select the exact portfolio of risks that it wishes to manage and for which losses it will be directly liable, passing on the remaining risks to the re-insurer for a contracted premium.

It is important to note that insurance instruments are not conventionally used to directly create new resources to be reinvested in risk reductions measures, but are instead managed by insurers to cover possible policy losses.

In recent decades insurers have experimented insurance policies that are linked to prevention measures: the insurance policy covers not only the potential loss of a catastrophic event but also the cost of a preventative program. It further reduces the insurance premium for those who demonstrate a good management of their urban area. These policies suggest how insurance premiums can be structured in such a way so as to create complementary funds for risk reduction measures in addition to coverage of potential losses.

Securitization and structured finance

Securitization of pools of revenue-generating assets into structured financial instruments reflects a basic idea that is complex in its execution. The basic idea is that similar investment instruments, such as mortgage loans, automobile loans, or credit card debt, can be structured into large portfolios in order to generate immediate revenues from long term revenue streams as well as to diversify risks. For example, when a bank originates a mortgage loan it secures a stream of revenues for the term of the loan. If the bank would like to gain more rapid access to that revenue stream it might transfer the ownership of the loan to a third party in exchange for part of the long-term revenue stream.

Consider a municipality, a local development corporation, or a utility company. The utility company may offer loans to thousands of building owners to retrofit their buildings. In exchange the utility holds a contract that gives it right to charge monthly loan payments from the building owners on regular utility bills. Similarly, the municipality may offer building owners finance for specific resilience upgrading measures, and charge quarterly fees on property tax bills to recover their loan. In both instances they would likely charge interest to the building owners on the loaned balances. If the utility or municipality would like to immediately access a large part of the revenues e.g. loan principal plus interest charges to invest in a resilience upgrade of the whole system, then it might structure the pool of loans into a secondary financial vehicle instrument. The special purpose vehicle would take ownership of the whole portfolio of outstanding loans and associated revenue collections. In exchange, the utility or municipality would receive an immediate payment that is equivalent to part of the total discounted revenue stream predicted over the term of the pool of loans. If a number of local development corporations or utilities, across a large number of cities, are supported to finance similar types of resilience measure across millions of buildings, then the ability to mobilize immediate capital via securitization of millions of small loans is even greater. This kind of securitization is an instrument in the world of high finance. The risks of such finance were made apparent in the collapse of mortgage-backed securities or “collateralized debt obligations” in the 2007-2008 global financial crisis. Nonetheless, the use of securitization to generate immediate capital from predictable, regulated long-term revenue streams such as utility bills or small loans provides a possible way to bring private capital into resilience investment activities.

Micro-finance

At the local level, analysis of microfinance (Agrawala and Carraro, 2010) in Bangladesh found that 70% of existing portfolios of the microfinance lenders analysed supported climate change adaptation. There has been little or no emphasis so far on actual delivery mechanisms to channel these resources at the sub-national level, particularly to target poor communities who are also often the most vulnerable to the impacts of climate change. It is in this context that microfinance must be taken more into consideration.

The empirical assessment has been run on 22 leading microfinance institutions in two climate vulnerable countries – Bangladesh and Nepal – to provide an analysis of the synergies and potential conflicts between microfinance and adaptation, and give an overview of the existing linkages between the top-down macro-financing for adaptation through international financial mechanisms and the bottom-up activities that can be implemented through microfinance. Also different areas of opportunity has been identified, where microfinance could play a greater role in fostering adaptation.

Insights from this analysis also have implications for OECD countries. This is because microfinance is also being increasingly tapped to reduce the vulnerability of the poor in domestic OECD contexts as well and may therefore have the potential to contribute to adaptation.

1.6 Focus on policy aim and generic adaptation objectives

The fundamental adaptation objective may look at adapting to unavoidable climate change with success. The policy aim is taken to imply not only minimising the risk associated with climate change and reducing the vulnerability of natural and human systems to the impacts of climate change, but also maximising the benefits that may arise from climate change.

USEFUL QUESTIONS

- ✓ *What is good adaptation ?*
- ✓ *What are the basic principles and criteria for a good adaptation?*

When a community decides to commit itself for adaptation, it has first to establish a clear overarching aim for its adaptation policy. In general, the overarching **adaptation objective** may look at adapting to unavoidable climate change with success. Policy aims not only at minimising the risk associated with climate change and reducing the vulnerability of natural and human systems to the impacts of climate change, but also at maximising the benefits that may arise from climate change.

Two key elements characterise this general aim: the word “unavoidable” which is associated to climate change (see the par. “*Adaptation to climate change: key issues*” for further details) and the word “success”.

Defining what is a good or successful adaptation is not easy, but many organizations have tried to identify some sort of criteria for successful policy development that may be used as principles (Example 4).

EXAMPLE 4

WHAT IS "GOOD ADAPTATION"?

Good adaptation is based on good information and communication within a community that is willing to adapt. It is important that all involved have an understanding of: i.) the objectives of the process; ii.) adaptation measures including feasibility; iii.) a desire for successful and appropriate adaptation. Implementing appropriate adaptation options, avoiding inappropriate actions and adopting a continuous improvement plan are consistent with the precautionary approach (Rio Declaration, principle 15).
The principles below have evolved through practice, and will help develop a good adaptation strategy:

- **Work in partnership:** identify and engage your community and keep them will informed.
- **Understand risks and threshold**, including associated uncertainties.
- **Frame and communicate smart** (specific, measurable, achievable, results-oriented, and time-bound objectives) **objectives/outcomes** before starting out.
- **Manage climate and non-climate risks using a balanced approach**: assess and implement your approach to adaptation in the context of overall sustainability and development objectives.
- **Focus on actions to manage priority climate risks:** identify key climate risks and opportunities.
- **Address risks associated with today's climate variability and extremes** as a starting point to addressing risks and opportunities associated with longer-term climate change.
- **Use adaptive management to cope with uncertainty:** recognize the value of a phased approach to cope with uncertainty.
- **Recognize the value of no/low regrets and win-win adaptation options** in terms of cost-effectiveness and multiple benefits.
- **Avoid actions that limit future adaptations** or restrict adaptive actions of others.
- **Review the continued effectiveness of adaptation decisions** by monitoring and re-evaluating risks.

Source: UKCIP website: http://www.ukcip.org.uk/essentials/adaptation/good-adaptation.

Successful adaptation to climate change requires local knowledge, local expertise, and local institutional capacity and ex-post evaluation and monitoring (see Chapter 6). Guiding principles for good practices in adaptation have been identified on the basis of specific principles:

1. initiate adaptation, ensure commitment and management;
2. build knowledge and awareness;
3. identify and cooperate with relevant stakeholders;
4. work with uncertainties;
5. explore potential climate change impacts and vulnerabilities and identify priority concerns;
6. explore a wide spectrum of adaptation options;
7. prioritise adaptation options;
8. modify existing policies, structures and processes;
9. avoid maladaptation;
10. monitor and evaluate systematically.

These principles are intended to provide support to planners and decision-makers facing the challenges of adapting to climate change and a common basis for cooperative adaptation activities for all decision-making levels (Prutsch et al, 2010).

1.7 Identify potential barriers to adaptation at local level

Different barriers exist on the way for adaptation to climate change. Among the most common barriers at local level, the lack of understanding about what adaptation actually is will be likely experienced.

USEFUL QUESTIONS

- ✓ *What are the barriers for adaptation in my community?*
- ✓ *What are the opportunities related to adaptation in my community?*

Different barriers exist on the way for adaptation to climate change. Among them one of the most experienced barriers at local level is the lack of understanding what adaptation actually is. In fact, adaptation is often confused with mitigation of climate change and is not conceived as much important as mitigation. Media attention to mitigation policies may have induced to the perception that climate change is a global and not a local issue, thus neglecting the idea that impacts of climate change are felt mostly at local scale.

Furthermore, local impacts of climate change may not be easily understood. In some cases even if impacts of climate change are already occurring in a community, it may happen that the community is not sufficiently aware about this, especially if information at local level is limited. In some other cases, it may happen that the community is already adapting to climate change without being sufficiently aware about it: in fact, some actions could be already in place and categorised as adaptation actions.

In addition, some climate change impacts will be clearly evident in the next decades. This time lag may induce the community to postpone the problem and think that climate change will be addressed when it is clearly occurring. This behaviour may lead to an increase of vulnerability and foreclose on lower cost and easier to implement adaptation options.

Uncertainty could represent a key barrier to adaptation strategies and plans, by providing a justification to decision-makers regarding the delay of actions.

Financial resource limitation would be surely a barrier to adaptation at local level. Due to lack of resources, communities may decide to focus just on mitigation and postpone adaptation initiatives.

Financial and institutional resources constraints may limit the ability of a community to address climate change impacts. Lack of technical expertise at local level represents a further key barrier for adaptation, as adaptation is a new issue and very few experts are available at this level. The support of external consultants could overcome this barrier, even if financial resources unavailability is an evident limit (Snover et al, 2007).

CHAPTER 1 CHECKLIST

- ✓ *Have you identified the adaptation team leader?*
- ✓ *Have you created the adaptation team?*
- ✓ *Have you aroused the political interest and ensured a political commitment?*
- ✓ *Have you established a common vision and identified your guiding principles?*
- ✓ *Have you identified and secured the financial resources for adaptation?*
- ✓ *Have you taken your first decisions on the approach to be adopted?*
- ✓ *Have you focused on your policy aim?*
- ✓ *Have you identified the potential barriers to adaptation at local level?*

2.
REVIEW THE AVAILABLE KNOWLEDGE AND ESTABLISH A BASELINE

Reviewing the available knowledge and establishing a baseline will provide the basis for setting priorities and monitoring of progress in adaptation. During this step the community will take stock of past and present climate conditions and will collect existing data as well as identify knowledge gaps. It will not be necessary to fill knowledge gaps immediately, as this might be one of the actions that can be defined in the LAP.

The information collected will serve as point of reference when monitoring and evaluating progress achievements, as the improvements will be recognized only if compared to the baseline – point of departure.

A baseline can be considered, in fact, as a reference against which future data can be compared. For this purpose, it is important to ensure that the necessary data for the development of indicators are available for the coming years. The purpose of creating a baseline is to define a framework of information that will serve later as a basis for setting priorities and targets. Information such as local climate trends, local climate change impacts, local vulnerabilities, risks and opportunities, existing local political priorities, decisions, commitments and actions directly or indirectly related to adaptation are needed at this stage. The more information is gathered at this stage, the better equipped the community will be to evaluate the progress and communicate the success of adaptation in the later steps. The choice of the baseline data and indicators is strictly dependent on the availability of data in the area as well as the type of phenomenon potentially monitored, the availability of resources and the local technical skills.

Furthermore, in order to lay the foundation for setting priorities and targets and formulating strategies and measures to achieve planning goals under future scenarios, the development of scenarios for adaptation is crucial as a strategic medium- to long-term planning tool in which planners develop multiple scenarios describing future potential environmental, social and economic conditions in a community.

2.1 Review the state of the art and learn from existing experiences

Learning from other experiences, while trying at the same time to avoid the mistakes previously committed, will help to make climate change adaptation successful.

Several countries, regions and cities around the world have already prepared adaptation strategies and plans, while other ones are in the process of doing so: different approaches have been therefore developed depending on several factors, such as the availability of scientific information and technical skills, the environmental conditions, the degree of socio-economic development, the natural and human adaptive capacity, and many others. For this reason, a state of the art review of existing adaptation strategies and plans will be a useful preliminary step, with a particular attention to similar experiences in climate change.

The primary objective of this step is to perform a comparative analysis to identify common key features and best practices, strengths and weaknesses of different existing approaches as well as gaps to be filled, and finally to set up good principles specifically based on the lessons learnt. Learning from other experiences, while trying at the same time to avoid mistakes already made in other contexts, will help to make climate change adaptation successful.

One of the most authoritative and relevant sources which could be helpful for this purpose is the European Climate Adaptation Platform "CLIMATE-ADAPT" [16]. The Platform has been recently developed for users requiring to access and share information on expected climate change in Europe, current and future vulnerability of regions and sectors, information on national, regional and transnational adaptation activities and strategies, case studies of adaptation and potential future adaptation options, online tools that support adaptation planning, adaptation-related research projects, guideline documents, reports information sources.

CLIMATE-ADAPT is a partnership between the European Commission (DG CLIMA, DG Joint Research Centre and other DGs) and the European Environment Agency, and is designed to support policy makers at EU, national, regional and local levels "practitioners" – engineers, planners and administrators – who can learn from the experience of others facing similar challenges in order to develop climate change adaptation measures. The website collates the extensive sources of information and provides the knowledge base to inform people about adaptation.

The section "Cities", in particular, provides access to information which could be useful for the purpose of users of these guidelines: climate challenges, adaptation option for cities, strategies and actions that have been developed or are currently under development.

[16] For further details: CLIMATE-ADAPT, the European Climate Adaptation Platform: http://climate-adapt.eea.europa.eu/web/guest/home

Although cities do not represent an area for which the European Commission has a specific responsibility, the Commission and other international organisations and working groups (e.g. OECD, ICLEI, ENCORE) pay increasing attention to the specific climate vulnerabilities of urban areas (Prutsch et al, 2010; EEA, 2012a; Ecologic Institute et al, 2010; Ministry of Interior - Hungary, 2011; Snover et al, 2007).

2.2 Establish a current baseline for adaptation

In order to track what has changed compared to before the implementation of a measure, a baseline should be established as a reference against which the future situation can be compared.
Relevant categories of data and indicators for the establishment of an adaptation baseline refer to: climate; climate change impacts; environmental and socio-economic conditions; adaptation policies, governance and measures.

As indicated by the IPCC a baseline (or reference) is the state against which change is measured. It might be a '*current baseline*', in which case it represents observable, present-day conditions, but it might also be a '*future baseline*', which is a projected future set of conditions. Alternative interpretations of the reference conditions can give rise to multiple baselines (IPCC, 2007a).

In order to track what has changed compared to the ex-ante situation, a current baseline should be therefore established: it will allow to monitor the progress and effectiveness of the adaptation actions, as it could help assess how vulnerability is changing after the implementation of actions and whether these actions increase or decrease the sensitivity, the exposure or the adaptive capacity to climate change impacts. Changes, and eventually improvements, can be identified only if they can be compared to a reference point. Measuring the progress and the effectiveness of adaptation actions without having established a comprehensive baseline could result in a rather less accurate evaluation (ICLEI, Workbook for Municipal Climate Adaptation).

Creating a baseline means therefore mapping the available knowledge on specific issues and thus analysing the current situation of a specific area: the impacts due to some pressures on society, economy and environment or for instance the policies and measures already in place. For this purpose, it is important to ensure that the necessary data are available today and for the coming years: available information and data should be collected and appropriate set of indicators should be established. Also knowledge gaps and data needs should be identified at this stage (UBC EnvCom, 2009).

The choice of the baseline data and indicators is strictly dependent on the availability of data in the area as well as the type of phenomenon potentially monitored, the availability of resources and the local technical skills. Based on these factors the baseline may be qualitative and descriptive or, alternatively, based on quantitative data.

In case of a quantitative approach indicators used for creating a baseline should be precise, clear and easy to understand. The required baseline data could range from being exhaustive to cursory (e.g. just two sample indicators). Clearly, the more information is gathered at this stage, the better equipped the community will be to evaluate the progress and communicate the success of adaptation in the later steps.

Ideally, the categories of information and data (qualitative and/or quantitative) illustrated in Table 9 should be included for this purpose.

Categories	Description
Current climate trends	Temperature, precipitation, extreme precipitation events, etc.
Current climate change impacts and vulnerabilities	Natural resources, health, energy, agriculture, tourism, etc.
Environmental and socio-economic conditions	Measures of well-being, demographics, access to basic services, migration, land-use, etc. Data on ecosystem services (e.g. agricultural yields, water salinity, coastal erosion, etc.). Proxy indicators might be necessary when the measurement of an actual climate impact is difficult.
Adaptation measures, plans and policies	Data on institutional and policy processes (e.g. existing adaptation strategies and plans, existing policies that incorporate adaptation issues, level of knowledge regarding climate change within local institutions, etc.).

Table 9 - Examples of categories of data required for the establishment of a current baseline on adaptation (Adapted from UNDP, 2004).

Together, the Adaptation Team and stakeholders will select the indicators and/or information that are most relevant to the area, sector, and people that are being analysed. Categories illustrated in the table above are not prescriptive but suggested, as in this step any combination of the indicators could be used. In cases where specific data and indicators for establishing a baseline are unavailable, comparing the indicators developed within the framework of the adaptation plan with those available outside the area of the plan in a similar context could be an appropriate alternative option.

2.2.1 Current climate trends

The implementation and evaluation of the potential adaptation strategies depends on the accurate knowledge of climate characteristics (e.g. temperature, precipitation, extreme events) and their variations.

The collection of available information about climate change and its current and future impacts is a fundamental part of adaptation to climate change. The information collected at this stage will provide a significant foundation on which the following stages of the adaptation process will be based. Deciding how much information is adequate will depend on the availability of resources (e.g. financial, technical, human, etc.) and the accessibility to information and data (Snover et al, 2007).

The implementation and evaluation of the potential adaptation strategies depends on the accurate knowledge of the climate characteristics, their variations and the impacts related to specific issues and vulnerabilities of the territory. In addition, it is fundamental that the most important elements of knowledge, along with the awareness of the uncertainties of the impact estimates, are continuously updated and clearly communicated to stakeholders.

The recognition and estimate of the **trends of climate variables** (e.g. temperature and precipitation) are carried out through the statistical elaboration of time series originating from meteorological monitoring stations. The series must be long enough (at least forty-fifty years of data), continuous in time, complete and quality checked. In order to get reliable trends estimates, it is necessary to control and eliminate from the series wrong data and to filter out from the series non-climatic signals, like those due to station relocation or change of meteorological instrumentation. For this reason, data series undergo a number of suitable homogeneity statistical procedures in order to homogenize whenever one or more break points are found (e.g. Kuglitsch et al., 2009; Aguilar et al., 2003). Finally, the variation of climatic variables, in terms of differences or, as in the case of precipitation, percentage differences in the unit of time (year or century), are estimated through the application of statistical models for trend recognition and linear and non-linear statistical models for trends estimate (e.g. Seidel and Lanzante, 2004; Tomé and Miranda, 2004).

When climate trends must be evaluated on large geographical areas, the data are usually interpolated with suitable geostatistical methods on a regular grid. This procedure is followed by the most authoritative climate research centers on duty for the reconstruction of the climate of the last two centuries at the global or continental scale (e.g., Mitchell and Jones, 2005).

2.2.2 Current climate change impacts and vulnerabilities

An essential condition to adequately address the issue of adaptation is the identification and accurate description of vulnerability and impacts of climate change.

An essential condition to adequately address the issue of adaptation is the identification and accurate description of **vulnerability and impacts of climate change.**

The environmental challenges that cities are already facing are in the most cases independent of climate change (Table 10) but climate change is exacerbating - and will likely exacerbate in the future - problems that are already existing. In some cases, climate change will produce completely new challenges (Table 10).

High population density
Urbanisation and expansion
Pollution
Social inequality
Urban heat island
Dependence on electricity supply for most services and security

Table 10 - Examples of non-climate threats to cities (Adapted from Ecologic Institute et al, 2010).

It is the interaction of climate and non-climate problems that pose significant challenges to urban decision-makers. Solutions that have been used until now to deal with the current problems will underestimate more and more the magnitude of the problem they seek to address (Ecologic Institute et al, 2010). Changes in temperature, precipitation, and sea level can affect local communities in different ways: increasing average temperature, increasing frequency and intensity of weather extremes (e.g. heat, drought, flooding, etc), increasing river discharges, and sea level rise (Figure 5). Urban settings – their form and socio-economic activity – can alter exposures as well as impacts at the local scale. Built-up areas in the cities create unique conditions and microclimates due to the replacement of natural vegetation with artificial surfaces, thus affecting in particular air temperature, wind direction and precipitation patterns. All of these components can be therefore exacerbated or modified by climate change. In addition to direct climate change impacts, such as health problems due to heat or damages to buildings and infrastructure due to flooding, cities can be affected by indirect and much broader impacts: **floods** can destroy homes, business sites and

infrastructure thus contributing indirectly to loss of jobs and income sources, for example.

Heat can compromise public health, reduce the ability to work and result in lower productivity thus shortening or delaying the delivery or products and services to clients in the city and elsewhere. They can reduce the use of public spaces and thus constrain social life. Infrastructure can be damaged by high temperatures: deformed roads and rail tracks can hamper the supply of goods and commuters or, in particular, in combination with droughts, power stations might not get sufficient cooling water and thus fail to deliver energy.

Water scarcity places cities into a water competition with other sectors such as agriculture and tourism and poses higher economic pressures on the city or individuals to access sufficient water thereby challenging social equity (EEA, 2012a).

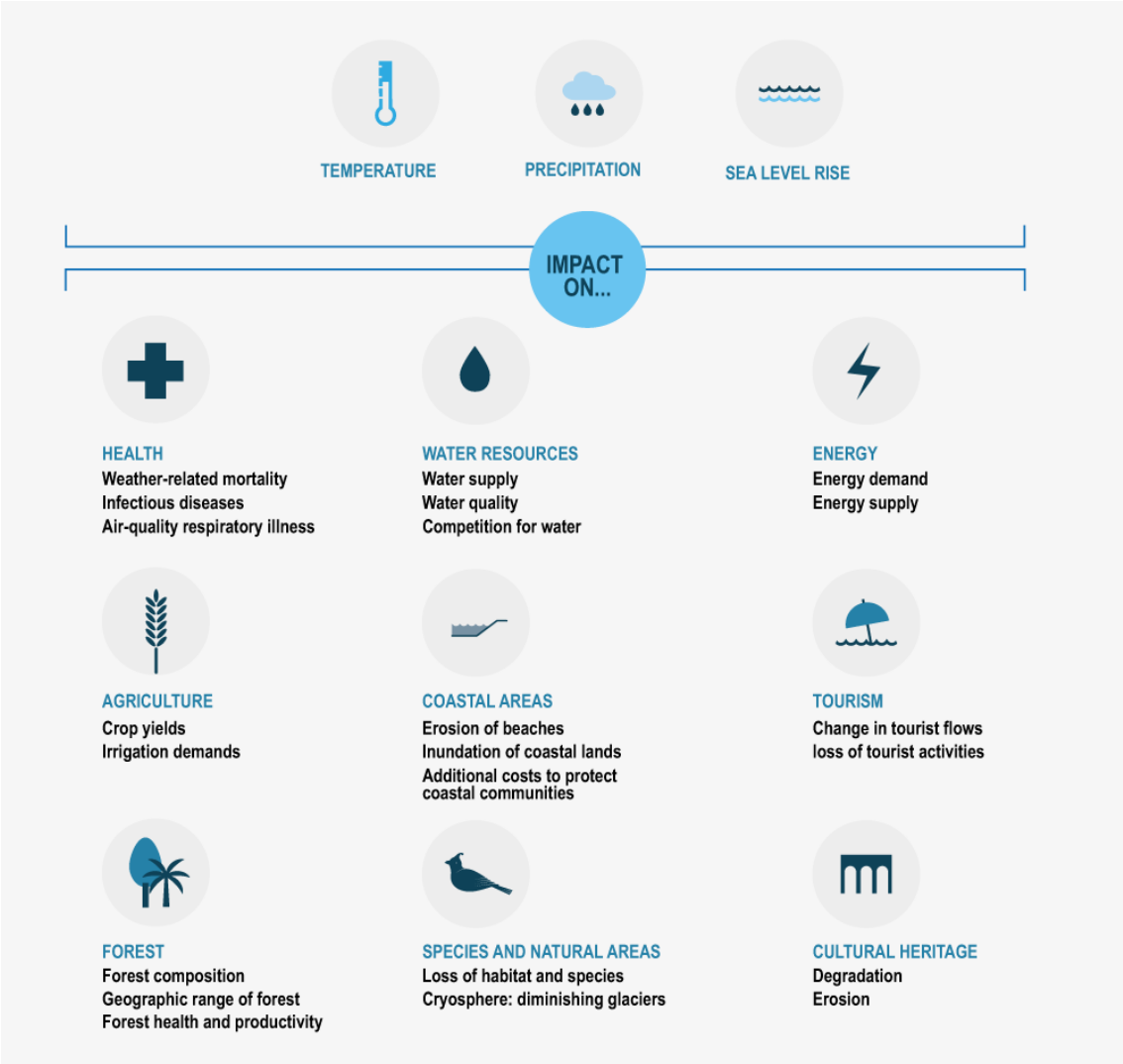


Figure 5 – Examples of current and potential impacts of climate change (Adapted from EPA).

The effects will range from short-term to long-term consequences – on human health, physical assets, economic activities, and social systems – depending on how well prepared a city is and how it will respond. Climate change impacts on communities include – and will likely include in the coming decades - some of the impacts that are illustrated in Table 11.

Services provided by cities and systems/sectors	Impacts of climate change
Health services	
Community/workplace health	- Milder winters improving communities' comfort levels - Decline in air quality in cities - Exacerbation of the urban heat island effect, leading to increased risk of heat-related mortality and illness, especially for the elderly, chronically sick, very young, and socially isolated - Increase in geographical range and seasonality of vector-borne diseases and the possibility for an expansion of receptive zones - High temperatures increasing incidence of food and water-borne diseases - Health impacts due to exposure to extreme weather, e.g. heatwaves - Extreme rainfall events transporting contaminants into waterways and drinking water supplies - Increased pressure on drinking water supplies - An increase in injuries due to increased intensity of extreme events, e.g. storm surge and coastal flooding in coastal regions due to changes in sea level rise and human settlement expansion into coastal catchments
Emergency/bushfire management	- Increased emergency response and recovery operations - Risks to public safety and tourism and longer term impacts on regional economies
Energy services	
Energy management	- Increase in energy demand of buildings
Planning and development approvals	
Planning policy and developments	- Inappropriate location of urban expansion areas - Increased uncertainty in long-term land-use planning and infrastructure design, e.g. location of future developments, suitability of infrastructure designs to cope with changing climate, etc. - Damage and losses to physical assets and infrastructure: houses, public facilities, utilities - Cost of retrofitting of systems - Loss of private property and community assets - Increase in insurance costs - Increased pressure on disaster management and response resources - Early retirement of capital infrastructure
Natural resources management	
Coastal management	- Increased coastal erosion and inundation - Loss of private property/community assets - Loss of beach width - Changes to wetlands due to sea level rise, shoreline erosion and saltwater intrusion - Loss of biodiversity linked to abduction of soil with natural habitats - Loss of areas affected by cultural heritage - Impacts on the infrastructure system for mobility and on the coastal tourism
Land degradation	- Land abandonment - Soil fertility loss

Weed/pest management	- Changes in distribution of invasive species due to changes in climate and associated loss of biodiversity and changes to bushfire intensity
Biodiversity	- Shifts in distributions of plant and animal species - Increased risk of population and species extinctions - Reduced ecosystem resilience to stress - Increased ecosystem and species heat stress - Increased pressure on dunal systems - Changes to mangrove habitats due to salt water intrusion - Increases in ecological disturbances
Water and sewerage services	
Stormwater/sewerage	- Inundation of storm water and sewerage systems - Increased peak flows - Changes in groundwater levels - Changes in flood plains - Reduced dry weather sewerage flows - Reduced/unreliability of power supply for sewage pumping and treatment if existing - electricity suppliers cannot maintain pace with long term changes in climate
Wastewater	- Changes in intensity of rainfall events impacting inflow and infiltration to wastewater - network - Potential for blockages and dry weather overflows during dry spells
Water supply	- Changes in mean and peak stream and river flows - Uncertain water availability - Insufficient water supply in some areas - Increased potential for water contamination - Salinization of surface and groundwater supplies - Changes in availability of groundwater available for irrigation
Cultural services management	
Cultural heritage	- Crystallization and salt dissolution due to “wetting and drying” cycles - Erosion - Corrosion of metals - Deterioration of facades caused by physical stress - Damage caused by freeze- thaw/ frost cycles - Physical changes to porous buildings materials - Stone recession by dissolution of carbonates - Blackening of materials - Biochemical deterioration
Agriculture services	
Agriculture management	- Decline in yields and production - Reduced marginal cost from agriculture
Tourism	
Tourism management	- Changing in seasonal touristic flows - Coastal touristic activities loss - Coastal wet areas and naturalistic areas loss

Table 11 - Current and potential impacts of climate change on cities and local functions (The World Bank, 2011).

The most authoritative and complete source of information on the global and continental climate change impacts and vulnerability is the IPCC Assessment Report of the second volume "*Impacts, adaptation and vulnerability*" (IPCC, 2007b). In this Report, the impacts of global warming already underway, the potential for adaptation to reduce the vulnerability to and risks of climate change are illustrated. The report pays great attention to regional impacts and adaptation strategies, identifying the most vulnerable areas. In particular, chapter 12 focuses on Europe and reports the results based on a range of emissions scenarios extending up to the end of the 21st century and assume no specific climate policies to mitigate greenhouse gas emissions. Further relevant sources of information on climate change vulnerability and impacts are the Technical Reports of the European Environment Agency (EEA), and in particular the Report on "*Climate change, impacts and vulnerability in Europe 2012*". This report presents an indicator-based assessment of past and projected climate changes, their observed and projected impacts, and the associated vulnerability of and risks to society, human health and ecosystems in Europe (EEA, 2012b). Another authoritative source of relevant information is the above mentioned CLIMATE-ADAPT Platform (see for further details par. 2.1). However, it is important to take into account that in order for the purpose ofto prepare the Local Adaptation Plans, information at local levels are the most appropriate oneslocal sources of information are required. Nevertheless, the availability of these sources will vary widely from area to area. Among the potential sources of relevant information, the National and or Regional Adaptation Strategies and Plans can be mentioned. When available, in fact, these documents could provide very useful data and information on climate change impacts and vulnerabilities that could be uptaken and used as a reference in LAPs. Furthermore, relevant information on observed - as well as projected - climate change impacts can be collected from universities, environmental agencies, climate centers: from sector-specific climate change reports (e.g. special reports on water resources, forest resources, etc.) to peer-reviewed assessment reports, from peer-reviewed journal articles and books to papers and reports from research groups and governmental agencies; from conference proceedings to broader-scale studies. In some cases, when information is lacking, studies carried out in regions with similar characteristics can be extrapolated and used to develop useful information. The involvement of local experts as well as local stakeholders related to some specific sectors affected by climate change could be an useful source of information.

ACT EXPERIENCE 2

A QUESTIONNAIRE FOR TAKING STOCK OF CURRENT CLIMATE CHANGE AND ITS IMPACTS IN THE COMMUNITIES

(F. Giordano, R. A. Mascolo - ISPRA, Life ACT Project 2010).

A questionnaire have been provided to the three municipalities participating to the Life ACT Project: municipality of Ancona (IT), municipality of Patras (GR) and municipality of Bullas (SP). The questionnaire was addressed to collect the available knowledge about climate change and its impacts and to stimulate local communities to consider the current consequences of climate change to which they are already exposed.

QUESTIONS	OPTIONS
Which were/are the most relevant climate-related events that affected/are affecting your community in the last decades?	Mean annual temperature increase Heat waves Change in mean annual precipitation patterns Floods

	Drought Windstorms Storm surges Sea level rise Sea temperature rise Other
Which systems/sectors have been/are mostly affected by climate-related events in the last decades? In which way?	Marine and terrestrial biodiversity Water Soil Coastal environment Health Tourism Agriculture Forestry Fisheries Infrastructure Historical and artistic heritage Other
Were/are the systems/sectors economically relevant for your community?	Yes No
Did you assess the economic consequences?	Yes No
What has been done to adapt to these impacts? Which measures, interventions, policies did relate/currently relate to relevant climate risks, impacts and vulnerability?	Technological solutions (e.g. so-called "grey" measures) Ecosystem-based adaptation options (e.g."green measures") Behavioural, managerial and policy approaches (e.g.: "soft measures", such as regulation, legislation, guidance, plan) Exploiting positive opportunities (e.g.: introduce new or develop previously limited activities, species, etc) Accepting the impacts and bearing losses Other
Did you estimate the funds allocated for the adaptation interventions?	Yes No
How effective were these measures, interventions, policies?	Very effective Effective Not effective
Are there studies, research, and data dealing with past/current climate change impacts, vulnerability or adaptation in your municipality?	Yes No
Which were the barriers for adaptation?	Lack of political will Lack of human resources available Lack of funds Lack of awareness about the climate change risks Lack of scientific knowledge base Other

2.2.3 Current environmental and socio-economic conditions

The environmental and socio-economic baseline should describe environmental assets and economic activities that have been systematically impacted by climate hazards, and where maladaptive trend has increased their vulnerability.

In developing an adaptation baseline, a relevant step is the overview of the environmental and socio-economic elements that make significant the selected area. In any adaptation process, the overview should be tailored to suit the priority areas chosen because their important environmental assets and economic activities have been systematically impacted by climate hazards, and because maladaptive trend has increased their vulnerability.

Socio-economic elements should describe producing food and other goods for consumption, natural resources such as forests, fisheries, and tourism, people and infrastructure at risk from floods, disease and internal migration as consequences of drought.

Current environmental and socio-economic baseline aims to identify a set of indicators which can be useful for the assessment of vulnerability and risk. Here in the tables below some examples of potentially relevant information to establish an environmental and socio-economic baseline are illustrated (UNDP, 2004).

Demography	- Access to clean water and sanitation - Withdrawals as a % of available water - % shares of total use (household, industry, agriculture) and rate of increase in uses
Economy	- Presence or absence of water markets - Contribution of water to products (e.g., irrigation to agricultural products) - Amount/kinds of water infrastructure (reservoirs, dams, etc.)
Natural resource	- Extent of natural resources - Forest cover - Protected areas
Culture	- Cultural meaning and recreational uses of rivers/lakes (sacred or forbidden uses) - % unpolluted stream and beach kilometres (and nature protection)

Table 12 - Examples of relevant environmental and socio-economic indicators for water sector (Adapted from UNDP, 2004).

Service areas	Indicators
Planning and zoning	- Total land area in flood risk zone - Utilized river bed area (km)/total land area (km) - Proportion of low lying coastal areas (in km) (altitudes below 1m) - Proportion of drought vulnerable area (e.g. km^2 agricultural land area/total land area (km^2) - Average number of permeable and non-permeable surface area m^2 in permitted developments - Ecologically sensitive area (e.g. area (km^2) of habitat of endangered species, or tidal wetland areas (km^2)
Communications	- Existence and regular use of ongoing forums for sharing information on climate change impacts - Existence of surveys to track requests for adaptation (e.g. heat-risk) related publications - Existence and regular use of ongoing forums for sharing information on climate change impacts - Number of people attending public meetings on adaptation - Tracking “hits” on community-sponsored or community-run webpage’s
Public health	- Number of patients with respiratory disease/total population - Number of patients with vector-borne disease/total population - Proportion of elderly population living alone (in %) - Proportion of people living in poverty (in %) - Proportion of population over 65 (in %) - Population density (e.g. total population/total land area km^2) - Availability of medical facilities (e.g. population/# of hospital beds; hospital workers/total population; public health center employees/total population; number of general hospitals)
Transportation	- Proportion of transportation and supply facilities
Environment	- Average temperature at assigned community hotspots
Engineering	- Proportion of industrial park area/total land area km^2
Housing	- Proportion of housing units older than 30 years/total housing units - Proportion of housing and development permitted in flood risk or vulnerable areas
Economic development, culture and tourism	- Gross Regional Domestic Product (GRDP) - Economic growth (e.g. GRDP growth rate over five years) - Fiscal independence (e.g. local tax + non tax revenue/general account budget)
Parks and recreation	- Park area (km^2) per capita - Average increase/decrease of green space and trees (e.g. square feet, meters or kilometres)
Water	- River improvement (e.g. river improvement length (km)/improvement needed (km) - % of population with access to clean drinking water - Capacity of sewage treatment systems compared to quantity of total sewage - Use of groundwater/available groundwater

Table 13 - Possible indicators by service area (ICLEI, Workbook for Municipal Climate Adaptation).

ACT EXPERIENCE 3

THE SOCIO-ECONOMIC CONTEXT OF THE MUNICIPALITY OF BULLAS
(P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert - Municipality of Bullas, Spain).

Bullas can rely on some particular natural, socio-economic and cultural features, where the vine and the wine are two of their main protagonists. Specific data have been collected in order to characterize the area in socio-economic terms.

- Population size and gender
- Age structure
- Population density
- Urbanisation
- Education
- Migration
- Land use
- Level of investment in economic activity
- Fiscal indicators
- Industry and construction
- Workers per activity sector
- Enterprises per activity sector
- Extent of infrastructure
- Social equipments

2.2.4 Existing adaptation measures, plans and policies

Before starting to develop the adaptation plan, it is important to verify if adaptation measures, plans and policies that address climate change impacts, already exist in the community and whether they are effective to address current vulnerability. Furthermore, the available capacities to address these vulnerabilities should be identified.

Before starting to develop an adaptation plan, it would be helpful to take stock of existing adaptation measures, plans and policies within the community, keeping a list of actions that are already underway and even planned actions that might be relevant to the adaptation planning process. This will help evaluate where there are existing actions already addressing climate change impacts, whether they are effective to address current vulnerability, how other actions might be revised to accommodate for climate change, and where there is a need for further action. Where relevant actions that address climate change impacts already exist (but perhaps not labelled as specifically responding to climate change), it would be useful to consider how that impact is likely to change in the future and how that action may require revisions to accommodate for future impacts associated with climate change. As an example, consider emergency management and response actions, scheduled infrastructure maintenance, or public health outreach policies. Similar to actions, there may be plans and policies that already address adaptation but perhaps are not labelled as an adaptation plan or policy. Looking into the variety of plans that exist across departments (e.g. Transportation Master Plan, Cycling Master Plan, Environmental Master Plan, etc.), as well as any other strategic policy documents (e.g. Official

Community Plan, Long-term Sustainability Visions, Strategic Plans, etc.) will allow get acquainted with what is in place and how adaptation might tie into it.

Also the coherence of the adaptation plan to the national/regional (where existing) and even European sectorial policies in place should be ensured to avoid potential conflicts and exploit possible synergies. EU regulations are also subject to change, which offers the potential for greater incorporation of climate change adaptation in a number of directives. However, at the local level, also amendment of the local policies (for example spatial development plans) could be considered in order to comply with high-level adaptation strategy framework.

Governance and policy indicators	- **Treaties or agreements regarding available water resources** - **% of water resources not under regional control** - **Development plans for area (e.g. population growth, agricultural development and water-use implications)**

Table 14 - Examples of governance and policy indicators for water sector (UNDP, 2004).

2.3 Develop baseline scenarios for adaptation

Developing scenarios for adaptation is a strategic medium- to long-term planning tool in which planners develop multiple scenarios describing potential environmental, social and economic and conditions in a community by laying the foundation for setting priorities and targets and formulating strategies and measures to achieve planning goals under one or more of those scenarios.

A scenario is a plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a "narrative storyline" (IPCC, 2007).

Climate change impacts and vulnerabilities, and the desirability of potential adaptation options, strictly depend on many uncertain environmental (e.g. the response of climate system to additional forcing from GHGs or the ability of ecosystems to cope with increasing temperature and modified climate patterns) and socio-economic (e.g. the amount of GHGs that will be emitted in the future and the ability of affected societies to cope with and adapt to climate change) factors. Developing scenarios for adaptation is

a strategic medium- to long-term planning tool in which planners develop multiple scenarios describing potential environmental, social and economic and conditions in a community by laying the foundation for setting priorities and targets and formulating strategies and measures to achieve planning goals under one or more of those scenarios.

2.3.1 Climate model projections

The most authoritative and complete source of information on the global and continental climate model projections is the IV Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and specifically the chapter 11 of the "Scientific basis" volume (IPCC, 2007a).

The capabilities of **medium and long term climate projections** are based on dynamic climate models: high resolution global models (GCM) and/or regional models (RCM) nested on GCM in order to get more specific predictions at continental and sub-continental scale. In addition, downscaling through empirical-statistical or statistical-dynamic models can be applied in order to refine climate projections at the local scale, coupling GCM or RCM fields of climate variables (predictors) with time series of local observations (predictands). GCM projections refer to different emission scenarios, representing different models of greenhouse gases evolution until the end of the 21th century and corresponding to different hypothesis for the global socio-economical development. Among the IPCC emission scenarios, A1B may be considered an "intermediate" scenario and is the most used for GCM simulations. It represents a very fast global economic growth, a global population reaching its maximum at the middle of the century, a rapid introduction of new and more efficient technologies and a balanced distribution among different sources of energy. In the A1B scenario, global average CO_2 concentrations are foreseen at the level of about 700 ppm at the end of the century. Therefore, from numerical models an ensemble of predictions for climate variables in different scenarios can be obtained. The uncertainties of the results are determined by both the intrinsic model uncertainties and the uncertainties associated with the different probabilities of occurrence of each scenario. Synthetically, for each climatic variable there is a range (that can be considerably large) of predicted values at a certain time, including the intrinsic model uncertainties, the spectrum of values predicted by different models and the spectrum of values corresponding to different scenarios. The most authoritative and complete source of information on the global and continental climate model projections is the IPCC Assessment Report and specifically the chapter 11 of the first volume "Scientific basis" (IPCC, IV Assessment Report). In this Report, climate projections for Southern Europe and the Mediterranean area can be seen, in particular for the A1B scenario[17]. Global climate models simulate the atmospheric component by using different layers for small time steps and they are numerically complex. To allow a relatively fast computation (and deal with computer memory limitations), the world is divided into a rather limited number of spatial units

[17] In 2013/2014 the V Assessment Report of the IPCC will be completed, and in particular: WG I – The physical Science Basis (23-26 September 2013); WG II – Impacts, Adaptation and Vulnerability (25-29 March 2014); WG III – Mitigation of Climate Change (7-11 April, 2014).

(grid cells). The GCM model outputs are generally rather coarse, typically from 2 to 4 degree (one degree of longitude is ~ 111 km). In order to get more specific predictions at continental and sub-continental scale, regional models (RCM) are nested on GCM. RCM resolve physical processes at higher resolution than GCM and provide a better representation of the main climate features of a region. They usually have a resolution of 20-25 km and do not provide a feedback to GCM (one-way nesting).

ACT EXPERIENCE 4

CLIMATE MODEL PROJECTIONS FOR ANCONA, BULLAS AND PATRAS

(F. Desiato, A. Toreti, G. Fioravanti, P. Fraschetti, W. Perconti - ISPRA, Life ACT Project - 2010).

Both temperature and precipitation projections for the three target areas of the Life ACT Project (Ancona, Bullas and Patras) were extracted from the gridded fields generated by three Regional Climate Models (RCMs) and two high-resolution Global Climate Models (GCMs). Such projections were downloaded from the website of the PCMDI (http://www-pcmdi.llnl.gov/) and of the ENSEMBLES project (http://ensemblesrt3.dmi.dk). From each gridded field, the grid point closest to each target area was considered. The results for the RCMs are available only for the 2intermediate" emission scenario A1B; for the GCMs, the results are also available for the A2 (pessimistic) and B1 (optimistic) scenarios. The RCMs which provided the projections were selected according to the following criteria: 1) high spatial resolution; 2) number of output parameters. Furthermore, the priority was given to the models characterised by easy and clear procedures for the extraction of gridded data. With regards to the GCMs, the two models with a spatial resolution closer to the spatial resolution of the selected RCMs were chosen.

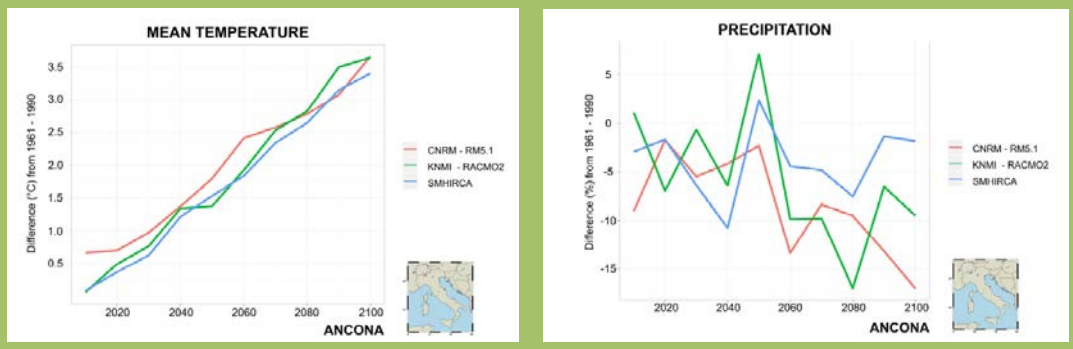


Figure 6 - Annual mean temperature variation and annual cumulated precipitation variation predicted by RCMs (°C and %).

2.3.2 Future climate change impacts and vulnerabilities

Table 11 illustrated a wide list of potential climate change impacts that may occur in cities. Regardless of a community is located, some relevant information about future regional climate changes impacts may be available at different sources. The most authoritative and complete source of information on the global and continental climate change impacts and vulnerability is the IPCC Assessment Report of the Working Group II "*Impacts, adaptation and vulnerability*" (IPCC, 2007b). In this Report, key

future impacts and vulnerabilities are described at sectoral as well as at regional level. Further relevant sources of information on future climate change vulnerability and impacts are the Technical Reports of the European Environment Agency (EEA), and in particular the Report on "*Climate change, impacts and vulnerability in Europe 2012*". This report presents an indicator-based assessment of past and projected climate changes, their observed and projected impacts, and the associated vulnerability of and risks to society, human health and ecosystems in Europe (EEA, 2012b).

The above mentioned CLIMATE-ADAPT Platform represents another authoritative source of relevant information (see for further details par. 2.1). Among the potential sources of relevant information the National and or Regional Adaptation Strategies and Plans can also be mentioned. When available, in fact, these documents could provide useful data and information on future climate change impacts and vulnerabilities that could be used as a reference in LAPs.

However, the availability of information at local level is crucial for preparing a LAP. Nevertheless, the availability of these sources will vary widely from area to area. In this context, relevant information on projected climate change impacts and future vulnerabilities can be collected from universities, environmental agencies, climate centers. Examples of useful documents may be: sector-specific climate change reports (e.g. special reports on water resources, forest resources, etc.), peer-reviewed assessment reports, peer-reviewed journal articles and books to papers and reports from research groups and governmental agencies, conference proceedings to broader-scale studies.

When information is lacking, studies carried out in regions with similar characteristics can be extrapolated and used to develop useful information. Furthermore, local experts as well as local affected stakeholders related to some specific sectors could represent a further useful source of information.

2.3.3 Characterising future socio-economic conditions

Any assessment of future climate change impacts and adaptation options thus needs to make assumptions about these drivers and their future pathways.

In planning for adaptation to climate change, developing scenarios may support policy-making in several ways: it may help stakeholders about the nature and extent of future climate-related risks and opportunities; it may provide useful information to identify emerging vulnerabilities (e.g. potential conflict over access to water); it may support efforts to prioritize climate change risks and it may assist in devising adaptation strategies and actions to address vulnerabilities. Planners may devise scenarios on the basis of scientific projections, expert assessment and other sources that demonstrate how changes in climate may affect the community under different development trends. These trends are based on a few key variables expected to drive change, such as population growth, technological shifts, energy demand, cultural changes, etc.

Any assessment of future climate change impacts and adaptation options thus needs to make assumptions about these drivers and their future pathways. Considering the

wide uncertainties affecting these drivers, using one such scenario only could be inappropriate. In order to make robust decisions, e.g. those that yield acceptable outcomes for a broad range of plausible futures, it is thus necessary to use a set of scenarios that spans the range of possible futures. For this purpose, the same five categories described in par. 2.2.3 and 2.2.4 (demography, economy, natural resources, culture and governance and policy) could be used to develop projections of socio-economic conditions.

EXAMPLE 5

CHECKLIST FOR DESCRIBING CURRENT AND FUTURE SOCIO-ECONOMIC CONDITIONS

- General overview of recent historical socio-economic conditions
- Stakeholder input and selection of indicators for analysis
- Current conditions (adaptation baseline):
    1. demographic analysis,
    2. economic analysis,
    3. natural resource assessment,
    4. governance/policy-based analysis,
    5. cultural analysis;
- Prospects:
    1. three storylines (constructing a reference scenario with adaptation to current climate, two significantly different alternatives);
    2. demographic prospects;
    3. economic prospects;
    4. prospects for natural resources
    5. governance/policy prospects;
    6. cultural prospects.

Source: UNDP, 2004.

CHAPTER 2 CHECKLIST

- ✓ *Have you reviewed the state of the art?*
- ✓ *Have you focused on the lessons learnt?*
- ✓ *Have you identified the appropriate indicators for the adaptation baseline?*
- ✓ *Have you collected all the available information on current climate trends?*
- ✓ *Have you collected all the available information on observed climate change impacts and vulnerability?*
- ✓ *Have you collected all the available information on the environmental and socio-economic conditions of your community?*
- ✓ *Have you identified and analysed the existing adaptation measures, plans and policies?*
- ✓ *Have you developed baseline scenarios for adaptation?*

3.
ASSESS VULNERABILITY AND RISK

Based on the previous step, the Adaptation Team may decide to proceed to perform a specific vulnerability and risk assessment if data and information collected are not appropriate for the purpose of the adaptation process (e.g. are not complete, are not at the local scale, do not cover the area investigated, etc.).

Climate impacts, vulnerability and risk are distinct but related concepts. As a consequence their assessments need to be distinguished. The key input for targeting, formulating and evaluating adaptation policies is represented by the manner in which human and natural systems could be affected by climate change. The extent to which climate change has an impact on these systems is strictly conditioned by the interaction of vulnerability and risk.

Vulnerability and risk are often confused. It should be clear that vulnerability is not the same as risk and that their assessments are performed at different stages of the assessment process providing different functions and outputs.

Vulnerability assessment is just one element, although a very important one, of a risk assessment and it is one element of risk that can be controlled and determine the likelihood a potential impact will produce a loss in a system/sector. Therefore, by reducing the vulnerability, the potential loss to systems/sectors can be reduced.

Risk assessment therefore represents the further step after the vulnerability assessment and is the necessary step in order to prioritize the adaptation interventions.

Due to the complexity of these topics and the extent of the ongoing research, this chapter is not intended to explore scientific challenges concerning the definitions and linkages between relevant concepts such as vulnerability, resilience, adaptive capacity and risk nor to provide a prescriptive format for their assessments. The chapter rather provides a supportive framework and useful key elements for the implementation of this specific part of the overall assessment process at local level.

3.1 Defining vulnerability and its elements: exposure, sensitivity, potential impacts and adaptive capacity

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2007b).

Vulnerability has no universally accepted definition, and there is no single "correct" or "best" conceptualization of vulnerability that would suite all assessment contexts.

Within the context of climate change, the IPCC defines vulnerability as "*the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity*".

Vulnerability is above all a local concept and can be described through the following expression:

VULNERABILITY = function [exposure (+); sensitivity (+); adaptive capacity (-)]

and in particular:

VULNERABILITY = potential impact (sensitivity x exposure) – adaptive capacity

Understanding vulnerability to climate change requires therefore understanding its components: exposure to climate change, sensitivity, potential impacts and adaptive capacity.

The three components of vulnerability are defined by IPCC as follows:

i. **exposure**: "*extent to which a system comes into contact with climate conditions or specific climate impacts*".
ii. **sensitivity**: "*the degree to which a system is affected, either adversely or beneficially, by climate variability or change*".
iii. **potential impacts**: "*impacts of climate change are the effects of climate change on natural and human systems. Potential impacts are all impacts that may occur given a projected change in climate, without considering adaptation*".
iv. **adaptive capacity**: "*the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantages of opportunities, or to cope with the consequences*".

As explicitly illustrated by the above mentioned formula, reducing vulnerability of a system would involve reducing impacts (e.g. by reducing system's exposure or sensitivity), or increasing adaptive capacity. Traditionally, the first two determinants (exposure and sensitivity) have been viewed as dictating the potential for adverse consequences to occur, thereby providing an indication of potential susceptibility to adverse impacts. Meanwhile, the third determinant (adaptive capacity) reflects the ability of the system to manage, and thereby reduce, vulnerability. Vulnerable regions or sectors can be therefore identified by linking the potential impacts and adaptive capacity. Assessing vulnerability to climate change is therefore more complicated than simply assessing the potential impacts of climate change, due to the "adaptive capacity" component.

Estimating adaptive capacity represents the key to vulnerability assessment. Without the evaluation of adaptive capacity no vulnerability assessment can be defined as such: in this sense, vulnerability assessment encompasses more than a simple measurement of the potential harm caused by events resulting from climate change, as it includes an assessment of the region's or sector's ability to adapt.

A very common concept when addressing urban adaptation is "resilience". In some way, vulnerability and resilience are "*two sides of the same coin*" and their understanding is really central to the development of adaptation policies.

Resilience can be considered, in fact, the antithesis of vulnerability, as it describes the amount of disturbance a system can absorb while still remaining in the same state or maintaining function: the degree to which a system is capable of reorganisation and renewal, the degree to which a system can build and increase its adaptive capacity.

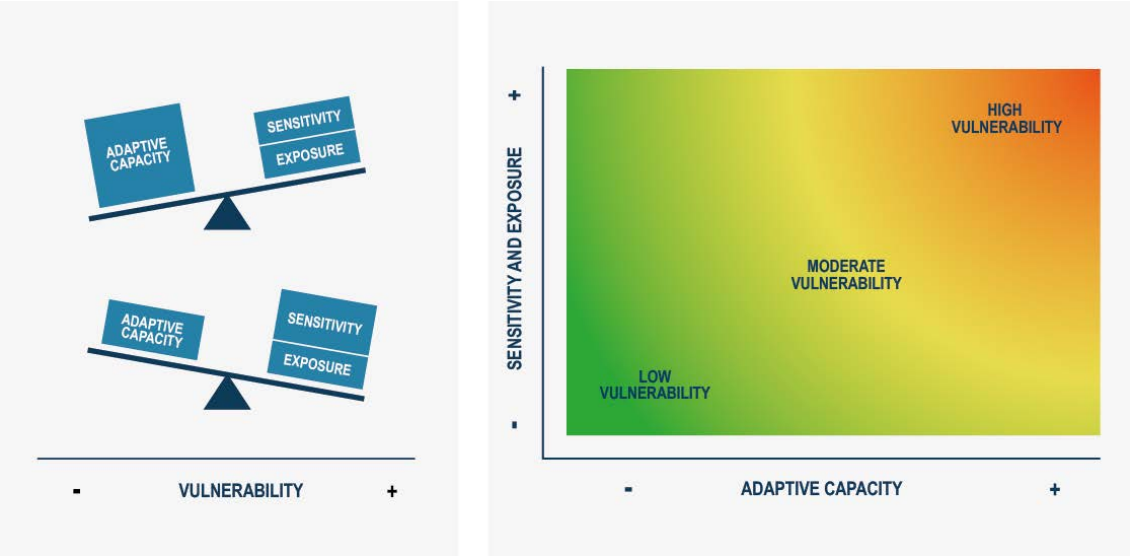


Figure 7 - Approaches to depicting vulnerability (Adapted from Alberta Sustainable Resource Development, 2010 (5) and http://www.adaptingtorisingtides.org/vulnerability-and-risk/ (6)).

As illustrated in Figure 7 the following rules need to be taken into account:

i. *assets with high adaptive capacity and low sensitivity/exposure can tolerate impacts to a greater degree and therefore have an overall low vulnerability*;

ii. *assets with high sensitivity/exposure and low adaptive capacity are more susceptible to impacts, and therefore have an overall higher vulnerability*.

Vulnerability can be considered as a measure of potential future harm. It is important to consider that in order to address vulnerability, it is relevant to identify the vulnerability of something/someone to something, namely a potential climatic event or related harm (e.g. flood damage or drought) in a specific time (now or in the future). Therefore, the following elements need to be investigated:

i. *who or what is vulnerable*: it can be an environmental system, a natural ecosystem, a group of population, some economic activities, etc;
ii. *the potential cause of harm (the risk)*: it is in general an external event to the system (e.g. storm, hurricane, heavy rainfall event, etc) which could cause relevant damages due to its intensity or duration, such as loss of human lives, environmental degradation, loss of biodiversity, economic damages, etc;
iii. *the amount of possible damage*: quantitative assessment of the economic, social and environmental system threatened by exposure to the risk;
iv. *time period*: period in which the damage can occur, which identifies when and for how long it is likely that the risk occur and thereby the damage (Ferrara & Farruggia, 2007).

Vulnerability is not a static concept: it can change over time and new vulnerabilities could emerge as a result of change in the frequency, duration and/or extent of specific climate events.

Other factors that could modify vulnerability are, for example, the emergence of new threats such as the introduction of new invasive species or disease into the community, the implementation of adaptation actions, the change in the community's size, economy, preferences or other factors that can influence a community/region/sector's vulnerability to climate change (Snover et al, 2007).

3.2 Assessing vulnerability to climate change

The assessment of vulnerability to climate change aims at improving the understanding of the potential behaviour of sectors/systems in presence of climate change, helps raising awareness of the community and provides the key elements for targeting the objectives, planning adaptation measures, allocating financial resources and finally monitoring and evaluating adaptation policies.

USEFUL QUESTIONS

- ✓ *What is the purpose of my vulnerability assessment?*
- ✓ *Do I have enough and appropriate data for a quantitative assessment?*
- ✓ *Do I have the technical capacity to perform it in-house?*
- ✓ *What currently determine the type and severity of the impacts in my community?*
- ✓ *What future socio-economic or other factors will determine the type and severity of the impacts in my community?*

Based on the review of available knowledge previously carried out, the assessment of vulnerability aims at improving the understanding of the potential behaviour of sectors/systems in presence of climate change. As a consequence, gaining a better understanding of specific phenomena will help raising awareness of the community and provide the key elements for targeting the objectives, planning adaptation measures, allocating financial resources and finally monitoring and evaluating adaptation policies.

The assessment of vulnerability can be one of the more intensive step of the whole local adaptation process: if adequate data and resources (e.g. technical, financial, etc.) are available it can be conducted in-house by the climate change Adaptation Team. In other cases, the support of external agencies, researchers or consultants may be required.

Assessing vulnerability does not mean calculating a specific number, nor measuring something with a specific instrument (the "*vulnerometer*" does not exist!) but it rather means describing a situation or a condition through a certain number of factors or elements related to its characteristics (Ferrara & Farruggia, 2007). There is no a single method to apply, and no methods fit better than others.

When assessing vulnerabilities at local level, a real demarcation should be made between quantitative and qualitative modes of inquiries. Each approach is based on different techniques, practices and interventions. Depending on the user goals and requirements, the type of available information, the technical expertise, the time and budget constraints, and other factors, assessments can be qualitative (e.g. high, medium, low) or quantitative (e.g. number, score).

Before starting the assessment, some relevant questions should be addressed (Table 15).

General process and scope
i. *What is the purpose of the assessment*? ii. *How much time is available for the assessment*? iii. *On which planning areas do you want to focus the assessment*? iv. *Who will perform the assessment*? *Do you have the technical capacity to perform it in-house*?

v.	*What questions do you want the assessment to answer? Who and what is vulnerable? Vulnerable to what (stressors/hazards)? In what context and circumstances (location)? Who want to know and why (actors, interest)? Who will use the result for what?*
vi.	*Which specific decisions do you want the assessment to support?*
Budget and political support	
i.	*What is your budget for the assessment?*
ii.	*Who will manage the assessment process and budget?*
iii.	*Do you have political support for the assessment?*
Technical	
i.	*Will any model(s) be developed for the assessment? Will the local government be able to operate the model for future scenario analysis?*
ii.	*What type of scenarios does the community want to model? (Best case? Worst case? Middle-of-the-road?)*

Table 15 - Relevant questions to address before starting a vulnerability assessment (Snover A. K. et al, 2007).

Based on the above mentioned definition of vulnerability, vulnerability assessment can be split into the three constituent components: exposure, sensitivity and adaptive capacity, each capturing different elements of vulnerability.

3.2.1 Exposure

Evaluating how the systems are exposed to the impacts of climate change represents the first step in the vulnerability assessment process.

The first step in the vulnerability assessment process begins by evaluating **how systems** (e.g. infrastructure, water resources, biodiversity) **are exposed to the impacts of climate change.** For this purpose, downscaling global climate models to generate higher-resolution climate change estimates is a fundamental activity.

These estimates can then be used in regional and even local-scale hydrologic, ecological, and other computer models to produce higher resolution estimates of projected impacts. In general, more specific information about exposure is likely to help reduce uncertainty and result in a more informed and targeted set of adaptation strategies.

Various factors influence exposure, such as the location of a system, its geographical extent or distribution: location in a risk-prone area (e.g. flood zones, urban heat islands, drought-prone areas, mountain areas, coasts and estuaries); the quality of housing (e.g. high degree of thermal isolation of houses reduces the rate of heat transfer); the geographic mobility (e.g. species that are unable to avoid climate hazards such as flood water or soil-drying are more exposed to the impact) represents some examples of influencing factors (Ribeiro et al, 2009). Examples of possible indicators for exposure to climate change are illustrated in the Table 16.

Examples of indicators for exposure to climate change	
Agriculture	• Spring frosts (average number of events) • Frequency of heavy rainfall events
Health	• Percentage and demographic distribution of population living in urban areas at risk of heat island phenomena • Anomalies in vector distribution
Water resources	• Length and severity of drought periods • Length and severity of flooding

Table 16 - Examples of indicators for exposure to climate change (ISPRA, Life ACT Project - 2011).

EXAMPLE 6

GEOGRAPHICAL LOCATIONS EXPOSED TO CLIMATE CHANGE AND INCREASED CLIMATIC VARIABILITY

Different geographical locations can be exposed to different climate hazards as well as different frequencies and intensities. It is therefore useful to understand how the exposure of different geographic areas will change as a result of changing climate hazards. Understanding what the exposed areas are, and how they will be affected, is important, as it is at these locations where the benefits of proactive adaptation will be greatest.

Changing climate hazard	Particularly exposed locations
Average temperature rise and increased risk of heat waves	regions where average temperatures are already high regions where temperature thresholds may be crossed (e.g. permafrost zones, mountainous regions, etc) urban centres, where the Urban Heat Island effect will exacerbate high temperature
Mean sea level rise, increased storms surge heights, wave heights, coastal flooding and erosion	areas already at or below sea level coastal zones and islands offshore locations

Source: EC, 2011.

3.2.2 Sensitivity

If a system is likely to be affected as a result of projected climate change, it should be considered sensitive to climate change.

If a **system is likely to be affected as a result of projected climate change**, it should be considered sensitive to climate change (Snover et al, 2007). The effects may be direct (e.g. a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g. damages caused by an increase in the frequency of coastal flooding due to sea-level rise).

Factors that could influence sensitivity to climate change include: physical and mental health and age (for socio-economic groups); extent to which products and services are affected by climate stimuli (for sectors); extent to which physical structure and services derived from those structure are affected by climate stimuli (for assets and infrastructure); health, connectivity and robustness of the ecosystem (for ecosystems).

In order to determine whether a system is sensitive to climate change, some questions could be of help (Table 17).

Will the systems associated with this planning area be significantly affected by projected changes in climate?
Is the system subject to existing stress?
What are the known climate conditions affecting the stresses on your systems in this planning area?
How do these climate conditions affect the systems you have identified?
Will climate change cause the demand for a resource to exceed its supply?
Does the system have limiting factors that may be affected by climate change?
What are the projected changes in stresses on a system as a result of the projected climate change impacts? *are they likely to get worse, stay the same, or improve as a result of climate change impacts*? *or, do new system stresses emerge altogether (e.g., the appearance of an infectious disease in a region, or the decline of a species)?*

Table 17 - Examples of guiding questions in order to determine whether a system is sensitive to climate change (Snover et al, 2007).

Examples of indicators for sensitivity to climate change	
Biodiversity	Species with narrow environmental tolerance Species dependent on specific environmental triggers
Tourism	Percentage of population annually affected by extreme weather events Km of beach length to be nourished in order to maintain tourist resort areas
Coastal areas	Geomorphological coastal type

Table 18 - Examples of indicators for sensitivity to climate change (ISPRA, Life ACT Project - 2011)

3.2.3 Potential impacts

Assessing the potential impacts of climate change means evaluating the magnitude of potential effects of climate change which strictly depends on exposure and sensitivity.

Assessing the **potential impacts of climate change** means evaluating the magnitude of potential effects of climate change which strictly depends on exposure and sensitivity.

The effects of climate change maybe be beneficial of harmful, with most observations and projections showing a range of effects on the environment, economy and society.

A list of the potential impacts of climate change have been already illustrated in par. 2.2.2. Different methods and models exist for the assessment of climate change impacts which vary depending on the type of sector.

ACT EXPERIENCE 5

THE POTENTIAL IMPACT OF CLIMATE CHANGE ON TOURISM IN PATRAS (G. Finocchiaro, A. Capriolo – ISPRA).

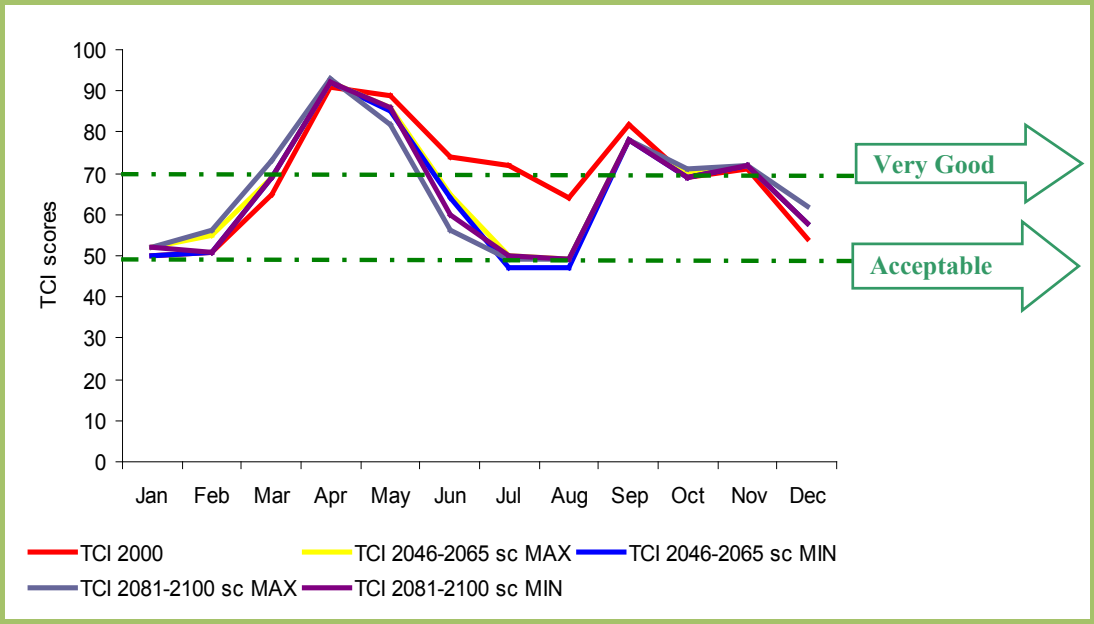


Figure 8 - Comparison of TCI scores in baseline year and in future scenarios (2046-2065 and 2081-2100).

In order to assess the potential impact of climate change on tourism in Patras, the Tourism Climate Index (Mieczkowski, 1985) has been calculated for the year 2000 (baseline) and the periods 2046-2065 and 2081-2100. The TCI is based on the notion of "human comfort" and consists of five sub-indices, each represented by one or two monthly climate variables:

- Daytime Comfort Index (CID)
- Daily Comfort Index (CIA)
- Precipitation (P)
- Sunshine (S)
- Wind (W)

The index is calculated as follows:
TCI = 2[(4*CID) + CIA + (2*P) + (2*S) + W]*

A TCI value of 70 or higher is considered attractive to the "typical" tourist engaged in relatively light activities such as sight-seeing and shopping.
A second key step in analyzing the impacts of climate change on the tourism sector is to model

subsequent impacts of climate change on tourist flows. For this purpose, the Hamburg Tourism Model (HTM) was used to assess the impact on tourist demand in Patras, being aware of the TCI outputs that put in evidence how tourism might partially depend on temperature change. The Hamburg Tourism Model[18] is an econometric simulation of tourism flows to and from 207 countries, and is used to analyse scenarios of population and economic growth as well as climate change and climate policy.
As shown in the simulation run, tourists arrivals are expected to decrease in 2100 in all the Greece and this general reduction will be partially allocated to Patras area depending on the differential between the mean temperature of the country and the mean value in Patras. The larger the differential will be (with the mean temperature in Greece higher than the one in Patras), the less the decrease in arrivals will be in Patras with respect to the rest of Greece.
The HTM may represent surely an interesting method to estimate somehow the dynamics of tourists demand even in such a small area like Patras over a year timeframe. Nevertheless it does not say a lot about the seasonality of the related flows, which is an important factor to assess the real impact on tourism business and plan effective adaptation policies to redirect tourists towards more comfortable periods.
Tourism-related economic activity and economic valuation of future impact at present price also have been estimated for Achaia prefecture (Source: Report on The economic valuation of climate change impact assessment - http://www.actlife.eu/EN/index.xhtml).

ACT EXPERIENCE 6

THE POTENTIAL IMPACT OF CLIMATE CHANGE ON WINE PRODUCTION AND QUALITY IN BULLAS

(A. Capriolo, C. Mastrofrancesco – ISPRA).

In order to examine the climatic effects on wine quality, Bullas vintage ratings, provided by the Municipality, were used (from 1970 to 2008). The ratings are based on 6 categories with general meanings of 0 Disastrous, 20 Very bad, 40 Bad, 60 Good, 80 Very good, 100 Excellent (a score of 0 or 20 has never been given). Average growing season temperatures were used as a climate factor and were taken by ISPRA's model simulations.
To account for potential non-climate trends in vintage ratings (i.e., better production technology) the following econometric regression model approach was applied in the climate/vintage ratings analysis (G.V. Jones et al., 2005):

$$R_t = a + b * temp_t + c * trend + \varepsilon_t$$

where R_t and $temp_t$ represent the vintage rating in points and the average growing season temperature in °C for year t. To account for quality improvements that are independent of climatic changes the model introduces a trend variable $trend$. The trend variable begins with the value 1 in 1970 and continues in one-unit steps. The full model is not statistically significant (R2=0,18): both the average growing season temperature in °C for vintage (temp) and the trend variable (trend) don't make a significant contribution to predicting vintage ratings. Although the time series data are not sufficiently long, the consequence is that the model does not make in evidence any significant correlation between the raising temperature and a worsening in the quality of the local wine. (Source: Report on The economic valuation of climate change impact assessment, http://www.actlife.eu/EN/index.xhtml).

[18] The model was originally developed by Jackie Hamilton, David Maddison, and Richard Tol, with later additions by Andrea Bigano and Karen Mayor.

ACT EXPERIENCE 7

CLIMATE CHANGE AND HEAT WAVES IN THE CITY OF PATRAS

(J. Tuscano, F. De Maio, S. Rieti, L. Sinisi, A. Capriolo - ISPRA).

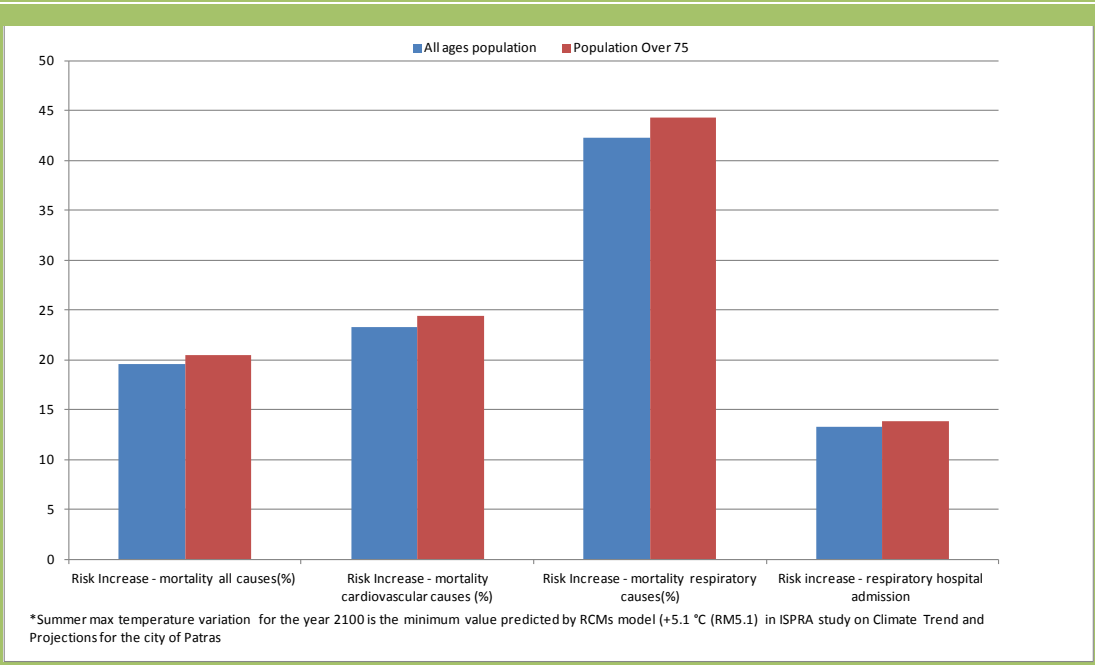


Figure 9 - Percentage in the risk of mortality due to summer maximum air temperature projection* – year 2100.

The assessment carried out by ISPRA and Patras municipality estimate the health risks associated with summer temperature scenarios and heat wave scenarios taking advantage of the results from two major studies in the field (EU and WHO research studies PHEWE and EuroHEAT). The estimated risk of an increase in mortality (natural, cardiovascular, respiratory) associated with summer temperature variations has shown to be very high, specially for people aged 75 and older. The number of heat waves will increase specially during the period 2018-2100, so as their average intensity and length. Over time, Patras population will be exposed to more frequent longer and more intense heat waves. The risk of mortality is higher in the “long duration + high intensity” scenario, and the effects of heat-wave would be greater when ozone or PM 10 levels are higher, particularly among the elderly (75–84 years) The above results lead to the confident conclusion, that the city's population will run a growing health risk, due to heat waves and temperature projections in the future decades. Considering the range for risk increase in morbidity and mortality for cardiovascular and respiratory diseases, additional expenses due to hospital admission and incremental deaths have been also estimated (Source: Report on The economic valuation of climate change impact assessment, http://www.actlife.eu/EN/index.xhtml).

ACT EXPERIENCE 8

THE POTENTIAL IMPACT OF CLIMATE CHANGE ON CULTURAL HERITAGE IN ANCONA

(C. Cacace[1], A. Giovagnoli[1], R. Gaddi[2], M. Cusano[2], P. Bonanni[2]).

[1] IsCR: National Institute for Conservation and Restoration, Via di San Michele 23, 00153 Rome, Italy
[2] ISPRA: National Institute for Environmental Protection and Research, Via Brancati 48, 00144 Rome, Italy

Figure 10 - Mole Vanvitelliana (Ancona): one of the 25 architectural objects studied in the LIFE ACT Project.

In the LIFE ACT Project, the assessment of climate change effects on cultural heritage was carried out by ISPRA and IsCR (Institute for Conservation and Restoration) for artworks in Ancona. The method applied for evaluating the potential climate risk of the artworks was based on The Risk Map of Cultural Heritage (IsCR, 1996). The calculation of the *risk* indicators was obtained by the estimate of *vulnerability* (V) for each single object and of *territorial hazard* (H) data. The vulnerability of each monument represents the variable indicating its level of exposure to environmental/territorial hazard in relation with its superficial conservation conditions.

In the LIFE ACT Project, the vulnerability data were collected through a data sheet model, for 27 cultural items in Ancona (25 architectural monuments and 2 archaeological sites). Statistical analysis showed that most of the forms of decay on considered objects were referable to humidity, to materials powdering and to superficial alteration. For the 25 architectural items studied in this project, superficial vulnerability was generally medium-high, while, for the archaeological sites, the global vulnerability was high. The *territorial hazard* is generally defined by climatic and environmental conditions of the area where the monument is placed; it is usually evaluated using specific dose–response functions that describe the potential damage with relation to pollutant concentrations and climatic parameters.

In this work, the territorial hazard is represented by the calculation of surface recession (R, expressed in mm $year^{-1}$) for calcareous objects in the current scenario and in a future scenario (2030). In the current scenario the results indicated that the surface recession was generally lower than the tolerable value fixed by literature (8 mm $year^{-1}$); the data obtained for the future scenario, showed that the foreseen precipitation and air pollutant decrease should cause a slight reduction of the damage.

As concerns the risk assessment, in the current scenario, the individual risk indicator was calculated correlating the territorial hazard (surface recession values) with the vulnerability of a specific monument. The results indicate that the risk is more considerable for those objects characterized by worse conservation conditions. In the future scenario, the risk assessment cannot be estimated because the vulnerability of the monuments has not been defined. Anyway, considering that the territorial hazard should not significantly change from the current situation, the risk for cultural objects will depend on the monument conservative conditions, that can be monitored and improved through the planning of rigorous and frequent maintenance activities (Source: Life ACT Project - http://www.actlife.eu/EN/index.xhtml).

ACT EXPERIENCE 9

THE POTENTIAL IMPACT OF CLIMATE CHANGE ON HYDROGEOLOGICAL RISK IN ANCONA

(D. Spizzichino, A. Capriolo – ISPRA).

The impact methodologies has been proposed and structured by ISPRA, while the data for the implementation has been provided by Ancona municipality that has carried out also the spatial analysis by GIS tools. Landslide hazard areas and exposed elements (population, land use, road network, urban settlement) have been estimated for the 2100 climate scenario using GIS buffer analysis.

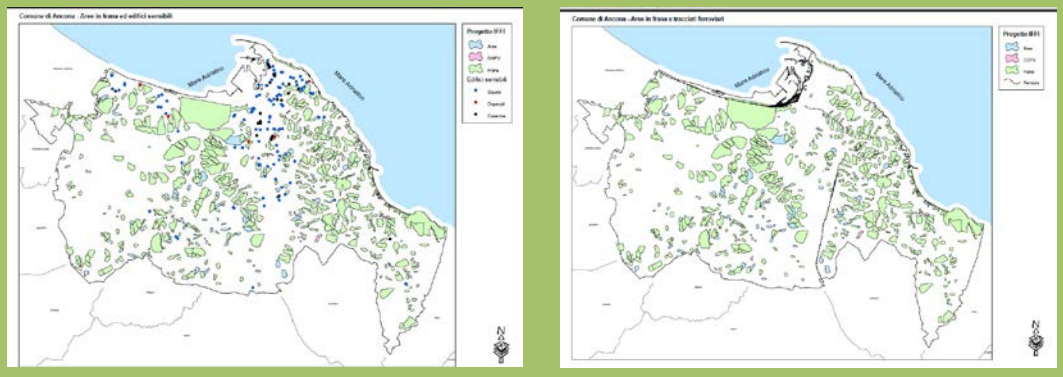


Figure 11 - Landslide areas, strategic and sensitive buildings and railways in the municipality of Ancona.

Figure 12 - Urbanized area affected by landslide in the worst scenario (2100).

The analysis focused also on the of the economic assessment of climate change impact assessment due to slow landslide. The future space distribution of building (in the municipality of Ancona) affected by slow landslide (fig.11) and compare the related costs (value of buildings) with the landslide risk reduction costs, in order to plan adaptation policies to climate change.

The analysis was based on the collection of the following data:

- Future urbanized area worst case in 2100 scenario) affected by slow landslide in Ancona municipality (H=spatial hazard);
- Different land use in urban area classified and derived from Corine Land Cover project 2006 (E = Exposed Elements);
- The building vulnerability was supposed constant in this stage (V = Vulnerability=1);
- Building value (estimated cost per m^2) derived by the Italian Real Estate Observatory Market.

By geo-processing through spatial analysis the above mentioned input data, the expected future costs due to landslide risk affecting urbanized area were calculated for 2100.

The adaptation costs were estimated considering the total costs necessary for landslide risk reduction (superficial and deep slow landslide restoration works). Concerning the adaptation costs due to landslide impacts, a site specific analysis was carried out. All the technical literature has been taken into account in order to provide the unit cost of measures for slow landslide. This analysis has identified the costs of measures (per m^2) that can be applied in order to reduce the urban area affected by landslide risk (fig.12). Findings from the above analysis showed that inaction cost (damage caused by slow landslide in the future) that the municipality of Ancona will have to incur without adaptation plan are much greater than the costs of landslide risk reduction. More in detail the adaptation costs are 1.6 % of the total inaction costs referred to the complete loss of property, giving evidence that adaptation cost are lower than cost of inaction (Source: Life ACT Project - http://www.actlife.eu/EN/index.xhtml).

ACT EXPERIENCE 10

THE POTENTIAL IMPACT OF CLIMATE CHANGE ON BIODIVERSITY IN PATRAS (C. Piccini - ISPRA).

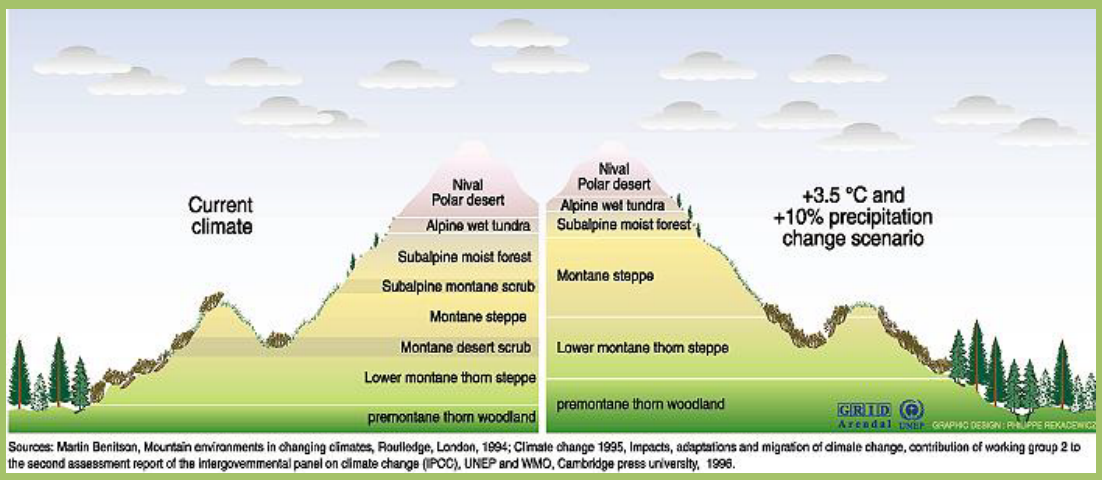
At first the main factors to be considered in drawing up an adaptation plan for biodiversity were analyzed. Among the climatic variables the main agents of GCC climate change impact that could affecton species and on ecosystems are temperature increase, changes to precipitation and wind regimes and variations in frequency and intensity of extreme events. Sensitivity to climate change of the various components of biodiversity is particularly linked to response times, to the biological characteristics of the species, to previous ecological condition. About exposure, given the restricted level of the project's scale, the general assumption that the territory is equally exposed to climate change is allowed. About the current and potential impacts, the effects of global climate changes on species and ecosystems may be classified in four main categories: physiological and behavioural impacts, lifecycle impacts (phenology), geographical distribution impacts (see the Figure below), impacts on the composition and on interactions of species in ecological communities.

Methods, models and indicators are still being studied at international level to assess the expected and potential impacts. The forecasting capacity, however, is strongly limited by the low level of knowledge on the behaviour of one species or the functioning of the ecosystems according to climate variations. Therefore it is only possible to refer to examples of studies and applications in different situations. The adaptive capacity of the various components of the biodiversity is linked to the surrounding conditions that may or may not favour their ability to resist (levels of vitality and resilience of natural systems, level of fragmentation, level of knowledge and monitoring activities, existing legislative framework for the conservation of biodiversity and economic resources, etc.). The assessment of vulnerability of the biodiversity system derives from qualitative and quantitative considerations carried out in the previous phases. The risk linked to climate change impact is a function of the probability of an impact occurring and its intensity. The calculation of risk is therefore greatly linked to an estimate of potential impacts for which methods, models and indicators of measurement are still being studied at international level, seeing as the predictive capacity is still strongly limited by the scarce amount of knowledge on the behaviour of a species or on the functioning of ecosystems according to climatic variations. Anyway, it is possible to formulate some hypotheses regarding adaptation measures, such as the reinforcement of the protection system, the integration of the issue of climate change in territorial planning and programming processes, the broadening of

knowledge and monitoring, the actions aimed at communication, the provision of financial instruments, etc.

Results of a local impact assessment for the Municipality of Patras.

Research studies have shown the occurrence of impacts in the natural regeneration of fir and pine forests in one of the most interesting protected area which is the Mount Panachaikos (Natura 2000). The analysis pointed out also some gaps in knowledge as scarce information about the climate trends in the area and about the sensitivity of flora and fauna to climate change; lack of knowledge and monitoring activity on the future impacts of climate change on biodiversity and on the future spreading of allochtonous species, both animals and plants. To overcome these gaps there is a need for local equipment of meteorological station for the area, advances in research, enhancing transfer of knowledge from research communities to local decisions makers. Furthermore, in its adaptation process the Municipality of Patras will have to deal with uncertainties at different levels, among which, at local level, there are the projections of survival of animal and plant species particularly sensitive to climate change; the projections of the geographical distribution of species; the projections of the spreading of allochtonous species (Source: Life ACT Project - http://www.actlife.eu/EN/index.xhtml).



Sources: Martin Benitson, Mountain environments in changing climates, Routledge, London, 1994; Climate change 1995, Impacts, adaptations and migration of climate change, contribution of working group 2 to the second assessment report of the intergovernmental panel on climate change (IPCC), UNEP and WMO, Cambridge press university, 1996.

Figure 13 - Impact of climate change on mountain vegetation zones

ACT EXPERIENCE 11

COASTAL RISK ASSESSMENT: THE ANCONA LITTORAL CASE STUDY (S. Mandrone, C. Vicini - ISPRA).

The objective of this contribution is to adopt an indicator based approach to evaluate the coastal vulnerability to sea level rise on Ancona shoreline referred to the climate change effects and human pressures. The analysis are referred to an application of Coastal Risk analysis, based on numerical indexes proposed by the EUROSION project (2002-2004), where Coastal Risk (CR) is the product of two parameters: the Coastal Sensitivity Index (CSI) and the Coastal Vulnerability Index (CVI).The methodology assessing the current and future *physical sensitivity* to coastal erosion and flooding. The *Radius of Influence of Coastal Erosion (RICE*) has been defined as the terrestrial areas within 500 meters of littoral, potentially be subject to coastal erosion or flooding in the coming period of 100 years. To assess the Ancona coastal risk, within the RICE some indicators has been used to calculate the coastal risk according to the following equation:

*CR = CSI * CVI*

The result of the previous equation do not express numerically the expected damage, but it is a

quantitative assessment of the presence of causal factors of events at potential risks for coast at local level, for every selected Physiographic Unit.

The study area covered the municipality of Ancona (Marche, Italy), affected by an intensive use of littoral and an accentuated erosive dynamic.

The Ancona littoral has been divided in three Physiographic Units, coastline portions with homogeneous characteristics:

- N.1 Cape (Conero area)
- N.2 Port (Ancona portual area)
- N.3 Alluvial plan

The Coastal Sensitivity Index (CSI) has been calculated for every Physiographic Unit: using the alghoritm:

CSI= SLR + TEV + HWL + GEC + ARice + ODC

The CS Index represents the sum of pressure indicators score. Listed below the pressure indicators in relation with the current and expected future exposure to coastal erosion and flooding at local level are:

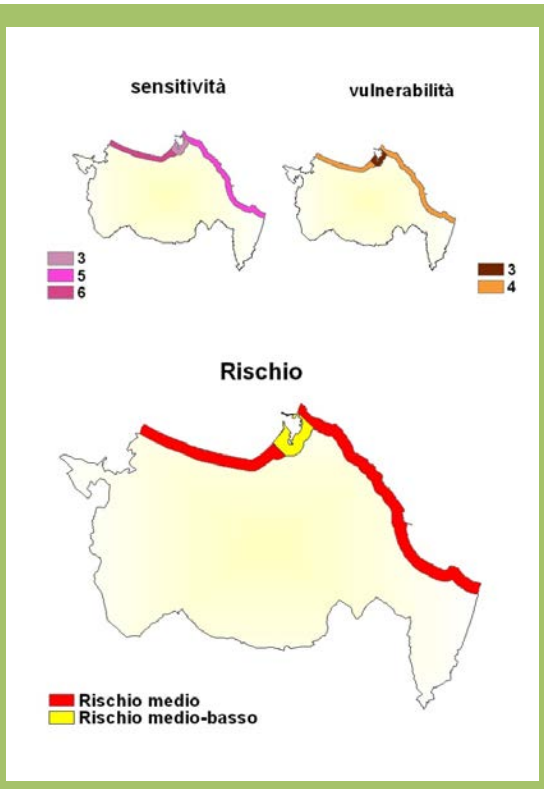


Figure 14 - Coastal Sensitivity Index, Coastal Vulnerability Index and Coastal Risk.

- Sea level rise–SLR (best estimate next 100 years)
- Shoreline evolution–TEV (erosion or accretion)
- Highest water level–HWL (surge level)
- Geo morphological coastal type–GEC (susceptibility to erosion)
- Elevation of near shore coastal zone-ARICE
- Coastal defence works systems–ODC (engineered frontage including protection structure).

The Coastal Vulnerability Index (CVI) has been calculated using the algorithm

CVI = P Rice + U Rice + E Rice + U10km

The Vulnerability Index allowed us to evaluate, for every Physiographic Unit, the potential impact of erosion and flooding through impact indicators, listed below:

- Population living within the RICE area (P RICE)
- % of coastal urbanisation and industrial areas in the *RICE* (U RICE)
- % of high ecological value areas in RICE (E RICE)
- % of urbanisation of coastal area in 10 Km (U10Km).

The results show that the North sectors of Ancona urban area is characterized by medium risk and about 1093 hectares of territory are erosion and flooding risk in the next 100 years (Source: Life ACT Project - http://www.actlife.eu/EN/index.xhtml).

Physiographic Unit	Coastal Risk Index	Class
Cape	20.8	Medium
Port	9.4	Medium-low
Alluvial plan	25	Medium

ACT EXPERIENCE 12

THE PROBLEM OF SOIL AND LAND DEGRADATION IN BULLAS

(M. Di Leginio - ISPRA).

Land in is dedicated to agriculture (61%), both irrigated (14%) and not irrigated (86%). The most important crop is grapevine, being therefore a key factor in the economy of the town.
Agriculture is a sector highly sensitive to climate change and extreme weather events; the consequences are changes in the hydrogeological regime, reduction of crop areas, reduction of water availability, loss of crops due extreme events and increase in the frequency of pest. Extreme events also contribute to decrease soil quality, increasing "threats" as soil erosion (the actual soil erosion risk in Bullas is quite high; mean annual soil loss in Bullas is around 50-200 t/ha/year), soil salinization, loss of nutrients, and the high rates of use of fertilizers and pesticides.

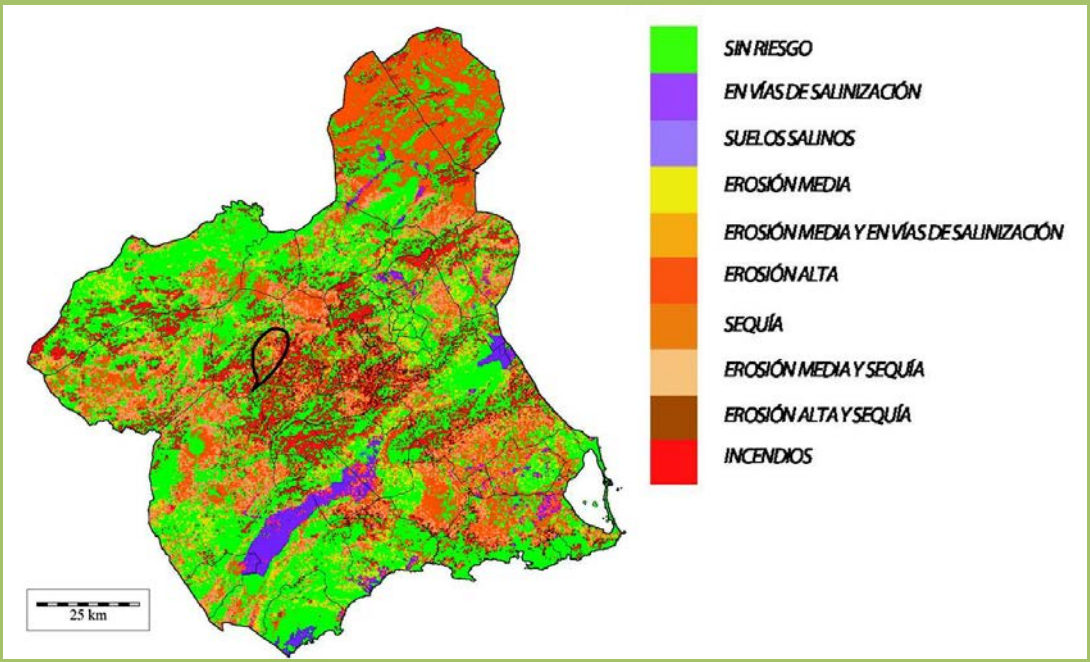


Figure 15 - Desertification risk in Region of Murcia. The black circle represents Bullas area.

Soil health is critically important to sustainable agricultural productivity and environmental wellbeing. Healthy soils provide a range of environmental services including water infiltration, habitat provision and profitable and sustainable agriculture. Measures of soil organic matter help assess fertility and structure. Soil fertility loss can be evaluated as soil organic matter change over a period of time. Many soil properties impact soil quality, but organic matter deserves special attention because it affects several critical soil functions that can be manipulated by land management practices, and it is important in most agricultural settings.

The final result of natural causes like extreme weather events, combined with inadequate human activities is represented by a concrete risk of desertification (Fig. 15). The primary effect of these impacts is the loss of crops and the income of farmers. Considering the municipality's economy is based on agriculture, these may be represent a real pressure to the Bullas growth (Source: Life ACT Project - http://www.actlife.eu/EN/index.xhtml).

3.2.4 Adaptive capacity

Adaptive capacity can reflect the intrinsic qualities of a system that make it more or less capable of adapting, but can also reflect the abilities to collect and analyze information, communicate, plan, and implement adaptation strategies that ultimately reduce vulnerability to climate change impacts.

Evaluating **adaptive capacity** is the further step in the vulnerability assessment of a planning area.

Adaptive capacity can reflect the intrinsic qualities of a system that make it more or less capable of adapting, such as the cooperative relationships between species in an ecosystem, the presence of effective leaders and organizers in a community, or the relative abundance of shaded parks in an urban environment. Adaptive capacity can also reflect the abilities of an organization responsible for managing an ecosystem, leading a community, or urban public spaces, to collect and analyze information, communicate, plan, and implement adaptation strategies that ultimately reduce vulnerability to climate change impacts. Several factors could influence adaptive capacity, such as access and ability to process information on climate change, ability to spread risk, resources to invest in adaptation, flexibility of system to change in response to climate stimuli, willingness to change and adapt, ability for species to migrate or for ecosystems to expand into new zones (Ribeiro et al, 2009). While assessing adaptive capacity, attention should be given to what may limit it, including knowledge, technology, resources, or political will, and how that can be changed. In evaluating adaptive capacity, the projected climate change impacts that will affect systems should be considered. In doing this, some guiding questions could be helpful and are illustrated in Table 19.

- *To what extent are the systems associated with this planning able to accommodate changes in climate at minimum disruption or cost*?
- *Are there barriers to a system's ability to accommodate changes in climate*?
- *Are the systems associated with this planning area already stressed in ways that will limit their ability to accommodate changes in climate*?
- *Is the rate of projected climate change likely to be faster than the adaptability of the systems*?
- *Are there efforts already underway to address impacts of climate change related to systems*?

Table 19 - Examples of guiding questions in order to determine the adaptive capacity of a system to climate change (Snover et al, 2007).

Examples of indicators for adaptive capacity to climate change	
Health	• Early warning system • Green spaces for reducing the Urban Heat Island

Agriculture	• Crop insurance • Change in agronomic practices
Desertification/Land degradation	• Soil erosion control measures • Reforestation/afforestation measures
Natural risk	• Funds allocation in order to improve dissemination and knowledge sharing • Programs and sector plan for the hydrological and geological risk reduction

Table 20 - Examples of indicators for adaptive capacity to climate change (ISPRA, Life ACT Project - 2011).

Findings (e.g. qualitative and/or quantitative) about exposure, sensitivity and adaptive capacity can be then combined in order to determine how and where a community is vulnerable to climate change. Due to a general scarcity of data and information, technical resources, expertise and skills, etc., and in particular at local level, there can be a fair degree of subjectivity in the evaluation of such components and the whole vulnerability. However, the goal is to gather as much information as possible. Based on user goals and requirements, type and quality of available information, available technical expertise, time and budget constraints, and other relevant considerations, the three components and the vulnerability as a whole will be assessed through a qualitative or quantitative approach.

3.2.5 Qualitative assessment of vulnerability

Qualitative assessments of vulnerability aim at gathering information that produce results that can not be easily measured or translated into numbers

Qualitatively assessing vulnerability means gathering information that produce results that can not be easily measured or translated into numbers. If qualitative methods are used with attention, they can yield reliable information. Such approaches are generally based on participatory initiatives involving stakeholders and stimulating them in providing answers and information, through individual interviews, group interviews, community meetings, etc. The information thus obtained may result in the perception by researchers and policy makers that qualitative methods are less accurate and less legitimate than quantitative ones, but this is not true. These methods produce results that are not always easy to compare, or even to check for accuracy, but qualitative evaluations are reliable.

Several reasons can lead to select qualitative methods rather than quantitative ones:

i. they allow for an analysis when quantitative data or technical capacity are unavailable;
ii. they answer some questions that quantitative measures can not (e.g. how and why);

iii. they are directly connected with the community and can involve the population at large in assessing the needs of the community.

ACT EXPERIENCE 13

QUALITATIVE ASSESSMENT OF VULNERABILITY FOR THE TOURIST SECTOR IN THE MUNICIPALITY OF BULLAS

(P. Garcia Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert - Municipality of Bullas, Spain).

Based on the approach proposed by Snover et al, 2007, the Municipality of Bullas performed a qualitative vulnerability analysis for the tourist sector. In this Box the case of "change in seasonal tourist flow" impact is illustrated.

EXPOSURE			
Impact	Factors influencing the exposure of tourism	Exposed elements/groups	Level of exposure
Change in seasonal tourist flow	Changes in temperature, precipitation and extreme events	Hotel business Rural housing Restaurant business Outdoor activities Wine industry Museums	Medium

SENSITIVITY			
Existing stress unrelated to climate	**Sensitive elements/groups**	**Factors influencing the sensitivity of tourism**	**Sensitivity**
Water shortage	Hotel business Rural housing Restaurant business Outdoor activities Wine industry Museums Health facilities	Seasonality of precipitation (heavy precipitation are expected in September and October which are currently the most touristic months in Bullas)	Functionality will get worse

ADAPTIVE CAPACITY					
Factors determining the adaptive capacity of the system / sector	Is the system already able to accommodate changes in climate with minimal costs and disruption?	Can the system/sector adjust to the projected impact with minimal cost and disruption?	Barriers to the system's ability to accommodate changes in climate	Rate of projected climate change compared to the adaptability of the system	Adaptive capacity
Flexibility to respond and adapt to climate stimuli Willingness to change Awareness	Yes	Yes, it is possible to implant some reduced-cost measures to adapt	Economic barriers Lack of political and citizens awareness	Slower than the adaptability of the sector / system	It will require some slight costs ($$) and staff interventi-ons

	VULNERABILITY RATING
	Medium exposure; Sensitivity: S4; Adaptive capacity: AC4 = Medium vulnerability

EXAMPLE 7

QUALITATIVE ASSESSMENT OF VULNERABILITY

The final step in the vulnerability assessment process is to combine your findings about sensitivity and adaptability to determine how and where your community is vulnerable to climate change. Planning areas with systems that are sensitive to climate and less able to adapt to changes are generally considered to be vulnerable to climate change impacts.

Vulnerability of water supply sector

PLANNING AREA	Current and expected stresses to systems in this planning area	Projected climate change impacts to systems in this planning area	VULNERABILITY ASSESSMENT		
			Degree of sensitivity of systems in this planning area	Adaptive capacity of systems in this planning area	Vulnerability of systems in this planning area
Water supply	Managing summer drought (current and expected)	More drought, summer water stress likely due to lower winter snowpack and warmer, drier summers. Population growth will compound this problem.	High – water supply is very sensitive to changes in snowpack.	Low – numerous regulatory constraints on reallocating water, options for expanding supply limited, summer demand already greater than supply.	High

Source: Snover et al, 2007.

3.2.6 Quantitative assessment of vulnerability

Quantitative methods express their results in numbers, by answering questions like “How many?” or “How much?” or “How often?”.

Quantitative methods express their results in numbers, by answering questions like “*How many*?” or “*How much*?” or “*How often*?”. Quantitative measures are often requested by policy makers as they are considered more reliable than qualitative ones: in fact quantitative results can be compared, leave less room for misinterpretations and are easy to communicate.

It can be stated that qualitative and quantitative methods are complementary as each one has strengths and weaknesses than the other one has not and, together, they can present a more accurate picture of the situation. Therefore, when it is possible it is recommended to use both approaches in order to provide better results.

Quantitative assessment are performed through indicators and indices with the main purpose of classifying groups or areas, compare vulnerabilities of areas and sectors. For this reason vulnerability indicators can be used as benchmarks for the effectiveness of the identified adaptation measures and may help understand where planned adaptation policy might be needed most.

Certainly, the feasibility of quantitative assessment is strictly limited by the availability of the required data.

In reviewing vulnerability indicator studies, the EEA have concluded that there is no common methodology for defining or developing vulnerability indicators. In fact, the discussion on whether and how such indicators could be developed is still wide.

One relevant issue in this context would be "*how and when it would be appropriate to separate out vulnerability caused by climate change and vulnerability as a result of other causes*".

From several points of view it may seem important to try to separate these components, but in the context of developing interventions to reduce vulnerability, there may practically be little advantage in separating these causes.

Furthermore, it may also be very difficult to separate the drivers in any measurement.

EXAMPLE 8

QUANTITATIVE ASSESSMENT OF VULNERABILITY (1)

Vulnerability of elderly population to change in the number of high temperature days.

Climate change: a regional assessment of vulnerability and adaptive capacity for the Nordic countries. For a quantitative assessment of vulnerability, the CARAVAN project has developed a web-based tool for visualising vulnerability to climate change as a function of exposure and sensitivity on the one hand and adaptive capacity on the other, by incorporating approaches used in Norway, Sweden and Finland for assessing climate vulnerability in social and environmental contexts. Recognizing that vulnerability to climate change is context specific, and that detailed studies at local level are necessary to provide a thorough understanding of the processes determining vulnerability, this tool is intended for high-level planners wishing to identify specific regions, sectors or communities that may have difficulties meeting the challenge of climate change. Maps are produced as a combination (arithmetic mean) of the normalised values of exposure/sensitivity (Figure 16) and adaptive capacity (Figure 17). Higher values of vulnerability (Figure 18) imply relatively high exposure/sensitivity and/or relatively low adaptive capacity, while lower values of vulnerability imply relatively low exposure/sensitivity and/or relatively high adaptive capacity.

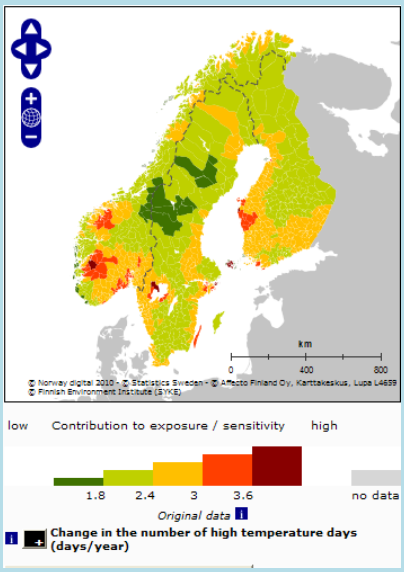


Figure 16 - Exposure/Sensitivity to projected change in the number of high temperature days (2021-2050).

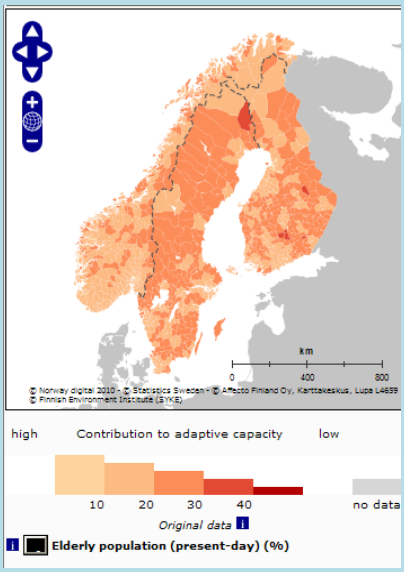


Figure 17 - Adaptive capacity of elderly population for the present-day situation.

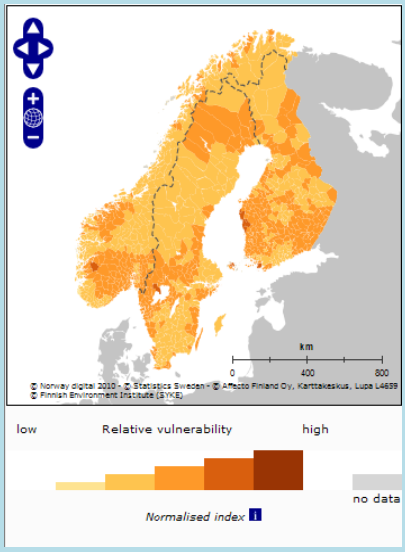


Figure 18 - Vulnerability of elderly population to change in the number of high temperature days.

Source: The CARAVAN Project : www.ymparisto.fi/default.asp?contentid=380099&lan=en&clan=en.

EXAMPLE 9

QUANTITATIVE ASSESSMENT OF VULNERABILITY (2)

GRaBS Adaptation Action Planning Toolkit – Planning for a Changing Climate Across Europe.

One of the major aims of the GRaBS project (**Green and Blue Space Adaptation for Urban Areas and Eco Towns)** was to develop an innovative, cost effective and user friendly risk and vulnerability

assessment tool, to aid the strategic planning of climate change adaptation responses in towns, cities and regions across Europe.

In particular, the toolkit ADAPTO aims at assessing current vulnerability of urban areas to the impacts of climate change, with an additional assessment of relative spatial patterns of risk where suitable data is available. The tool is based on a Geographical Information System (GIS) and was built on top of the Google Maps interface using a range of spatial data for the whole of Europe, together with specific spatial data from project partners – in total over 325 different map layers.

Application of the assessment tool at local level has been performed in the territory of the Genoa Province. The toolkit allows to display the values of the 8 selected indicators, the level of vulnerability associated with the relevant thresholds, and a parameter of final vulnerability.

Areas investigated: Val Polcevera and Valle Scrivia, sub-divided into sub-areas (Polcevera Basso and Alto, Scrivia Basso, Medio and Alto).

The following indicators have been used: matrix, interfering areas, hydrogeological risk, specialised uses, fragmentation, abandoned lands, soil consumption, drainage surface, heterogeneity, biological capacity, habitat standard.

Source: http://www.ppgis.manchester.ac.uk/grabs/.

3.3 Assessing climate change risk

Risk associated to climate change is the product of the consequence of an impact and the likelihood of its occurrence.

In the climate change framework **risk** is generally defined as the product of the consequence of an impact and the likelihood of its occurrence or more simply:

RISK = consequence x likelihood of occurrence

Consequence of an impact refers to the known or estimated – economic, environmental, social, cultural, legal - consequences of a particular impact.

Likelihood or probability of an impact aims at assessing how likely is it that a projected impact will occur. In fact, the probability of occurrence of the climate change impacts is not the same for all the impacts. Climate represents a present-day hazard that we manage based largely upon past experience. However, the probability associated with an hazard could change as a consequence of global warming. Impacts that are likely to occur and which would have serious consequences if they did occur, would be considered high risk and high priority impacts. On the contrary, impacts that are unlikely to occur would present little risk and would fall into the green, lower left corner of the diagram below (Adaptation Wizard, UKCIP).

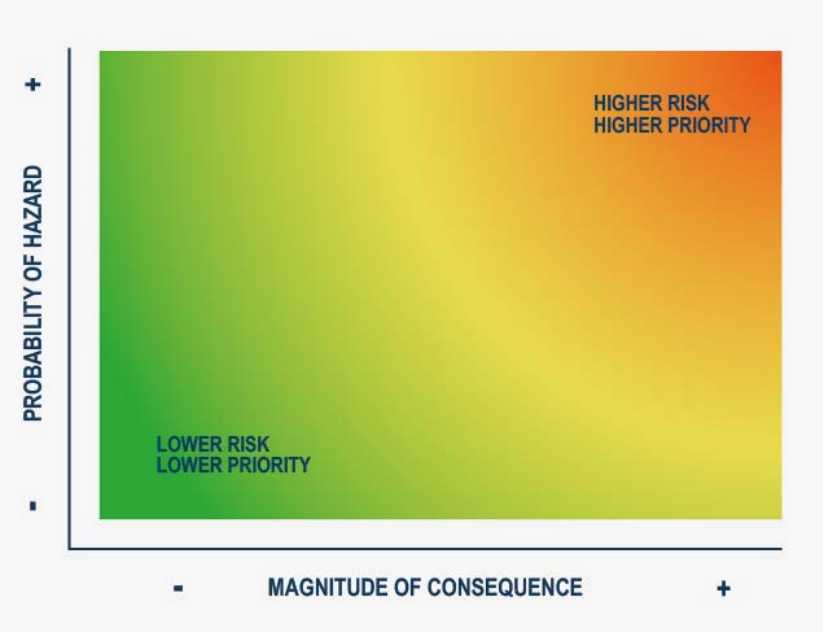


Figure 19 - Risk depends on both probability and consequence (Adaptation Wizard, UKCIP).

Based on the definition of risk and on the information developed within the previous vulnerability assessment, risk assessment will be performed through the evaluation of the two components:

i.) the probability, or likelihood, of the impact occurring;

ii.) the magnitude, or consequence, of the impact should it occur.

The purpose of this step is therefore the identification of risks and hazards that may be induced or exacerbated by climate change and to evaluate their consequences and likelihood. Together with the assessment of vulnerability, risk assessment will provide the necessary information for the prioritisation of adaptive actions.

When a local authority has already performed a risk assessment, climate change could be added to it. On the contrary, for those who are new to risk assessment, quantitative to qualitative approaches could be available. Certainly, where relevant decision would be needed more quantitative methods should be used.

Like vulnerability, risk is not a static concept but it may evolve during the lifetime of an asset, infrastructure, etc. Consequently, the time horizon to be considered is the lifetime of that asset, infrastructure, etc.

Furthermore, it is important also to consider the attitude towards risk that can affect the way how individuals within the community accept certain levels of risk. Interviews to government leaders and meetings may provide useful information on what risks are acceptable and what are not, and which are the thresholds to distinguish them.

3.3.1 Assessing the consequence of occurrence

For each impact the appropriate level of consequence should be identified, based on the known or estimated consequences (e.g. on environment, economy, public safety, etc.). When considering the level of impact, some issues should be taken into account, such as the value of the assets and its future trend, the easiness of its relocation, the character of the hazard (e.g. continuous in case of coastal erosion and intermittent in case of flooding).

CONSEQUENCE RATING	DESIGNATION	EXAMPLE
Catastrophic	5	• Widespread loss of environmental goods and irreversible environmental damage • Loss of life or serious injury
Major	4	• Widespread decline in services and quality of life • Isolated events of serious injury and loss of life
Moderate	3	• Isolated but significant instances of environmental damage that might be reversed with intensive efforts • Small number of injuries
Minor	2	• Individually significant but isolated areas of reduction in economic performance relative to current forecasts • Minor injures
Negligible	1	• Appearance of a threat but no actual harm • No environmental damage

Table 21 - Consequence rating (Workbook for Municipal Climate Adaptation, ICLEI).

3.3.2 Assessing the likelihood of occurrence

For each impact a likelihood rating should be assigned, by taking into account if it is recurring or a single event. For example, increased demand on water supply is a recurrent event, whereas a damage due to an extreme event is a single event (Table 22). This sort of likelihood assessment is designed for use by non-experts, however this step would benefit from input from skilled experts.

Likelihood rating	Recurrent impact	Single event	Ipcc definition
			Virtually certain (> 99% chance that a result is true)
Almost certain	Could occur several times per year	More likely than not-probability > 50%	Very likely (90-99%)
Likely	May arise about once per year	As likely as not – 50/50 chance	Likely (66-90%)
Possible	May arise once in 10 years	Less likely than not but still appreciable – probability less than 50% but still quite high	Medium (33-66%)
Unlikely	May arise once in 10 years to 25 years	Unlikely but not negligible – probability low but noticeably greater than zero	Unlikely (10-33%)
Rare	Unlikely during the next 25 years	Negligible – probability very small, close to zero	Very unlikely (1-10%)
			Exceptionally unlikely (< 1%)

Table 22 - Likelihood rating (Workbook for Municipal Climate Adaptation, ICLEI).

3.3.3 Evaluating the risk

In order to evaluate the risk, the results from Table 21 e 22 should be used in order to position the risk in Table 23.

	CONSEQUENCE				
	Catastrophic	**Major**	**Moderate**	**Minor**	**Insignificant**
Almost certain	E	E	E	H	M
Likely	E	E	H	H	M
Possible	E	E	H	M	L
Unlikely	E	H	M	L	L
Rare	H	H	M	L	None

E: Extreme risks demand urgent attention at the most senior level and cannot be simply accepted as a part of routine operations without executive sanction.
H: High risks are the most severe that can be accepted as part of routine operations without executive sanction but they will be the responsibility of the most senior operational management and reported upon at the executive level.
M: Medium risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for actions, maintained under review and reported upon at senior management levels.
L: Low risk will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.

None: Negligible risk; no response required.

Table 23 - Example of a risk matrix (Adapted from Workbook for Municipal Climate Adaptation, ICLEI: UKCIP, Adaptation Wizard).

The example illustrated in the table 23 represents just an approach but each local authority needs to determine its own risk classification or which squares are “H”, “M” or “L”. It is important to highlight that a risk may have today a *minor consequence* and a likelihood equal to *unlikely*, but it will become *possible* in 30 years and *likely* in 100 years. Thus, a risk could go from low to high in the next 100 years. This means that it could be possible to tackle some of those risk that are labelled as low risk and prevent them from becoming high risks in the future.

Furthermore, it is important to note that **also opportunities should be prioritized** in a different table in order to allow the local community to take advantage of the benefits associated with those opportunities. Risk assessment may involve either quantitative or qualitative techniques and methods, or even a combination of both, in order to describe the nature of the two components of risk. Of course the use of one technique or another strictly depends on the availability of knowledge about probabilities. In some cases data on the occurrence of past events could be available, thus allowing to calculate the probability (or “risk”) of a future event. In case stakeholders are not represented in the Adaptation Team, it may be helpful to involve them for input at this stage on the risk assessment (Adaptation Wizard, UKCIP).

3.3.4 Qualitative assessment of risk

Qualitative methods rely on descriptive information and expert knowledge and evaluation ranking into qualitative classes such as “high”, “medium” and “low”.

In cases where resources are scarce, information is limited, or the consequences of the impacts are small, a qualitative approach may be preferred. These methods rely therefore on descriptive information and expert knowledge and evaluation ranking into qualitative classes such as “*high*”, “*medium*” and “*low*”. Stakeholders and experts could be involved through appropriate workshops, focus groups, questionnaires.

EXAMPLE 10

QUALITATIVE ASSESSMENT OF RISK

Risk assessment for water supply.

In qualitative assessments, it is good practice to describe why a high, medium, or low rating was assigned to a given system. In order to develop risk scores for each impact, qualitative statements can be converted into numeric score (e.g. high=5, medium-high=4, medium=3, medium-low=2, low=1).

In cases where one of the risk components is unknown (e.g. consequence or probability of an impact), other factors can be considered that may help determine the appropriate level of risk:

i. *the importance of the potential impact compared to other issues the government is currently managing*;
ii. *how problematic would the increase in probability of the impact for the system*;
iii. *how the government is managing the stresses to systems that are exacerbated by the projected impact*;
iv. *the adaptive capacity associated to the systems.*

PLANNING AREA	Current and expected stresses to systems in this planning area	Projected climate change impacts to systems in this planning area	RISK ANALYSIS		
			Consequence of impact – high, medium, low	Probability of impact – high, medium, low, unknown	Estimated risk to systems in this planning area – high, medium, low
Water supply	More summer drought	More drought, summer water stress likely due to lower winter snowpack and warmer, drier summers. Population growth will compound this problem.	High – threat to public safety, loss in consumer confidence, lost revenue. Affects entire customer base.	High – already a concern and warmer, drier conditions expected	High

Source: Snover et al, 2007.

3.3.5 Quantitative assessment of risk

Where technical expertise and appropriate models are available, quantitative assessment of risk may be performed.

Fewer examples of quantitative climate change risk assessment are available, in particular for those risks that are highly uncertain and difficult to quantify. In case where technical expertise and appropriate models are available (e.g. to quantify potential damages, probability of occurrence, etc), a quantitative assessment of risk may be performed.

EXAMPLE 11

QUANTITATIVE ASSESSMENT OF RISK

London is prone to flooding from five sources of floodwater: from the sea (tidal flooding), from the Thames and tributaries to the Thames (fluvial flooding), from heavy rainfall overcoming the drainage system (surface water flooding), from the sewers, from rising groundwater. Nearly 15 of London lies at risk from tidal and fluvial flooding. Figure 20 shows the extent of the area of London protected by flood defences with probability of being flooded expressed as a return period (Source: Environment Agency).

Risk assessment for flooding.

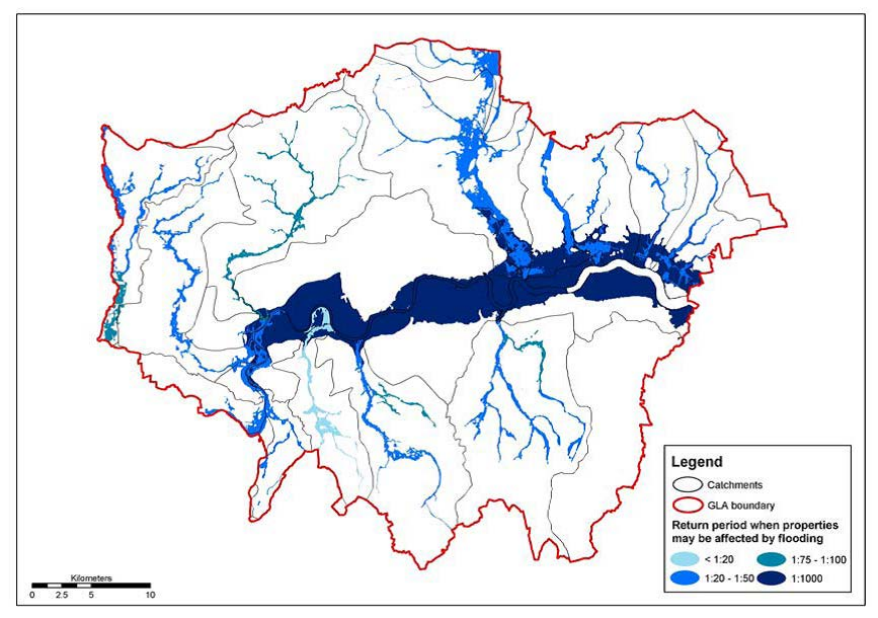


Figure 20 - Area of London protected by flood defences with probability of being flooded expressed as a return period.

Further information can be found: www.london.gov.uk/climatechange/

Source: Greater London Authority, 2010.

3.4 Vulnerability and risk assessment for the prioritisation of impacts

Vulnerability assessment could be considered as a preliminary step for the upcoming risk assessment: by determining the vulnerability to each impact, risk assessment can be performed for those impacts to which the community has a high vulnerability.

The combination of vulnerability and risk assessment is fundamental for the **prioritisation of impacts** which is the main objective of the assessment activity. Ideally, vulnerability assessment could be considered as a preliminary step for the upcoming risk assessment: by determining the vulnerability to each impact, risk

assessment can be performed for those impacts where the community has a high vulnerability (ICLEI, Workbook for Municipal Climate Adaptation).

Conducting a vulnerability assessment means therefore to identify weak spots for further investigation and to figure out which impacts can be adapted to with available capacity and which require actions outside available capacity. There will be four different outputs from the vulnerability assessment:

1. *identification of impacts we are not vulnerable to now*;
2. *identification of impacts we are vulnerable to now (high or low vulnerability)*;
3. *identification of impacts we are likely to be vulnerable to in the future (high or low vulnerability)*;
4. *identification of impacts we are not likely to be vulnerable to in the future*.

In two cases (2 and 3) the process will proceed to the further risk assessment. It is up to the Adaptation Team to decide whether to select just the impacts the community is highly vulnerable to (now and in the future) or to select all the impacts the community is vulnerable without distinction of the level of vulnerability. The Team could decide to give priority to the first ones and to postpone to a second stage the risk assessment of the impacts where the community is less vulnerable. Anyway, the iterative nature of the vulnerability assessment will allow to identify at a later time new arising vulnerabilities and to submit them to the risk assessment later in a second stage.

The main objective of a risk assessment is to rank the likelihood and the consequence of a climate impact's effect on a particular unit exposed to climate change (e.g. asset or population), thus providing a list of prioritized impacts in terms of risk.

In order to identify the priority areas on which the strategy and actions will focus on, the results of vulnerability and risk assessment should be grouped into the following categories of systems:

i. *high risk/high vulnerability*;
ii. *high risk/low vulnerability*;
iii. *low risk/high vulnerability*;
iv. *low risk/low vulnerability*.

As illustrated in the Figure 21 the main adaptation purpose will be to make the areas that are at high risk and highly vulnerable an absolute priority of the adaptation strategies, plan and actions. In this way, the combination of vulnerability and risk assessment will allow to figure out the main risks that need action.

However, it is a task of the Adaptation Team to decide how to prioritize systems that are not at high risk and are not highly vulnerable. This decision will likely depend on various criteria not necessarily identified within the vulnerability and risk assessment (e.g. values, economic drivers, other factors specific for a specific community). Furthermore, priority risks will also be determined by the level of risk that different communities will decide to accept (risk tolerance).

Thus, prioritising the risks is a complex process which requires that each community sets their own criteria.

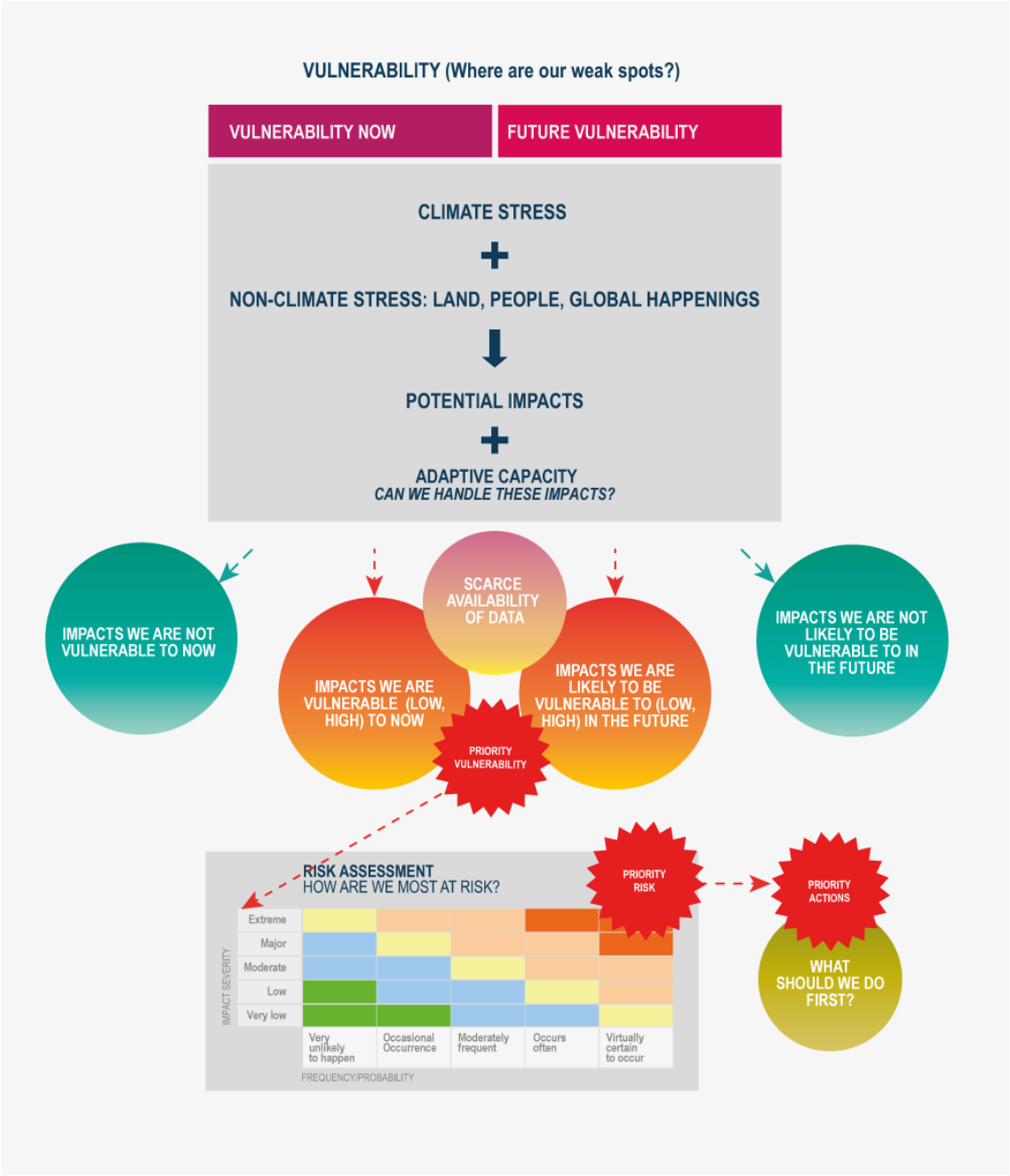


Figure 21 - Vulnerability and risk assessment (Adapted from adaptationresourcekit.squarespace.com).

At this stage it is important to take into account that lack of information and data could affect vulnerability and risk assessment and, consequently, priorities to be considered. For example, it could be decided that sectors that are highly vulnerable but lack of sufficient information on risk should be included among priorities.

3.5 Identify the knowledge gaps, needs and uncertainties to manage

Enhancing and developing the knowledge base, thus bridging as much as possible the gaps and reducing the uncertainties, will mean to empower decision-makers to formulate more scientifically-sound policies and better address the challenges posed by climate change. Knowledge gaps or uncertainties do not represent reasons for inaction.

More knowledge is needed on climate science, vulnerability and impacts of climate change so that appropriate policy responses can be developed. In fact, enhancing and developing the knowledge base, thus bridging as much as possible the gaps and reducing the uncertainties, will mean to empower decision-makers to formulate more scientifically-sound policies and better address the challenges posed by climate change.

Knowledge gaps or **uncertainties** do not represent reasons for inaction. However, they represent a very challenging issue. Research on this issue is already considerable, but results are not always downscaled at local level and shared among the local decision-makers. In many cases a local community will not be able to bridge them by itself as many knowledge gaps and uncertainties concern global and regional level and need to be developed at a higher scale. However, based on its administrative competences, financial resources and available technical expertise, municipalities will be able to reduce knowledge deficit on local issues. Table 24 illustrates examples of knowledge gaps that can be identified at local level.

Gaps	Needs
Scarce availability of continuous and complete observed data series	Strengthening of local equipment of monitoring stations
Scarce availability of methods for monitoring the impacts of climate change	Advances in research
Scarce availability of models for the estimation of future impacts	Advances in research
Scarce knowledge on the sensitivity of natural resources to climate change	Enhance the transfer of knowledge from research communities to local decision makers

Table 24 - Examples of knowledge gaps and needs that can be identified at local level (ISPRA, Life ACT Project).

Furthermore, the use of models for the prediction of global, regional and local climate change and its consequences involves a number of uncertainty factors. In fact, it is not possible to know with an absolute certainty the way how climate will change in the future in a certain area and which the effects on people, natural systems and society will be: not only climate change will have different impacts in different places, but the

likelihood of those impacts will vary significantly. Projections of trend in emissions of greenhouse gases and aerosols are still very uncertain, as they depend on various socio-economic factors. Furthermore, climate change models predict temperature increases reasonably well, but uncertainty still surrounds the intensity and frequency of extreme weather events and moreover precipitation patterns. However, where different models come to similar results it is already possible to make first reliable statements about the direction and/or range of possible changes. Nevertheless, even with further refinement of climate scenarios, future impacts of climate change will remain uncertain and need to be continuously updated over time. Table 25 illustrates examples of some uncertainties that communities will have to take into account during their adaptation process[19].

Global and regional level
• Greenhouse gases emissions scenarios • Socio-economic scenarios • Projections of climate variables, in particular extreme events and precipitation patterns • Projections of climate change impacts on natural systems and socio-economic sectors
Local level
• Projections of climate and non-climate variables at local scale • Projections of non-climate variables at local scale • Seasonality of tourist flows • Demographic indexes variations

Table 25 - Examples of uncertainties about the future (ISPRA, Life ACT Project).

CHAPTER 3 CHECKLIST

- ✓ *Have you assessed vulnerability to climate change, at least in qualitative terms?*
- ✓ *Have you assessed the risks posed by climate change, at least in qualitative terms?*
- ✓ *Have you performed a vulnerability-risk matrix in order to prioritise the impacts?*
- ✓ *Have you identified knowledge gaps, needs and uncertainties?*

[19] For further details: http://climate-adapt.eea.europa.eu/web/guest/uncertainty-guidance-ai.

4.
DEVELOP THE ADAPTATION PLAN

After the identification of the most significant risks posed by climate change, the real adaptation planning phase can start. Planning can be defined as the process of setting goals, objectives and targets and developing the appropriate strategies to accomplish them. In short, planning will help to define what the community want to achieve and how it will manage it.

At this stage it will be determined how best to address those risks, by identifying a range of adaptation options and then selecting preferred adaptation options using specific criteria. Adaptation options will be addressed to bring negative impacts at an acceptable level as well as take advantage of any positive opportunities that may arise from climate change.

Different activities are therefore needed at this stage:

- *identifying the adaptation goals, objectives and targets to be achieved;*
- *formulating the strategies to achieve these goals, objectives and targets;*
- *defining cross-sectoral issues and identifying synergies and conflicts.*

Options for adapting to climate change will vary from actions that build adaptive capacity (e.g. building knowledge base, sharing information, etc) to concrete adaptation measures (e.g. green infrastructure, technical solutions, etc) (EC, 2013a).

4.1 Set the adaptation goals, objectives and targets

Setting adaptation goals and objectives will help provide a structure for the next steps, by identifying clearly what the community want to achieve through adaptation actions.

USEFUL QUESTIONS

- ✓ *In which way can I face the priority risks previously identified?*
- ✓ *Which targets do I have to achieve in order to manage the risks identified?*

Based on priority risks (and eventually opportunities) identified in the previous steps, adaptation goals, objectives and targets will vary from one community to another one as a consequence of various factors, such as types and magnitude of projected climatic changes and impacts, availability of financial resources, areas on which the community has direct responsibilities and influence. This means that it is not possible to prescribe them in general, but they will have to be selected case by case, community by community.

However, it is important to take into account some common elements that should characterize goals and objectives. In fact, they should be as much as possible:

- **specific**: focus on important factors and avoid broad expression like “being more environmentally friendly”;
- **achievable**: if the goals/objectives are too high it will be more difficult to accomplish them, and this will demotivate people working on them. It is also important to avoid setting too many goals;
- **realistic**: if goals/objectives are set too low, it may not be possible to reach the full potential for action;
- **prioritised**: prioritising will ensure that the most appropriate adaptation responses are selected. (GRABS Project).

Setting adaptation goals and objectives will help provide a structure for the next steps, by identifying clearly what the community want to achieve through adaptation actions.

The development of **adaptation goals** may be guided by the following considerations:

1. at this stage it is important that the Adaptation Team and the government leadership should agree on the goals. For this purpose, clearly written, attainable and measurable adaptation goals should be developed and shared by all their representatives.

2. adaptation goals will require the identification of a time period for the accomplishment (e.g. 10, 20 or 50 years) that is consistent with other long-range planning programs.
3. take into account that adaptation to climate change is an on-going process: policies and practices will be regularly re-evaluated in light of known and projected climate change impacts and other changes in the community.

Adaptation goals may be, for example:

- **increasing public awareness on increased temperatures and their projected impacts on our community;**
- **increasing technical capacity to prepare for the impacts of increased precipitation in winter;**

(ICLEI, Workbook for Municipal Climate Adaptation).

After the identification of the adaptation goals, it will be possible to set specific **adaptation objectives**, thus indicating the way in which the community intends to face the risks previously identified. In order to draft the objectives, it may be useful to rephrase each impact description and point out the potential improvement by reducing the severity of the impact.

Examples of adaptation objectives may be:

- **to improve and diversify water supply;**
- **to slow down erosion, desertification and soil loss;**
- **to enhance the energy efficiency of buildings;**

A number of **adaptation targets** will be defined just after the definition of goals and objectives. The aim of this step will be to break down the objective into tangible segments of effort. Targets should be linked therefore to specific objectives. Defining the timeframe of targets (now: by 2015; soon: 2015-2030; later: 2030-2050) will depend on the long-term and forward looking policy, as for example:

- **to designate reliable shelters for warm extreme weather events by 2012;**
- **all the Departments of the Government will have screened the effects of climate change in their policies by 2012.**

Adaptation targets may also include relevant numerical standard to measure the progress, such as:

- **to improve energy conservation by 25%;**
- **to increase local food production by 20%.**

It is important to define quantitative targets in order to measure and compare them with a reference or base year. In general, climate adaptation processes require both strategic and long-term (10-15 years) as well as operational and short-term targets (1-3 years) (ICLEI, Workbook for Municipal Climate Adaptation and GRABS Project). Adaptation goals, objectives and targets should be compared with other existing plans, strategies and regulations in terms of potential conflicts and synergies, and in particular with existing National and Regional Adaptation Strategies or Plans.

EXAMPLE 12

ADAPTATION TO CLIMATE CHANGE: 12 SHEETS TO ACT AT COMMUNITY LEVEL

1) To understand climate issues in its territory in order to prepare and adapt to future change.
2) To introduce climate issues in urban planning documents.
3) To develop a common culture for the heatwaves management and their health, environmental and economic consequences.
4) To encourage project managers to integrate summer comfort in public buildings from their design to their exploitation.
5) To mitigate situations of thermal discomfort in managing the city.
6) To valorise spaces in fresh areas.
7) To define a strategy for the sustainable management of stormwater by favouring their infiltration and to limit the extent of impermeable surfaces.
8) To manage water consumption of the collectivity and to improve the efficiency of its distribution service.
9) To diversify water resources for water supply in the territory.
10) To limit the risk of shrinkage and swelling of clays.
11) To promote the development of urban green space by favouring plant species adapted to local climate conditions.
12) To favour silvicultural practices that are adapted to future climate conditions.

Source: ADEME.

4.2 Build a portfolio of adaptation options

Adaptation actions may be defined as actions aiming at managing the climate risks posed to human and natural systems as well as taking advantage of any positive opportunities that may arise.

Once defined adaptation goals, objectives and targets for the adaptation plan, it is time to build a portfolio of adaptation options that could help achieve them.

Adaptation actions may be defined as actions aiming at managing the climate risks posed to human and natural systems as well as taking advantage of any positive opportunities that may arise. This means that adaptation actions may be addressed to reduce sensitivity and/or exposure to climate change, or to enhance adaptive capacity. These actions may include different behavioural, structural and technological adjustments, and can be grouped into different ways based on:

- timing: anticipatory vs reactive; ex ante vs ex post;
- scope: short-term vs long-term; localized vs regional;
- purposefulness: autonomous vs planned; passive vs active;
- adapting agent: private vs public; societies vs natural systems.

Adaptation options can be therefore categorised in many different ways. One common way to categorise adaptation options is illustrated in the Figure 22 (UKCIP, Adaptation Wizard).

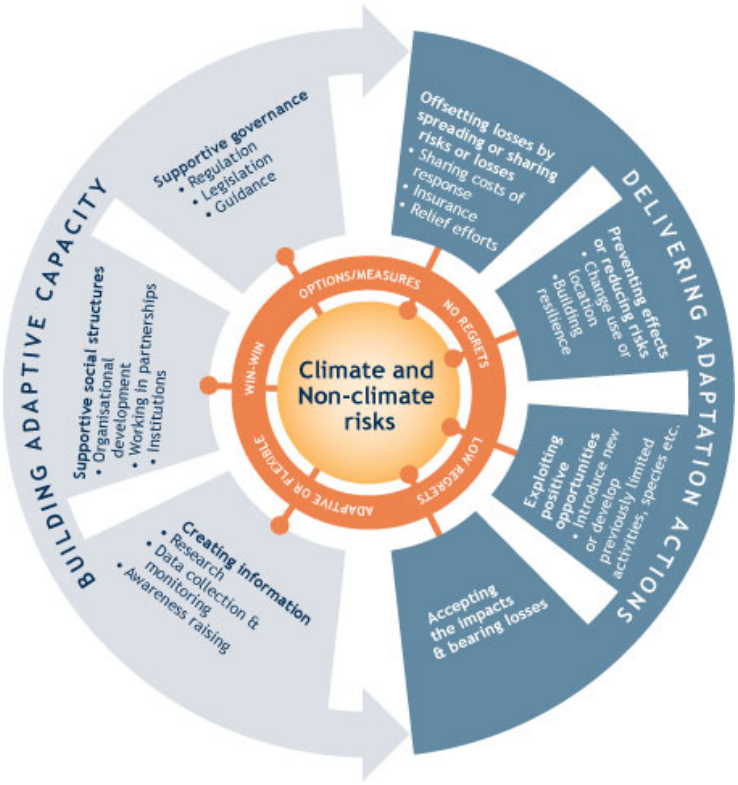


Figure 22 - Building Adaptive Capacity (BAC) and Delivering Adaptation Actions (DAA) (UKCIP, Adaptation Wizard).

Building Adaptive Capacity (BAC) options involve developing the institutional capacity to respond effectively to climate change. These options include: i. creating the information (e.g. research, data collection and monitoring, awareness raising); ii. supportive social structures (e.g. organisational development, working in partnership, institutions), and iii. supportive governance (regulations, legislations, and guidance) that are needed as a foundation for delivering adaptation actions. These measures are fundamental to delivering responsive adaptation actions.

Delivering Adaptation Actions (DAA) include practical actions to either reduce vulnerability to climate risks, or to exploit positive opportunities and may range from

simple low-tech solutions to large scale technological interventions. These options include: i. accepting the impacts, and bearing the losses that result from those risks (e.g. manage retreat from sea level rise); ii. off-setting losses by sharing or spreading the risks or losses (e.g. through insurance); iii. avoiding or reducing one's exposure to climate risks (e.g. build new flood defences, or change location or activity); iv. exploit new and positive opportunities (e.g. engage in a new activity, or change practices to take advantage of changing climatic conditions).

EXAMPLE 13

ADAPTATION OPTIONS				
BUILDING ADAPTIVE CAPACITY				
Adaptation options	**No-regret**	**Low regret**	**Win-win**	**Flexible**
Research				
Conducting risk-based assessments to evaluate current and future climate and non-climate risks and opportunities	x			
Undertaking technical/quantitative impact and adaptation assessment		x		
Data collecting and monitoring				
Phenological observations		x		
Monitoring the impacts of observed climate, including extreme events		x		
Changing or developing regulations, standards, codes, plans, policy or programmes				
National, regional and local policies and plans that recognise climate risks and opportunities and adaptation				
Resource allocation that recognise the need for investment in understanding and addressing climate risks and opportunities, as well as adaptation	x			
Internal organisational development				
Training and individual development programmes – targeted capacity building to include identifying and evaluating climate risks	x			
Identifying climate change champion	x			
Awareness-raising				
Promoting conservation and efficiencies in the use of resources (e.g. water and energy)	x		x	
Capacity building programmes, including communication programmes	x		x	
Working in partnership				
Undertaking risk and adaptation assessments (and response implementation) through sectoral partnerships		x	x	

Promoting the integration of climate risks and adaptation into existing and emerging policy and planning frameworks and strategies in key socio-economical and environmental areas	x		x	
DELIVERING ADAPTATION ACTIONS				
Living with and bearing losses or risks				
Accept losses (habitats, species or coastal lands) where there are no other "acceptable" or feasible options – implications for biodiversity, recreation, fishing and hunting		x		
Close access to recreation areas, marinas, hiking trails and other areas, including temporary loss of land during and following extreme events	x			
Sharing responsibility for losses or risks				
Invest in insurance to cover unavoidable risks yet retain incentives to adapt		x		x
Diversify business activity, market, sources of income, location, etc. as a means of spreading the risks (reducing overall exposure to risk)			x	x
Preventing effects or avoiding/reducing risks				
Reduce pressure on systems or areas at risk (e.g. Introduce alternative land cover and gardens species, reduce the number of fishing/hunting licenses, reduce the number using trails, etc.)		x	x	x
Climate proof or increase resilience of new and existing infrastructure and systems, including through introduction of behavioural change. This include managing flood risk, increasing water supply and pumping capacities, improve supply chain management, more efficient use of resources (e.g. water, energy, raw materials), and dredging or waterways to enhance flows.			x	
Exploiting opportunities				
Exploit new markets and social opportunities emerging as a consequence of climate change both locally and globally		x	x	
Cultivate new agricultural crops and develop alternative land use consistent with climate (current and projected)		x		x
Source: UKCIP, 2005.				

In the most cases, adaptation will involve introducing a mixture of measures or actions introduced in a particular sequence or pathway as risks evolve: some building climatic resilience, some living with risks, some acceptance of loss. An optimum mixture may also include the exploitation of potential opportunities (UKCIP, http://www.ukcip.org.uk/wizard/wizard-4/4-1/).

Based on the classification used in the EU's White Paper on adapting to climate change (EC, 2009b) and the EEA's Report on Urban adaptation to climate change in Europe (EEA, 2012a) three different categories of adaptation actions can be distinguished:

1. ***grey infrastructure****: correspond to physical interventions or construction measures using engineering services to make buildings and infrastructure essential for the social and economic well-being of society more capable of withstanding extreme events*.

EXAMPLE 14

ADAPTIVE STRATEGIES FOR BUILDING DESIGN

Building flexibility into design to allow for the unexpected makes investment decisions robust to most possible changes in climate conditions. This may include no-regret strategies that bring benefits even in the absence of future climate change, e.g. strengthening tile fixtures securely to a roof to avoid wind damage, or polishing or tiling a concrete ground floor to allow quick recovery after a flood. Beyond these measures, designers should be researching localised risks of climate change and preparing their buildings for the predicted hazards which may include: increasing temperatures, coastal storms surges and inundation, flooding, tropical cyclones, intensified downpours, hail events.
Increasing temperatures. Passive design strategies have the double benefit of countering increasing temperatures without undermining mitigation efforts. The fundamental of passive design are:

- **thermal mass:** to reduce the internal temperature variation;
- **insulation** and the use of low emissivity roofing paints and high performance glazing to reduce the rate of heat transfer through building structure;
- **external shading** of vulnerable building surfaces, and strategic siting of deciduous vegetation;
- **cross ventilation** and mixed-mode design to cool internal spaces (ensuring insect-repellent screens are also used);

Source: Snow M. and Prasad D., 2011. Climate Change Adaptation for Building Designers: An Introduction. Environment Design Guide 66 MSa, February, 2011.

2. ***green infrastructure****: contribute to the increase of ecosystems resilience and can halt biodiversity loss, degradation of ecosystem and restore water cycles. At the same time, green infrastructure use the functions and services provided by the ecosystems to achieve a more cost effective and sometimes more feasible adaptation solution than grey infrastructure.*

EXAMPLE 15

ECOSYSTEM-BASED APPROACH IN ADAPTATION TO CLIMATE CHANGE

Ecosystems affect the climate and play an important role in adaptation to climate change. However, climate change affects ecosystems, their functions and the many benefits and services they provide to people along the ability of ecosystems to regulate water flows and cycle nutrients. As these services are eroded, the implications of the impacts will be felt by people, communities and economies throughout the world. Climate change adds a further pressure on many ecosystems and people already negatively impacted by pollution, deforestation and land degradation. Loss of the services that ecosystems provide is also a significant barrier to the achievement of the Millennium Development Goals,
There is a growing recognition of the role that healthy ecosystems can play in increasing resilience and helping people to adapt to climate change through the delivery of the range of services that play a

significant role in maintaining human well-being.
Approaches that involve the services that biodiversity and ecosystems provide as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change are known as **ecosystem-based approaches to adaptation**. The underlying principle is that healthy ecosystems can play a vital role in maintaining and increasing resilience to climate change and in reducing climate-related risk and vulnerability.
Examples of such approaches include flood defence through the maintenance and/or restoration of wetlands and the conservation of agricultural biodiversity in order to support crop and livestock adaptation to climate change.

Source: UNFCCC, 2011.

*3. **soft non-structural approaches**, correspond to design and application of policies and procedures and employing, inter alia, land-use controls, information dissemination and economic incentives to reduce vulnerability, encourage adaptive behaviour or avoid maladaptation. They require careful management of the underlying human systems. Some of these measures can facilitate the implementation of grey or green measures (e.g. funding, integration of climate change into regulations).*

Examples of these categories are illustrated in table 26.

Grey infrastructure	Green infrastructure	Soft non-structural approaches
Building or strengthening of coastal and river flood defences/dikes including beach nourishment	Land-use management and crop diversification	Early warning systems
Reinforcing the built environment and natural defences such as dunes and other green infrastructure		• Vaccination campaigns for health and heat wave risks • Disaster risk management
Water supply and demand management for drought and water scarcity risks	Green infrastructure to enhance connectivity for plant and animal species	• Economic diversification and insurance • Natural hazard monitoring • Awareness raising campaigns

Table 26 - Examples of adaptation options: grey infrastructure, green infrastructure and soft non-structural approaches.

All these categories include different solution to a problem, and for this reason they all should be taken into account. The identification of a portfolio of possible actions will be a very important step towards the adaptation planning, whatever the categorisation the community will intend to adopt.

It is important to consider that adaptation options should be carefully selected in order to identify those options that best match the needs and expectations of the organizations responsible for implementation.

This is now the time and chance to organize meeting, workshops or other similar initiatives and brainstorm with the relevant stakeholders and citizens in order to produce a "wish list" of adaptation options that could be taken in order to address the climate risks previously identified. For this purpose, participants could be encouraged to "*think outside of the box*" in order to generate a range of possible responses, to analyse them within the community before taking a decision, thus avoiding the premature rejection of feasible options. Possibilities will range from "do-nothing" to "do little" or "do a lot".

EXAMPLE 16

CHECKLIST FOR CLIMATE PROOFING YOUR DEVELOPMENT AGAINST THE IMPACTS OF CLIMATE CHANGE

Location

- Undertake an appropriate flood risk assessment and evaluate the flood risk over the design life of the development. Demonstrate that this is acceptable for the proposed use(s) and, at minimum, that there will be no overall increase in flood risk (likelihood and negative impact);
- Help reduce the Urban Heat Island effect, e.g. by planning green space and using appropriate shade when locating your development;
- Consider the implications of coastal erosion when planning a development.

Site layout

Ensure the overall layout and massing of the development:

- does not increase the flood risk and where possible reduces risk;
- minimises solar gain in summer;
- maximises natural ventilation;
- maximises natural vegetation;
- takes account of the increased risk of subsidence;
- provides homes and other appropriate uses with a private outdoor space wherever possible.

Buildings: A) Structure

Demonstrate the structure is:

- strong enough or able to be strengthened if wind speeds increase in the future due to climate change;
- strong enough to avoid movement due to expected future levels of subsidence and heave;
- able to incorporate appropriate ventilation and cooling techniques/mechanisms;
- of an appropriate thermal mass for the intended use and occupancy.

Buildings: B) Physical envelope of structures

Demonstrate the envelope of the building is designed so that:

- drainage systems and entrance thresholds can cope with more intense rainfall;
- there are opportunities for incorporating green roofs or walls;
- the exterior of buildings reduces heat gain in summer;
- the overall envelope avoids infiltration from increased wind and temperatures;
- cladding materials are able to cope with higher wind speeds.

Buildings: C) Materials

Ensure the materials specified will perform adequately in the climate throughout the lifetime of the development.

Ensure the construction methods to be used are suitable for the weather conditions at the time of construction.

Ventilation and cooling
Ensure that ventilation brings clean pollution-free air into the building and does not compromise noise levels or security. Demonstrate the building has or is capable of having installed a ventilation system which will deliver comfortable temperatures (e.g. exceeding 28°C for less than 1% of the time and exceeding 25°C for less than 5% of the time) for the expected climate throughout the design life of the development. Cooling and ventilation systems, where necessary, should be designed to use as little carbon-based energy as possible by utilising renewable energies and being as energy efficient as practicable.
Ventilation and cooling
Carry out a site survey to determine which SUstainable Drainage Systems techniques will be appropriate for use on the site. For example, ground conditions will determine the suitability of infiltration systems. Consider rainwater harvesting, green roof systems and opportunities for permeable paving if soil permeability is low. Consider using permeable paving anywhere that loadings will not cause structural failure. In practice, all pavements, driveways, footpaths, car parking areas and access roads could have permeable surfaces. In developing the drainage plan for the site, ensure that the design standard takes account of climate change and that carriageways, paths and other features of the site are designed to convey this excess flow safely.
Water
Estimate the net water consumption of the development under normal use and under water conservation conditions (e.g. during a drought), both initially and during the lifetime of the development in consultation with the relevant water company. Discuss existing sewerage infrastructure and sewage treatment capacity with the local sewerage provider. Regarding water use, for housing, achieve a target of 30 m^3 per person per year under typical use and for offices, 1.05 cubic metres per person per year. Minimise water use in buildings, consider the use of rainwater collection/re-use systems and consider the environmentale impact (in terms of water consumption) of product, materials and building methods.
Outdoor spaces
Incorporate an appropriate range of public and private outdoor spaces in developments, with appropriate shade, vegetation and water features. Ensure the design of surfaces take account of more intense use, permeability, potential for causing dust and for soil erosion. Ensure the selection of vegetation with longer life (over 10 years) takes account of future climate change. Ensure water features have minimal net water use. Provide a rainwater collection system/grey-water recycling for watering gardens and landscaped areas. Ensure there are arrangements for storing waste which allow for separation and prevent excessive smell in hotter conditions.

Connectivity A) Infrastructure resilience
Ensure there are safe access routes above the likely flood levels and the routes are clearly marked (e.g. by a series of poles) during the design life of the development. Negotiate with utilities and others over the resilience of services and infrastructure to the development.
Connectivity A) Impact on neighbours
Identify immediate neighbour impacts as well as the cumulative impacts and the increased demands on services.
Source: Greater London Authority, 2005.

Adaptation options could be identified in other ways. The experience of other communities and other organizations facing similar problems in similar geographical contexts could be taken into account, by evaluating whether these are transferrable in time and space to the considered situation. Surfing on web portals such as, for example, Climate-Adapt, national web portals, and consulting database, research projects, and other relevant source could be a very helpful activity at this stage. A recent publication contributed to provide a great overview of practical and early examples of actual adaptive actions already taking place across Europe.

The actions illustrated aim to make a region or a city less vulnerable to the effects of climate change, enhance resilience or provide new opportunities and could inspire science, policy and practice in the adaptation field (CIRCLE-2 Project, 2013). Once a wide range of adaptation options has been identified, the Adaptation Team will collect all the hypothesis, analyse them, eliminate inappropriate proposals (e.g. those options that are not really adaptation options) and redundancies, checking potential overlapping with already existing relevant measures that are not labelled as adaptation, before proceeding to evaluate them.

ACT EXPERIENCE 14

THE ACT DAY AGAINST CLIMATE CHANGE IN BULLAS

(P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert - Municipality of Bullas, Spain).

Figure 23 - The ACT Day held in Bullas in 2012.

Among the various initiatives organised by the Municipality of Bullas within the Life ACT Project, the “ACT Day” took place in February 2012 in Bullas. The “ACT Day” represented a moment for a broader exchange between all the target groups and citizens through the Market of ideas against Climate Change, which included expert speeches, citizens’ and enterprises’ working groups and produced at the end of the day an Instant Report to be used for the elaboration of the LAP.

For further details: www.proyectoactbullas.blogspot.com.es.

4.3 Collect and organize relevant information on adaptation options

Once a wide “wish list” has been prepared, the adaptation options should be formulated and described in such a manner that their assessment, selection and prioritisation is feasible and will produce a short list of prioritized options for the further implementation.

Once a wide “wish list” is prepared, the adaptation options should be formulated and described in such a manner that their assessment, selection and prioritisation is feasible and will produce a short list of prioritized options for the further implementation. As part of the process, adaptation options should be first assessed and compared. For this reason, all the candidate adaptation options should be characterized and described with relevant information (Table 27).

INFORMATION	DESCRIPTION
Name of the action and description	Description of the contents and objectives of the adaptation action, how the action should be implemented
Social, economic and environmental context	Characteristics of the context in which the option may be implemented
Lead department	Potential role and responsibility of the lead department
Other relevant departments	Potential role and responsibility of any other departments that should be involved with planning and/or implementation
Financial resources	Description of the financial resources required for the implementation
Pre-cursors to action	What steps need to be taken to enable the implementation of an action (e.g. research studies, establishing partnerships, etc)
Timeline	Start and end dates; short, medium or long-term timelines; immediate or ongoing actions, etc;
Framework	Legal, institutional, policy framework
Expected results	Description of the results that are expected following the implementation of the action
Potential barriers	What are the potential barriers to the implementation of the action and the mechanisms to overcome these
Other information	

Table 27 - Examples of information to collect for each adaptation option (ICLEI - Workbook for Municipal Climate Adaptation, LIFE ACT Project, UKCIP Adaptation Wizard http://www.ukcip.org.uk/wizard/wizard-4/4-4/).

In some cases, some information will not be easy to access or elaborate at this stage as, for example, those on the availability of financial resources and the timeline. However, it will be important to try to collect as much information as possible in order to perform a better comparison of options.

ACT EXPERIENCE 15

A FORMAT FOR THE DESCRIPTION OF ADAPTATION OPTIONS IN ANCONA

(M. Cardinaletti, Project Manager for Sustainable Development, Consultant for the Municipality of Ancona).

In the Local Adaptation Plan of Ancona, a set of adaptation actions are included and designed as real projects to be implemented in the very short period. The main aim was to organize and structure all the project ideas into an Integrated Urban Adaptation Policy. To this aim, a standard format has been made in order to easily share the project ideas among the stakeholders, picking up a lot of useful information for the start up phase of the project.

DESCRIPTION

- Time horizon
- Responsible
- Correlated planning
- Expected results
- Monitoring indicators
- Critical aspects
- Financial resources
- Parties to be involved

4.4 Define criteria, assess, select and prioritize the adaptation options

Specific sets of criteria will guide the assessment of different adaptation options for the community.

USEFUL QUESTIONS

- ✓ *Which actions will allow to meet the adaptation goals, objectives and targets?*
- ✓ *Is the action robust under a range of climate change scenarios?*
- ✓ *Can the action be implemented, and in what time frame?*

There is no “one size fits all” prescription for determining which adaptation actions are better than others. It is therefore very important that the Adaptation Team define a specific **set of criteria** that will guide the assessment of different adaptation options for the community. Thus, it will be helpful that each component of the Team will have a shared understanding of these criteria. Some criteria may be considered more important than others, and should be taken into particular account. As a general rule, it is important to remember that *proactive adaptation is generally more effective and less costly than reactive adaptation*.

Examples of possible criteria are illustrated in the table 28.

CRITERIA	DESCRIPTION
Effectiveness	It is able to meet the objectives and the guiding principles of the adaptation process (e.g. reducing impacts, reducing exposure, enhancing resilience or enhancing adaptive capacity) without impeding adaptation elsewhere or in the future It is appropriate with respect to the severity of climate change impacts the options would address relative to other impacts expected in the community It is cost-effective
Efficiency	The (economic and non-economic) benefits gained from the action exceed the (economic and non-economic) costs of the implementation It considers benefits in terms of economic, social and environmental costs
Equity	It distributes the benefits of adaptation equally across society It considers the effects on vulnerable groups, including economic, social, cultural and knowledge distribution considerations It helps allocate risks in a fair manner in social terms It is able to bring advantages for broad parts of society It tackles threats for old, chronically sick and poor people
Flexibility	It allows easily adjustments and incremental implementation later if (climate and non-climate) conditions change again or if (climate and non-climate) changes are different from those expected today It can be adapted, revised or made undone at low cost
Sustainability, Impacts And Side-Effects	It is sustainable and contributes to sustainability It avoids the so-called maladaptation (e.g. to avoid introducing perverse effects, to avoid limiting future adaptation) It brings benefits in terms of alleviating pre-existing problems (No-regret) It entails side-benefits for other social, environmental or economic objectives (e.g. to help reduce social inequality, to decrease energy demand, to help raising resilience of ecosystems services, etc) It avoids affecting other sectors or agents in terms of their adaptive capacity It avoids causing or exacerbating other environmental pressures It has the potential role in protecting unique environmental or cultural resources It should not limit the adaptive capacity of other communities, vulnerable populations, or future generations
Acceptability	It is culturally, socially, environmentally and politically acceptable It is accepted by those affected and by stakeholders
Urgency (Time Scale, Time-Lag, Lifetime)	It is needed in case of high danger of significant impacts in the near future It is appropriate in terms of timescale actions need to be taken with respect to the expected climate change impacts (e.g. short, medium and long-term climate change impacts)

	There is a unique "window of opportunity" for implementing a particular action It likely become costly (e.g. large and long-lived infrastructure projects), difficult to implement (e.g. spatial planning for nature conservation) or redundant (e.g. raising awareness) when postponed, and it therefore should be undertaken immediately (due to long time spans before they take effect). The consequences of not acting are higher compared to the degree of risk in acting
(External And Internal) Coherence	Is it aligned to the EU Adaptation Strategy and other sectoral policies? It is coherent and support other development goals and priorities (including mitigation), and not just a "bolt-on". Is the measure aligned with other local sector policies? It is coherent with policy, investment, maintenance and other planning cycles It includes potential conflicts and synergies within and across sectors
Robustness	It reduces vulnerability under current climate, low-regrets, incorporate safety margins, mindful of actions by others It is robust under different climate scenarios and different socio-economic scenarios It is robust to changes in the frequency or severity of specific climate impacts It reflects the range of uncertainty if the climate change is not the expected one (e.g. no regret measures)
Dependencies	It complies with actions, legislation, regulatory framework, incentives, investments, externalities, etc. that are needed as pre-requisite to implementation
Deliverability And Feasibility	It is easily and quickly feasible in legal, technical, social, institutional, political and financial terms and the barriers, when existing, can be overcome

Table 28 - Examples of criteria for assessing adaptation options and their impacts (Adapted from Ribeiro et al, 2009; UKCIP http://www.ukcip.org.uk/adopt/adaptation-options/; Snover et al, 2007; Prutsch et al, 2010).

Among all the potential adaptation options, no-regrets, low-regrets and win-win may be the most appropriate ones and should be used where possible. In fact, these options may be practical, cost-effective options delivering adaptation and able to minimise the risks even with existing uncertainties (UKCIP, 2005):

- **No-regrets options** - adaptive measures whose socio-economic benefits exceed their costs whatever is the extent of future climate change. This type of measures includes those that are cost-effective and justified under current climate conditions, and are further justified when their introduction is consistent with addressing risks associated with projected climate changes. Focusing on no-regrets options is particularly appropriate for the near term as they can deliver obvious and immediate benefits and can provide experience on which to build further assessments of climate risks and adaptation measures.
- **Low-regrets (or limited regrets) options**. Adaptive measures for which the associated costs are relatively low and for which the benefits, although primarily realised under projected future climate change, may be relatively large.
- **Win-win options**. Adaptation measures that have the desired result in terms of minimising the climate risks or exploiting potential opportunities but also have other social, environmental or economic benefits. Within the climate change context, win-win options are often associated with those measures or activities

that address climate impacts but which also contribute to mitigation or other social and environmental objectives. These types of measures include those that are introduced primarily for reasons other than addressing climate risks, but also deliver the desired adaptation benefits (UKCIP, 2005).

These measures are useful in particular when the risks associated with inaction are high, and when the uncertainty and the risk associated with introducing inappropriate adaptation measures is also high. In this cases, **flexible or adaptive management approach** could be useful. This approach in fact involves putting into practice incremental adaptation options rather than undertaking large-scale adaptation all at once. For the implementation of this approach, measures should be adopted in a sequential manner, based on an iterative evaluation of risks, costs, feasibility, etc. as knowledge, experience and technology evolve. At this stage, the Adaptation Team should have established the criteria for the selection and prioritization of the future adaptation actions. An active involvement of the relevant stakeholders should be promoted at this stage. It is important to take into account that these actions will not – and do not need to – meet all the selected criteria but a general rule will be that the more criteria are met, the more likely the action will help reduce the vulnerability to climate change (Snover et al, 2007).

Selection and prioritisation of adaptation actions will represent then the further step which will allow to choose, reject or postpone actions for implementation (Table 29).

TOOLS	DESCRIPTION
Expert judgement	Assessment by experts in the field of probabilities and risks
Focus groups	Groups of stakeholders that discuss their opinions on specific topics
Brainstorming	Free-flowing lists/diagrams of all ideas and options
Cost-benefit analysis	Assessment of economic efficiency, assigning a monetary value to the measure of effect
Cost-effectiveness	Economic analysis that compares the relative costs and outcomes (effects) of two or more courses of action
Delphi	Iterative, group-oriented, idea-generating strategy
Multi-criteria analysis	Examination of more than one and some non-monetary criteria involving subjective judgement
Decision/probability trees	Charts of relationships between decision modes
Influence diagrams/mapping tools	Graphic identification of options

Table 29 - Examples of tools for selecting and prioritising adaptation options (UNDP, 2004).

Some useful consideration for the prioritization of actions could be the following:

- priority 1: actions that can be implemented in the current adaptation process;

- priority 2: actions that require additional information, knowledge and resources before being implemented. However, communities may want to explore them as part of the current planning activity;
- priority 3: actions that are not suitable candidates at this time, but could be in the future.

ACT EXPERIENCE 16

IDENTIFICATION, SELECTION AND PRIORITIZATION OF ADAPTATION OPTIONS IN BULLAS

(P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert - Municipality of Bullas, Spain).

Among the variety of possible measures applicable to transform Bullas into a resilient community, the specific actions selected for the Local Adaptation Plan of Bullas have been identified through:

- *literature review*: a review was undertaken of the existing literature and information on climate change adaptation actions available at both the international and national level that are relevant to the key responsibilities of local government.

- *key informative interviews*: in order to support the review of relevant information addressing climate change adaptation strategies and the development of possible new strategies, informal discussions were held within the adaptation team and with Bullas' citizens. During these discussions, stakeholders and citizens views were obtained on the possible types of adaptation strategies, existing local government initiatives that were of relevance to climate change adaptation, and recommendations of possible mechanisms for implementation.

Finally, in order to select the best options for Bullas, the existence of various types of adaptation, including policy-driven adaptation and autonomous adaptation, was taken into account.

The actions identified in the previous steps will constitute the bulk of the Local Adaptation Plan. Of course, the need will be to move from a simple list of priority actions to a more formalized action plan. The information collected, together with the list of adaptation actions, should be structured so as to develop a detailed plan which sets out what needs to be done by whom, by when and how in order to convert the adaptation strategy into practical actions.

4.5 Draft the Local Adaptation Plan and get the political approval

All the time and resources addressed to investigate climate change and its impacts, assess vulnerabilities and risks posed by climate

change, involve local stakeholders for the identification of adaptation options will be put together in a formal Local Adaptation Plan (LAP).

It is at this stage where all the time and resources addressed to investigate climate change and its impacts, assess vulnerabilities and risks posed by climate change, involve local stakeholders for the identification of adaptation options, will be put together in a formal Local Adaptation Plan.

Even though the decision on how to structure the Local Adaptation Plan is up to the Adaptation Team, it may be helpful to consider what are the main elements that could be included in the final version of the Plan (Table 30) (ICLEI, Workbook for Municipal Climate Adaptation).

TABLE OF CONTENTS OF A LAP

Element	Description
Acknowledgements	Acknowledgements are addressed to those people who have provided a contribution to the adaptation process within the community, e.g. the members of the Adaptation Team, the stakeholders, the members of the city Council, etc.;
Mayor's/Council Foreword or Commitment	The Mayor's/Council foreword or commitment is very important and helps demonstrate the official political engagement of the local administration to the adaptation process.
Executive summary	It provides the synthesis of the adaptation process developed and implemented at local level.
Glossary	It lists and explains the key terms which could be useful for the readers.
Introduction and structure of the document	Introduction aims at explaining, for example, why the community has undertaken an adaptation process and why it is important. It points out the main features of the Local Adaptation Plan and describes the structure of the Plan itself.
Vision Statement	It represents a call to action for the community.
Background and context	Description of the main socio-economic and environmental characteristics of the area; description of the existing adaptation policies and measures.
Climate change	Description of current and projected climate change in the area.
Impacts, vulnerability and risk	It reports and illustrates the results of the impacts, vulnerability and risk assessment conducted by the Adaptation Team.
Objectives and targets	It describes the adaptation objectives and targets for achieving the vision.
Adaptation actions	It identifies, lists and describes the adaptation actions selected for achieving the objectives and targets.

Implementation schedule	It provides a description of the costs of actions, financial and technical responsibilities, timeline, tools for implementation, potential barriers to the implementation, etc.
Additional Information	References, sources of information, etc.

Table 30 - Example of a Table of Contents of a Local Adaptation Plan (ICLEI, Workbook for Municipal Climate Adaptation; LIFE ACT Project).

It is important to consider that a LAP is not a static document but a "living" document: the document will not be closed after the development of the LAP, but it will be fed over time by new assumptions, new results, new lessons learnt.

Once the Team has a draft of the LAP, it will be important to communicate with senior departments, directors and other staff about the LAP and involve them in the preparation of the final draft. Once prepared, the final document will be submitted to the political approval.

CHAPTER 4 CHECKLIST

- ✓ *Have you set the appropriate adaptation goals, objectives and targets?*
- ✓ *Have you identified a portfolio of adaptation options?*
- ✓ *Have you collected and organised all the relevant information on the adaptation options?*
- ✓ *Have you defined your own criteria in order to assess, select and prioritise the adaptation options?*
- ✓ *Have you identified cross-sectoral overlap, synergies and conflicts among the adaptation options?*
- ✓ *Have you prepared a draft of the local adaptation plan?*

5.
DESIGN THE IMPLEMENTATION OF ACTIONS

At present, the experience of implementing adaptation actions is rather limited, as most of the measures, taken into consideration, relate to cases in which climate change adaptation was just one of the drivers that determined how specific projects were implemented.

The adaptation plan can be developed as a dedicated document, but adaptation is more often streamlined by incorporation of its principles into the relevant policy documents. During policy analysis it is useful to link adaptation options to established policy programmes and funding programmes already running.

An implementation plan should set out what needs to be done by whom and by when to convert an adaptation strategy into practical action.

The development of an implementation plan converts adaptation options into action by listing the operational objectives, assigning the responsibilities and setting the deadlines for completion.

The actions to be taken and the way in which they will be implemented, will be strongly influenced by the organisation's existing internal procedures, as well as external influences such as regulations, policy targets, financial resources, etc.

Key factors that should be considered when starting the implementation process of the adaptation actions, are pointed out here below:

- *Ensure a common understanding of adaptation actions in the organisation;*
- *Set a clear and robust leadership identifying roles and responsibility for the individuals involved;*
- *Ensure a common understanding of adaptation actions and a good internal communication in the organisation;*
- *Describe how preferred adaptation actions should be implemented (e.g. through new or existing management systems);*
- *Ensure that the organisation has the right implementation tools (including economic tools to secure the needed financial support);*
- *Identify organizational opportunities that could be exploited to synergize climate adaptation actions with other planning and development activities;*

- *Indicate what resources (staff, training for staff officials and capacity building, facilities and infrastructure, financial resources) will be required to implement the adaptations and monitor their effectiveness (existing or additional);*
- *Note what institutional and community support will be required to implement the adaptations;*
- *Contain an effective communication strategy, a social market campaign and a tailored stakeholders involvement;*
- *Identify potential barriers and constraints to action and mechanisms to overcome these;*
- *Mechanisms for evaluating the performance of the strategy, and the actions within it.*

5.1 Establish new instruments

There may be cases where the modification of existing instruments alone is insufficient to handle the adaptation needs and **new instruments for implementing adaptation** must be developed. These might be of legislative, economic, informal or cooperative nature.

Opportunities will emerge under the next Multi-annual Financial Framework (2014-2020), which includes a proposal for increasing the share of climate-related expenditure (e.g. for climate change mitigation and adaptation as a whole) to at least 20% of the EU budget.

In the table below we provide an overview of possible instruments for implementing adaptation (EC, 2013a).

OVERVIEW OF POSSIBLE INSTRUMENTS FOR IMPLEMENTING ADAPTATION

Instruments	Strong	Weak	Ideal for
Legal instruments (laws, regulations, policies, decrees)	Strong and rapid controlling effect Effective achievement of objectives	Unpopular/politically risky Inflexible in achieving objectives, requires monitoring Often complicated and expensive to implement (for the regulators and the regulated)	Ensuring a minimum standard Emergency situations
Economic instruments (taxes, fees, tax-incentives, grants, interest-free loans, public procurement)	Behaviour control through economic incentives rather than bans /requirements Makes use of market mechanisms, flexible in implementation	Unpopular (taxes) or expensive (grants) Achievement of objectives is not always ensured because behaviour changes are uncertain	Fostering innovation Creation of niche markets Alternative to legal instruments
Informational instruments (studies, brochures, websites, campaigns, events, label, etc)	Apolitical, unproblematic because of cost-effectiveness and limited interferences in personal freedoms Fosters awareness and individual responsibility	Only indirect and frequently weak or uncertain effects Effectiveness is difficult to assess	New problems whose resolution is in the self-interest of individuals Promoting awareness

Partnership instruments (voluntary agreements among companies, partnerships, collaborative projects, etc.)	Politically unproblematic because not mandatory Pools resources of several actors Cost-efficient for the public sector	Complex process (high transaction costs) Achievement of objectives uncertain Often ineffective	Problems that one actor alone cannot solve because of a lack of resources (e.g. money, knowledge, contacts)
Hybrid planning /strategic instruments (plans, strategies, action plans, programmes, etc)	Facilitates holistic view Presents an overview and establishes connections Combines several instruments, exploiting their strengths and avoiding their weaknesses	Implementation is often difficult (due to low levels of political interest over longer periods) Requires the cooperation of several actors	Systematic approach to the solution of complex problems

Table 31 - Overview of possible instruments for implementing adaptation (EC, 2013a).

5.2 The stakeholder analysis in the implementation process

Although in these Guidelines a specific chapter has been dedicated to the stakeholder involvement (Chapter 7), here below a quick picture is given to highlight what is needed specifically during the crucial step of implementation in order to be as much effective as possible.

Set Up an interdisciplinary Adaptation Team (see Par. 1.1)

A first critical step in the stakeholder analysis process consists of establishing an effective team that is interdisciplinary and includes scientific experts as well as policy and socio-economic experts. The team should encourage the active participation of various stakeholders, including community leaders. The team members should be experts from different fields, representatives from various relevant institutions. This mixture will permit an optimal analysis of the problem at hand from a variety of viewpoints.

Engage Stakeholders Early

Early engagement of relevant stakeholders is critical to any adaptation initiative to ensure commitment and ownership of the process. This is especially true at the community level, where many autonomous adaptation measures are already taking place, and where a wealth of traditional knowledge provides a basis for the design of adaptation measures.

Pursue Inter-Sectoral Engagement

An inter-sectoral engagement, including the participation of a national reference and the relevant focal points from key line Ministries (including National Planning and Finance), is a recommended part of this process. Key stakeholders from government, the private sector, civil society, non-governmental organizations, academia, as well as international development organizations of relevance should be involved in the process.

Manage the Number of Stakeholders

The number and span of stakeholders will vary depending on the size of the adaptation initiative. A coherent balance must be found in engaging stakeholders at different levels. An initial bottom-up approach is highly suggested (involving the direct beneficiaries), but it is also important to incite the interest and commitment of government agencies and other actors from civil society, key research institutions, and non-governmental organizations, especially for more programmatic-based approaches.

Methods for Engaging Stakeholders

There are a variety of ways in which planners can consult and engage stakeholders at all levels. It is important to keep in mind that the techniques will be different depending on the type of stakeholder.

Focus Group Discussions/Group Work

Focus group discussions can lead to the identification of autonomous adaptation efforts that are already ongoing as well as evident adaptation needs that require more systematic interventions and investments. Focus group discussions are usually guided by a series of open-ended questions to foster discussion. Information obtained from focus groups can be greatly affected by the dynamics of the particular group (e.g., gender relations, local hierarchies, power relationships, etc). Women and children, as well as elderly, the poor and the marginalised people have been identified as being among the most vulnerable groups affected by climate change, meaning that these stakeholder groups should be involved since the very beginning. Gender-specific focus groups might be necessary. Also, facilitator-group dynamics will need to be taken into consideration. For example, a male facilitator would not necessarily illicit the same responses from an all female focus group, as a woman facilitator would.

Awareness-Raising Campaigns

The objective of awareness-raising campaigns is to engage local stakeholders and build sufficient momentum at the community level for new adaptation initiatives. Such campaigns include tangible communication activities that explain the linkages between local priorities, which might not be explicitly linked to climate change, and the impacts of climate change. Local stakeholders such as households, local organizations, influential leaders and educators should be involved in these campaigns. They should explain how local risk contexts are changing, how this will affect individual households and livelihood groups, and what can potentially be done to increase preparation and protection from climate-induced shocks and stresses. Materials should be translated into local dialects and should use a variety of appropriate communication tools (e.g., local radio, drama, flyers, posters, video screenings, etc.). Visual art can be used to communicate the potential impacts of climate change at the community-level. It includes an interpretation of current coping strategies and how they may be changed in the future. It should be noted that awareness-raising campaigns increase awareness

and also expectations. Ideally, such campaigns should take place with a concrete follow-up or investment perspective for tangible risk reduction activities.

Start with an existing process

Start with a process that is already part of what the community does. Integrating climate change adaptation into existing emergency management, public health, and water resources plans, etc. can help with institutionalization.

Utilize local activists

Local activists can help to get elected officials to pay attention to climate change and in the long term to make sure the issue stays relevant, regardless of who is in charge.

5.3 Drivers and constraints

The implementation of adaptation plans in European cities can be potentially threatened by their lack of compatibility with local, national or European policies. The adherence of the adaptation plan to the national (where existing) and European policies in place should be ensured to avoid potential conflicts. EU regulations are also subject to change, which offers the potential for greater incorporation of climate change adaptation in a number of directives. However, at the local level, also amendment of the local policies (for example spatial development plans) could be considered in order to comply with high-level adaptation strategy framework.

Decision makers face significant **barriers** while implementing climate action plans. The types of barriers varies over the different stages of the process. Local governments and government entities may need additional training for their staff and increased budgets or might be concerned about a deficient support from leadership, lack of quality downscaled climate models, and uncertain returns from investments.

More in general problems may occur when there is a lack of communication, transparency and coordination between the different scales and sectors, in case authority and responsibility are not clearly defined, and when financial constraints might limit certain scales ability to take effective adaptation actions.

5.4 Definition and types of barriers

Barriers can be therefore a combination of information constraints, institutional failures, capacity constraints, economic constraints, and political factors.

Specifically, they might refer to the following cases:

- Lack of scientific knowledge at local level: unreliable/inadequate information or support for decision-making (from basic data to results of policy relevant analytical and feasibility assessments);
- Local communities' limited awareness regarding the issues, limited access to information/knowledge;
- Weak institutional capacity of relevant public and private entities to support/facilitate the necessary behavioural adjustments;
- Lack of political will and rapid turnover of politicians: even if the local government is actually totally committed to the Adaptation Plan, a political change may occur, causing uncertainty in its future implementation, although already approved by the current local government;
- Weak governance and shortage of qualified staff with relevant skills and necessary mandates;
- Financial constraints to support implementation: reduced budget;
- Overlap of responsibilities between institutions leading to inefficient and ineffective implementation of adaptation measures;
- Difficulties in policy enforcement;
- Lack of participatory process in decision-making;
- Limited scientific demonstration of successful adaptation interventions.

CHAPTER 5 CHECKLIST

- ✓ *Have you identified the instruments for the implementation of adaptation?*
- ✓ *Have you established new instruments for this purpose?*
- ✓ *Have you focused on implementation step-by-step?*
- ✓ *Have you identified drivers and constraints?*
- ✓ *Have you defined the barriers?*

6. MONITOR, EVALUATE AND UPDATE THE ADAPTATION PLAN

It would be inappropriate to think that after the elaboration and implementation of an adaptation plan, the process of adaptation is completed. In fact, adaptation is an iterative process that requires regular review in order to verify if the community is adapting well in a dynamic world, to assess what is working well, what is not working and why, and finally to provide regular feedbacks to stakeholders on the progress being made.

Good planning, combined with effective monitoring, evaluation and review, can play an important role in enhancing the effectiveness of development programmes and projects. While a good planning helps to focus on the results that matter, the others help to learn from past and identify better solutions for the future. Monitoring, evaluation and update of the plan are therefore required in order to determine whether the plan is achieving the intended adaptation objectives, targets and benefits and/or is creating negative impacts. In other words, these activities are addressed not only to confirm whether the community is taking the actions previously decided, but also to verify the effectiveness of measures taken and to identify the need of adjustments. Furthermore, updating the plan means to keep up-to-date with climatic, scientific and technological developments, since our understanding of climate change and the experience on how to adapt are increasing during time. For this purpose three recurring steps to pursue at regular intervals for the future are illustrated in this chapter:

1. ***monitor and evaluate the progress (M&E)**, in order to verify whether the adaptation actions are helping to achieve the adaptation objectives and targets and/or are creating negative impacts;*
2. ***periodically review the basic assumptions** coherently with the evolution over time of information and knowledge about vulnerability and risk, vision and guiding principles, objectives and targets, results of previous measures of actions;*
3. ***regularly update the climate change adaptation plans and actions**, as a consequence of the information collected during the previous steps.*

Some steps will be reviewed annually or sooner if some significant change has occurred before, while the whole revision of the plan will be needed every 3-5 years. In fact, this could be the right time lag in order to appreciate significant results.

6.1 Design a monitoring and evaluation framework

Monitoring and evaluation are different but they must go hand-in-hand and are aimed at assuring a continuous feedback-correction cycle that can help communities to adjust their adaptation strategies and plans and make them increasingly effective.

USEFUL QUESTIONS

- ✓ *Are we doing the right things? Are we doing things right? (EC, 2013a)*
- ✓ *How could I demonstrate to the community and to stakeholders that the climate change adaptation plan is working towards a more resilient community? (Snover et al, 2007)*
- ✓ *Is the plan achieving the strategic objectives previously identified?*
- ✓ *Have things stayed the same or grown worse because the adaptation was ineffective, or because unanticipated stresses have aggravated the situation?*
- ✓ *Is the plan able to continue to do so in the future? (UKCIP, Adaptation Wizard).*

Learning what works (or not) in which circumstances and what are the reasons that allow to achieve the success in adaptation is critical to assure the relevance and effectiveness of a plan.

The **purpose of Monitoring and Evaluating (M&E)** a plan is to determine whether:

(i.) the community is taking the actions previously decided;

(ii.) the measures adopted are effective (e.g. are the adaptation actions delivering the intended benefits? are the adaptation actions creating negative impacts and maladaptive developments?). It is important to point out that this aspect will not be verifiable for some years to come after the implementation.

The information provided by the M&E can help identify the adjustments eventually needed and inform decisions, improve performance and achieve planned results (EC, 2013a; Ribeiro et al, 2009).

As illustrated in Table 32 planning, monitoring and evaluation are different steps but inter-linkages and dependencies among them exist.

Understanding inter-linkages and dependencies between planning, monitoring and evaluation
• Without proper planning and clear articulation of intended results, it is not clear what should be monitored and how thus making the monitoring difficult to be performed; • Without effective planning (clear results frameworks), the basis for evaluation is weak; • Without careful monitoring, the necessary data is not collected and hence evaluation cannot be done well; • Monitoring is necessary for evaluation but not sufficient as it requires different data and framework for analysis; • Monitoring combined with evaluation often lead to changes in plans.

Table 32 - Adapted from UNEG,'UNEG Training—What a UN Evaluator Needs to Know?', Module 1, 2008.

In order to perform a M&E step, the assessment of progress against the previously set targets and objectives will be performed. This means that M&E is needed when moving form planning to action.

Even if monitoring and evaluation are different they must go hand-in-hand. In order to define a good monitoring and evaluation framework, **key elements** should be identified:

1. clearly formulated goals, objectives and output measures (see par. 4.1);
2. clearly defined baseline as reference for M&E (see ch. 2);
3. the availability of quality data;
4. involvement of affected stakeholders.

The M&E framework should guarantee a continuous feedback-correction cycle that can help communities to adjust their adaptation strategies and make them increasingly effective.

Properly conducted, M&E mechanisms can contribute to an evolutionary "learning by doing" function that will provide insight into how the adaptation process can evolve most efficiently.

An M&E process can thereby lead to:

- well-supported decisions;
- well-documented responses to critical questions (e.g. a more complete understanding of how a particular strategy or plan can reduce vulnerability);
- credible suggestions of how strategies might be improved or corrected (UNDP, 2004).

Engaging a wide range of stakeholders at this stage and gathering feedbacks from these representatives throughout the process can help understand how adaptation interventions can be made most relevant to their needs (EEA, 2013).

Table 33 illustrates the various purposes of the M&E activity.

Identify negative effects of a particular strategy so that corrective actions might be applied	**Analyse adaptation objectives and indicate the progress towards meeting the goals of adaptation (measure, results and impacts achieved and the distance to target)**

Provide insights for ongoing policy/decision-making processes	Verify alignment between internal objectives and specific policy framework (Internal coherence)
Help to achieve specific adaptation goals, objectives and targets more effectively	Check the consistency between critical issues in the environmental ex-ante context and objectives and targets of policy intervention (External coherence)
Supporting the learning process (e.g. identifying good practice, improving actions, avoiding maladaptation, finding new opportunities, etc)	Measure the state of implementation in financial, procedural and physical terms
Provide regular feedbacks to stakeholders on the progress being made	Measure the outputs per unit of inputs used (eco-efficiency)
	Measure the achievement of the policy or plan objectives at the less costly conditions (cost-effectiveness)

Table 33 - Purposes of the monitoring activity (Adapted from UNDP, 2004).

6.1.1 Identify the key indicators

In order to monitor progress towards adaptation a combination of two categories of adaptation indicators is needed: i. process-based adaptation indicators and ii. outcome-based indicators.

Monitoring and evaluating adaptation can be a challenging activity. For this purpose, **adaptation indicators** should be identified in order to monitor and assess progress towards the implementation of the LAP. Given the range of potential evaluation needs, it is unlikely that a single indicator or set of indicators for adaptation would be universally applicable but a combination of different types of indicators should be appropriate. In particular, two categories of adaptation indicators are defined:

i. **process-based adaptation indicators**, are designed to monitor the progress in implementing adaptation measures (building adaptive capacity);
ii. **outcome-based indicators**, are designed to measure the effectiveness of adaptation policies and measures in achieving the desired outcomes (delivering adaptation actions).

The first approach considers adaptation as a decision **process**, rather than a specific action or a series of outcomes. There are many adaptation initiatives, in fact, that focus on the establishment of an adaptive process mainly aiming at understanding and addressing risks and vulnerabilities. In this case, decision makers will be enabled to match their actions to the needs deriving by climatic circumstances, vulnerability drivers, stakeholders' priorities and risk tolerance. However, there is no guarantee that successful progress and achievement of the measure will also mean that effective adaptation is taking place.

Examples of outcome-based indicators are:

- degree and quality of participant involvement in adaptation decisions;
- number and quality of laws or policies addressing climate change.

EXAMPLE 17

PROCESS-BASED INDICATOR

An example of a process-based indicator is the Performance Indicator for Climate Change Adaptation NI188 in the UK that measured the progress through self-assessment on assessing and managing climate risks and opportunities, and incorporating appropriate action into local authority and partners' strategic planning. The indicator aimed to ensure that local authorities are sufficiently prepared to manage risks to service delivery, the public, local communities, local infrastructure, businesses and the natural environment from a changing climate, and to make the most of new opportunities. The indicator had five levels each of which could be either fully or partially completed covering: Level 0 - Getting started, Level 1 – Public commitment and impacts assessment; Level 2 – Comprehensive risk assessment; Level 3 – Comprehensive action plan and Level 4 – Implementation, monitoring and continuous review.

Source: Harley et al, 2008.

The second approach considers adaptation as an **outcome**. This task, aiming at measuring the effectiveness of an adaptation policy, is more challenging. In this case adaptation means building specific capacities, reducing a specific vulnerability, managing some risks, or exploiting a particular opportunity.

The emphasis is then on evidence of change, rather than on the processes through which change occurs. Examples of outcome-based indicators are:

- change in degree of exposure to climate risks and threats;
- utility and quality of early warning systems.

EXAMPLE 18

OUTCOME-BASED INDICATOR

An outcome of adaptation to climate change in the UK could be reflected in our ability to adapt to hotter summers. One aspect of our progress in adapting to these might be monitored through:
"the number of excess deaths from heat related illnesses during the hottest 3 months of the year"
Such an indicator might be analysed in a number of ways: it could be looked annually or over longer time periods. Limiting increases or observing a sustained decrease in such a number, in the face of increased heat, might reflect an increase in the UK's ability to adjust to our changing climate. However, such an outcome indicator could be influenced by a great variety of factors drawn from systems right across society.

Source: DEFRA, 2010.

The table below illustrates relevant differences between the two approaches (Harley et al, 2008).

PROCESS-BASED INDICATORS	OUTCOME-BASED INDICATORS
Advantages	**Advantages**
Allow stakeholders/sectoral experts to choose the most appropriate adaptation action to meet an outcome. Flexible approach – can adjust to new information as it becomes available.	Most other government policy objectives/targets are outcome-based. May be possible to link adaptation objectives with objectives in other policy areas.
Disadvantages	**Disadvantages**
Defining a process does not guarantee successful adaptation. A different approach from most other government targets, so more limited experience. May be difficult to integrate adaptation targets with objectives in other policy areas (because they are different in nature). Not necessarily sector-specific.	Defining an outcome does not guarantee successful adaptation. Risk of being overly prescriptive of adaptation options (specifying sub-optimal options). May be inflexible and make it difficult to introduce new information (though great scope for flexibility in implementing specific actions to achieve outcome).

Table 34 - Advantages and disadvantages of process- and outcome-based indicators (Harley et al, 2008).

It is expected that a combination of process-based and outcome-based indicators will be needed in order to monitor progress towards adaptation.

At this stage it is important to take into account the **criteria** previously set up (see par. 4.4) and consider some useful questions, such as for example:

- has the measure caused adverse impacts, e.g. environmental impacts? were these anticipated? how can they be improved? if unanticipated, do these adverse impacts outweigh the potential benefits of the project? (impacts and side-effect);
- has the measure produced immediate benefits? (creation of benefits);
- is the measure cost-effective? (effectiveness).

However, some kind of **problems** may occur in this phase and should be taken into account. For example:

i. it can be evaluated if the event (or the events) to which the community is adapting occurs, otherwise it may be difficult to determine if the action was properly implemented. Of course, if the event does not occur after the implementation of an action it does not mean that the intervention is unjustified. However, using indicators related to climate impacts is not really useful for measuring adaptation actions as they depend not only on the extent and effectiveness of adaptation measures but also on the actual weather events that occur.
ii. risks of climate change may be even long-term risks and they may not be evident when it comes time to evaluate the measure (Harley et al, 2008).

Furthermore, complications in monitoring adaptation are related to the difficulty in separating progress in adaptation from progress achieved within sectoral policies: in fact, it might be difficult to attribute a success to adaptation policies and programmes and distinguish it from any wider sectoral progress. For the M&E purpose, a list of

qualitative and quantitative indicators for each adaptation actions should be created. Once identified, these indicators will be useful to determine whether and the degree to which the community has achieved its adaptation objectives and targets.

EXAMPLE 19

ADAPTATION INDICATORS IN THE ADAPTATION STRATEGY OF MURCIA

SOIL	
Creation of the European Thematic Centre against drought and desertification	• Degree of execution • Number of research projects developed • Number of visitors
WATER	
Use in green areas of native species or plants with low water requirements and of effective irrigation water saving systems	• % of native species or low water requirements species • % of green areas with native species • % water consumption saving
HEALTH	
Setting up of a network for the control of legionella and allergenic substances	Degree of execution
INFORMATION AND PUBLIC AWARENESS	
Awareness campaigns addressed to employers, families and schools: lectures, workshops and visits	N participants
Exhibition on climate change	N of visitors
Annual report on progress in the municipality of Murcia in the fight against climate change	N of copies published

Source: the local strategy against climate change in the municipality of Murcia (Spain).

ACT EXPERIENCE 17

ADAPTATION INDICATORS FOR THE MONITORING OF THE LAPs

BULLAS (P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert - Municipality of Bullas, Spain)

For the LAP of Bullas, and accordingly with the selected adaptation measures, specific adaptation indicators were selected.

Tourism

- number of updates of the tourist register
- number of updates of Bullas' website
- number of website visits
- number of awareness campaigns
- percentage of streets with awnings or trees providing shadow
- amount of water consumption

Agriculture and soil

- number of updates of the standardized record
- number of updates of knowledge-sharing platform
- number of updates of the local early climate warning system
- number of website visits

Health

- number of awareness campaigns (local, regional and national promoted ones)

Transportation infrastructure

- degree of integration of the measures in local urbanization plan

ANCONA (M. Cardinaletti, Project Manager for Sustainable Development, Consultant for the Municipality of Ancona)

Interventions to protect the coasts	• Number of beach replenishments carried out • Number of active and passive protections put in place • Number of renewed cliffs
Portonovo: coastal defence by moving back the bathing establishments and restaurants	• Extension of the new mobility network/final total extension • Extension of new technological systems/final total extension • Surface of the water
Study and monitoring of the coastline and survey of the defence work through high-resolution satellite images	• Number of satellite images acquired • Creation of the database • Definition of the sustainability matrix
Study of inshore currents in the stretch of sea from Ancona to Senigallia	• Number of currents monitored • Creation of the wave motion pattern • Construction of the map of wind fields
Reduce the landslide risk with drainage and environmental engineering interventions aimed at the use of the drained water for industrial	• Amount of water drained (m^2/year) • Expenditure for extraordinary maintenance to the road network due to the landslide (€) • Magnitude of the gravitational dynamics (m/year)

purposes	
Map of landslide speeds	• Number of landslides for which the speed was estimated (n.)
Extension of P4 landslide monitoring for the entire City of Ancona	• Number of P4 landslides monitored
Improvement and optimisation of the Ancona landslide early warning system	• Number of interferometric radars placed • Implementation of the study of triggering thresholds
Informational campaigns for the population	• Approval of the Multi-year Informative Plan
Creation of new professional positions	• Number of specialised courses created • Number of higher education institutions involved • Number of university faculties involved
Establish a natural laboratory for raising public awareness	• Number of days of training for the high school students • Number of explanatory signs • Number of students involved
Extension of the early warning system at a regional level	• Number of alert procedures updated • Number of agreements between the Civil Protection and local authorities involved • Number of P4 landslides monitored in the Marche Region
Staff Exchange Project	• Number of days spent with the host team • Number of City of Ancona technicians involved
System for the prevention of climatic effects on the urban road network – “Free Road” Project	• Number of alternative routes identified
Restore full functionality and safety to the railway and Via Flaminia	• Number of reforming operations
Training courses for the creation of specific professions for the assessment, analysis and monitoring of the historical and cultural heritage	• N. of active courses • N. of participants
Completion of the Risk Map of the Cultural Heritage of the City of Ancona	• N. of buildings monitored and inserted in the GIS Map • N. of improvements actions taken as a result of the analysis performed

Preservation of plant and animal species and habitat	• N. of interventions • N. of species safeguarded • Protected habitat area (ha)
Alarm system for the prevention of the effects of heat waves on health – "Helios" Project	• N. of local plans developed
System for the surveillance and prevention of the effects of climate change on urban and suburban territory – "Just in Time" Project	• N. of persons involved • N. of reports/year • N. of procedures/year • Euros invested/year
Improving *land* governance	• N. of subjects involved • N. of action plans/paper commitments signed
"Green Comet" Project	• N. of paths created • N. of pedestrian connections created • N. of cliff safety interventions • Euros invested/year
Assignment of a financial budget for adaptation within the budget for the City of Ancona	• Euros set aside annually for adaptation to climate change

By examining the data collected, the implementation process may be changed or the plan modified.

Furthermore, this step contributes to the preparation of the successive baseline review in order to restart the adaptation cycle and progress adaptation efforts further. The results of this activity might be published in a so-called "Evaluation Report" and shared with the stakeholders and the whole community (GRaBS Project).

With this report the stakeholders and community will be informed on what the city has done and if it has succeeded in fulfilling their targets. In case of negative results coming from the evaluation stage, then it would be necessary to return back, re-assess possible adaptation and select new adaptation or modify the current set of adaptations.

How often evaluating the progress will depend on various factors, such as the type of vulnerabilities and risks to be addressed, the planning horizon, the budget cycle, etc.

6.2 Periodically review the scientific assumptions and update the LAP

As natural, social, economic and political conditions change, the original assumptions on climate change and its impacts may also need to change.

USEFUL QUESTIONS

- ✓ *Are there new information available calling for updates in the adaptation plan?*
- ✓ *Is there a need to revise the baseline review since major changes occurred in the city?*

Climate change adaptation is an ongoing process. As natural, social, economic and political conditions change, the original assumptions may also need to change. Further to the M&E results, some questions could help to review the basic assumptions guiding the work on adaptation. Examples of useful questions for reviewing the scientific assumptions and ensuring that they remain appropriate to current natural, economic, social and political conditions may be the following:

i. *Is the understanding of climate change, its impacts and vulnerabilities of the community's changed*? Scientific investigations are continuously occurring and new scientific reports produced. It is therefore important to determine whether new findings are truly relevant to the adaptation process work or not. Unless a new scientifically reliable advice or evidence it is however not suggested to change the initial assumptions used to scope the assessments.
ii. *Have your priorities changed*? A change in policy-makers or in stakeholders relationships can drive to a change in priorities in the adaptation process. Furthermore, new scientific information can lead to change the focus of adaptation effort on some new and more urgent challenges. In this case new adaptation goals should be set up.
iii. *Are your vision and guiding principles still relevant to the results the community would like to achieve?* Vision and guiding principles are generally rather broad and are flexible for new different conditions. However, new findings and information could require the need to make them more relevant.
iv. *Do you have significant new information about the success or failure of your adaptation actions?* After measuring the progress over a period of time, findings could demonstrate that adaptation actions are successful and you need funding to continue in this direction or adaptation actions are not going towards the right direction. In the second case adaptation actions should be re-thought with a new approach (Snover et al, 2007).

6.3 Update the Plan and share the results

Once collected new and useful information for reviewing the assumptions, the climate change adaptation plan can be updated, by taking into account some relevant items. Sharing the results of the plan with the community will help demonstrate that the adaptation actions are achieving the desired results.

Once collected new and useful information for reviewing the assumptions, the climate change adaptation plan can be updated, by taking into account some relevant items (Example 20).

EXAMPLE 20

SUGGESTIONS FOR UPDATING THE LAP

- Create a document outlining the accomplishments to date and explaining which are the next steps.
- Renew the commitment of the Adaptation Team and the political engagement.
- Update the baseline, by using the indicators that have been identified to do this. Socio-economic and environmental conditions may have changed during time.
- Refer back to the vulnerability-risk matrix: the “may be priority” categories can now be addressed as you update the plan.
- Consider that some new hazard may require shorter-term decisions, in a shorter time scale and more detailed action.
- Re-evaluate the community’s vision, targets and goals. Assess whether they are still relevant or if they need to be updated to reflect the actions that have been taken or will be taken.
- Identify the actions that were not implemented in the first round. *Which are the reasons why implementation did not move forward? Did a shift in vulnerabilities cause a re-ordering of actions? Were there insurmountable constraints that hindered implementation? Have conditions changed enough to enable implementation now?*
- Identify new adaptation options and actions to address the new impacts.
- For each action consider new relevant indicators, drivers and constraints. There may be elements that were not considered the first time around.
- Assess funding opportunities. *Are there any new opportunities? Are previous funding sources still available?*
- Update the implementation schedule to reflect new adaptation actions.

Source: ICLEI, Workbook for Municipal Climate Adaptation adapted from ISPRA.

As the improvement of the LAP goes on, sharing the results of the plan with the community will help demonstrate that the adaptation actions are achieving the desired results.

This activity will also contribute to improve the community partnerships and to provide evidence that your actions deserve funding and political support from other levels of government.

CHAPTER 6 CHECKLIST

- ✓ *Have you designed a monitoring and evaluation framework?*
- ✓ *Have you identified the key adaptation indicators?*
- ✓ *Have you reviewed the scientific assumptions?*
- ✓ *Have you updated the plan and shared the results within your community?*

7.
ENGAGE STAKEHOLDERS

7.1 Why to engage stakeholders? A public-private partnership approach for adaptation

Adaptation requires innovative ways to unite the efforts, commitments and knowledge of different groups and individuals that can contribute – each in their own way – to the achievement of a common goal: the development of resilient community and territory.

Urban regions require a targeted long-term adaptation strategy to reduce their vulnerability. Urban vulnerability will, however, be influenced by the way adaptation strategies (behaviourally, technically or spatially) are taken into account in urban development policies. *The adaptive ability of a city is therefore influenced by the political and societal willingness to deal with climate change*. In addition to ongoing restructuring of buildings, infrastructure, and public space, strategies for urban development, including reducing vulnerability to effects from climate change, are a *multi-level governance* issue. This process is also linked to socio-economic vitality and improvement of quality of life and living. Cities are therefore challenged to consider and apply **integrated solutions in the urban planning and design process.**

In this context, Public Administrations play a key role but need the support and the collaboration of private sector subjects that, given their own businesses and their impacts on the environment, are influenced by the planning solutions developed and, at the same time, can help to reach the targets. A co-ordinated action has more effective results.

Therefore there is need of finding an innovative way to unite the efforts, commitments and knowledge of different groups and individuals that can contribute – each in their own way – to the achievement of a common goal: the development of resilient community and territory.

The model proposed as reference is the “New Social Partnership”, defined by the Copenhagen Centre as “people and organisations coming from some public, private and civic entities/bodies which are engaged in voluntary, mutually beneficial and innovative relations with the aim of dealing/pursuing with social goals by putting together their own resources and competencies.”

There are three basic and innovative aspects featured in the Copenhagen Centre model:

1. the common goal to pursue;
2. innovative measures of collaboration;
3. the resources of every participant in the partnership.

As such, **Private-Public Partnership** is an innovative tool that systematizes the possibility of these two elements to take action regarding the issue, appraising the possible existing synergies while creating win-win conditions for all the partners. This means that private participants find it advantageous to contribute with their own technical and economic resources to the solution of the problem that the public alone would not be able to solve. This condition holds true particularly in the presence of externalities and interconnections among motivating factors like adaptation to climate change. This new approach is essential and implies an evolution from participation, as it has been intended since the conference in Rio in 1992 and by the Local Agenda 21 process, to partnership; as a consequence the word “partners” should be used instead of “stakeholders”, meaning that these subjects are no longer external elements to be activated on call in precise steps of the process but they are partners that share with the Public Administration every step of the process and become promoters of efforts. The classical model of stakeholder engagement, with the Public Administration that leads the process, is inadequate to tackle the climate change challenge because:

- strategies for urban development, including reducing vulnerability to effects from climate change, are a multi-level governance issue, since they imply a radical transformation of cities and lifestyles;
- a large amount of resources is needed to carry out the process, so the Public Administration can act at most as a catalyst;
- the time is running out, it’s necessary to act now and rapidly.

The success of this new approach relies on the ability to make the community “be part of” the change instead of “taking part” in it. And in this context, the involvement of private subjects, such as enterprises and other economic subjects, is essential for putting in place the initiatives for pursuing the goals connected to climate change adaptation. Namely, a Public-Private Partnership diverges from the usual stakeholder engagement for the following features:

- objectives and targets are quantified;
- the partnership lasts for a quite long period, and ends when the goal is attained;
- cooperation among all the subjects from the very beginning to the end;
- resource and risks sharing among partners (including financial ones);
- definition of a formal agreement and of a system of governance;
- definition of a monitoring and evaluation system.

Such a kind of scheme goes beyond the traditional model of participation, funded on listening and inclusion of the stakeholders’ points of view, and moves forward a structured collaboration process where every partner plays according to its own resources for the attainment of the common goal.The success of the Public-Private Partnership is linked to the added contribution that it provides to traditional systems of social, institutional and market interactions. Its added value is derived from the sharing of skills, actions, economic resources and innovative solutions that this kind of relationship is capable of achieving. It is necessary to emphasize that the Partnership process does not have to be a mere summation of individual contributions from the actors involved, but the result of a collaboration based upon the following variables:

- context
- organisation
- goals
- results
- participants

	Private sector	Public sector	Non-profit sector
What they offer	• Skills, technology and solutions • Potential of reduction and climate-changing emissions • Familiarisation with final consumers	• Knowledge of the territory • Financing and incentives • Facilitation and guarantees regarding agreements	• Trust • Knowledge of the area of intervention
What they acquire	• Strengthening relationships with stakeholders and corporate reputation • Promoting positive values among employees • Improving company efficiency • Innovating business offers • Improving knowledge of the market • Reinforcing know-how	• Carrying out company social environmental policies efficiently • Learning new work methods (reducing bureaucracy) • Improving knowledge of the territory • Reinforcing company's role in civic society	• Obtaining legitimization of businesses • Improving internal and external communications • Reinforcing company programmes through economic support and public support

Table 35 - The partnership's partners exchange (Life+ L.A.C.Re Guidelines).

The parameters with which added value is measured, and thus the success or failure of the Partnership process, are the internal benefits (of each single partner and members of the group) and external benefits (aimed at the collective group). In terms of internal benefits: access to economical, technical and managerial resources that each member is capable of offering as a contribution to the improvement of the Partnership's operative efficiency. In terms of work methods and enforcement of activities: innovation of suggested solutions and improvement of provided services and products. External benefits are broader in scope: they extend to the structural area of the social-economic fabric in which it is established and developed. Moreover, Partnership includes a resource on an informative level as well, in that it enables partners to acquire more information regarding the context in which it works and – more specifically – to obtain in-depth knowledge of its stakeholders, beginning with customers/users.

Internal benefits ***Shared among partners***	**External benefits** ***For the external community***

• Increased knowledge and skills (human capital):
  ○ Improvement of pre-existing ones
  ○ Adoption of new ones through exchanges between partners
• Creations of new methods and solutions
• Improvement of operative efficiency (organisational innovation)
• Accelerated improvement and development of products and services
• Strengthening of credibility, trust and
	• Satisfying collective needs
	• Strengthening of civil society (civic sense)
	• Sustainable territorial development
	• Creation of social and economic wellbeing for the community through:
	  ○ More job opportunities
	  ○ Improvement of quantity/quality of services and public/local facilities

reputation among stakeholders (social and relationship resources) • Increase the possibilities of access to contextual information and material and immaterial resources	

Table 36 - Internal and external benefits of a partnership (Life+ L.A.C.Re Guidelines).

Moreover, the development of socially responsible behaviours by companies is an essential element along the path of sustainable development in an area. Such an inclination from companies should not only be encouraged, it must be integrated and channelled in such a way that is coherent with the governmental policies for climate change adaptation, that is reputed to be a public asset par excellence due also to the costly and dangerous consequences that it creates.

From the awareness and sharing of this necessity comes the origin of the will, on the part of Public Administration, to involve private companies in responsible management and safeguarding of local public assets.

Some significant experiences regarding corporate social responsibility have demonstrated the potential and efficiency of Public-Private Partnerships in the realization of common interventions. The added value is found in the choice of sharing specific skills, resources and knowledge as well as in the contribution of various people to find innovative solutions to problems that come up.

This is a process of transformation which will require a transaction that will not be simple or brief; such a transformation involves not only an investment on the part of businesses but – above all – a new, great opportunity to base a company competitiveness upon the creation of more efficient relationships.

More studies of Corporate Responsibility present this relational aspect as an element of competitive and qualified development, capable of characterizing the production process in its ability to relate with society and its protagonists. The systems of small and medium enterprises with an economy that is diffused throughout the territory (like the Italian industry) are based upon two fundamental principles: “doing it together” and the acceptance of “mutual responsibility”, to be intended here as individual responsibility – identifiable and verifiable – of each and every participant to obtain the common goal, and not as a way to make the individual not subject to this commitment.

It is obvious how such principles acquire a strong strategic value in today’s global recession, financial and environmental crisis and can constitute important factors for the affirmation of a new idea of development along with a stronger social and civic cohesion.

Working together and sharing the responsibility of actions and results means carrying out positive interventions together that go beyond what is required by law as well as developing regulatory obligations in a different manner.

Moreover, Public Administration – the one in that particular place – could become a dependable partner for corporations that are socially responsible or wish to become so, as it can provide decisive support to the realization of excellent actions. Vice-versa, companies could become partners of the local administration and contribute to the creation of joint projects and the attainment of common goals.

One final essential element in the creation of a new social relationship between businesses and the territory – through a multi-stakeholder approach – is the existence of a "political-value" sharing: in this way, those traditional relationships between Public Administration and local economy are put aside, looking for new, innovative routes that could facilitate an active collaboration between Public Administration and private companies to attain complex goals, such as those related to climate protection.

7.2 Who to engage? The identification of the key stakeholders for the adaptation process

There are many different actors who can develop a Public-Private Partnership for adaptation and there are just as many different methods of organization and financing that govern it.

The adaptation process requires the involvement of different subjects with different roles: of course not all these subjects will be involved in Public-Private Partnerships for the implementation of the adaptation projects; many of them will be involved during the definition of the Adaptation Plan, as individuals or groups joining the adaptation team or as part of the research effort or marketing strategy. As suggested by ICLEI – Canada (an association of local governments committed to sustainability), the first step in identifying stakeholders is to look at the **community's spheres of influence**, in order to identify who is accountable to and who it can learn from.

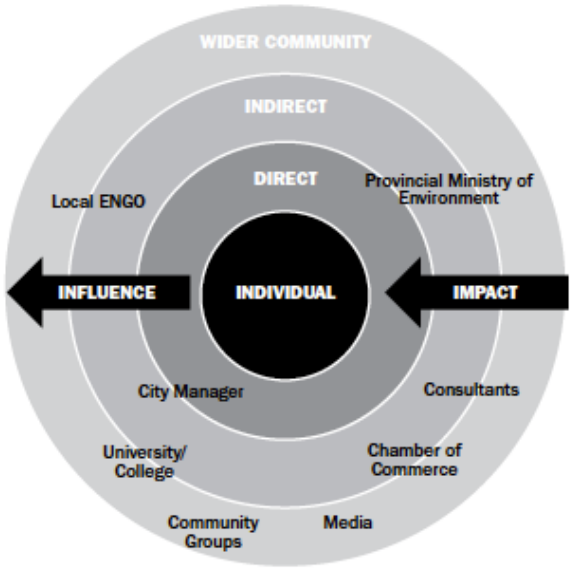


Figure 24 - Identification of stakeholders - Spheres of influence (ICLEI, Workbook for Municipal Climate Adaptation).

As shown in Figure 12, the circle at the centre of the diagram represents the person (or department) tasked with initiating the adaptation planning effort in the community; this sphere represents the area with the most control and responsibility over. The next layer includes the departments, organizations, or individuals with which there is a direct relationship or partnership, and then the next layer includes those individuals or organizations that have indirect effects on the work the person does, perhaps through loose or informal relationships, but where he/she has even less control than with those in the previous circle. The final outermost layer represents the wider community over which there is minimal control but should remain included (or acknowledged) in this initial stage.

It is important to note that getting closer to the centre sphere the direct influence or control increases and moving out from the centre the ability to impact the external circles decreases. Also, stakeholders may move between the different spheres as the adaptation work progresses.

Who are possible stakeholders? Of course it depends on the kind of city considered and its territory; a non-exhaustive list is shown in table 37.

POSSIBLE STAKEHOLDERS	
Other municipal department – staffand department heads (engineering, parks & recreation, corporate services, legal, publichealth, emergency, response, finance, etc.)	Local businesses
City manager of CAO	Media
Mayor of council	Community groups
City operations contractors	Local neighbourhood associations
Utilities	Consultants
Flooding	Public transit authorities
Other levels of government (federal,provincial,territorial, regional)	Large industry representatives
Residents	Developers
Agriculture	Social policy groups
Agricultural community	Hospitals
First nation groups	Port authority
Housing authority	Coast guard
School boards	Airport authority
Local universities, colleges or other knowledge institutions	Chamber of commerce
Non governmental organizations	

Table 37 - Possible stakeholders (ICLEI, Workbook for Municipal Climate Adaptation).

Some of the subjects identified could be worth to be involved in the creation of Public-Private Partnerships for the implementation of adaptation projects. There are many different actors who can develop a Public-Private Partnership for adaptation and there are just as many different methods of organization and financing that govern it. Aside from the specifics of the single experiences, partners involved could be split up into 3 categories:

- Promoters
- Facilitators
- Members

Partnership **promoters** are the actors in the socio-economic-political and cultural system that conceive the process and act as engines for the start-up of the Partnership. They can be a group of people or even just one individual, depending upon strength and resources available. In any case, their task is to start up the process, aggregate other actors that can offer the maximum added value and define the Partnership's general goals.

Facilitators are all those who can contribute directly to the success of the Partnership by providing technical support, know-how or resources. Possible facilitators are: Universities and innovation research centres, Chambers of Commerce, Banking and Credit Institutes, Associations and NPOs. An important role is played by organizations that support and bring businesses and economic operators together, such as business associations and Chambers of Commerce, because they can spread the contents of the partnership acting as multipliers. Nevertheless, the involvement of enterprises themselves is a key factor for the success of the partnership, because they are the subjects who have the means for realisation. Among the facilitators there should be members capable of verifying and guaranteeing the transparency and honesty of the process, such as exponents from the academic and research world, experts of environmental and energy issues. More specifically, the presence of third parties is important in the approval phase of the plan of action, monitoring and assessment of results.

The **members** are the actors who are more directly involved in the process. They are the true leaders of the partnership and with their commitment they contribute concretely to the implementation of the adaptation measures.

In order to assign the role of promoter, facilitator and member to the subjects to be involved, it is necessary to chart out a map of various categories of contacts that are active in the territory and an assessment of some key criterion.

The criteria for the mapping of both kinds of actors must be dual:

- Potential contribution to the attainment of results;
- Predisposition and collaboration potential.

As far as Promoters are concerned, their task is to be the driving force of the Partnership's start-up process, the kind of actors to take into consideration are:

- "Sponsor" companies with substantial experience;
- Business associations;
- Organisations that manage public assets and services (e.g. health services, transportation, natural resources etc.);
- Institutes that deal with territorial development;
- Local administration;

- Groups of interest.

Facilitators are to represent the various requests at stake and provide factual knowledge and technical support. The kind of actors to take into consideration are:

- NGOs and NPOs;
- Universities and research centres;
- Certification companies;
- Environmental Associations;
- Service companies that work for Promoters involved;
- Consumer Associations;
- Other actors on the territory.

The final category of actors to map are potential partnership members. The kinds of organisations to involve in this role must be acknowledged by Promoters and (if possible) Facilitators. The kind of actors to take into consideration are:

- Companies (in particular, those who do not fall into the category of mandatory emission trading systems);
- Public Capital companies;
- Public Administration (e.g. health services, universities etc.);
- Local administrations;
- Other actors.

7.3 When to engage stakeholders? The role of stakeholder engagement in each phase of the adaptation process

Stakeholder engagement must be realised since the very beginning of a Public-Private Partnership for adaptation.

These Guidelines have illustrated a possible structured approach to adaptation planning (see “Structure of the Guidelines”), which takes local governments through a series of progressive steps, each one moving on from the results of the previous; the cycle can be gone through many times, allowing to re-evaluate and review findings and decisions.

Stakeholder engagement must be realised during all the steps, in order to make the relevant subject join the process since the very beginning and be ready for the construction of the partnership in the implementation step.

Namely, stakeholders have to be engaged in the following steps:

1. Step 1: get started.

    a) **Identification of possible internal and external stakeholders**, looking for relationships that will bring support, knowledge and collaboration both for the planning for adaptation and for the implementation of adaptation actions. Many of the challenges of adapting to climate change can be overcome by developing working relationships with both internal and external stakeholders; relationships between and among local governments, utilities, universities, non-governmental organizations, community-based entities and business organizations are helpful in turning the abstract idea of planning for climate change into concrete joint activities.
    b) **Identification of the climate change adaptation team**, that constitutes the foundation of expertise which will be drawn upon throughout the community's adaptation effort and will be responsible for maintaining momentum throughout each of the milestones. The team's creation also represents the first step towards initiating the community's internal capacity to adapt to the impacts of climate change. The team can be any mix of stakeholders (internal or external) that the community deems appropriate.

2. Steps 2 and 3 review the knowledge and establish the baseline; assess impacts, vulnerabilities and risks:

    a) **Performing a risk assessment**: in the risk assessment process, it may be helpful to bring in the adaptation team stakeholders and/or department heads for input, if their functions are not already represented. Alternatively, the responsibility of conducting a risk assessment can be delegated to relevant working groups within departments if the capacity or expertise required to conduct a thorough assessment is not contained within the adaptation team itself.

3. **Step 4: develop the plan.** Stakeholders are required to give their contribution during the planning phase, in order to identify the best adaptation options for the community.

4. **Step 5: implement.** In this step, where the Adaptation Plan is put into practice, the engagement of stakeholders corresponds to the construction of the partnership.

5. **Step 6: monitor, evaluate and update.** The monitoring of the Adaptation Plan's results contains the monitoring of the partnerships' results.

The accomplishments of the community's adaptation effort should be conveyed to the external stakeholders identified in step 1: citizen groups, local NGOs, universities and businesses.

7.4 How to engage stakeholders? The establishment and management of a Public-Private Partnership for adaptation

Clear roles, quantified targets, specific actions to be implemented and a monitoring and evaluation system are the minimum requirements for the success of a Public-Private Partnership.

In this chapter, the **main stages of the creation of a Public-Private Partnership** are described, as shown in figure 25.

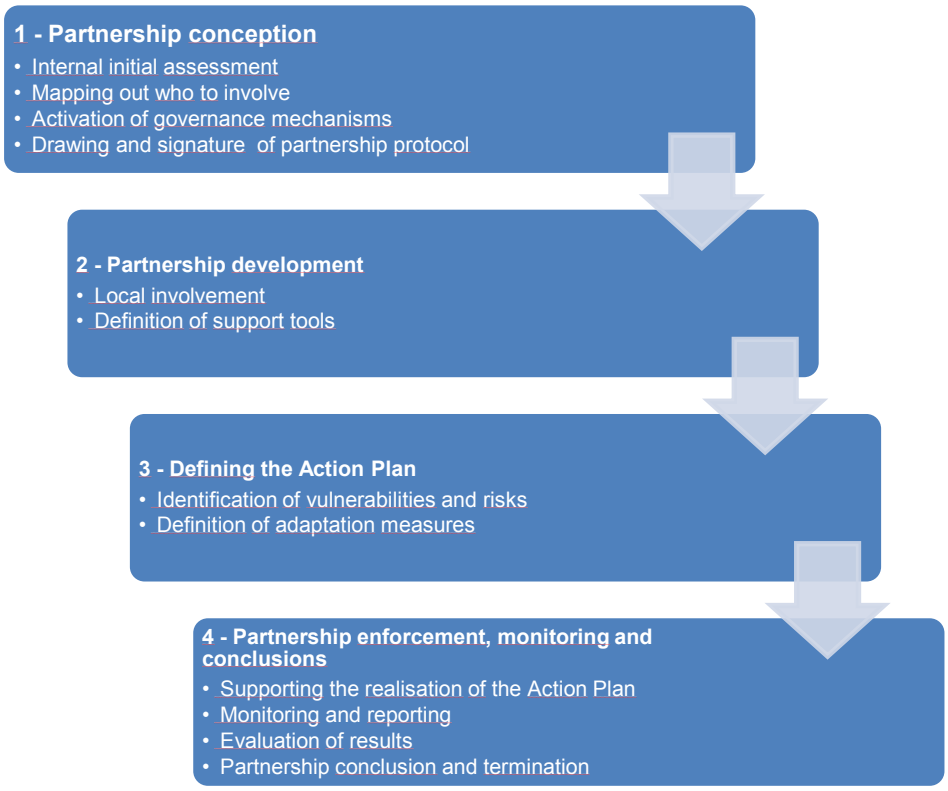


Figure 25 - Main stages of the creation of a Public-Private Partnership for adaptation.

7.4.1 Partnership conception

The first phase in the construction of a Public-Private Partnership is of an explorative nature and it sets the base for the achievement of the project's goals. It is essential that the phase is carried out with a thorough assessment of each aspect and possible implications before proceeding to the more operative phases. The chosen Partnership model will have an influence upon the role, kinds of relationships and collaboration there will be among partners, as well as transaction costs linked to the implementation of activities and the final impact the process could have on the territory.

The specific goal of this phase is choosing the Partnership model most suitable to the set goals, involving those subjects who could assume the roles of Promoter and Facilitator of the process and draw up a formal agreement of Partnership.

The process must begin with a feasibility analysis that would allow for the identification of key factors which could offer added value, limiting the risks of resistance that could arise from both public and private partners. Issues linked to climate change and adaptation are very complex, transversal and at the core of many debates; it is essential that the Promoter of the initiative defines the boundaries and the goals of the Partnership during the starting phase.

An aspect that should never be underestimated (right from the very beginning) is that the Partnership requires economic resources suited to its activation and maintenance until the set goals have been attained. Available resources must be carefully assessed and goals must be defined in line with the amount of funds that can be made available to the process. It is useful to involve a panel of stakeholders in this explorative phase of the Partnership.

This panel can be made up of business associations, Chambers of Commerce and other economic operators that would be interested in participating. Moreover, it is important to involve companies with substantial experience right away, since they could take on a sponsorship role and be the driving force for the launch of the project.

The **initial assessment** is the base for defining the feasibility of the Public-Private Partnership, its structure and its goals; it is the phase directly involving those who promote the partnership dealing directly with the strategic political level as well as the technical structure. Key elements of this analysis are:

1. available resources that could be used in activities related to involving others, partnership technical support and communication;
2. desired impact upon the territory in terms of the reduction of greenhouse gases emissions and the increase of the eco-efficiency of the local production system.

The interaction between these two variables (available resources and the desired results) enable the outline of the Partnership to be proposed.

The most complex Partnerships, aiming at building investments and infrastructures for the adaptation (e.g. river banks) require a substantial investment of resources in order to involve and motivate members as well as to support them in carrying out necessary activities for emission reduction.

The intermediate partnerships are linked with maintenance or management changes in services or business (e.g. early warning systems) require incentives or supporting

mechanisms (e.g. training, technical assistance, etc.) in order to attain significant results and to pro-actively involve a great number of partners.

The simplest partnerships takes on the structure of a network with limited objectives that are mostly related to the diffusion of information and sharing of experiences.

After having mapped out who to involve (see paragraph 7.2), and before proceeding to the establishment of the Partnership, it is necessary to establish the mechanisms of Partnership management and relationships between various entities involved. The management groups could be:

- a steering group made up of Promoters in order to keep control of Partnership goals and to guarantee a strategic direction;
- a support committee made up of Facilitators as a permanent advisory board that supports the steering group and members, bringing forth different requests and viewpoints, know-how and technical skills.

Obviously, the role of these groups will vary in intensity, becoming more or less binding depending on the type of partnerships.

At the end of the process of mapping out and involving members from various categories, the establishment of the Partnership must be formalised through the drawing up of a Protocol Agreement or a similar document. It must offer a detailed explanation of:

- the goals and partnership model;
- the categories and roles to be carried out;
- the governance mechanisms of the partnership.

This document must be shared with the facilitation group and officially signed by all those who will decide to adhere to the Partnership. It is also possible to include different levels of participation, if the complexity of goals to obtain should call for such an action.

7.4.2 Partnership development

Once the agreement establishing the Public-Private Partnership has been formalised, it is time to work in an operative manner to involve companies throughout the territory (members) and expand the partnership's visibility in the area. More specifically, the goals of this phase are to:

- communicate the existence of the partnership and its goals throughout the area;
- promote the adhesion of more and more subjects: in the initial phase, the partnership can be made up of even a few participants, as long as they are strongly motivated and very much involved and oriented towards the attainment of the goals. It is this very strong motivation of the "group of pioneers for adaptation" that could stand at the foundation of the "potential multiplier" thanks to which more and more companies will be stimulated to enter this partnership.

Now that the dynamic part of the project has arrived, the first step is to involve local actors which would then animate the partnership and ensure the attainment of all

goals. Therefore, a campaign should be promoted to expand partnership to as many elements as possible, valorising and capitalizing the role, knowledge and networks of each entity.

It could be decided to involve only one economic sector, a group of businesses or to even extend participation to anyone showing interest. Based upon the target to contact (e.g. a specific economic sector, small and medium enterprises or every business located in the area without distinction), a specific strategy to involve them will be defined.

If a partnership open to all companies and organisations in the area has been chosen, the communication of the existence of such a partnership could be conveyed through the press and local media.

If the partnership is aimed at a more specific target such as an economic sector (e.g. agriculture, tourism, etc) or a kind a company (e.g. cooperatives, small or medium enterprises etc.), it would be opportune if the promotion of the partnership took advantage of direct and specific channels made available by the companies themselves.

Business associations or the spheres in which they operate, associations and networks involved in sustainable and innovative issues are all elements which could facilitate contacts and memberships of these companies. Once again, in this case the involvement of these elements from the beginning of the Partnership would make the promotional phase in an area more rapid and effective. In order to guarantee the success of the Partnership, it is fundamental to set up the operative tools to support the development of the entire project; in fact, the lack of information, knowledge and instruments could halt innovation even more than a lack of funds.

In this phase, the determining role is played by the Facilitators. Technical know-how and the experiences of the various stakeholders involved could contribute to the definition of scientifically valid standard support tools that are easily used by partners. By structuring a valid instrumentation of support for members, the Promoters would facilitate the attainment of the Partnership's goals. Instrumentation of support could include various tools such as:

- information tools: guidelines, manuals, training and information courses etc;
- technical tools: matrixes for analysing the process and other analysis tools, spreadsheets, databases etc.
- direct support tools: audits by technicians, support in the planning of the creation and interventions on installations, support in the creation of management activities.

It is important that support tools be built upon acknowledged methods and linked to national or international standards.

7.4.3 Defining the Action Plan

Once the partnership has been signed by enough organisations, the next step is to define the action plan which clarifies the specific goals and commitments of every subject in terms of adaptation to specific climate change impacts.

Starting with this phase, Promoters must support participants with the tools described in the previous paragraph. It must also be agreed upon in this phase if minimal goals must be set which are valid for all partners or if every organization should define their commitments independently.

Putting together an Action Plan requires – first of all – a phase of identification and mutual awareness of the goals and expectations of every single participant. Initial transparency is one of the essential conditions for the success of the Partnership, for the purpose of avoiding that any initial misunderstanding or conflict among the actors might turn into insurmountable obstacles during the rest of the process.

The contents of the plan depend on the specific goal of the Partnership; whatever the goal is, it is fundamental that companies carry out the forecasted activities, and this might require specific technical skills and available resources, in terms of both time and personnel.

Obviously, this could be a barrier to partnership participation by companies and other potential subjects and could also represent a delay in forecasted timetables. In order to avoid that this could compromise the success of the partnership, dedicated technical support is useful.

In order to facilitate monitoring and communication activities, it would be opportune that the Action Plan includes a monitoring system that everyone agrees upon which would enable the periodic detection of qualitative information regarding the realization of forecasted activities.

7.4.4 Partnership enforcement, monitoring and conclusion

This is the longest and most critical of the partnership phases. In fact, the undersigning of the goals is not synonymous with their realisation. To the contrary, it must be aided by constant monitoring and support of the partners. More specifically, the goals of this phase are:

- supporting partners in the realisation of activities outlined in the plan of action;
- monitoring and evaluating the advancement of the partnership periodically and communicating the results achieved through a reporting system;
- evaluating overall results of the partnership in terms of contribution to the adaptation issue;
- concluding the partnership cycle once the expected results have been obtained.

The final piece of the partnership coincides with the implementation phase of the Action Plan and the evaluation of results obtained in comparison with the goals and planned benefits.

The actual realisation of what has been included in the Action Plan is the condition for the concrete attainment of partnership goals in terms of adaptation to climate change and resiliency of the territory and of the local economy.

Constant support must be offered in order to guarantee that the partnership project is not interrupted and that the Action Plan is tangibly carried out. The kinds of support and their intensity can vary in function of the availability of economic resources and professionalism which the partnership possesses. If resources are limited, support actions will be oriented mostly towards networking and information, facilitating awareness and access to credit, possibilities of funding and incentives as well as contact between supply and demand services. If the partnership possesses adequate resources or if there are subjects within the group which can offer technical know-how (e.g. technical facilities of sector-related associations, universities and research centres etc.), support can be done through more tangible activities such as technical planning or co-financing of investments.

Transparency is an essential element to guarantee the partnership's success. All those involved must have access to information regarding: commitments taken of every member, what has actually been done and results obtained.

In order to guarantee all of this, a monitoring system must be enforced that has been agreed upon and acknowledged by all members and possibly even verified by an independent third party. Verification can be carried out by a subgroup of the Facilitation Group which involves experts and technicians capable of evaluating the quality and dependability of gathered information.

Monitoring is related to the advanced phases of the plan of action's implementation, but it is opportune that the system be defined during the initial phases of the process, so that measurement and evaluation parameters are explicit and the gathering of data and information is facilitated.

The monitoring system is developed on two levels:

1. measurement of actions that have been carried out;
2. measurement of the results of the partnership.

Both levels call for both quantitative and qualitative information.

Measurement of actions that have been carried out call for the prompt monitoring of the actions which each partner actually enforces - in comparison with the commitment found in the plan of action. This information is useful in order to single out and manage critical factors which delay or hinder the realization of forecasted actions, as well as offering suitable initiatives (e.g. additional technical support, training etc.).

Measurement of the results is based upon outcome indicators that have been especially created to measure and communicate the impact of the partnership on adaptation issues. Key parameters to be measured are both environmental and economic.

In order to get the full picture, even the most qualitative aspects must be monitored such as processes or initiatives developed by partners, the adoption of evaluation tools used to measure eco-efficiency or management and communications.

Monitoring can be carried out from a distance through questionnaires or check lists to be given to members periodically or through field visits in order to verify monitored information in person.

A summary report must be written periodically which features an update of: all obtained results, the level of realization of actions taken, forecasted timetables for the

conclusion of actions in order to guarantee that the project continues. This report must be shared and formally approved by all the subjects of the partnership.

Evaluation is one of the key elements of the entire process and it is not limited to the evaluation of the final results alone.

It is opportune that Promoters and the facilitation group organise exchanges and share ideas throughout the life cycle of the partnership in order to:

- in the initial phase, verify the actual added value in terms of the innovation of relations and potential contribution to the fight against climate change;
- while the project is being carried out, evaluate the progress of forecasted interventions; individuate critical elements and possible actions of support in order to guarantee the attainment of forecasted results;
- evaluate the conformity of attained results with those forecasted and decide upon when the partnership is to terminate.

The evaluation process is supported by monitoring system and monitoring report. Aside from the attained results, evaluations of the partnership in terms of relations, communication, internal transparency and management are necessary during the project and at its end.

It is opportune that formal evaluation meetings are scheduled that involve all promoting elements of the partnership. Evaluation meetings can also be held during monitoring every 6 or 12 months in such a way as to have suitable information for discussion and to promptly define measures of modification (e.g. additional technical support, redefinition of the plan of action etc).

The Private-Public Partnership is a delimited course through which different elements work on a common goal. Once the set goal has been attained, the process is concluded and the partnership is terminated. It is essential that goals and initial targets are all specific and well-calibrated in such a way that expected results can be attained within a limited period of time.

Other structures or organizations - such as associations, networks or NGOs - can be established through this experience that can inherit, valorise and promote what has been attained.

7.5 The DOs and DON'Ts of Public-Private Partnerships

Rules about what should be done and what should not be done in Public-Private Partnerships are illustrated in the tables below.

DOs
• A realistic analysis of skills, human and economic resources as well as time available.
• Mouth-to-mouth is the best incentive to diffuse innovative solutions and technology: facilitating the circulation of information regarding what these partners have attained, their results, problems, suppliers used and other technical aspects via e-mail lists, online communities and social networks as well as guided tours, meetings, networking meetings et al.
• Give visibility to the commitments of the companies and to the plan of action.
• Involve both the technical and managerial factions of the companies in the various stages of the drawing up of the plan of action.
• Try to channel economic resources to facilitate the realisation of actions and to award virtuous enterprises (e.g. European funding being managed by the Region, funds from the Chamber of Commerce etc.).
• Ask for constant feedback from partners in order to promptly signal out obstacles encountered while carrying out forecasted actions in such a way as to provide technical support if needed.
• Define indicators that are clear and suitable to the evaluation of the partnership's impact on economic, social and environmental levels.
• Keep constant monitoring of the progress of the partnership, relations, level of involvement of each partner and communication management.
• Organise public encounters in order to offer visibility to those partners which have attained the goals they set.
• It is important to offer public acknowledgement to the commitment of each partner and results attained. Organize an annual ceremony during which those involved could receive an acknowledgement (a plaque, diploma, award); partners who improved their performance in a most significant manner could receive a special acknowledgment.
• Involving local press and media among Promoters in such a way as to facilitate the communication of attained results.
• If the partnership does not possess enough resources to provide direct technical support, agreements could be made with external suppliers (e.g. technicians for energy audits, plant designs, funding etc) to offer partners support services at advantageous conditions.

Table 38 – Dos.

DON'Ts
• Neglect previous experiences of the administration and the "relations of power" between those you want to involve.
• Make the partnership seem like a vertical, hierarchical structure.
• Avoid that the Partnership Protocol be approved with formality, without an authentic dialogue and exchange of shared ideas between the partners.
• The partnership is a process that will last for several years. Do not block the process while trying to involve every single actor singled out during mapping.
• Once results start being evident, others will join in spontaneously.
• Confuse the membership campaign with a promotional campaign: the objective is to stimulate an authentic and motivated participation in the partnership, even if the number of participants should be limited (rather than a large membership).
• Define goals that are generic, not concrete or excessively ambitious.
• Define binding targets that discourage membership to this Partnership.
• Extending the partnership indefinitely: the partnership must have a precise and quantifiable goal and must be terminated once it has been attained.

Table 39 - DON'Ts.

ACT EXPERIENCE 18

STAKEHOLDER ENGAGEMENT IN ANCONA

(M. Cardinaletti, Project Manager for Sustainable Development, Consultant for the Municipality of Ancona).

The Municipality of Ancona during the ACT project developed a structured process of stakeholder engagement, creating the basis of a stable collaboration among different public and private organizations. The engagement process involved at the beginning stakeholders internal to the Municipality and then was extended to several external organizations, through:

- The Municipality Working Group, that involves several departments connected with the adaptation plan implementation (e.g. urban planning, environment, infrastructures, etc.);
- The Act "Local Adaptation board", where stakeholders external to the Municipality were involved (e.g. Province of Ancona, civil protection, etc.);
- The thematic working groups, that developed specific parts of the adaptation plan (e.g. infrastructures and mobility).

The Adaptation Board met on a regular basis during the project. The partnerships established will be the basis for the successful implementation of the adaptation plan on a long-term perspective.

CHAPTER 7 CHECKLIST

- ✓ *Have you identified the key stakeholders?*
- ✓ *Have you defined the role of stakeholder engagement in each phase of the adaptation process?*
- ✓ *Have you established tools and strategies for stakeholders engagement?*

8.
MAINSTREAM ADAPTATION

Mainstream adaptation means integrating considerations of climate change adaptation into policy-making, budgeting, implementation and monitoring processes at national, sector and subnational levels.

From the perspective of government, the UNDP-UNEP Poverty-Environment Initiative[20] (2011) defines mainstreaming as '*integrating considerations of climate change adaptation into policy-making, budgeting, implementation and monitoring processes at national, sector and subnational levels*'. The process is seen as ongoing, involving multiple stakeholders, and aimed at contributing to human well-being. In an urban context, addressing climate change at the local level is intricately associated with planning for sustainable urban development – e.g., an approach that ensures that today's needs are met without limiting those of future generations. Adaptation to climate change is, to a large extent, a challenge of policy integration.

Integration of adaptation into different sector policies – like policy integration in general - is needed for two reasons: first and essentially, with a view to sustainable development, it is necessary to integrate it into all affected sector policies in order to ensure that all responsible stakeholders take appropriate action. This mobilization challenge applies to both societal and governmental actors. Secondly, adaptation policies have to be coordinated with each other and across sectors in order to avoid contradictions between different policies and to realize synergies where this is possible (Swart et al, 2009).

An integrated approach to climate change risk may require changes to a wide range of existing urban plans (including land-use or development plans and sector strategies). This is a good way of making sure that all aspects of urban functions are protected from the worst impacts of climate change. This approach requires considerable knowledge and commitment from a wide range of municipal/urban functions. Cities concentrate people and production, together with all the inputs/goods they use and the wastes they generate. In the process cities also concentrate a variety of hazards.

Any well-conceived urban development plan is inevitably seeking to reduce three types of environmental hazard: biological pathogens (disease-causing agents), chemical pollutants and physical hazards. Indeed, most forms of infrastructure (e.g., provision of water, sanitation and drainage) and most regulations on the workplace, buildings and planning find their roots in the reduction of environmental risk, even if the form they take or the way they are implemented no longer serve this purpose. Many regulations, services or forms of infrastructure are not designed to be specific to particular hazards, but rather to provide general protection. For instance, sewers and drains reduce the risks of water related diseases and flooding. Health care systems are intended as responses to all illnesses and injuries, regardless of whether these arise from pathogens, pollutants or physical hazards. Insurance – for property, possessions, workplace equipment, or life – is also intended for a 'multi-hazard' environment. Building regulations similarly reduce risks to a variety of environmental hazards. Infrastructure standards, building regulations, land-use controls and the way services are organised should all also include protection against the effects of extreme weather events and their prospective higher intensity or frequency.

If climate change is to be mainstreamed into existing or amended urban plans, the following three priorities should be addressed:

[20] For further details: http://www.unpei.org/

1. **Prevent**: *What can be done to prevent climate impacts in the particular sector at hand*?
2. **Prepare:** *For impacts that cannot be prevented, how best to anticipate and make sure that any damage is not extensive*?
3. **Respond:** *How can local authorities, civil society and business address the consequences of a climate event*?

EXAMPLE 21

PLANS THAT REQUIRE CLIMATE CHANGE MAINSTREAMING

Local authorities are in charge of a variety of plans, many of which require amendments if they are to take in the challenges of climate change. Among these plans are the following:

- Medium/long-term urban/municipal development and strategic plans
- Strategic land-use plans;
- Development orders;
- Strategies and plans for water management;
- Strategies and plans for waste management;
- Strategies and plans for energy supplies;
- Management plans for coastal zones.

Source: Un-Habitat, Developing Local Climate Change Plans, 2012.

Table 40 highlights some examples of areas in which urban governments could be active before a weather-related disaster: longer-term protection against likely changes and damage limitation before an extreme event[21] (OECD, 2009).

ROLE OF CITY/MUNICIPAL GOVERNMENT	LONG-TERM PROTECTION	PRE-DISASTER DAMAGE LIMITATION
Built environment		
Building codes	High	
Land use regulations and property registration	High	Some
Public building construction and maintenance	High	Some
Urban planning (including zoning and development controls)	high	
Infrastructure		

[21] It is important to note that adaptation sometimes overlaps disaster risk reduction (DRR), as they share common goals. Both fields aim to reduce the vulnerability of communities to hazards by improving the ability to better anticipate, resist and recover from their impact. DRR, however, expands beyond weather-related disasters, while adaptation includes not only climate extremes, but also the more slowly evolving risks posed by climate change. Thus, while there are clear synergies which must be exploited, there are also some exclusive elements within DRR and adaptation which need to be addressed separately (OECD, 2009).

Piped water including treatment	High	Some
Sanitation	High	Some
Drainage	High	High
Roads, bridges, pavements	High	
Electricity	High	Some
Solid waste disposal facilities	High	Some
Waste water treatment	High	
Services		
Fire protection	High	Some
Public order /police / early warning	Medium	High
Solid waste collection	High	High
Schools	Medium	Medium
Health care / public health / environmental health / ambulances	Medium	Medium
Public transport	Medium	High
Social welfare (includes provision for child care and old-age care)	Medium	High

Table 40 - The role of city/municipal governments in the four aspects of adaptation (Adapted from OECD, 2009).

While in certain situations stand-alone adaptation measures will be needed – for example to partially drain a potentially dangerous glacial lake – in most other cases adaptation measures will need to be implemented as part of a broader suite of measures within existing development processes and decision cycles.

For example, adaptation responses to the risks posed by climate change on agriculture might need to be incorporated as part of existing farming practices, within irrigation and community development plans and projects, as part of sectoral policies in agriculture, and within donor countries‘ assistance strategies as well as within national development and poverty alleviation strategies.

Clearly the nature of the adaptations required as well as the specific decision-making setting would be very different depending upon whether the context is that of an individual, a community, a region, a sectoral ministry, centralized government agencies, or international donors. Adaptation at the farm level, for example, might be limited to relatively short-term decisions related to the choice of crops and other inputs, as well as to planting dates, purchase of insurance, alternative livelihood choices, and even migration.

8.1 Identify the key actors for mainstreaming adaptation

The most appropriate entry points for mainstreaming climate change adaptation in local government depend upon the details of the individual administrative systems, and these vary widely from country to country.

USEFUL QUESTIONS

- ✓ *Has the project formed partnerships to ensure appropriate scientific and technical input on adaptation and other related issues*?
- ✓ *Has the project fostered cross-sectoral partnerships since climate change is a cross-sectoral challenge*?
- ✓ *Has the project allocated adequate resources for building capacity of partners on climate change vulnerability and adaptation*?
- ✓ *Has the project formed different types of partnerships to achieve different objectives*?

Decentralization has created opportunities for local government agencies to become more accountable to their constituencies. However, as the OECD (2009) has noted, the most appropriate entry points for mainstreaming climate change adaptation in local government depend upon the details of the individual administrative systems, and these vary widely from country to country. The need for balancing bottom-up and top-down processes to improve adaptation is particularly critical at the local level. Inputs from subnational actors are likely to be critical to successful adaptation actions (OECD, 2009).

Planning processes should provide channels through which lessons and experiences at the local level can influence decision-making at higher levels, and ensure that higher-level decisions and programmes incorporate local strategies and actions (Lebel et al, 2012).

Other considerations include the partners' potential contribution to policy influence and change, which could be beneficial to the project. For example, engaging relevant government agencies and local government in project activities could facilitate integration of climate change adaptation into relevant policies and plans at local and/or national levels. New partners could be those well placed to facilitate and support the scaling up and replication of successful adaptation interventions e.g. NGOs working in other regions could replicate adaptation interventions. This would help in spreading

project interventions and outcomes over a larger area. In addition, it may facilitate sustainability of project interventions in the longer term.

8.2 Establish tools and strategies for the integration of adaptation

Local governments create an enabling environment for local adaptation action. They should provide a supportive framework of norms, standards, financial incentives, and other types of knowledge, services and capacities to help individuals, households and community organizations take decisions that reduce their exposure to climate risks.

Local governments create an enabling environment for local adaptation action. They should provide a **supportive framework of norms, standards, financial incentives, and other types of knowledge, services and capacities** to help individuals, households and community organizations take decisions that reduce their exposure to climate risks. Local governments can play several roles in helping communities understand and reduce climate risks – *e.g.* as educator, planner, regulator, enforcer and manager. This largely involves building on their core functions, which include:

- Political representation of local population in provincial or national decisions. Local governments can act to ensure that grassroots socio-economic and environmental priorities are understood and adequately reflected in regional and national decision making and policies.
- Strategic development planning for infrastructure, housing, land use and allocation, and regulation of natural resources. Rural development planning and enforcement processes offer some of the most concrete entry points for integrating climate change adaptation. The incorporation of adaptation issues in these processes can lead to the identification of new development priorities, revised strategies, supporting by-laws, and law enforcement mechanisms, as well as monitoring and evaluation frameworks. The more participatory the planning processes, the greater the opportunities for addressing the conditions that shape vulnerability to climate risk and adaptive capacity.
- Delivery of public service. Local governments have a role to play in the provision of services such as water and sanitation, health, law enforcement, education, emergency response, social protection, energy, and engineering and public works, such as road repairs and maintenance. These services, if delivered efficiently and equitably, can go far in building the adaptive capacity of communities, particularly if the delivery mechanisms (especially infrastructure and technology) are selected or designed with a climate lens.
- Raising and managing local revenue (depending on the form and extent of decentralization in the country). Through actions such as collecting taxes or

charges (including licenses) and allocating the finances to identified budget items, local governments are able to generate the revenue needed to support adaptation efforts. However, local governments in developing countries are often faced with financial constraints. Nonetheless, in cases where local governments are given the authority to raise revenues and allocate them to development priorities, addressing climate change adaptation may call for different levels and sources of local revenue, as well as for modified budget allocations.

- Co-ordination of more localized development plans. In some rural contexts, because the local government jurisdiction is vast, covering settlements over a large area, development planning at the grassroots level may be encouraged. The formulation of village-level development plans or micro-plans may help local governments in their own strategic planning processes. Civil society actors, who tend to operate more regularly at the grassroots level, can play an important role in ensuring that climate change adaptation is integrated into these localized plans and in making sure that these plans are adequately considered in district development planning processes.
- Local administration. Local governments are usually responsible for local administration, including human resources, which often includes the registration system for births, deaths, and marriages. Some of the information gathered and organized by local government administrations can be useful to the monitoring and evaluation of adaptation.

CHAPTER 8 CHECKLIST

- ✓ *Have you identified the key actors for mainstreaming adaptation?*
- ✓ *Have you established tools and strategies for mainstreaming adaptation?*

9.
COMMUNICATE AND RAISE AWARENESS

Clear and effective communication, together with stakeholder engagement, is the best mean for overcoming the barriers emerging in the adaptation process.

Clear and effective communication, together with stakeholder engagement, is the best mean to overcome the barriers emerging in the adaptation process. A communication and dissemination plan should allow to pave the way towards a successful adaptation process.

Sharing the results publicly will help the community see that the actions achieve the desired results. In addition, disseminating the story of the experience and lessons learned through a faster, complete and easy exchange and dissemination of information will provide evidence that the actions deserve funding and political support from other levels of government.

QUESTIONS TO CONSIDER
Think when to communicate. Communication should not just be about dissemination at the end of the evaluation process–consider how emerging lessons can be communicated, shared and tested effectively with stakeholders throughout the process.
Communication should be two-way – have you set up mechanisms to gather feedback?
Determine the purpose for communicating and the probable audiences.
Once you have established the target audiences, consider their preferred media, the time they have available, their level of engagement, the amount they would be prepared to read, the type of language they use (technical, non-technical).
Consider how can your evaluation contribute to (a) wider understanding of climate adaptation and (b) wider understanding of how to evaluate climate adaptation?

Table 41 - Questions to consider when communicating climate change adaptation. (Adapted from: www.ukcip.org.uk/adaptme-toolkit/).

This should be undertaken within and outside the responsible authorities in order to raise awareness, enhance acceptance and motivate to take adaptation actions. Wirth and Prutsch (2013) identify several aspects to be taken into account when communicating climate change adaptation.

Various formats for communication exist and can prove useful such as personal consultations, internet communication/platforms and mass media to spread information on climate change, impacts and possible adaptation actions.

The following table presents a look at several communications options and rates the pros and cons of each (ICLEI, Workbook for Municipal Climate Adaptation).

Communication Method	Pros	Cons
Community event e.g. an "Adaptation Week", launch even, or awards ceremony	• More likely to get participation • Provides an opportunity for community involvement • High profile	• Costly • May only reach a small number of people
Press Release e.g. a public announcement on the accomplishments of the adaptation plan	• Minimal costs • Reaches a wide audience (i.e. entire community)	• Difficult to ensure that it is read • Low profile – not celebratory
Issue Brief e.g. interdepartmental memo on the accomplishments of the adaptation plan	• Minimal costs • Reaches all arms of the corporate structure • Could create internal awareness of adaptation issues and spur interdepartmental involvement	• Only reaches a small internal audience • May not appropriately represent the scale of the adaptation effort
Reporting e.g. annual progress report on adaptation plan and implementation efforts or community website update or feature	• Documents progress in a formal way • Minimal costs	• Only reaches a small, mostly internal audience • Is not accessible to wider audience

Table 42 - Pros and Cons of communication methods (ICLEI, Workbook for Municipal Climate Adaptation).

Sharing information is, among others, an essential pre-condition for good adaptation. Information on climate change, impacts and possible adaptation actions should be bundled and refined in user-oriented ways to reach different audiences. Good practice examples from other cities might further foster the adaptation process and allows learning.

ACT EXPERIENCE 19

THE MARKET OF IDEAS AGAINST CLIMATE CHANGE IN BULLAS

(P. García Moreno, Head of Local Development and Tourism Department; I. Costa Gómez, External Expert; E. Llorente Palao, External Expert - Municipality of Bullas, Spain).

Figure 26 - The Market of ideas against climate change held in 2012.

The Municipality of Bullas is convinced that the necessary actions to change habits and ways of living and working can only be made well if it is planned and then done together with the citizens and with the enterprises from Bullas, because it needs the ideas and the conviction of all to have real success. For this reason, the municipality of Bullas on 4th February 2012 organized the DIA ACT in Bullas.

More info can be found in the website: www.proyectoactbullas.blogspot.com.es.

Participants involved included:

- political and administrative-technical levels of the Bullas local administration, particularly those in charge of socio-economic development, for environment, energy, rules for private buildings, waste collection, training and schools;
- management and technical-professional levels of small and medium, as well as big enterprises operating in Bullas, particularly those of the sectors agriculture, tourism and high-energy and water consuming industries;
- representatives of intermediate organisations, like enterprise associations, chamber of commerce, industry and agriculture, workers unions, cultural associations, schools, environmental associations, etc.
- political representatives of the region of Murcia and of the neighbouring local administrations (Mula, Cehegin, Caravaca, etc.)

Participants were involved through a specific methodology called Open Space Technology. This methodology is a simple but powerful way to canalize into an effective work all the opinions provided by the stakeholders involved in a moment when climate change is fast developing. Furthermore, it is a methodological tool that allows all size groups self-organization to be able to deal with complex issues in a short time period, thus inspiring creative solutions and strengthening communication and a collective responsibility to find solutions.

ACT EXPERIENCE 20

THE ACT "CHANGE" SCHOOL COMPETITION

(Forum of Adriatic and Ionian Cities, Life ACT Project 2013).

Figure 27 - The award ceremony.

Within the ACT Project, the Forum of Adriatic and Ionian Cities has announced the international competition "CHANGE" reserved for students of secondary high schools (age 14-18) for the creation of a Multimedia CD-ROM or DVD. The competition aims at raising awareness, among young generations, about the issues related to climate change and its consequences and is addressed to groups of learners, classes or schools of higher education of the cities involved in the project and are members of the Forum of the following countries: Spain (Municipality of Bullas), Italy, Slovenia, Croatia, Montenegro, Bosnia-Herzegovina, Albania and Greece.

CHAPTER 9 CHECKLIST

- ✓ *Have you identified the key targets for communications?*
- ✓ *Have you established the tools for communication and raise awareness?*
- ✓ *Have you considered the pros and cons of each communication form?*

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Annex I – the adaptation actions database of the Life ACT Project

Annex I provides a list of adaptation actions that the three municipalities of the Life ACT Project (Ancona-IT, Bullas-SP and Patras-GR) have included in their Local Adaptation Plans. For further details concerning the actions visit the website: http://www.actlife.eu/EN/index.xhtml.

MUNICIPALITY OF ANCONA

MUNICIPALITY	ANCONA
SECTOR	COASTAL ZONE
SPECIFIC MEASURES	
NAME	Interventions to protect the coasts
DESCRIPTION	The project involves the construction of a series of coastal protection interventions protecting the natural *habitat* and restoring the degree of accessibility of the maritime territory.
TIME HORIZON	5 years
NAME	Portonovo: coastal defence by moving back the bathing establishments and restaurants.
DESCRIPTION	• landscaping works through removal (where necessary) and pruning; • the creation of a new road network, through the identification and tracing of the new route; • parking area; • construction of the roundabout and service road up to the border of the Portonovo PPE;

	• inclusion of green areas through the creation of an informal hedge between the parking area and the green on the pond side consisting predominantly of laurel and holm oak. Privet shrubs and mastic will also be planted to create a green boundary in the parking areas; • development of new technological systems consisting of a new sewer line for the disposal of rainwater, a new lighting system, water supply line and the preparation of a fire extinguishing line; Specific measures are planned to conserve and, where possible, increase the extent of diversified environments. The project interventions therefore provide for: a. the expansion of the lake; b. excavation of the bed to counter the landfill phenomena; c. operations aimed at ensuring the permanence of salty conditions; d. diversification of the depth of the water to create different habitats; e. re-naturalisation of the area. Therefore, the processes anticipated are enlargement of the perimeter of the lake and the deepening of the lake bed with removal of sediment and silt that creates anoxic conditions that are unfavourable to the development of communities around lakes. Regarding the restoration of the lake-sea exchange during other parts of the year besides the summer, the project tends to favour the contribution from the sea in order to form saline habitats of considerable interest for migratory and sedentary birds.
TIME HORIZON	5 years
NAME	Study and monitoring of the coastline and survey of the defence works through high-resolution satellite images.
DESCRIPTION	This project aims to study and monitor the coastline of the Marche Region to create a database of the coastline and the interventions carried out to: • control coastal erosion; • provide an information base for the preparation and updating of the programming tools in the sector.
TIME HORIZON	Until 2020
NAME	Study of inshore currents in the stretch of sea from Ancona to Senigallia
DESCRIPTION	Premonitory studies of the Integrated Coastal Zone Management Plan for the Marche region provide the basis for all analytical-numerical applications of coastal dynamics. In-depth studies in some areas of the coast may be useful to clarify the moving and sorting of sediments.

	The Marche Region can work together to make a contribution to the study of marine currents inshore also partially aimed at civil protection interventions related to marine accidents and subsequent pollution. In addition, follow-up studies will allow the reconstruction of the wave motion near the coastline and a more accurate knowledge of the wind fields, the peak period of the spectrum, the average period and the average direction of propagation. In addition, climatology studies of the coastal sector concerned may be analysed in depth; spectral models for the study of wave propagation and to estimate the sediment transport potential may be performed.
TIME HORIZON	Until 2020
SECTOR	LANDSLIDE RISK
NAME	Reduce the landslide risk with drainage and environmental engineering interventions aimed at the use of the drained water for industrial purposes.
DESCRIPTION	The project calls for the construction of a drainage network, consisting of a system of wells connected to the base with a flexible tube that can support the deformations due to the gravitational activations on the decollements up to depths of 30 - 40 meters from the ground level. In this system of drainage, wells will be associated with a network of drainage trenches made using a clamshell bucket and filled with medium-size gravel stabilised with cement grout.
TIME HORIZON	3/5 years
NAME	Map of landslide speeds
DESCRIPTION	It is therefore appropriate to perform a study of the landslides at the municipal (or better yet regional) level, also indicating, in addition to the classical geomorphology classification, the individual speed (mm/sec), in order to define a "Landslide speed map" that shows the structures, infrastructures, buildings, villages and number of people exposed at each landslide speed. This map will provide more complete information to decision makers. To define the speed of landslides *surface* tools will be used such as: GPS, TCA, LASERS, extensometers, etc. and *in depth* such as DMS, inclinometers, etc.
TIME HORIZON	1 year
NAME	Extension of P4 landslide monitoring for the entire City of Ancona
DESCRIPTION	24/7 monitoring of the Ancona landslide and the early warning system associated with it for the safety of the people living with the landslide has gained global experience in its 5 years of experimental activity. This evidence allows us to state

	that it is appropriate to extend the control system to P4 (very dangerous) landslides. The integrated warning system for people living with active landslides could also be applied to all other complex clay type landslides where the deformations are slow. For these types, the expenditure for the expansion of the system would be widely covered by the expected results. For landslides from collapse or fast gravitational deformations, where the reaction time between the recorded deformation and the implementation of the evacuation plan is in seconds or minutes, the early warning system should be adapted with different instrumentation in relation to the sensors, communications and warning for the populations concerned. It must be noted that the north-east coast of the municipality of Ancona is affected by a clay/marl cliff of considerable size that is subject to collapse, and during the summer season the coast is enjoyed by swimmers and tourists who flock to the shoreline that is subject to collapse. These areas are not monitored and an early warning system could ensure the protection of those who are in the area.
TIME HORIZON	3 years
NAME	Improvement and optimisation of the Ancona landslide early warning system.
DESCRIPTION	The project is aimed at increasing the Early Warning system, composed of different topographic and geotechnical sensors, with an interferometric ground radar, which will be positioned on the jetty in front of the landslide to identify any surface movements and be able to correlate them with precise data recorded by the sensors. This integration will allow us to monitor the changes in width, length and depth and immediately record the millimetric deformation of the inhabited houses, automating the activation of the audible warning signals for evacuation of the people. The project also includes a study of the landslide triggering thresholds due to rain influencing the water table in the more superficial bodies (up to 80 m from the p.c.). This scientific aspect, currently lacking in the geodynamic modelling of the Ancona landslide, would allow us to define the levels of accumulated rainfall which should trigger the different administrative procedures defined in the evacuation plan: attention, warning, evacuation.
TIME HORIZON	2 years
NAME	Informational campaigns for the population
DESCRIPTION	The project calls for the establishment of a Multi-Year Informative Plan, to be updated every 3 years, which defines the methods for informing the population on the status of the ground and on the results of the evolution of the hydrogeological instabilities. The information distribution tools could be, for example: • district meetings; • posters and publications; • a simulation project of evacuations of populations at risk who are living with

	landslides; Ancona landslide memorial event on December 12 of each year: a day dedicated to knowledge of the historical event, delivery of giveaways and brochures, active involvement of schools to raise awareness of young people about environmental and safety issues due to the hydrogeological instability.
TIME HORIZON	1 year
NAME	Creation of new professional positions
DESCRIPTION	The project aims to add graduate programs to the faculties of engineering and geology and new courses aimed at the creation of specialised professions in landslide monitoring and early warning system management. These professionals can take advantage of the experience gained from the "Ancona Monitoring Centre" to do internships, meetings, short courses and field visits. In addition, at the upper secondary education level, it would be a good idea to incorporate a number of hours for small informative seminars on opportunities related to these new professions.
TIME HORIZON	1 year
NAME	Establish a natural laboratory for raising public awareness
DESCRIPTION	The project involves the creation of an educational trail on the Ancona landslide that includes guided visits to major instabilities and the geomorphological forms of the landslide as well as to the stations and instruments of the monitoring system. Along the trail there will be signs explaining the landslide and monitoring system. The guides will be students in the last year of high school who are properly trained and educated.
TIME HORIZON	1 year
NAME	Extension of the early warning system at a regional level
DESCRIPTION	The project aims to extend the early warning system, already widely tested with the 24/7 monitoring of the Ancona landslide for the safety of people living with the landslide and recognised worldwide, to P4 (very dangerous) landslides located in other parts of the Marche Region. To do this it is necessary to develop a more efficient early warning system integrated into the national grid Operational Centres to reduce false alarms and improve predictions of adverse weather and its effects on the land. The integrated use on the regional scale of the hydropluviometric magnitudes recorded onsite in telemetry with weather radar and satellite estimates will improve understanding of the atmospheric phenomena and the territory's response to them. The implementation of a hydrological and hydraulic model at the regional and basin

	level, the development of methodologies designed to increase understanding of the relationship between rainfall and the triggering of landslides and the study of historical events based on the data in the regional network, will allow the optimisation of alert thresholds, which are essential in order to provide adequate notice and reference to the organisation in charge of territorial management.
TIME HORIZON	5 years
NAME	Staff Exchange Project
DESCRIPTION	The project involves the cultural exchange between Italian and Swedish technicians regarding landslide monitoring and early warning systems. Sweden has twenty years experience in the field of risk prevention and is a country that is open to international collaboration. The Swedish team of experts who will be involved is made up of: • civil protection experts and experts from the Geotechnical Institute • university researchers (Calmers Technical University and Lulea Technical College) • technical experts from the local municipalities The objective of the partnership is primarily the integration between the monitoring and early warning systems with land use planning.
TIME HORIZON	2013
NAME	
SECTOR	INFRASTRUCTURE
NAME	System for the prevention of climatic effects on the urban road network – “Free Road” Project
DESCRIPTION	The project involves the study of alternative routes as a useful planning and prevention activity to reduce the negative effects produced by extreme weather events. These events call for the urgent definition of an in-depth study to organise a comprehensive intervention system to quickly clear blocked roads in case of crisis and maintenance work on both the main and alternate route. To complete the project for the prevention and reduction of the effects of general road problems, the study will also consider the displacement of buildings and structures of strategic and functional interest to the public such as schools, hospitals and offices of various types in order to define infrastructure intervention priorities in order to make it easier to reach the structures identified above.

TIME HORIZON	2015
NAME	Restore full functionality and safety to the railway and Via Flaminia
DESCRIPTION	Following the landslide in 1982, the railway line in the landslide area has undergone a modification resulting in the formation of an irregular layout which impairs the full functionality of the railway. The project involves the reforming of the coastline for area stabilisation and the restoration of full functionality and travel safety of the railway and Via Flaminia.
TIME HORIZON	N.D.
SECTOR	CULTURAL HERITAGE
NAME	Training Courses for the creation of specific professions for the assessment, analysis and monitoring of the historical and cultural heritage.
DESCRIPTION	The courses will be targeted and aimed at providing specific skills that can be applied within the monitoring and preservation of historical heritage. The expertise gained can also be used in partnership with the ICR in other territorial contexts besides those regarding the City of Ancona, ensuring trained subjects the possibility of career opportunities on the national and European level. The course will provide theoretical training in the classroom and practice in the field.
TIME HORIZON	N.D.
NAME	Completion of the Risk Map of the Cultural Heritage of the City of Ancona
DESCRIPTION	The project involves the completion of a survey, analysis and risk assessment of the entire historical and cultural heritage of the City. The ACT project has made it possible to carry out the impact assessment only on a limited number of monuments and historical complexes. The project objective is to complete the impact study in order to define an updated and complete map of the cultural assets with respect to the level of vulnerability and risk related to climatic and environmental factors (environmental/air risk).
TIME HORIZON	2015
SECTOR	BIODIVERSITY
NAME	Preservation of plant and animal species and habitats

DESCRIPTION	The project provides a series of measures aimed at strengthening the natural systems and their ability to adapt to changes caused directly or indirectly by climate change, minimise the loss of their characteristics and functionality (ensuring the functionality of the ecosystems, work to stem the risk of species extinction, be capable of flexibility in the face of change-adaptive management, think on a homogeneous systems scale - for example, for the Apennines - and ensure the maintenance of ecosystem services on a regional and local scale) .
TIME HORIZON	5 years
SECTOR	HEALTH
NAME	Alarm system for the prevention of the effects of heat waves on health – “Helios” Project
DESCRIPTION	This project aims to improve information to the population and the expansion in the area of structures for heat wave management. Our country can only refer to the existing models of management and emergency responses already developed by municipalities, provinces and regions together with the Department of Civil Protection. e following is needed: • adequate scientific support • the preparation of local plans with the alarm level, calibrating interventions to previously highlighted categories. The coordination of the various levels of intervention is a crucial element and must be identified before the event, with a clear identification of the roles, actors, responsibilities and resources. e objectives of the project are: • to reduce the effects of heat waves on the population at risk • to spread the culture of self-protection • to reduce social and health costs with policies for prevention rather than intervention
TIME HORIZON	2015
NAME	System for the surveillance and prevention of the effects of climate change on urban and suburban territory – “Just in time” Project
DESCRIPTION	The project calls for the construction of a stable surveillance and monitoring system throughout the territory but one that is also precise regarding areas of known weaknesses and vulnerabilities, through a network of internal structures and voluntary civil protection associations. In this manner, we intend to extend and enhance the monitoring of the territory through a process of inspections and

	prevention with the involvement of the volunteer sector. It is therefore an emergency prevention activity, and not a contingency phase activity.
TIME HORIZON	By 2015
NAME	Improving land governance
DESCRIPTION	During the ACT project, various subjects in the area were invited to form the Local Adaptation Board (LAB), a structure that, first and foremost, aims to identify and systematise the projects in this plan. After the project, however, the role of the LAB does not change and continues, evolving into a coordination structure for the adaptation to climate change. The LAB will become the adaptation control room, resulting in both the strategic direction and the instruments for the implementation of the strategic guidelines.
TIME HORIZON	2015
NAME	“Green Comet” Project
DESCRIPTION	This project/guide designs the city-wide penetration of the linear environmental system which is consolidated in the Conero promontory and the park area.
TIME HORIZON	2020
NAME	Assignment of financial budget for adaptation within the budget for the City of Ancona
DESCRIPTION	The action provides for the establishment of a specific chapter called "adaptation" within the municipal budget that would allow the annual measurement of the total resources allocated to the management of multi-level risk by the City of Ancona. The Adaptation budget will not be managed centrally, but each department will maintain its financial independence and programming in relation to the resources allocated and the targets stated in the PEG. This would imply that each department "concerned" by the issue of adaptation must include in its PEG a line item in which to gather the annual goals and in which to allocate the resources assigned each year to achieve them. This would allow the monitoring of the achievement of objectives in relation to the issue of adaptation, both in the Department/sector and central level. This could facilitate the essential mainstreaming process in the approach to the "Adaptation" problem while ensuring the possibility of a precise program for individual issues, delegated to the responsible area, and the ability to define a strategy and a policy that is integrated and coordinated on the political and institutional level.
TIME HORIZON	2015

MUNICIPALITY OF BULLAS

MUNICIPALITY	BULLAS
SECTOR	TOURISM
GENERAL MEASURES	
DESCRIPTION	1. Improve the Register of Tourism Indicators that is being compiled by the Wine Museum and Tourism Office adding at least data about: average stay of tourists, tourism spending, level of satisfaction of tourists and preferences (best value for money, state of natural areas, tourist offer, service offered by the tourist office, accesses, etc.), number of employees in the tourism sector steady and seasonal, water consumption, total volume of water consumed, energy consumption and its origin (% renewable energies), number of tourist treated for climate change related health issues.
	2. Develop an ecotourism website (as an effective communication system) where Bullas Council can share the trends extracted from the Register of Tourist Indicators, practical information on adaptation measures, options and advices, etc. with stakeholders, including the actions (among the proposed ones) that Bullas Council is taking each year. In this website, every Bullas touristic offer will be advertised and promoted. It is necessary to bear in mind that for transferring updated knowledge to stakeholders, technician from Bullas Council must be formed. Bullas Council should assure periodical training in these issues to its workers.
	3. Promote sustainable tourism as Bullas Natural winery giving value to climate change mitigation and adaptation measures that Bullas Council is carrying-out and involving tourists. To achieve this goal a green or natural passport can be designed. This passport can include issues like: - General tourist information (different options, touristic routes, accommodation, restaurant business, presents, etc.); - Awareness campaigns (health, water, energy, etc.); - Sustainable activities for children (games, workshops, etc., to raise awareness of the importance of the conservation of the natural environment and sustainable tourism. For each overcame activity, kids will acquire stamps that will result in prizes or discounts).
SPECIFIC MEASURES	
IMPACT	Change in seasonal tourist flow
TIME HORIZON	Short and medium-term measures

	1. Make a more comprehensive and systematic record that complements the previous one and includes indicators of sustainable tourism, such as: average stay of tourists, tourism spending, level of satisfaction of tourists and preferences (best value for money, state of natural areas, tourist offer, service offered by the tourist office, accesses,...), number of employees in the tourism sector steady and seasonal.
	2. Collect meteorological data in order to update the TCI index: Max. Mean T (^{o}C), Min. Daily rel. Humidity, mean daily rel. Humidity, effective T (CID) (^{o}C), mean T (^{o}C), effective T (CIA) (^{o}C), precipitation (mm), sunshine (h/month), mean daily sunshine (h) and wind speed (km/h).
	3. Enable the adaptation of tourist and commercial schedules at times with greater influx of visitors.
	4. Provide tourist information and guided visits in other languages.
	5. Suggest a variety of leisure options to lure tourist during the low-season (e.g., Salto del Usero, roman baths, Mula's river spring, etc.).
	6. Go on promoting and facilitate rural accommodation, encouraging the owners of second homes in the area to rent them, and include it within the tourist offer.
	7. Encourage the development of thematic and seasonal tourist packages that include, not only a range of activities appropriate for the less touristic months, but also the possibility of accommodation. Therefore middle and long distance (not regional) tourism is boosted.
	8. Assure that Bullas' tourist offer is included within the main itinerary of tourist routes of the Region (e.g.: arrange an information point at Cartagena port cruise pier offering all include experiences - transport, food, winery visits, and the Museum of wine, etc.).
	Long-term measures
	1. Review the recorded indicators and include or eliminate those considered significant or not, so that the tourist offer is adapted to reality.
	2. Continue compiling meteorological data in order to keep on updating the TCI.
	3. Adapt tourist and commercial schedules to reality according to the tourist indicators collected.
	4. Keep promoting tourist information and guided visits in other languages (the ones selected using tourist indicators).
	5. Keep on suggesting different leisure alternatives to lure tourist during the low-season.
	6. Carry on working to promote rural allocation in order to attract middle and long distance (not regional) tourism.

	7. Encourage stakeholders to assure that thematic and seasonal tourist packages are conformed to visitors' preferences (identified using the recorded tourist indicators).
	8. Guarantee that the tourist information provided in large tourist influx points – such as Cartagena port cruise pier- is updated.
IMPACT	Tourists' health problems
TIME HORIZON	Short and medium-term measures
	1. In collaboration with nearby public health centres try to collect data about the number of tourists treated for heat strokes, and other health problems – related to climate change.
	2. Gather daily and nightly pollution indicators in collaboration with competent authorities and research centers (e.g. air quality, noise, etc.).
	3. Increase public awareness about the public health implications of climate change, including risks and the need for emergency preparedness and translate it into other languages.
	4. Be attentive to national health alerts and recommendations –related to climate change- to be able to act in advance.
	5. Enable the adaptation of tourist and commercial schedules at times with greater influx of visitors.
	6. Provide accessible air conditioned public facilities.
	7. Evaluate the possibility to place awnings over more streets to supply shade.
	8. Consider the viability of seed plants in parks and open spaces (where awnings cannot be placed) that are indigenous to the local council area.
	9. Give information to catering businesses about different cooling options both inside and outside (trying to promote the more efficient ones).
	10. Study the feasibility of placing more outdoor drinking facilities.
	Long-term measures
	1. Keep collecting data about number of tourists treated for health problems related to climate change.
	2. Carry on with the compilation of daily and nightly pollution indicators in collaboration with competent authorities and research centers (e.g. air quality, noise, etc.)
	3. Increase public awareness about the public health implications of climate change, including risks and the need for emergency preparedness and translate it into the

	languages selected using the data compiled by the Wine museum and Tourist office.
	4. Be attentive to national health alerts and recommendations –related to climate change- to be able to act in advance.
	5. Adopt heat-emergency contingency plans for recreational/tourist events, health within local council area (state governments are responsible for emergency services but local governments are usually first in line for provision of services) Local governments approve applications for tourism events and can be involved in emergency contingency planning.
	6. Adapt the schedules of municipal touristic facilities taking into account the collected data about tourist influx.
	7. Enable the adaptation of tourist and commercial schedules at times with greater influx of visitors.
	8. Encourage scheduling recreational, tourist and sporting events and activities to avoid the hottest part of the day and at shady locations where possible.
	9. Provide accessible air conditioned public facilities.
	10. Keep on increasing the number of awnings over streets.
	11. Restudy the possibility of seeding more plants in parks and open spaces (where awnings cannot be placed) that are indigenous to the local council area.
	12. Include provision of shade structures in design of new council recreational facilities.
	13. Ensure sufficient shade, either natural or built, is available or planned for when developing new recreational facilities or centres and in any development plans for picnic areas, playgrounds etc.
	14. Continue giving information to catering businesses about different cooling options both inside and outside (trying to promote the more efficient ones).
	15. Study the feasibility of placing more outdoor drinking facilities.
IMPACT	Water shortages
TIME HORIZON	Short and medium-term measures
	1. Compile a database that contains data of water consumption, total volume of water consumed, etc, to include it in the Register of Tourism Indicators. To be able to act preventively in case of water shortages.
	2. Since tourists typically use relatively more water than local inhabitants (in part because of additional water uses such as garden irrigation, cleaning, swimming pools, etc.) manage additional awareness campaigns for sustainable water

	consumption.
	3. Investigate the possibility of a deeper management and water control at a local level.
	4. Evaluate the application of mulches in more parks than already have, to avoid evapotranspiration as well as weds.
	Long-term measures
	1. Carry on and, if necessary, improve the acquisition of data for the Register of Tourism Indicators of water consumption, total volume, etc.
	2. Increase awareness campaigns for sustainable water consumption amongst tourist and local population.
	3. Keep looking into the possibility of water controls and management being tailored for specific council areas
	4. Increase application of mulches in more parks to avoid evapotranspiration and weds, if applicable.
	5. Promote water controls and management being tailored for specific council areas.
	6. Analyze water requirements for new recreational facilities/areas and the way to manage them if needed.
	7. Inquiry and advertise new ways to save, reuse, and manage water efficiently.
	8. Develop a guide for homeowners, developers, architects, etc., to educate them about the significance of water saving options.
IMPACT	Problems with energy supply
	Short and medium-term measures
	Include information of energy consumption and its origin (% renewable energies) in the Data Register.
	Engage energy providers to enhance local renewable generation opportunities.
TIME HORIZON	Work actively in the Covenant of Mayors.
	Long-term measures
	Take steps to decrease municipal and community energy consumption.
	Increase municipal and community energy security, use of renewable resources, and overall energy efficiency.

	Work toward the increase of the resiliency of emergency energy systems.
	Engage energy providers to enhance local renewable generation opportunities.
	Inquiry and advertise new ways to save, reuse, and manage energy efficiently.
	Develop a guide for homeowners, developers, architects, etc., to educate them about the significance of sustainable energy consumption and renewable energies.
IMPACT	Impact on biodiversity. Changes in flora, fauna and landscape.
TIME HORIZON	Short and medium-term measures
	Compile indicators that show tourist preferences related to activities concerning flora, fauna and landscape.
	Study the feasibility of upgrading the length of the Green Pathway or to propose alternatives routes with a variety of landscape.
	Dedicate additional resources to the provision and maintenance of parks, forests and other green areas in case of budget excess.
	Try to provide for increased regular maintenance of park/green space in council management plans and council budgets.
	Take steps to protect habitats and migration routes in collaboration with regional, national and European authorities.
	Aware private forest owners about the importance of maintenance of the land and the need to work more in the prevention “better safe than sorry”.
	Long-term measures
	Take advantage of changes of local flora and fauna to be able to offer new activities taking into account tourist preferences identified from the collected indicators.
	Promote and improve those activities identified as tourist favourites using the compiled data.
	Dedicate additional resources to the provision and maintenance of parks, forests and other green areas in case of budget excess.
	Try to provide for increased regular maintenance of park/green space in council management plans and council budgets.
	Take steps to protect habitats and migration routes in collaboration with regional, national and European authorities.
	Increase public awareness.

MUNICIPALITY	BULLAS
SECTOR	AGRICULTURE AND SOIL
GENERAL MEASURES	
DESCRIPTION	1. Create a standardised record that includes at least the following items to provide farmers with updated information and trends to be able to act upon time when needed: - Meteorology - Crop production (including wine production) - Crop area (irrigated and non irrigated areas) - Phenology - Pest and weeds - Wine quality data The aim of this standardised record is to collect indicators to be correlated with meteorology data in order to foresee trends (and research in models). Having correlated information about crop production, phenology, wine quality, etc., with climate conditions allows stakeholders to predict and to be able to act in advance when needed. In order to achieve this measure, Bullas Council should assure that its technicians are correctly formed and trained.
	2. Create a knowledge-sharing platform where all concerned parties can learn and exchange practical information regarding energy efficiency, irrigation, farm-level adaptation options, new technology, other innovations, etc (see specific measures). Furthermore, in this platform, Bullas local government should include the data from the Standardised Record created. The aim of this measure is to offer an effective communication system to increase the awareness, information and formation of stakeholders and to allow them to act in advance to potential risks. It is necessary to bear in mind that for transferring updated knowledge to stakeholders, technician from Bullas Council must be formed. Bullas Council should assure periodical training in these issues to its workers.
	3. Attempt to provide a local early climate warning system for daily weather predictions, seasonal forecasts and weather alerts, within the limits of the knowledge-sharing platform.
	4. Develop an early alert system with consultation forums regarding weeds and pests so that farmers are informed in time of new pests, action protocols, new methods of prevention, etc, within the limits of the knowledge-sharing platform. Bullas municipality should assure that municipal technicians identify and control pest arrival and proliferation by asking farmers regularly.
SPECIFIC MEASURES	
IMPACT	Crop area changes (including impacts in native plants and crops)

TIME HORIZON	Short and medium-term measures
	1. Ensure that there is a Standardised Record with updated data regarding crop area (crop varieties; irrigated/ non irrigated areas; biologic/traditional agriculture).
	2. Seek and inform farmers about new crop changed climatic conditions that affect growth and dispersion.
	Long-term measures
	1. Encourage farmers to participate in the knowledge-sharing platform by enhancing its benefits.
	3. Keep informing farmers about new crop varieties suitable to foreseeable future and invasive species management policy/strategy that takes into account changed climatic conditions.
	4. Advice farmers to review mowing and weed control schedules to take into account changed climatic conditions that affect growth and dispersion.
IMPACT	Irrigation requirements (water availability)
TIME HORIZON	Short and medium-term measures
	1. Work towards the creation of the adaptation framework enabling information exchange such as general advice and information on conservation, tactical irrigation guidance, rainwater recovery and advice on leakage and educating citizens.
	2. Inform farmers regularly about water management innovations, including irrigation, to address the risk of moisture: - Keep working towards the creation of the adaptation framework enabling information exchange such as general advice and information on conservation, tactical irrigation guidance, rainwater recovery and advice on leakage and educating citizens. - Ensure that farmers are regularly informed about water management innovations, including irrigation, to address the risk of deficiencies and increasing frequency of droughts and promote the use of irrigation practices to address the moisture deficiencies associated with climate change and reduce the risk of income loss due to recurring drought.
	3. Study the feasibility of developing and implementing policies and programs to influence farm-level land and water resource use and management practices in light of changing climate conditions.
	4. Encourage competent authorities the creation of drought and water conservation plans that includes irrigation, drought monitoring and communication systems.
	5. Check old drainage systems and study the possibility of investing in water transfer infrastructure improvement for a greater efficiency in distribution that will entail leakage reduction.

	Long-term measures
	1. Keep working towards the creation of the adaptation framework enabling information exchange such as general advice and information on conservation, tactical irrigation guidance, rainwater recovery and advice on leakage and educating citizens.
	2. Ensure that farmers are regularly informed about water management innovations, including irrigation, to address the risk of moisture deficiencies and increasing frequency of droughts and promote the use of irrigation practices to address the moisture deficiencies associated with climate change and reduce the risk of income loss due to recurring drought.
	3. Take steps on creating the conditions (regulatory, institutional, and managerial) that enable adaptation actions to be undertaken. Including irrigation regulations, water-saving policies, thieves control amongst others, when needed and force its binding by Municipality Laws.
	4. Make a follow-up with competent authorities about the creation of drought and water conservation plans that includes irrigation, drought monitoring and communication systems.
	5. Re-check old drainage systems and continue studying the possibility of investing in water transfer infrastructure improvement for a greater efficiency in distribution that will entail leakage reduction.
IMPACT	Wine quality and production
TIME HORIZON	Short and medium-term measures
	1. Encourage the Regulation Council of Bullas Denomination of Origin to continue with its guidance work and promote the inclusion of hazards climate change related.
	Long-term measures
	2.Keep encouraging the Regulation Council of Bullas Denomination of Origin to continue with its guidance work and promote the inclusion of hazards climate change related.

MUNICIPALITY	BULLAS
SECTOR	HEALTH
SPECIFIC MEASURES	
IMPACT	Thermal stress
TIME HORIZON	Short and medium-term measures

The municipality of Bullas should be attentive to national health alerts and recommendations – related to climate change- to be able to act in advance and ensure that all the information and awareness campaigns carried out by the Autonomous Community and by the competent Ministry reach the citizens.
Increase public awareness and educate citizens about health implications of climate change, (dangers of sun exposure, symptoms of heat stress, etc.) including risks and the need for emergency preparedness.
Reduce the impact of thermal stress via advice on how to stay cool including the use of portable fans, improved ventilation of homes, public buildings, and other residential institutions and workplaces.
Study the possibility of developing a Public Health Plan that looks at the current health and wellbeing of the communities within the council area and develop Wellbeing Indicators so that the program can be assessed over future years.
In collaboration with nearby public health centres try to collect data about the number of citizens treated for heat strokes, and other health problems – related to climate change.
The municipality of Bullas should take into account specific measures as provide accessible air conditioned in public facilities; evaluate the possibility to place awnings over more streets to supply shade; consider the viability of seed plants in parks and open spaces (where awnings cannot be placed) that are indigenous to the local council area; study the feasibility of placing more outdoor drinking facilities, etc.
Long-term measures
The municipality of Bullas should carry on being attentive to national health alerts and recommendations –related to climate change- to be able to act in advance and ensure that all the information and awareness campaigns carried out by the Autonomous Community and by the competent Ministry reach the citizens.
Keep on increasing public awareness and educate citizens about health implications of climate change, (dangers of sun exposure, symptoms of heat stress, etc.) including risks and the need for emergency preparedness and provide it in other languages.
Reduce the impact of thermal stress via advice on how to stay cool including the use of portable fans, improved ventilation of homes, public buildings, and other residential institutions and workplaces.
Keep on working in the Public Health Plan that looks at the current health and wellbeing of the communities within the council area and develop Wellbeing Indicators so that the program can be assessed over future years.
Keep collecting data about the number of citizens treated for heat strokes, and other health problems – related to climate change- in collaboration with nearby public health centres.
The municipality of Bullas should carry on developing account specific measures

	such as provide accessible air conditioned in public facilities; evaluate the possibility to place awnings over more streets to supply shade; consider the viability of seed plants in parks and open spaces (where awnings cannot be placed) that are indigenous to the local council area; study the feasibility of placing more outdoor drinking facilities, etc.
	Ensure sufficient shade, either natural or built, is available or planned for when developing new recreational facilities or centres and in any development plans for picnic areas, playgrounds etc.
IMPACT	Vector borne infectious diseases
TIME HORIZON	Short and medium-term measures
	In collaboration with nearby public health centres try to collect data about the number of citizens treated for heat strokes, and other health problems – related to climate change (including monitoring for waterborne diseases (such as E. coli, toxic algae, and viruses).
	Provide public education on mosquito and tick protection and disease prevention.
	Educate residents about disease risks, precautions and symptoms.
	Long-term measures
	In collaboration with nearby public health centres keep collecting data about the number of citizens treated for heat strokes, and other health problems – related to climate change (including monitoring for waterborne diseases (such as E. coli, toxic algae, and viruses)) and evaluate this information to be able to act in advance if needed.
	Develop a program that identifies various vector control methods and local policies to apply those methods.
	Increase council-run immunization programs to address any increased threats where possible (should be undertaken in collaboration with state health programs/agencies).
	Intensify public education on mosquito and tick protection and disease prevention.
	Continue educating residents about disease risks, precautions and symptoms.
IMPACT	Air pollution
TIME HORIZON	Short and medium-term measures
	Try to gather local daily and nightly pollution indicators in collaboration with competent authorities and research centers (e.g. air quality, noise, etc.).
	The municipality of Bullas should be attentive to regional air quality alerts and recommendations to be able to act in advance and ensure that all the information

	and awareness campaigns carried out by the Autonomous Community and by the competent Ministry reach the citizens.
	Increase public awareness and educate citizens about health implications of air pollution, including risks and the need for emergency preparedness.
	Long-term measures
	Carry on with the compilation of daily and nightly pollution indicators in collaboration with competent authorities and research centers (e.g. air quality, noise, etc.)
	The municipality of Bullas should carry on being attentive to national air quality alerts and recommendations to be able to act in advance and ensure that all the information and awareness campaigns carried out by the Autonomous Community and by the competent Ministry reach the citizens.
	Keep on increasing public awareness and educate citizens about health implications of air pollution including risks and the need for emergency preparedness and provide it in other languages.

MUNICIPALITY	BULLAS
SECTOR	TRANSPORTATION INFRASTRUCTURE
GENERAL MEASURES	
DESCRIPTION	1. Awareness rising for transportation infrastructure use during extreme events.
	2. Inventorying process of critical transportation infrastructure.
	3. Identify alternate routes and modes for goods transport and evacuation efforts during emergency situations.
	4. Identify and obtain funds (local, regional, national) for the development of a local public transportation system that connects with the regional transportation system.
	5. Local policy makers to make changes in transportation policy to support the development of state-wide multimodal transportation infrastructure in areas less susceptible to significant climate impacts.
	6. Increase multi-modal trail infrastructure throughout the City to connect people from where they live to services and work through walking, bicycling, etc. Changes in site plan, subdivision, and land use policies may support the development of a more comprehensive system.
	7. Investigate design standards for buildings that currently handle weather conditions similar to the climate forecast Bullas can expect in the future.
	8. Explore the use of traditional and alternative building materials for added strength

	and durability of construction to improve the longevity of buildings and then incorporate these materials into building code requirements.
	9. Update City code to include green building standards for all major renovations.
SPECIFIC MEASURES	
IMPACT	Flooding and mudslides
TIME HORIZON	Short and medium-term measures
	1. Awareness rising for transportation infrastructure use during extreme events.
	2. Revision of the flood management activities to improve the process and planning for future events.
	3. Flood-proof or re-site infrastructure and plan transport routes and roads to avoid disruption by flooding activities.
	4. Establish a plan for review and verification of transportation infrastructures against flooding and mudslides.
	5. Review of facilities with more than 50 years or those present in areas where the terrain has changed significantly in order to asses new situations of risk.
	6. Identify areas where increased infrastructure capacity is needed to hold/divert water and include replacement or upgrade in Local Improvement Program.
	7. Identify areas within the City that have infill or redevelopment potential and are outside an area of potential significant impact to flooding. Aim to have 50% of these areas developed by a certain year.
	8. Devise incentives to foster infill development in areas within the City that have been identified as being at high risk for flooding.
	9. Update the City's Infrastructure Standards to ensure public safety in the event of major flooding or severe storm events.
	10. Incorporate sustainable storm water design and management techniques to lessen the ecological footprint of new development, and take into account the potential for greater storm loads, floods and mudslides.
	11. Change design requirements for new or refurbished roadways to include different pitches combined with storm water design and/or use of more permeable surfaces to effectively remove water from the roadway.
	12. Flood insurance.
	Long-term measures

	1. Increase awareness rising for transportation infrastructure use during extreme events.
	2. Continue the revision of the flood management activities to improve the process and planning for future events.
	3. Revision of flood-proof or re-site infrastructure and plan transport routes and roads to avoid disruption by flooding activities.
	4. Restudy, and improve if possible the plan for review and verification of transportation infrastructures against flooding and mudslides.
	5. Review of facilities with more than 50 years or those present in areas where the terrain has changed significantly in order to asses new situations of risk.
	6. Keep on identifying areas where increased infrastructure capacity is needed to hold/divert water and include replacement or upgrade in Local Improvement Program.
	7. Carry on identifying areas within the City that have infill or redevelopment potential and are outside an area of potential significant impact to flooding. Keep track of the percentage of these areas developed each passing year.
	8. Continue devising incentives to foster infill development in areas within the City that have been identified as being at high risk for flooding.
	9. Review the City's Infrastructure Standards to ensure public safety in the event of major flooding or severe storm events.
	10. Be attentive and try to incorporate sustainable storm water design and management techniques to lessen the ecological footprint of new development, and take into account the potential for greater storm loads, floods and mudslides.
	11. Restudy changing design requirements for new or refurbished roadways to include different pitches combined with storm water design and/or use of more permeable surfaces to effectively remove water from the roadway.
	12. Promote flood insurance for business in case their activity might suffer from transportation problems due to floods and mudslides.
IMPACT	Heat waves -> wildfire
TIME HORIZON	Short and medium-term measures
	1. Awareness rising for transportation infrastructure use during wildfire.
	2. Evaluate bushfire risks.
	3. Maintenance of firewalls.

4. Grazing in the forest area when possible due to its private ownership.
5. Study the feasibility of use of fire adapted vegetation at least surrounding transportation routes.
6. Encourage new developments, or changes to existing developments, to include improved protection and adaptations to increased bushfire risk.
7. Improve community disaster preparedness and response systems.
8. Ensure that 'fire management zones' have been identified.
9. Establish a plan for review and verification of the infrastructures.
10. Risk assessment to ensure new infrastructure is not placed in fire-prone areas.
11. For those infrastructures where location is not flexible, investigate standards of construction that reduce their sensitivity to fire.
12. Review local disaster management plans.
13. Preparation of evacuation.
14. Cool areas on red/orange alert.
Long-term measures
1. Increase awareness rising for transportation infrastructure use during wildfire.
2. Revaluate bushfire risks if pre-existing conditions have change.
3. Assure that maintenance of firewalls is being made properly.
4. Promote grazing in the forest area to private owners.
5. Continue using fire adapted vegetation at least surrounding transportation routes, when possible, if previous studies show its validity.
6. Keep encouraging new developments, or changes to existing developments, to include improved protection and adaptations to increased bushfire risk.
7. Continue improving community disaster preparedness and response systems.
8. Assure that existing "fire management zones" have been identified and new ones are included if necessary.
9. Re-evaluate the established plan for review and verification of the infrastructures, if necessary.

	10. Improve the existing risk assessment to ensure new infrastructure is not placed in fire-prone areas when needed.
	11. Keep on researching standards of construction that will reduce infrastructure sensitivity to fire.
	12. Continue improving local disaster management plans.
	13. Have an updated preparation of evacuation.
	14. Keep on with cooling areas on red/orange alert.
IMPACT	Increase in extreme temperature
TIME HORIZON	Short and medium-term measures
	1. Awareness rising for transportation infrastructure use during extreme events.
	2. Introduction of planning disaster contingency.
	3. Establish a plan for infrastructures review and verification in municipal bylaws.
	4. Review of infrastructure over a certain number of years.
	5. Encourage the research of roadway materials that may be utilized in road construction that are more tolerant to quick changes in hot or cold weather in order to decrease repair costs, enhance safety, and increase longevity of road surfaces.
	6. Promote the design of buildings related to transportation infrastructures (e.g. train station, etc) to allow for ease of future adaptation (e.g. have the ability for significant amounts of shade to be added or removed from a facade).
	7. For infrastructure developments with a lifetime greater than 50 years, design for staged construction to allow future climate change impacts to be taken into account.
	Long-term measures
	1. Continue improving awareness rising for transportation infrastructure use during extreme events.
	2. Study the establishment of planning disaster contingency.
	3. Review the inclusion of the plan for infrastructures verification in municipal bylaws.
	4. Ensure that infrastructure over a certain number of years are reviewed.
	5. Keep encouraging the research of roadway materials that may be utilized in road construction that are more tolerant to quick changes in hot or cold weather in order

	to decrease repair costs, enhance safety, and increase longevity of road surfaces.
	6. Continue the promotion for designs of buildings related to transportation infrastructures (e.g. train station, etc) to allow for ease of future adaptation (e.g. have the ability for significant amounts of shade to be added or removed from a facade).
	7. For infrastructure developments with a lifetime greater than 50 years, keep-on with designing for staged construction to allow future climate change impacts to be taken into account.
IMPACT	Water shortage -> droughts
TIME HORIZON	Short and medium-term measures
	1. Promote water sensitive urban design at the plan-making and development assessment stages of the planning process.
	2. Encourage the development of roadsides/utility corridors as native vegetation corridors, in consultation with relevant road authorities to ensure road use safety is protected.
	3. Introduction of planning disaster contingency.
	Long-term measures
	1. Keep promoting water sensitive urban design at the planmaking and development assessment stages of the planning process.
	2. Continue to develop roadsides/utility corridors as native vegetation corridors, in consultation with relevant road authorities to ensure road use safety is protected.
	3. Review of existing planning disaster contingency.

MUNICIPALITY OF PATRAS

MUNICIPALITY	PATRAS
SECTOR	WATER
SPECIFIC MEASURES	
DESCRIPTION	1. Create "points of information" for the sustainable management of water in places that are called "Water House" through which promote the education, training, events and new consulting services to help professionals involved in water management and consumers.

TIME HORIZON	2013
DESCRIPTION	2. A water dam construction in the Piros and Parapiros rivers of Patras. The aim of these projects is the water supply of the city of Patras, the industrial zone and the coastal settlements and low zones of Achaia prefecture south of the city of Patras.
TIME HORIZON	2015
DESCRIPTION	3. Public awareness program for water saving – Distribution of water flow regulators
TIME HORIZON	2013
DESCRIPTION	4. A permanent Leakage Control System according to the International Water Association (IWA) methodology. Proper equipment will be installed for measuring, logging and controlling pressures and flows.
TIME HORIZON	2013

MUNICIPALITY	PATRAS
SECTOR	BIODIVERSITY
SPECIFIC MEASURES	
DESCRIPTION	1. Center of Environmental Information of Panachaiko Natura 2000 area
TIME HORIZON	2013
DESCRIPTION	2. Hire equipment for cleaning grass – branches to prevent fires
TIME HORIZON	2013
DESCRIPTION	3. Environmental awareness program for students to protect biodiversity and forests of Panachaiko
TIME HORIZON	2014

DESCRIPTION	4. Plan a forestry fire protection
	5. Study maintenance, improvement and boring forest roads and placement notices
	6. Technical studies on fire protection
	7. Silvicultural manipulations of vegetation in areas mixing Hood - Settlements
	8. Informing residents about fire-and building fire protection measures
	9. Enrichment vegetation – additional plantings - reforestation
	10. Maintenance of existing firebreaks zones in high risk areas
	11. Cleaning vegetation along high voltage transmission lines
	12. Maintenance of existing forest roads
	13. Improvement of existing forest roads
	14. Opening of new forest roads in high risk areas
	15. Placing information signs
	16. Construction of new fire observatories
	17. Construction of new water reservoirs fire protection
	18. Silvicultural manipulations vegetation in high risk areas
	19. Silvicultural manipulations vegetation in forests of Aleppo pine
	20. Install new fire hydrants
	21. Update firefighting personnel and volunteers
	22. Update OTA staff and elected evacuation plans for communities
	23. Evacuation plans

MUNICIPALITY	PATRAS
SECTOR	ENERGY

SPECIFIC MEASURES	
DESCRIPTION	1. Energy information centre for biomass
TIME HORIZON	2013

MUNICIPALITY	PATRAS
SECTOR	COASTAL ZONE
SPECIFIC MEASURES	
DESCRIPTION	1. From Porto Rio Hotel by Rio Beach hotel, protective wall inclined to the promenade. From hotel Rio Beach Street until Alexander the Great, str. a protective wall with a flair for the coastal road to spread gravel to create an "artificial beach".
	2. 24 breakwaters freeboard and 7 lateral projections

MUNICIPALITY	PATRAS
SECTOR	TOURISM
SPECIFIC MEASURES	
DESCRIPTION	A network of rural bike routes on Panachaiko mountain area
TIME HORIZON	2013

Contacts

Alessio Capriolo - ISPRA
+39.06.50072557
alessio.capriolo@isprambiente.it

Francesca Giordano - ISPRA
+39.06.50072547
francesca.giordano@isprambiente.it

Rosa Anna Mascolo - ISPRA
+39.06.50072505
rosanna.mascolo@isprambiente.it

www.actlife.eu

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