GUIDE FOR THE ELABORATION OF SUSTAINABLE ENERGY AND CLIMATE ACTION PLANS (SECAP)

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Guide for the elaboration of Sustainable Energy and Climate Action Plans

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LIFE Adaptate project

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1. Introduction and purpose of the guide

Climate change represents the greatest challenge that humanity has faced throughout its history. The warming of Earth's atmosphere, caused by the massive use of fossil fuels since the Industrial Revolution, leads to an increase of extreme climate events, the impact of which is already there: torrential rains, droughts, heat waves or sea level rise. This climate change has significant negative impacts on the planet, such as ecosystem displacement, agricultural productivity reduction, human health problems, flood-related losses or the increase in demand for emergency services. But it also creates social, economic and environmental opportunities, and has positive aspects such as the extension of the tourist season or new employment niches related to the fight against climate change and its effects.

Globally, any strategy to combat climate change follows two clearly distinct lines: actions that seek to mitigate the risk of climate change and its severity, and actions that try to adapt our environment to its effects. In this fight, the Covenant of Mayors for Climate and Energy constitutes a valid platform for action at the local level. Joining this initiative entails the elaboration of a Sustainable Energy and Climate Action Plan (SECAP), which includes climate change mitigation and adaptation actions, including strong commitments to combat energy poverty and protect the most vulnerable population sectors from losing access to energy services.

While climate change mitigation, which involves designing actions that drastically reduce greenhouse gas (GHG) emissions, has been sufficiently researched and evaluated in recent decades, the methodology to adapt our cities to climate change is complex and requires a detailed analysis of the local climate and vulnerabilities.

This guide aims to bring to municipal technicians and managers a methodology based on the qualitative analysis of their city as it faces climate change. In this way, the diagnostic phase is significantly simplified, as it does not require quantitative information that, in most cases, is not available to municipalities. Thus, the guide is a useful tool for municipalities facing for the first time the challenge of designing a city adapted to climate change. Local authorities can then plan their actions in a manner consistent with the local situation, integrating them with actions related to mitigation and the combat against energy poverty.

2. The Covenant of Mayors

The European Covenant of Mayors for Climate and Energy is a voluntary grouping of thousands of local governments that are committed to achieving the objectives set by the European Union in terms of climate and energy. It was launched in 2008 with the ambition to help local governments achieving the climate change mitigation targets set by the European Union for 2020: 20% energy from renewables, 20% reduction in energy demand by improving efficiency and 20% cut in greenhouse gas emissions. The initiative had a great success from the beginning thanks to its innovative approach to actions related to climate and energy.

The movement, which originated within the European Union, now gathers more than 9,800 municipalities across 57 countries on 5 continents, involving multiple stakeholders. Currently, the Global Covenant of Mayors is building upon the key success factors of the initiative: its bottom-up governance, its multi-level cooperation model and its context-driven framework for action.

Some milestones of the history of the Covenant of Mayors are:

2008 Launching of the Covenant of Mayors by the Committee of the Regions and the European Commission, with the objective of engaging and supporting mayors to commit to reaching the EU climate and energy targets.

2011 Due to its success, the Covenant of Mayors was already gathering 2000 cities by October 2010, thus encouraging the European Commission to develop a similar initiative in the EU Eastern Partnership countries, which now operates in Belarus, Ukraine, Moldova, Armenia, Georgia and Azerbaijan.

2012 Within the framework of the European Neighbourhood policy, the Covenant of Mayors was launched in the Southern Mediterranean Region, supporting ambitious sustainable development policies in Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestine and Tunisia.

2014 The European Commission launched the Mayors Adapt initiative, aware that climate change is a reality to which our cities must adapt. Mayors Adapt invited local governments to demonstrate leadership in adaptation through the development and implementation of local adaptation strategies.

2015 The Covenant of Mayors and Mayors Adapt initiatives officially merged on the occasion of a ceremony held on 15 October 2015 in the European Parliament. The new Covenant of Mayors for Climate and Energy is both more ambitious and broad-ranging: signatory cities now pledge to actively support the implementation of the EU 40% GHG-reduction target by 2030 and agree to adopt an integrated approach to climate change mitigation and adaptation and to ensure access to secure, sustainable and affordable energy for all. During the Climate Summit in Paris, the geographical extension of the Covenant of Mayors for Climate and Energy to Sub-Saharan Africa, North and South America, Japan, India, China and South-East Asia was announced.

What is known today as the Global Covenant of Mayors for Climate and Energy is fully in line with the UN Sustainable Development Goals and climate justice principles, and tackles three key issues: climate change mitigation, adaptation to the adverse effects of climate change and universal access to secure, clean and affordable energy.

Figure 1. Merging ceremony of the Covenant of Mayors and Mayors Adapt, creating the Covenant of Mayors for Climate and Energy (2015)

Participation in the Covenant of Mayors for Climate and Energy allows local authorities to play a leading role in climate change mitigation and adaptation, supporting them in this endeavour, by providing them the recognition, resources and networking opportunities necessary to take their energy and climate commitments to the next level.

Figure 2. Main steps for a municipality to join the Covenant of Mayors for Climate and Energy (source: Covenant of Mayors)

The Covenant of Mayors for Climate and Energy is open to all local authorities democratically constituted with/by elected representatives, whatever their size and whatever the stage of implementation of their energy and climate policies. To join the Covenant, local authorities should undertake the following process:

Step 1 Present the Covenant of Mayors for Climate and Energy initiative to the municipal council and request the approval of the commitment document. Once an official resolution has been adopted by the council, mandate the mayor to sign the Covenant adhesion form. After signature, complete your information online on the Covenant website and upload your duly signed adhesion form. The municipality has joined the Covenant of Mayors.

Step 2 A period of two years starts then, in which the municipality must improve its territorial knowledge to diagnose its current situation in the face of climate change, both in terms of mitigation (emissions inventory) and adaptation (climate change scenarios and risk and vulnerability analysis). Through a highly participatory process, involving the main local and regional stakeholders, the Sustainable Energy and Climate Action Plan (SECAP) is prepared. It includes concrete actions for mitigation, adaptation and access to energy (fight against energy poverty). Once this Plan is approved by the municipal council and prior to its implementation, it is submitted to the European Commission for evaluation.

Step 3	Every two years, monitoring reports of the SECAP must be submitted. They should propose updates and corrective actions in case of significant deviations from the initial objectives.

3. LIFE Adaptate Project

The LIFE Adaptate Project, entitled "Common methodology for the development of Sustainable Energy and Climate Action Plans in European municipalities", aims to address the effects of climate change on urban areas, such as intense heat, sea level rise, extreme rainfall, flooding, landslides, air pollution, food shortages or water scarcity. The impacts of these threats are intensified when they cause damage in the provision of services, infrastructure and housing.

The main objective of LIFE Adaptate is to increase the commitment of European municipalities to the Covenant of Mayors for Climate and Energy through the development of local adaptation plans, that will be integrated into the previous mitigation objectives of several municipalities, giving a comprehensive approach to the fight against climate change. To this end, it has supported 6 municipalities in Portugal, Spain and Latvia in the process of joining the new Covenant. In addition, the project has developed a common methodology, presented herein, for the elaboration of Sustainable Energy and Climate Action Plans (SECAP), so that any European municipality can implement it.

The main solution provided by LIFE Adaptate against climate change effects is to contribute to the development of adaptation policies at the local level and to the improvement of European climate change adaptation policies. The end objective is to meet the 2030 EU targets regarding climate and energy, which aim to curb greenhouse gas emissions, improve energy efficiency, increase the use of renewable energy and ensure access to cheap and safe energy.

The project carries out its action in six municipalities belonging to three countries of the European Union: **Spain (Cartagena, Lorca and Águilas), Portugal (Alfândega da Fé and Mértola) and Latvia (Smiltene).** The following actions stand out:

- **Develop, implement, monitor and evaluate Sustainable Energy and Climate Action Plans (SECAP)** in the participating municipalities, taking advantage of the synergies and know-how of different entities supporting technical development and public participation.
- **Carry out demonstrative pilot actions** related to mitigation and adaptation at the local level to fight against climate change, which can then be replicated in other European areas, widening the experience and knowledge about adaptation measures. **Test cooperation schemes between municipalities** of different countries and the positive effects of public participation.
- **Evaluate** how **local initiatives** and the adoption of measures allow climate change adaptation and mitigation.
- **Promote** these **specific resources and tools** and support their development, transfer and replication at European level.

This set of specific objectives points towards a final one: that local authorities and support entities have reinforced mechanisms to develop effective measures for climate change adaptation.

The pilot actions are:

Águilas

Creation of a wooded area with drip irrigation using treated water from the local WWTP

Lorca

Creation of shaded areas in the busiest passageways of the old town by installing awnings

Cartagena

Connection of green areas through a mixed cycle-pedestrian corridor with shaded areas generated by new trees and pergolas

Smiltene

Recovery of the Vidusezers artificial lake

Mértola

Creation of shaded areas with renewable energy integration

Alfândega da Fé

Creation of shaded areas with photovoltaic pergolas and building a natural lake

4. Introduction to SECAP elaboration process

The design of any action plan requires a prior analysis of the current situation and of internal and external aspects that can positively or negatively affect the local fight against climate change. From the beginning of the Covenant of Mayors until its merger with Mayors Adapt, two completely independent action plans were made. Now that both initiatives have merged, a single Sustainable Energy and Climate Action Plan (SECAP) has to be implemented, encouraging synergies among its actions.

The previous analysis for Climate Change Mitigation involves the elaboration of a Baseline Emissions Inventory, corresponding to the year 1990 or to the closest one for which data is available, in which the amount of emissions due to energy consumption in the territory is quantified through selected emission factors. The sectors considered in the mitigation plan are the following:

- Municipal buildings and facilities.
- Public lighting.
- Tertiary sector.
- Residential sector.
- Transport and mobility.
- Industrial sector (optional).
- Agricultural and livestock sector (optional).

Small-scale (less than 20 MW) energy generation facilities that take advantage of renewable energy are also taken into account.

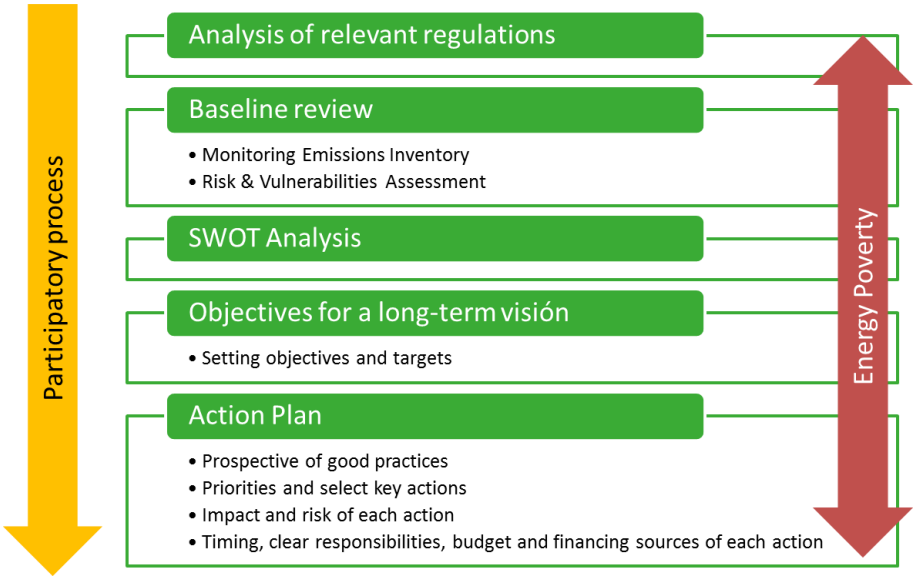


Figure 3. Proposed key steps for preparing a SECAP

If a Sustainable Energy Action Plan (SEAP) with **mitigation** targets for 2020 is already underway, the baseline emissions are kept unchanged and a new Monitoring Emission Inventory is compiled, corresponding to the closest year for which complete data is available, in order to provide a more current picture of local emissions.

A whole set of energy efficiency and renewable energy actions is designed on the basis of these inventories, determining the emission reduction target (at least 40% compared to the baseline) by the expected deadline (2030).

Similarly, the local **adaptation** to climate change requires a prior analysis of local climate trends and the degree of local resilience, which is reflected in the analysis of risks and vulnerabilities, which will be explained in detail later. This analysis will lead to the definition of concrete actions that allow increasing the local resilience to climate change.

The new guide published by the European Commission for the development of PACES[1] proposes a new, more systemic approach to the three main pillars of the Covenant of Mayors: **mitigation, adaptation and energy poverty.** This new proposal is reflected in Figure 3.

SECAP development is based on a detailed review of the regulatory framework affecting climate change and that has to be taken into account throughout the process. Next, the analysis of the current situation includes the inventory of emissions and the analysis of risks and vulnerabilities, depending on the climate scenarios. This allows doing a local SWOT analysis, in which local weaknesses and strengths in the face of climate change will be studied, as well as the environmental threats and opportunities for the municipality. The definition of long-term goals to mitigate, adapt and fight against energy poverty in the municipality allows the development of a single action plan that seeks greater integration between both aspects for each proposed action.

In fact, this new approach, even though it is more systemic, does not present major differences compared to the previous process, defining two separate action plans.

[1] Guidebook "How to develop a Sustainable Energy and Climate Action Plan (SECAP)". https://op.europa.eu/en/publication-detail/-/publication/338a9918-f132-11e8-9982-01aa75ed71a1/language-en

5. SECAP elaboration

Climate change is a reality and evidence is already there. Therefore, fighting against it depends on mitigation efforts, but also on adapting our cities to this change in the climate that can decisively affect the lives of its citizens.

This is a decision-making process that involves some uncertainty. In this context, there are four aspects that should guide any adaptation and mitigation process:

- It is a continuous process.
- It is a specific process.
- It is a process that must involve multiple stakeholders, encompassing individual perspectives and contexts.
- It is a process that must be guided.

The SECAP represents the local strategy for the municipality to become a territory where its citizens can continue to develop their life and activity despite the threats of climate change. For this, it is essential to have a thorough knowledge of the municipality, physically, socially and economically, as well as valid information about the impacts that climate change could have on its territory and its citizens.

Like any strategic plan, its implementations is divided into two distinct parts: The first focus on diagnosing, by analysing the territory and the climate (at the most local scale possible), carries out a emissions inventory and a study on climate hazards that, together with local vulnerabilities, pose risks for the municipality. The second part defines an action plan which permits a emissions reduction of at least 40% in 2030 and prioritising actions based on climate urgency and the severity of the impacts caused by climate change in the territory.

The reference methodology for the development of a climate change adaptation plan is based on the European Climate Adaptation Platform (Climate-ADAPT)[2] and the UKCIP Adaptation Wizard[3] tool, adopted by the Covenant of Mayors for Climate and energy. Developed and tested by the United Kingdom Climate Impacts Programme (UKCIP), the wizard seeks to provide a robust tool for adaptive planning, constituting a support tool for decision-making through a step-by-step planning guide for adaptation actions.

This methodology aims to answer two key questions: how to identify the main climate risks that affect or could affect the studied territory and how to define the main necessary and available adaptation measures to respond to said climate risks.

The methodology used in the preparation of the plan to combat climate change must also be in line with the guidelines of the Directorate-General for Climate Action (DG CLIMA), the EC Joint Research Centre (JRC), the Institute of Environment and Sustainability (JRC-IES), the European Environment Agency (EEA), the Covenant of Mayors for Climate and Energy and the Intergovernmental Panel on Climate Change (IPCC), the European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation (ETC/CCA) and with the relevant national organizations, presupposing the use of basic principles of decision making and risk analysis to allow determining which climate risks should be taken into account when making decisions and what adaptation or mitigation measures should be implemented to address these risks.

The methodology used in the preparation of this climate change plan should also be in line with the guidelines of the Directorate-General for Climate Action (DG CLIMA), the EC Joint Research Centre (Joint Research Center), the Institute for Environment and Sustainability, the European Environment

[2] https://climate-adapt.eea.europa.eu/
[3] https://www.ukcip.org.uk/

Agency (EEA), the Covenant of Mayors on Climate and Energy and the Intergovernmental Panel on Climate Change (IPCC), the European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation (ETC/CCA) and with relevant national agencies, presupposing the use of basic principles of decision making and risk analysis and enabling the determination of which climate risks should be taken into account in decision making and which will identify which adaptation and/or mitigation measures are necessary to address those risks.

5.1. Preparatory actions

Participation in the Covenant of Mayors for Climate and Energy entails a new approach on local management that involves all municipal departments, external agents related to local development and climate change and, ultimately, all the citizens. It is required that all these actors participate from the initial phase of the SECAP, an involvement that has to be extended to the monitoring phase until the objectives are eventually achieved.

Thus, the SECAP must include an initial section that deals with preparatory actions, which includes at least the following information:

5.1.1. Coordination and organisational structures assigned

This section must specify the composition of the internal work team, designated by the local council for the correct development of the SECAP and its implementation and monitoring over time. This should be mostly a technical team, composed of local authority workers, although the councillor in charge of climate change, environment or energy can certainly participate.

Among the members of the technical team, there must be representatives of the local departments dealing with climate change, environment, energy, mobility, infrastructure, social services, housing and economy, depending on the size of the municipality. This section will show the organisational structure of the work team and its relationship with the mayor. It can also describe its work methodology and its interaction with other departments of the local administration or supra-local structures.

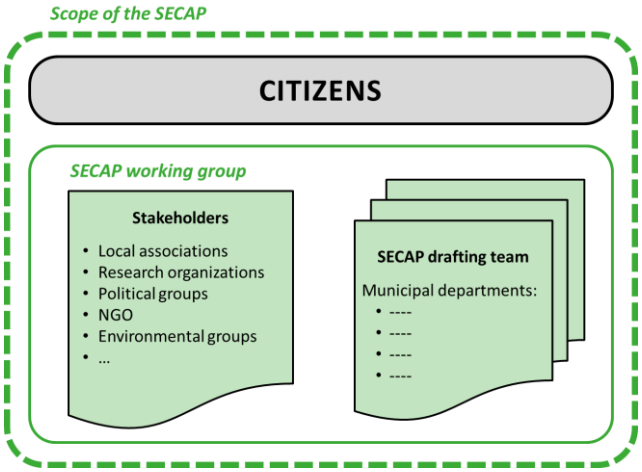


Figure 4. Organisational structure for the development of the SECAP (source: own elaboration)

5.1.2. Identification of stakeholders and citizens

Stakeholders' and citizens' involvement must be ensured as long as the municipality participates in the Covenant of Mayors. For this, the first step is to identify the main stakeholders affected by the different aspects addressed in the SECAP. Regardless of the number of these agents, which may vary depending on the municipality or region, the goal is to establish a more robust and efficient process, by involving stakeholders that, for example, supply data, help in the process, provide costs or financial information, or can disseminate the work done.

Among the different types of stakeholders, we can highlight:

- Municipal departments, such as energy utilities, urban planning, civil protection, environment, zoning, regional planning, social services, public infrastructure, structural funds, management, green spaces, etc.
- Local policy-makers or political groups, as well as environmental agencies and advisors.
- Commercial and industrial associations, energy suppliers, transport companies and others that operate in sectors with high GHG emissions or that may be vulnerable to the impacts of climate change.
- Organizations involved in the research and development of mitigation or adaptation solutions.
- Educational institutions.
- Finance and insurance partners.
- Land-owners and administrators.
- Non-governmental organisations engaged in the promotion of environmental and social issues.
- Institutions that technically assist both the government and the industry (universities, research institutions, expert groups or consultants).
- Water supply and waste management companies.
- Civil protection, police, firefighters and civil society representatives.
- Agricultural and forestry sectors.
- Health sector.
- Tourism sector.
- Media.
- Quaternary sector organizations related to climate, energy and social vulnerability.

The creation of a Panel of Experts that includes stakeholders able to provide detailed local information about the municipality and its exposure to climate change is also suggested. This panel may meet more frequently than the stakeholders' group.

SECAP elaboration is eminently a participatory process. For this, it is highly recommended to create a working group including involved stakeholders. While this group may meet as frequently as deemed necessary, it is advisable to hold at least three participatory workshops. It is advisable that these workshops be especially dynamic, favouring the participation and creativity of the attendees in order to inspire the most appropriate solutions to face the proposed challenges. The content of these workshops could be as follows:

Workshop 1 Presentation of the results of the diagnostic phase for mitigation, adaptation and energy poverty, and survey of a portfolio of proposed solutions, in order to gather the opinion of the group members. This survey should also be proposed to the rest of the citizenry, in paper or electronic format (online), in order to collect the maximum information from stakeholders and citizens.

Workshop 2 Restitution of the results of the previous survey and presentation of a portfolio of actions to be carried out. In the case of adaptation measures, a multi-criteria methodology will be applied to prioritise the execution of the actions.

Workshop 3 Presentation of the results of the action plan, both for mitigation and adaptation, previously approved by the local corporation. A broader workshop, it invites all citizens and proposes the active participation of stakeholders who have collaborated in the development of the SECAP, or other experts outside the organization.

5.1.3. Internal and external communication

Communication is an essential means, both within the local authority, so that all departments are duly informed about the design and subsequent implementation of the plan, as well as towards citizens, encouraging them to actively participate and obtaining their feedback on a permanent basis. Do not forget that citizens themselves will be the main actors of many of the mitigation and adaptation actions proposed in the plan.

5.1.4. Human and financial resources

Covenant signatories commit to allocate human and financial resources. This section describes the expected dedication of local authority staff to the tasks required to implement the Covenant. The financial capacity of the municipality and the commitment of the necessary economic resources to carry out the SECAP are also commented.

5.1.5. Planned measures for monitoring and follow-up

As discussed in chapter 2 of this guide, joining the Covenant of Mayors entails certain obligations. The most important is to monitor the implementation of the Action Plan and its impact on the territory. Therefore, it is necessary to specify what monitoring and follow-up measures are planned to bring the SECAP to fruition.

It is recommended to maintain the involvement of the stakeholders working group throughout the implementation of the SECAP. Thus, periodic meetings (at least twice a year) must be duly planned and described in this section.

Finally, it is necessary to specify the monitoring methodology for the indicators specified in the SECAP: reduction of CO_2 emissions in the mitigation section and specific indicators selected for each measure in the adaptation to climate change section.

5.2. Contextualisation of the municipality regarding climate change

It is essential to know the geographical and territorial situation of the municipality. Its urban structure, building inventory, their age, etc. This section is also used to collect all urban development plans. It is also important to analyse local population structure and demographic trends.

The analysis of urban mobility must also be taken into account in this section. Climate change can significantly affect infrastructure, limiting the mobility of people and goods.

Also, one of the most obvious impacts of climate change on citizens of urban areas is environmental pollution. Therefore, it is necessary to analyse the availability of green areas, their layout, composition and use by citizens. In addition, it is necessary to know the current levels of air pollution and establish measurement protocols for monitoring.

Finally, effective waste management is also considered crucial in the process of adaptation to climate change. Likewise, universal water supply and wastewater treatment and purification for subsequent reuse must be effectively managed.

It is important to carry out an analysis of the historical events that have affected the municipality, as they can serve as an indication of the possible aggravation due to climate change (in terms of frequency and severity), as well as point out the most important climate hazards to consider. For this, a compilation of the information available on climate change and natural hazards (floods, landslides, heat island effect, heat wave records, etc.) will be carried out.

The most important points to analyse in this section are:

5.2.1. Geographical situation of the municipality

- Geographical location.
- Locator maps.
- Building structure: age, main features.
- Existing urban plans.
- Land use.

5.2.2. Urban mobility

- Vehicle fleet analysis: number and type of vehicles.
- Use of vehicles in urban and interurban transport.
- Existing mobility plans.

5.2.3. Environmental analysis

- Green areas: extension, distribution, maintenance and use.
- Air quality Air pollution level.

5.2.4. Waste management

- Urban waste management.

5.2.5. Water and sewage

- Water supply.
- Water consumption.
- Sewerage and sewage drains.
- Wastewater treatment and purification.

5.3. Climate change mitigation

Mitigation, in the local fight against climate change, is based on the reduction of greenhouse gas emissions ('CO_2 equivalent' being its indicator). This is achieved through two main measures: the reduction of the energy demand by improving the efficiency of processes and services, and the increase in the use of renewable energies. The actions resulting from this define the local climate change mitigation strategy.

It should not be forgotten that the reduction emissions target at the local level is the one set by the European Union for its entire territory: 20% by 2020 and 40% by 2030. Although this target refers to the emissions generated in 1990, local data that old is sometimes not available, so the closest year for which data can be collected should be chosen as the baseline year.

The assessment part permits to know the starting situation in terms of emissions generated by the energy consumption at the local level. This is done through the emissions inventory. This inventory is considered the baseline when it refers to the year chosen as the starting point for emission reduction. The same inventory, carried out in subsequent years, is considered as a follow-up and part of the monitoring of the results of the plan.

These inventories, together with the territorial context, will result in a collection of measures, duly quantified in their scope, cost and impact, which must allow achieving the targets (at least 40% in 2030). An important aspect to consider is the analysis of the demographic and urban evolution.

The methodology to develop this type of inventories and actions has been sufficiently addressed in the literature since the Covenant of Mayors was initiated in 2008. The European Commission, through its Joint Research Centre, published in 2010 a guidebook entitled "How to develop a Sustainable Energy Action Plan (SEAP)"[4], which is a reference document for the Covenant. This guidebook describes in detail the appropriate method to draft a locally consistent and satisfactory plan, but does not deepen the mitigation aspects, focusing on adaptation, a more novel approach for which simple guidelines are lacking to support the development of a SECAP.

5.4. Fight against energy poverty

The Covenant signatories will have to commit to defining actions that address equitable access to secure, affordable and sustainable energy, that is, to taking action to alleviate energy poverty. Energy poverty can be defined as "*the lack of access of a household to secure energy services, adequate for its needs and reasonably affordable*". This means the inability of a household to afford heating, cooling, lighting and other energy demanding services. The EU Energy Poverty Observatory[5] has defined four primary indicators of energy poverty:

- the inability to pay utility bills on time;
- the inability to keep home at the right temperature;
- a very low share of household expenditure on energy compared to the national median (also known as 'hidden energy poverty' as it may indicate under-consumption of energy);
- a very high share of household expenditure on energy compared to other expenses (greater than 10%).

Energy poverty may be caused by low household income, high energy prices, inefficient energy performance in buildings or a combination of all three (Figure 5).

[4] https://www.covenantofmayors.eu/IMG/pdf/seap_guidelines_es-2.pdf
[5] https://www.energypoverty.eu/

While the fight against energy poverty in Europe has so far focused on lighting, heating, cooling and running household appliances, this approach is being expanded to consider mobility and proximity to public transport.

In the context of SECAP development, cities and regions are called to determine whether energy poverty exists, and where relevant, to design a strategy to address the problem, by identifying who is affected (vulnerable population) and which actions will be taken to assist them. In order to facilitate signatories' work towards the integration of energy poverty actions in their SECAPs, the European Commission's science and knowledge service, the Joint Research Centre, poses three questions for authorities to consider:

- Assessing energy poverty — Is my municipality affected by energy poverty?
- Identifying vulnerable groups — Who are the most vulnerable groups in my municipality?
- Designing actions — How can I design effective energy poverty actions?

In reality, the SECAP does not have to include a specific action plan with measures to combat energy poverty. Instead, some of the measures proposed for mitigation and adaptation will contribute to this aim.

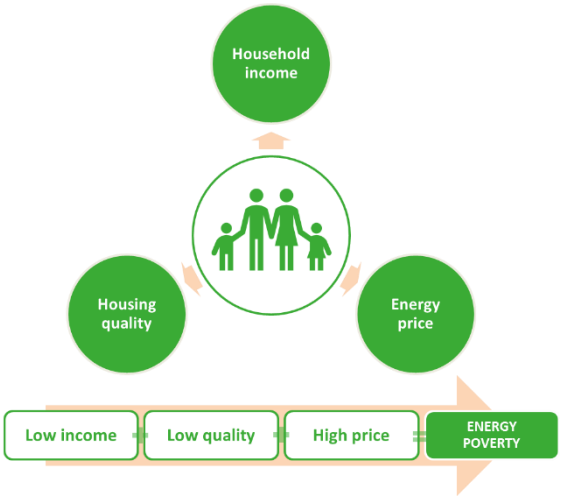


Figure 5. Key aspects of energy poverty (source: own elaboration)

5.5. Climate change adaptation

As mentioned above, the previous local analysis to define adaptation actions involves some complexity. Knowledge of climate change scenarios and the hazards they pose, together with a study of local vulnerabilities, is essential in order to design effective actions to adapt the municipality to climate change.

5.5.1. Local climate change scenarios

In order to make decisions regarding climate change adaptation policies, it is essential to collect the recorded data on climate variables and other elements (such as sea level rise). Then, it will be necessary to assess the potential consequences of these scenarios on the activities carried out in the affected territory.

Existing documents on climate change in the municipality

Before beginning to gather official information on the climate change scenarios, it is necessary to carry out an analysis of the historical events that have affected the municipality in recent years or even decades, since they can serve as an indication of potential events that could occur, aggravated in their frequency and severity by climate change. In this phase, all available documents that provide information on events related to climate change and natural disasters are collected: floods, avalanches, heat island effect, heat waves, etc. These documents can be collected in a table as shown in Table 1.

Table 1. Summary of existing documents on climate change in the municipality

Title	Author	Year	Description

Climate variables

The first step consists in selecting the key climate variables for the municipality, based on the documents gathered in the previous section. A sample of these variables could be:

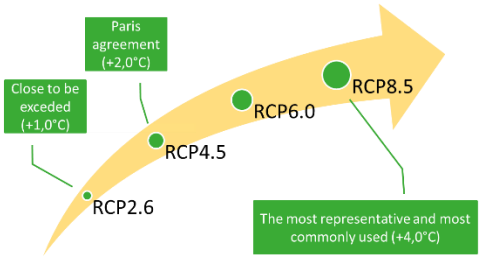
- Precipitation (mm).
- Number of rainy days.
- Duration of dry spells.
- Torrential rain events (mm/h).
- Maximum temperature.
- Minimum temperature.
- Number of warm days.
- Number of warm nights.
- Number of frost days.
- Heat wave duration.
- Cooling degree days.
- Heating degree days.
- Winds.
- Other.

In addition, it is necessary to consider other phenomena related to climate change such as floods, avalanches and forest fires. Information on flood areas can be obtained from data provided by river basin management authorities. Finally, it is up to the Civil Protection programs to manage the data related to avalanches and wildfires.

Representative concentration pathways

The next step consists in selecting the time horizon and the representative concentration pathway (RPC) that will be considered for the assessment of climate risks. The fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) selected four emissions scenarios or pathways: RCP2.6, RCP4.5, RCP6.0 and RCP8.5. The indicative values of these pathways represent the total radiative forcing. That is, the evolution of global warming, from now to 2100, resembles an increase in the level of solar radiation, called radiative forcing, ranging from 2.6 to 8.5 W/m². The value for the first scenario has already been reached, therefore it is not valid. The second RCP4.5 corresponds to the

most optimistic objective of the 2015 Paris Agreement that, although desirable, will be difficult to achieve. RCP8.5 is chosen between the other two more pessimistic scenarios, as it reflects in a clearer way the climate trends (Figure 6).



	Radiative forcing	$[CO_2]$ in 2100
RCP2.6	2,6 W/m²	421 ppm
RCP4.5	4,5 W/m²	538 ppm
RCP6.0	6,0 W/m²	670 ppm
RCP8.5	8,5 W/m²	936 ppm

Figure 6. Comparison between the different representative concentration pathways (source: own elaboration)

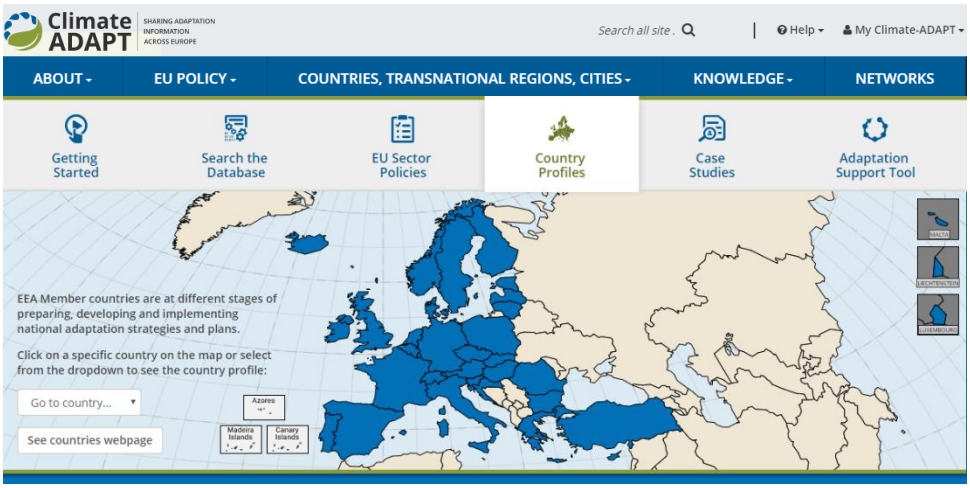


Figure 7. Climate-ADAPT web portal

Local climate projections using national tools

All member states of the European Union have developed websites including tools that provide information on the expected evolution of different climate variables, at the regional or even local level. There is a European platform where all these tools are collected. This is *Climate-ADAPT*[6] (Figure 7), which aims to share information on adaptation to climate change throughout the entire European continent.

[6] https://climate-adapt.eea.europa.eu/

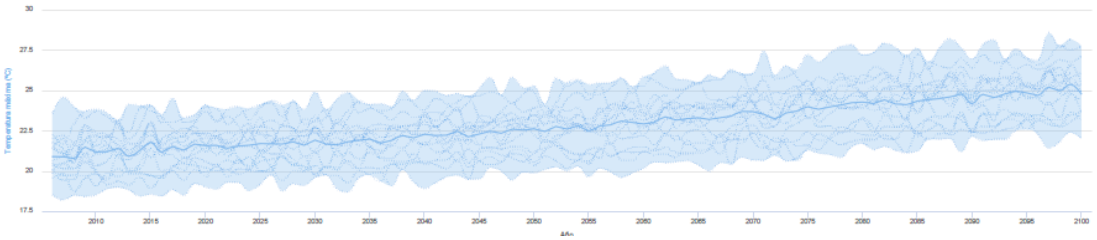


Figure 8. Example of the evolution of the maximum temperature in a municipality according to AdapteCCa (Spain)

Once the analysis is done, the summary information is collected in a similar way to that shown in Table 2. In this way, the historical values (average of the base period), the current value and the projection by 2100 are collected, together with the estimated average value and the maxima and minima, depending on the methods applied (up to 16 different approaches from several international research organizations).

Table 2. Summary table of climate change indicators. Historical, current and forecast values by 2100.

Indicator	Mean (base period)	2018	2100 projection		
			Min	Mean	Max
Precipitation (mm/day)					
Number of rainy days					
Duration of dry spells (days)					
95th percentile of daily rainfall (mm)					
Maximum temperature (°C)					
95th percentile of max. temp. (°C)					
Minimum temperature (°C)					
5th percentile of min. temp. (°C)					
Number of warm days					
Number of warm nights					
Number of frost days					
Heat wave duration (days)					
Heating degree days (°C·day)					
Cooling degree days (°C·day)					
Wildfires (affected ha)					
Other					

In addition to this table, historical information and corresponding trend analysis should be summarized for other phenomena such as floods, avalanches and forest fires.

5.5.3. Risk and vulnerability analysis

The risk and vulnerability analysis is carried out following the approach proposed by the IPCC in its AR5 report (Figure 9). A series of climate hazards are determined from the climate change scenarios previously defined, that, together with the local vulnerabilities detected and the exposure of different sectors of the population or fundamental infrastructure, give rise to a certain impact risk that needs to be assessed in order to be able to articulate concrete actions capable of reducing it.

Next, we carry out, step by step and following the guidelines proposed by the Covenant of Mayors, an assessment of these climate hazards. A quantitative evaluation of all the intervening aspects would lead to great complexity, mainly due to the lack of local data and the need to establish complex

correlations between the different values obtained. This explains why this guide proposes a qualitative analysis, based on perceptual evidence, but which can also be quantified to better depict the importance of each indicator. This choice greatly simplifies the analysis and facilitates the development of SECAP by local administrations, which always have limited resources.

In any case, the national tools that study climate change scenarios have evolved and are already offering geographic information of the climate variables. Inasmuch as the study of vulnerabilities can be more precisely georeferenced, all the analysis discussed below could be carried out through the use of a geographic information system (GIS), applying the corresponding layers and using the GIS tool to perform the calculations required to assess the climate-related risks.

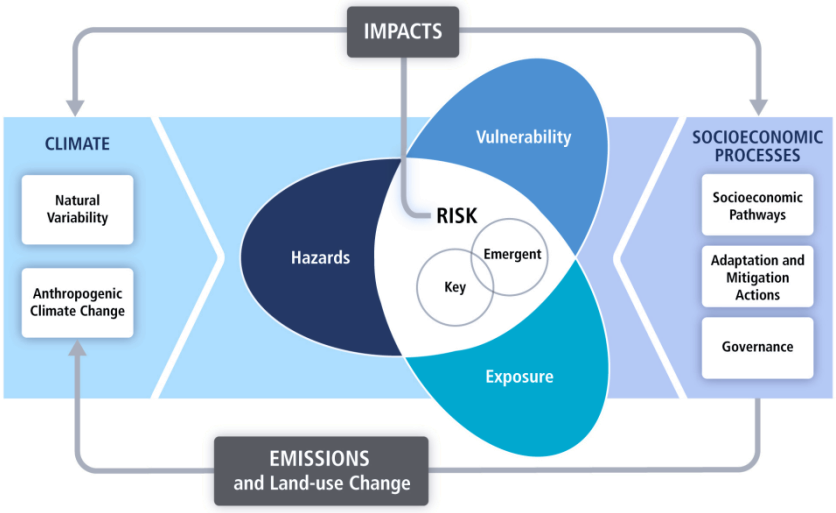


Figure 9. Interaction among climate hazards, local vulnerabilities and impact risk (source: IPCC AR5)

Local climate hazards

As a result of the previous assessment, it will be understood that the municipality is exposed to a series of climate hazards that will depend on its geographical location and the climate trends above mentioned. Those hazards are, according to the Covenant of Mayors:

- Extreme heat.
- Extreme cold.
- Heavy precipitation: rainfall, snowfall, fog or hail.
- Floods: flash/surface flood, river flood, coastal flood, groundwater flood or permanent inundation
- Droughts and water scarcity.
- Storms: severe wind, tornado, cyclone (hurricane/typhoon), tropical or extratropical storm, storm surge or lightning/thunderstorm.
- Mass movement: landslide, avalanche, rockfall or subsidence.
- Wild fires: forest or land fire.
- Chemical change: saltwater intrusion, ocean acidification or atmospheric CO_2 concentrations.
- Biological hazards: water-borne disease, vector-borne disease, airborne disease or insect infestation.
- Other (specify).

Each of these hazards is assessed according to five criteria that offer information about the current situation and its trend, both in intensity and frequency, over time. Although this assessment is merely qualitative, a result of the perception which accompanies the information collected, a value is assigned to each criterion in order to quantify it, as follows:

Current risk of hazard occurring

Probability of hazard
1- Low.
2- Moderate.
3- High.

Impact of hazard
1- Low.
2- Moderate.
3- High.

Risk = Probability x Impact

Future hazard

Expected change in intensity
1- Decrease.
2- No change.
3- Increase.

Expected change in frequency
1- Decrease.
2- No change.
3- Increase.

Timeframe
1- Long-term.
2- Medium-term.
3- Short-term.

Table 3. Summary of local climate hazards, based on their qualitative assessment.

	Current risk of hazard occurring		Future hazard		
Climate hazard	Probability	Impact	Change in intensity	Change in frequency	Timeframe
	Low Moderate High	Low Moderate High	Decrease No change Increase	Decrease No change Increase	Long-term Medium-term Short-term

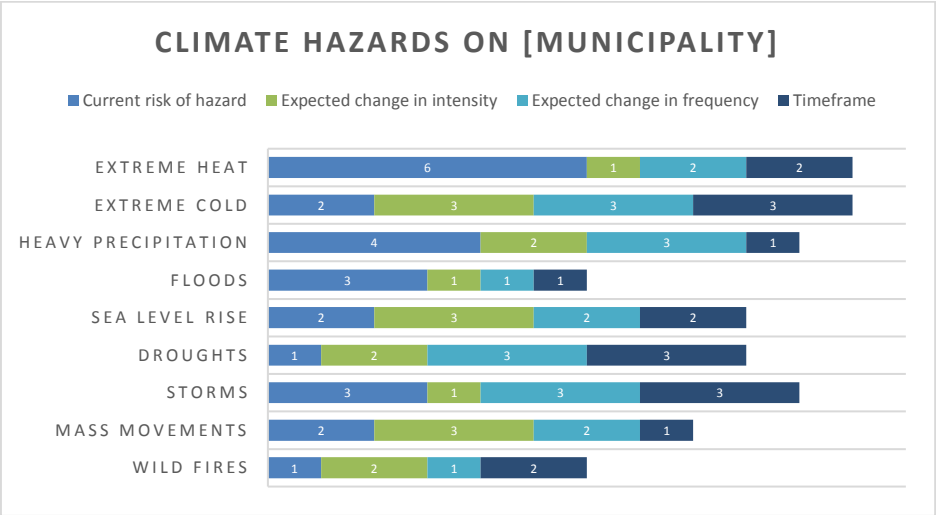


Figure 10. Example of chart of the quantification of local climate hazards, based on their qualitative assessment (source: own elaboration)

In this way, hazards can be categorised according to these four criteria to prioritise those that pose a greater risk on the municipality. The result of this assessment is collected in a table and a chart (e.g. Table 3 and Figure 10).

Assessment of local vulnerabilities to climate hazards

Vulnerabilities can be understood as the capacity that a system has to cope with the adverse effects of climate change, that is to say the hazards described above. The Covenant of Mayors distinguishes two major types of vulnerabilities:

- **Socio-economic vulnerabilities:** they reflect the lack of resilience of a territory due to social (population) and economic (local economy) factors, as well as others that aggravate the situation. Some examples of socio-economic vulnerabilities are:
    - Population growth
    - Population density
    - Percent share of sensitive population (elderly, young, living alone, unemployed, etc.)
    - Percent share of population living in high-risk areas (floods, fires, etc.)
    - Presence of areas not accessible for municipal services
    - Percent share of population with low cultural level
    - Economic activity sensitive to climate change (agriculture, fisheries, etc.)
- **Physical and environmental vulnerabilities:** they reflect the lack of resilience caused by the geographical situation of the territory, its spatial planning or environmental aspects, as well as the factors that aggravate the situation. Some examples of physical and environmental vulnerabilities are:
    - Presence of affected coastal areas
    - Presence of affected rivers
    - Transport networks in areas at risk
    - Buildings in areas at risk
    - Age of the buildings
    - Air pollution
    - Water pollution
    - Soil pollution

- Urban heat islands
- Difficult access to areas at risk for emergency services
- Forest cover

Next, it is important to identify the least resilient sectors regarding climate change, which will be the main targets of the action plan for the adaptation of the municipality. The Covenant of Mayors proposes, in a non-exclusive way, the following sectors:

- **Buildings:** Refers to any (municipal, residential, tertiary; public or private) structure or groups of structures, surrounding spaces, permanently constructed or erected on its site.
- **Transport:** Includes road, rail, air or water transport networks and related infrastructure (e.g. roads, bridges, tunnels, hubs, ports and airports). It comprises an extensive range of both public and private assets and services and excludes all related vessels, railways or vehicles.
- **Energy:** Refers to the energy supply service and related infrastructure (transmission and distribution networks, generation systems), for all energy types: coal, petroleum products, natural gas, combustible renewables and waste, electricity and heat.
- **Water:** Refers to the water supply service and related infrastructure. It also covers water use (e.g. by households, industry, energy production, agriculture, etc.) and (waste-, rain-) water management system, that includes sewers, drainage and wastewater treatment systems.
- **Wastes:** Includes activities related to the management (including collection, treatment and disposal) of various forms of waste, such as solid or non-solid industrial or household waste, as well as contaminated sites.
- **Land Planning and Use:** Process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long-term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans or regulations that describe the permitted or acceptable uses.**Agriculture and Forestry:** Includes land classified for agricultural and forestry use, as well as organisations and industries linked to production within and surrounding the boundaries of the municipality. It includes animal husbandry, aquaculture, agroforestry, beekeeping, horticulture and other agriculture and forestry management and services in the area.**Environment and Biodiversity:** Environment refers to green and blue spaces, as well as air quality, including urban ambient air. Biodiversity refers to the variety of life in a specific, measurable as the variety within species, between species and the variety of ecosystems.
- **Health:** Refers to the geographical distribution of pathologies (allergies, cancers, heat stroke, respiratory and heart diseases, etc.), information indicating the effect on health (biomarkers, decline of fertility, epidemics or vector-borne diseases such as those transmitted by the tiger mosquito or ticks) or well-being of humans (fatigue, stress, post-traumatic stress disorder, death, etc.) linked directly (air pollution, heat waves, droughts, severe flood events, ground level ozone, noise, etc.) or indirectly (food or water quality and availability, genetically modified organisms, etc.) to the quality of the environment. It also includes the health care service and related infrastructure (e.g. hospitals).
- **Civil Protection and Emergency:** Refers to the operation of civil protection and emergency services by or on behalf of public authorities (e.g. civil protection authorities, police, fire-fighters, ambulance, paramedic and emergency services) and includes local disaster risk reduction and management (i.e. capacity building, coordination, equipment, emergency planning, etc.).
- **Tourism:** Refers to the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated within the place visited.
- **Education:** Educational, sports and leisure infrastructures for children, young people and in general, all citizens.

- **ICT:** Infrastructures corresponding to information and communication technologies.
- Any **other** sector such as industry or financial.

The selection of the sectors by the municipality is based on how they are affected, positively or negatively, by climate change. This needs to be justified by the climatic hazards and current level of vulnerability with respect to those previously detected. The result of this task can be represented in the form of a table (Table 4).

Table 4. Justification of the sectors most vulnerable to identified climate hazards.

Climate hazard	Sector	Level of current vulnerability
	Buildings Transport Energy Water Wastes …	Low Moderate High

It is also interesting to identify the population groups most vulnerable to each climate hazard. To this end, the Covenant of Mayors suggests the following groups:

- Women and girls
- Children
- Youth
- Elderly people
- Marginalized groups
- People with functional diversity
- Chronically ill
- Low-income households
- Unemployed
- People living in substandard housing
- Migrants and displaced persons
- Others

Table 5. Table identifying vulnerable population groups .

Climate hazard	Most vulnerable population groups
	Women and girls Children Youth Elderly people …

Exposure, sensitivity and adaptive capacity to detected vulnerabilities

Once local vulnerabilities to climate hazards have been identified, it is necessary to assess them according to three parameters:

- **Exposure:** Information about the location and characteristics of relevant local assets must be collected. This could result in a map of relevant places and their level of exposure to different

threats, which could be georeferenced, for example, on the Google Earth platform. Mapping could also highlight municipal growth trends.

- **Sensitivity:** In the context of risk assessment, this term refers to the degree to which a system (relevant local asset) could be affected or is capable of responding to a hazard. Sometimes, this sensitivity is determined by how relevant and critical that asset is for the municipality.
- **Adaptive capacity:** It will be determined by the existence of technical and scientific knowledge, as well as the financial capacity and other factors mentioned in the next point, which favour to carry out adaptation actions against such vulnerability.
- **Relevant adaptive capacity factors:** the Covenant of Mayors suggests: access to services, socio-economic factors, governance and institutions, physical and environmental factors and knowledge and innovation.

As has been done for threats, for simplicity of operation this assessment will be made by using a qualitative approach; each category will be assigned a numerical value that quantifies it. This analysis will be carried out either for each vulnerability or for each sector (and hazard) on which vulnerabilities have been identified. Thus, for each criterion, the categories defined and their quantification are as follows:

Exposure

1- Very low: the level of exposure to climate change of assets is very low. Climate hazards cannot affect local assets.
2- Low: the level of exposure to climate change of assets is low. Some climate hazards can slightly affect local assets.
3- Moderate: assets are exposed to climate change through one or more climate hazards.
4- High: assets are highly exposed to climate change through one or more climate hazards.
5- Very high: assets are very highly exposed to climate change through one or more climate hazards.

Sensitivity

1- Very low: the effects of the vulnerability will not have any impact on the municipality.
2- Low: the effects of the vulnerability on the municipality will be observed in the long term.
3- Moderate: the effects of the vulnerability on the municipality will be observed in the medium term.
4- High: the effects of the vulnerability on the municipality will be observed in the short term.
5- Very high: the effects of the vulnerability on the municipality are already visible.

Adaptive capacity

5- Very low: the potential of the municipality in terms of adaptive capacity is very low; there are great difficulties in implementing adaptation measures.
4- Low: the potential of the municipality in terms of adaptive capacity is low; but some adaptation measures can be implemented.
3- Moderate: the municipality has some potential to mitigate the effects of climate change, although no adaptation measure has been implemented.
2- High: the municipality has implemented some measures to reduce its vulnerability to climate change, but much work remains to be done.
1- Very high: the municipality has resources and has implemented measures to reduce the impact of climate change.

Table 6. Summary of local vulnerabilities assessed qualitatively.

Vulnerability	Exposure	Sensitivity	Adaptive capacity
	Very low Low Moderate High Very high	Very low Low Moderate High Very high	Very low Low Moderate High Very high

Table 7. Summary of local vulnerabilities assessed qualitatively.

Sector	Climate hazard	Relevant factors for adaptive capacity	Present level of the adaptive capacity
		Access to services Socio-economic Governmental & institutional Physical & environmental Knowledge & innovation	Very low Low Moderate High Very high

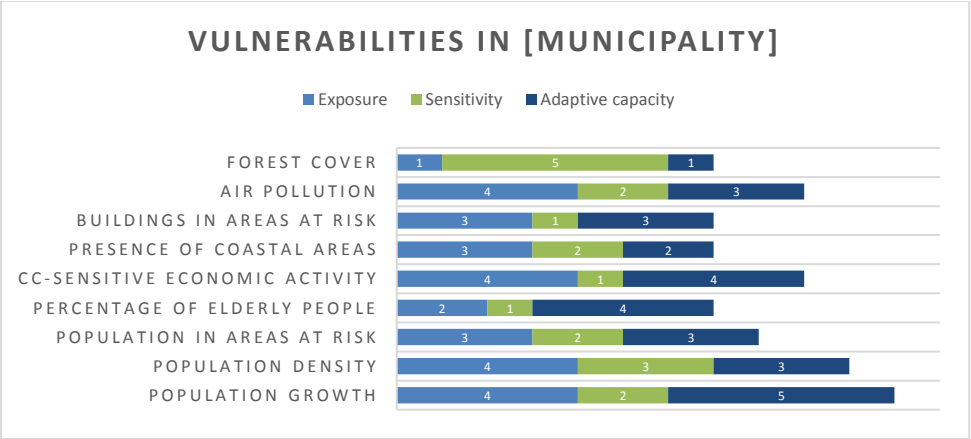


Figure 11. Example of chart of the quantification of local vulnerabilities, based on their qualitative assessment (source: own elaboration)

In this way, vulnerabilities can be categorised according to these criteria to prioritise those that pose a greater risk on the municipality. The result of this assessment is collected in a table and a chart (Table 6 and Figure 11).

Expected risk of impact in the municipality

For these detected sectors, prioritizing climate hazards and vulnerabilities assessed with a higher rating, the different local impact risks produced by climate change are identified for each affected sector. That is, a climate hazard in conjunction with a local vulnerability results in a specific impact risk (Figure 12). In other words, the identified vulnerabilities must be associated with the climate hazards to which they apply, obtaining a set of possible impacts produced by climate change.

Finally, in order to assess each risk, the Covenant of Mayors defines three criteria: likelihood of occurrence, expected impact level and timeframe. After the complete analysis of the situation carried out so far, it will not be difficult to qualitatively assess each of these criteria. And once again, in order to obtain numerical values, a value is assigned to each of the categories corresponding to the qualitative assessment. The categories and their related values are as follows:

Likelihood of Occurrence

1- Unlikely.
2- Possible.
3- Likely.

Expected Impact Level

1- Low.
2- Moderate.
3- High.

Timeframe

1- Long-term.
2- Medium-term.
3- Short-term.
4- Current.

In this way, a first classification of climate-related impact risks can be achieved based on the defined set of criteria, to prioritise them according to their importance and define the most appropriate adaptation measures for the municipality. The result of this assessment is collected in a table and a chart (Table 8 and Figure 13).

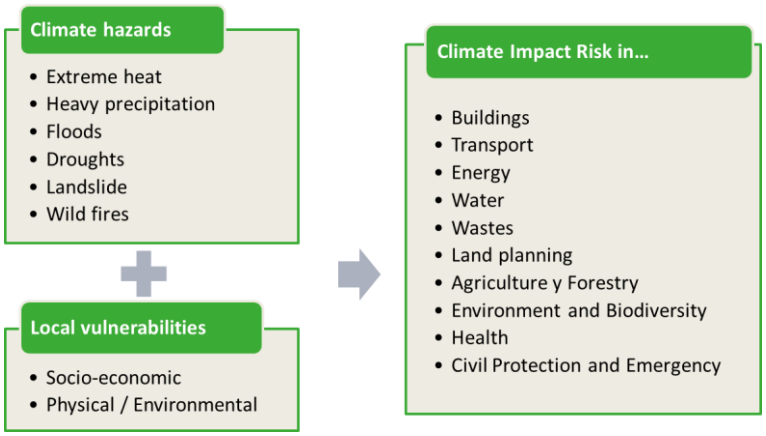


Figure 12. Scheme for obtaining climate risks from local hazards and vulnerabilities (source: own elaboration)

Table 8. Summary of the expected climate impact risks in the municipality, assessed qualitatively.

Sector	Climate Hazard	Vulnerability	Expected Impact Risk	Likelihood of Occurrence	Expected Impact Level	Timeframe
				Unlikely Possible Likely	Low Moderate High	Long-term Medium-term Short-term Current

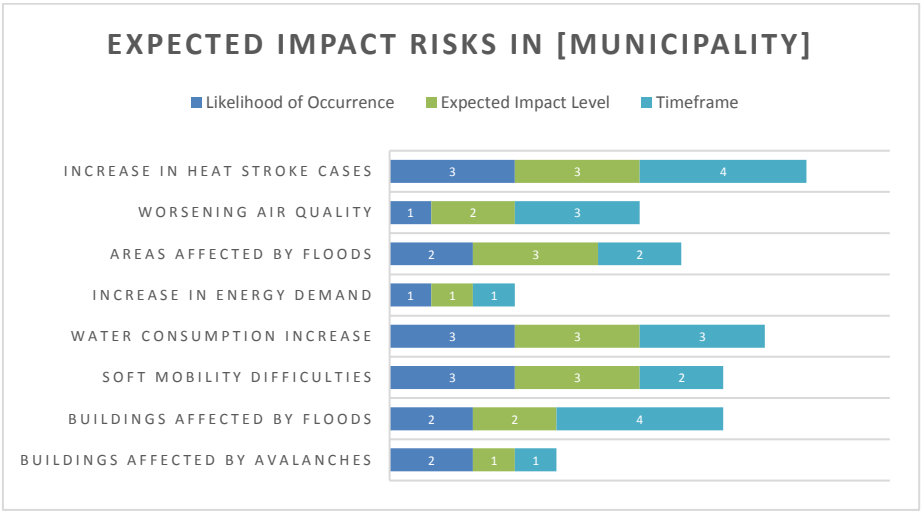


Figure 13. Example of chart of the quantification of climate impact risks in the municipality, based on their qualitative assessment (source: own elaboration)

5.6. Definition of the action plan for mitigation and adaptation of the municipality

The action plan will contain measures covering the three pillars that make up the Covenant of Mayors' commitment: mitigation, adaptation and energy poverty. The mitigation actions aim to reduce local emissions to a minimum of 40% compared to those inventoried in the reference year. Adaptation actions must seek to manage the climate impact risks identified above, at a level acceptable to the municipality, taking into account the vulnerabilities detected and allowing any positive opportunities to be seized. It is advisable to take advantage of possible synergies between mitigation and adaptation actions, since a more integrated approach means cheaper investment and greater success in implementation. Therefore, it may be the case that mitigation and adaptation actions are available simultaneously (such as a photovoltaic pergola that generates clean electricity and produces a shaded area for citizens).

In addition, both mitigation and adaptation actions, as well as mixed mitigation and adaptation actions, can also contribute to the local fight against energy poverty, so they will also be typified within this third pillar.

The process for prioritising these actions involves the initial identification of a set of measures and the subsequent multi-criteria selection among them. This concludes the definition of a duly scheduled action plan, with an economic quantification of its actions and with potential financing lines for their implementation.

5.6.1. Identification of a range of adaptation measures

At this stage, a comprehensive set of mitigation and adaptation measures (and addressed to the energy poverty fighting) that reduce locally generated greenhouse gas emissions and respond to the main local climate risks should be identified, assessing their integration based on the options identified by the PACES working group. It is interesting to have examples of both national and international good practices, to portray the widest possible set of potential options and verify their suitability for the local territory.

Possible measures are thus identified, taking into account the type of actions they promote, that is, if it concerns green infrastructure (e.g. conservation and recovery of habitats and forest areas of high natural value), grey infrastructure (e.g. improvement of ventilation and air conditioning conditions, with

special attention to school facilities and support structures for the elderly) or a non-infrastructure option (e.g. awareness raising of population, education and training).

Another way of categorising different adaptation options could be: temporary (e.g. use large umbrellas to reduce solar heat gains); managerial (e.g. introduce flexi-time; facilitate working from home); technical (e.g. refurbish building; enhance flood defences); or strategic (e.g. commission new building with climate-resilient design as part of a planned programme).

A list of possible climate change mitigation and adaptation measures has been included in the Annex to this guide, depending on the sector affected and the hazard considered. Finally, in order to prioritize the execution of these actions, by means of a structured assessment of the different options, a multi-criteria analysis is carried out using a wide range of evaluation criteria such as efficiency, effectiveness, urgency of implementation, need for financing, among others.

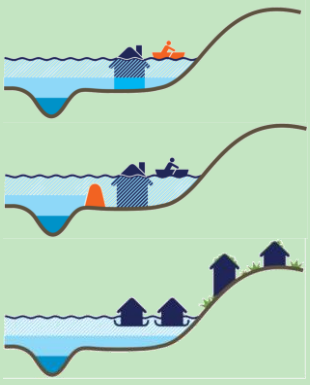
5.6.2. Factors to be considered when defining actions

It's time for action

If the municipality is already experiencing problems with climate-related impacts, it may wish to address those risks straight away. If some climate change opportunities have already been identified, it will also want to act quickly to get a head start in the implementation of measures.

The road to resilience

The European Environment Agency, in its report "Urban adaptation to climate change in Europe 2016" presents three different approaches for dealing with the adaptation of our cities to climate change:



Coping: develop skills to deal with adverse conditions (extreme events). Respond to damage by recovering from catastrophic events (disaster management).

Incremental: Progressive adaptation, applying known adaptation solutions, which save us from certain levels of risk (individual measures).

Transformative: Disruptive transformation that addresses the root causes of the problem. Tries to reduce our vulnerability to CC. Behaviours, practices, city design, territory management.

Long-term Planning

If a long-lifespan strategic plan is being developed, it is crucial to take account of climate change in the decision-making process. It is much easier and cheaper to incorporate adaptation options at the design stage than to introduce them late in the planning process, or after an asset has been built. Other factors that will determine the time frame of the adaptation plan include how soon it is expected any critical thresholds to be exceeded, and the lead-in time for planning and implementing adaptation measures.

Level of Adaptation

Although we are confident in the general trends for our future climate, its hazards and impact risks, there will always be some uncertainty over the severity of the impact and the ideal level of adaptation needed. It is what is called "level of adaptation". The adaptation plan must take into account the attitude to risk and the costs involved. Therefore, a suitable balance between the following possibilities should be found:

- not adapting and dealing with the costs and consequences;
- adapting to a level of risk and accepting the costs of the remaining or residual risks;
- the cost of an adaptation plan and the benefits of those actions.

For example:

- Where the cost of planning for climate change is low, but the climate risks are high, there is an obvious case for adaptation.
- Where the costs of adaptation are high, but the climate risks are low, an adaptation plan may be disproportionate to the risks.
- Where the cost of planning and the risks posed by climate change are both low, there are few downsides, regardless of the choice made.
- In contrast, where the costs of adapting to climate change are high, and the climate risks are also high, an adaptation plan needs a delicate balance as the risks are very high for the planner.

To help municipalities think about adaptation options, compare the benefits of adaptation with the costs of implementation. The adaptation option they choose should offer the highest net benefit, taking account of the risks and uncertainties surrounding climate change.

Opportunity Analysis

It is important to look for ways of incorporating climate response strategies into mainstream activities, and think about how they work with or against other strategies and policies. The costs of adaptation can be minimised when it is factored into:

- the early steps of planning new developments;
- infrastructure that is being upgraded anyway;
- routine maintenance that is being conducted;
- plans that come up naturally for review;
- a routine work plan rather than being dealt with as an emergency situation.

Risk vs. Attitude

How much climate risk municipalities are prepared to accept will have an impact on the adaptation plan. If the organisation is risk-averse, identifying and implementing quick fixes that will reduce short-term vulnerability to climate risks may be an option while investigating further options. Decision-makers have to think about organisation's overall attitude to risk, as well as the individual risks facing every activity or decision.

Over- and under-adaptation

If the organisation over-estimates the importance of climate risks compared to the other risks it faces, it may over-adapt, leading to a waste of resources. However, if it under-estimates climate risks compared to other organisational risks, and don't include sufficient adaptation measures, the organisation will not be well enough protected (under-adapted).

Adopting a flexible decision-making process and using adaptive management — or "learning by doing, and adapting based on what's learned" — can help the organisation to keep its options open, and be more responsive to changing situations.

5.6.3. Multi-criteria selection methodology for proposed measures

It is necessary to assess the ability of each of the proposed actions to achieve its strategic objectives. This process is carried out in a participatory manner, so that the involved stakeholders can provide their opinion. Each municipality may have its own selection criteria, although the following have been defined in the LIFE Adaptate project:

- **Effectiveness:** Extent to which the proposed solution is able to solve the problem.
- **Efficiency:** Extent to which the benefits exceed the costs.
- **Equity:** Extent to which the action adversely affect other areas or citizens groups.
- **Flexibility:** The action allow for adjustments or incremental implementation.
- **Legitimacy:** Extent to which the action is politically and socially acceptable.
- **Urgency:** Timeframe to solve the problem.
- **Synergies:** Degree of coherence with other objectives or measures.
- **Costs:** Investment amount.
- **Funding:** Availability of internal or external funding to implement the measure.

Each of the proposed actions must be quantitatively evaluated according to these criteria. However, it may be the case that the significance of each criterion is different, so it is necessary to weight their relative importance. The weight assigned to each criterion can be determined differently. The LIFE Adaptate project uses the TOPSIS (*Technique for Order of Preference by Similarity to Ideal Solution*) methodology for multi-criteria decision making. It is based on a hierarchical analytical process that identifies the best solutions among a finite set of options. Its basic principle is that the chosen alternative should have the shortest distance from the positive ideal solution, and the longest distance from the negative ideal solution.

In this way, a vector of weights is obtained that assumes that, if each criterion is evaluated over 10 points, the value of each action entails a final rank equal to the sum of the values awarded to each criterion, multiplied by their corresponding weights, expressed as a decimal. As abovementioned, both the definition of the criteria and the weight assigned to each of them can be done by the municipality. The measure selection tool proposed by the LIFE Adaptate project proposes as vector of weights the values shown in Table 9.

Table 9. Vector of weights obtained for the measure selection criteria.

Effectiveness	Efficiency	Equity	Flexibility	Legitimacy	Urgency	Synergies	Costs	Funding
9,9%	8,7%	20,4%	3,2%	10,8%	20,5%	3,1%	5,9%	17,4%

5.6.4. Definition of the action plan

The action plan is definitely constituted by the development of the actions that have been shortlisted. Each action can be detailed in a file containing at least the following information:

- Identification code.
- Title.
- Type of action: mitigation, adaptation and/or energy poverty.
- Origin of the action: local, regional, national.
- Responsible organism or department.
- Timetable.
- Present implementation status.
- Affected sector.
- Technology used (mitigation)
- Policy tool or instrument (mitigation)
- Energy savings, renewable energy generated and emissions reduction (mitigation)
- Climate hazard to which it responds (adaptation).
- Climate impact risk that it tries to mitigate (adaptation).
- Description and general objectives.
- Concrete action.
- Costs estimation.
- Monitoring indicators.

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Annex: Examples of climate change mitigation and adaptation measures

The IPCC defines adaptation options as concrete actions to adjust to actual or expected climate, resulting from a range of appropriate adaptation strategies and options to address specific needs of the system. They include a wide range of actions that can be categorised as structural, institutional or social. Sometimes, mitigation corresponds to a specific human intervention in the form of strategies, options or measures to reduce the sources or enhance the sinks of greenhouse gases, responsible for climate change.

For the preparation of Sustainable Energy and Climate Action Plans, mitigation and adaptation measures and actions are defined for different sectors identified as priorities. These measures are developed together with the different stakeholders, according to the specific vulnerabilities identified.

The following points provide some examples of adaptation measures and options, categorised according to the climate hazard. Options may have a more general approach and should be adapted to become more specific and appropriate measures for a particular sector. A range of possible climate change mitigation measures at the local level is also included.

A. Drought

- Creation of water supply alternatives (e.g. rainwater retention, SUDS).
- Improvement of efficient use of water and waste reduction.
- Improvement of the primary and secondary water supply network.
- Development of a meshed and micro-sectorised water supply network.
- Implementation of a fire protection plan.
- Implementation of a vegetation mass control system.
- Invasive species control.
- Reduction of the use of harmful agents.
- Promotion of planting with native species, more adapted and with lower water demands.
- Management of protected and classified areas.
- Implementation of monitoring, modelling, forecasting and disaster management systems.
- Promotion of forest maintenance without resorting to burning.
- Improvement of abandoned land cultivation.

B. High temperature – Heat waves

- Improvement of efficient use of water and waste reduction.
- Implementation of a fire protection plan.
- Improvement of forest planning and management.
- Restoration of forest ecosystems.
- Development of habitats and forest conservation and restoration areas with high nature value.
- Reconversion of mismatched ecological conditions, using better adapted species.
- Encourage the sustainable cultivation of abandoned lands.
- Planning of new urban green areas.
- Creation of shadow areas outside buildings.
- Planning of new urban areas taking into account the orientation of buildings and streets.
- Use of reflective materials on building roofs and facades.

- Implementation of green roofs.
- Creation of specific alternative routes for public transport.
- Development of green areas inside and on the peripheries of urban spaces (green areas and corridors) improving their role as regulators of the urban microclimate.
- Use of materials favouring the cooling of pavements.
- Enhance the cooling of urban spaces by using underground and surface waters.
- Increase evapotranspiration as a cooling effect in dry climates, by planting vegetation within cities and their surroundings (trees, vertical gardens, green facades and roofs).
- Encourage the use of natural ventilation systems.
- Promote the use of cold roof technologies (reflective materials and good insulation).
- Dissemination on the use of passive and high efficiency heating and cooling systems.
- Rehabilitation of public buildings and social housing, using these examples as good demonstration practices.
- Rehabilitation of residential buildings (intervention in neighbourhoods and blocks), through incentives and in collaboration with stakeholders.
- Promote the elimination of pruning without resorting to burning.
- Implementation of a control system for invasive species.
- Identification of risk areas: overheating areas, vulnerable population groups and emergency areas.
- Creation of municipal guides with information on bioclimatic measures and adaptation strategies in buildings.
- Creation of local vulnerability maps with temperature indicators that report on the most affected urban areas.
- Education and training of citizens in relation to emergency situations due to heat waves.
- Development of contingency plans: identification of vulnerable groups to ensure their monitoring during a heat wave. Local coordination with the Civil Protection, Social Welfare and General Health Management services.
- Strengthening of the primary health care system to address the expected increase in cardiorespiratory diseases associated with intense heat.
- Development of a monitoring and control system with regard to diseases associated with the increase in the number of heat waves.
- Development of a monitoring system for allergens present in the atmosphere.
- Development of an air quality monitoring network with a pollution forecast model that allows establishing an alert system to inform the population about high pollution events.
- Development of mechanisms for the early recognition of potential mosquito-borne diseases and the risk of importing new strains.

C. Torrential rains – Floods

- Promotion of the cleaning of water channels and sewage and rainwater collectors.
- Adequate maintenance of vegetation.
- Restriction of crops in areas that favour runoff.
- Implementation of incentives to reduce the use of nitrogen fertilizers.
- Restriction and conditioning of buildings in flooding risk areas.
- Recovery and conservation of streams, riparian spaces and wetlands.
- Recovery, improvement and conservation of water retention infrastructures, especially in agricultural areas.
- Improvement of water flow conditions in the critical areas identified.
- Creation of specific rules for possible flood zones.
- Promotion of water collection and reuse systems.
- Ensure the implementation and monitoring of measures to safeguard coastal areas.

- Reduction of urban soil sealing.

D. Strong winds

- Identification areas vulnerable to strong winds.
- Improvement of structures that withstand strong winds.

E. Mitigation measures

- Promote the renewal of the fleet and the acquisition of the most efficient vehicles.
- Promote the improvement of the energy supply and transport network.
- Promote active monitoring of energy consumption and energy management systems.
- Promote urban renewal, improving accessibility and modernizing networks.
- Awareness, education and improvement of the capacity of the population and municipal services.
- Elaboration of management plans and updating of existing ones — Development and implementation of mobility and transport plans, logistics management (demand management, passengers and products) and urban planning to reduce the volume (traffic) and the distance of trips, distribution and fleet management, route optimization, among others.
- Conformity to the requirements related to CO_2 emissions of vehicles.
- Promotion of transport on demand (flexible) in low density areas.
- Creation of areas with reduced emissions and calm traffic.
- Promotion of shared mobility initiatives such as the shared use of cars and cycles, and the adaptation of the transport offer to the demand (urban lines and services by minibus, flexible transport services in areas and periods of low demand).
- Creation of infrastructures that favour fluid mobility, promoting the softer modes.
- Adoption of tools to support mobility management and information systems and technologies in support of mobility, aimed at users (generalization of real-time information at stops, public information portals, mobile applications).
- Setting of an age limit for fleets.
- Promotion of the use of information technologies to induce more sustainable behaviour.
- Use of locally generated biomass.
- Reuse of already built areas, such as old industrial land.
- Renewal and regeneration of the urban fabric.
- Diversification and reinforcement of the supply of proximity services and commerce, which encourage more sustainable modes of mobility.
- Promotion of energy sustainability in the public space, including efficiency of public lighting and urban water and sanitation systems.
- Avoid the removal of green areas (and subsequent soil sealing).
- Promotion of urban agriculture, through the creation of specific spaces integrated into the urban structure.
- Promotion of the use of the most favourable renewable energies at the local level.
- Promotion of the use of photovoltaic systems in buildings.
- Implementation of treatment systems based on anaerobic digestion with biogas production and energy recovery.
- Promotion of good agricultural and forestry practices that increase carbon stocks in the soil.
- Establishment of incentives for the implementation of energy efficiency actions.
- Promotion of the use of forestry products in green economy and sustainable construction.
- Promotion of the most efficient indoor and outdoor lighting systems.
- Improvement of fleet management systems.
- Promotion of bicycle use.

- Development of solar energy projects (thermal and photovoltaic).
- Development of a sustainable tourism plan.
- Promotion of the use of active monitoring systems, which improve the efficiency in the use of energy in buildings.

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