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THE INTERNATIONAL INSTITUTE FOR
INDUSTRIAL ENVIRONMENTAL ECONOMICS

Client Report

From Strategy to Action

Kickstarting Climate Change Adaptation Action in Figueira da Foz



PRESENTED TO

Município da
figueira
da foz. para todos

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Executive Summary

(1)

Introduction

After the devastating impacts of Cyclone Leslie in 2017 and the deadly forest fires in 2018, climate change adaptation has come to the forefront of discussions in Portugal, both at the National and local level. Municipalities have stepped up by developing climate adaptation strategies and integrating adaptation into the municipal planning and policy.

In 2016, Figueira da Foz published its adaptation strategy for climate change, containing 30 possible adaptation options. Over the course of our four-week project in Figueira da Foz, we assisted the municipality with the process of developing a climate adaptation action plan. The following report presents our analysis on the steps that Figueira da Foz has taken so far, and our recommendations on the next steps towards the development of Figueira's action plan for climate adaptation.

Policy Context

In the first part of our report we analyse the Policy context of climate change adaptation. At the global and EU level, the emphasis is on building resilience. In the case of Portugal, this has manifested in the development of a National Adaptation Strategy and mainstreaming adaptation into national, regional, and local policies. With 30 municipalities, including Figueira da Foz, already participating in climate change adaptation, and more to come, adaptation is expected to become a staple of local agendas throughout Portugal.

Adaptation Process

Secondly, we look at the Adaptation process for Figueira da Foz, based on the six-steps of the Urban Adaptation Support Tool methodology. Figueira has already gone through steps 1-4, resulting in the identification of local risks and vulnerabilities to climate change, along with 30 adaptation options to address these risks as outlined in the Municipal Strategy for Adaptation to Climate Change (EMAAC for its Portuguese acronym). For steps 5 (implementation of actions) and 6 (monitoring and evaluation), which Figueira has yet to implement, we provide a general process overview of each.

Learnings

The next section identifies the key **Challenges** that Figueira faces in the creation of an adaptation action plan: budgetary constraints, staff shortages, and reduced stakeholder involvement. To overcome these challenges, we suggest creating an interdepartmental task force, permanently engaging stakeholders in the adaptation process; and raising public awareness for example, by linking adaptation with tangible benefits for citizens. These recommendations are detailed in the **Best practices** section, drawing from the experience of six coastal municipalities in the European Union with challenges similar to Figueira.



Executive Summary

(2)

Implementing Adaptation

Next, we address Implementing adaptation. First, we highlight the need to review adaptation strategies and update risks if necessary. Moving to developing actions, we suggest using a layout containing key aspects for the implementation and monitoring of climate adaptation actions. Using this layout, we suggest 29 sample actions under 5 thematic areas, including climate risks addressed, implementation timeframes, estimated investment, indicators, and leadership responsibilities, among others. The full set of actions is provided in the Annex.

Funding

Lastly, we provide a brief overview of Funding options available to finance climate adaptation actions. In terms of Public funding, we touch upon specific funds within the European Structural and Investment Funds (ESIF), the Portuguese Carbon Fund, and other climate-related grants and loans. Having an action plan is a prerequisite to apply for most of these funds, as well as the ability to co-finance the project. We also address two private funding options: Public-private partnerships (PPP), usually in the form of contracts for the provision of a good or service to the public; and green bonds, which are used to finance projects that create environmental benefits.

Conclusion

As Figueira continues its climate adaptation process, we suggest to start out by taking into account the policy context, reinforcing the use of the six-step urban adaptation methodology, and reflecting on the experiences of other municipalities addressing similar obstacles around climate adaptation action. In moving from strategy to action, the layout and suggested actions are meant to serve as a starting point for discussions with stakeholders, illustrating what the actions could look like. Finally, the information on funding opportunities could expand the options already underway.



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1. Introduction

Portugal is known for its beautiful coast and exceptional wine. However, in the past couple of years the country has made headlines due to several disasters including Cyclone Leslie (2018) and massive wildfires (2017) in central Portugal, resulting in a number of casualties and injuries. These are just two examples of events that have intensified and are expected to increase in frequency due to climate change.

While it is crucial to mitigate climate change as much as possible, certain changes are unavoidable due to historic and near-term greenhouse gas emissions, forcing countries such as Portugal to adapt [1]. This is why adaptation to climate change needs to be addressed at the same time as mitigation efforts are intensified. Accelerating the adaptation process is necessary to increase communities' resilience to changing climate conditions and to deal with the effects of increasing inequalities [1].

Another reason to engage in adaptation is that it is in our economic self-interest since adaptation measures are typically cheaper than the recovery or rebuilding after disastrous events [1,2]. In economic terms, adaptation measures offer a triple dividend because of:

- avoided costs for damages,
- economic benefits due to increasing security to make investments and to innovate,
- and social and environmental (non-market) benefits, even though the quantification of those is contested.

As a result of the understanding that adaptation action is needed and makes economic sense, approaches for adaptation are and have been established on a global, national, regional and municipal level. This report deals with climate change adaptation on the municipal level in Figueira da Foz (Figueira for short) and is the output of a student consultancy project within the Environmental Management and Policy master's programme at the International Institute for Industrial Environmental Economics located in Lund University, Sweden.

Our hope is that this document is helpful as Figueira moves forward with the development of their climate adaptation action plan. We are deeply grateful to the municipality of Figueira da Foz for their engagement, valuable insights, and support throughout this project. We look forward to hearing what Figueira's next steps look like and are confident in Figueira's potential to become a leading example of climate adaptation action.

Justin, Levke, Mariana, and Ramya

1.1. Policy context

Climate change adaptation is addressed in policies on multiple political levels. An overview of the relevant policy context for Figueira can be found in Figure 1.



Figure 1: Climate Change Adaptation Policy Context for Figueira

1.1.1. Global and EU

On a global level, the Sustainable Development Goals (SDGs), which are “a blueprint for a better and more sustainable future” [3] set out by the United Nations, specifically address adaptation in Goal 13 “Climate Action”. Additionally, Article 7 of the Paris Agreements asks its signatories to engage in adaptation planning and implementation. In both cases the aim is to increase the adaptive capacity and strengthen the resilience to adverse impacts from climate change.

Similar approaches can be observed at the EU level: The EU strategy on adaptation to climate change, adopted in 2013, seeks to increase climate resilience within Europe by promoting member states to adopt strategies and action plans for climate adaptation [4]. This is complemented by the Covenant of Mayors initiative, a platform which provides support for local adaptation initiatives since 2014 and promotes networking at the city level [5].

1.1.2. National

As part of the adaptation process, Portugal presently follows a National Climate Change Adaptation Strategy (ENAAAC) and Plan (P-3AC) to respond to such challenges. The main areas of focus of the ENAAAC include creating a knowledge base for climate change through stakeholder collaboration, prioritising and implementing adaptation measures along with identifying suitable funding mechanisms, and mainstreaming climate change adaptation into sectoral policies at the national, regional and local levels. Following the strategy, Portugal

adopted the National Adaptation Plan for Climate Change in August 2019, identifying 8 adaptation action lines along with achievement and outcome indicators [6].

Furthermore, the revision of the Programme on National Spatial Planning Policy (PNPOT) - the primary national planning framework which sets guidelines and principles for territorial development - aims to include climate change factors in urban planning policies, thus also acting as a driver for climate adaptation interventions at the national and local levels [7].

1.1.3. Local

The need for adaptation at a local level prompted thirty Portuguese municipalities to develop adaptation strategies in recent years, as part of the ClimAdaPT.Local project. Figueira participated in this initiative and adopted a comprehensive adaptation strategy in 2016 [8]. Furthermore, adaptation to climate change was incorporated in the Municipal Master Plan (PDM) with defining no-construction areas based on future flood risks.

1.2. Task

Since the adoption of its climate adaptation strategy, Figueira has proposed a number of options to enhance the climate resiliency of the municipality. As a next step, the municipality aims to develop an action plan specifying timeframes, funding sources, and monitoring mechanisms in order to operationalise this strategy.

This report is meant to support the municipality “jumpstart” the action planning process by:

- Illustrating important methods and steps related to climate adaptation
- Providing best practices in action planning based on other municipalities
- Offering initial examples and a proposed template for its adaptation actions

1.3. Approach

In order to solve the task, a four-step research process was incorporated, split across desktop and field research (see Figure 2).

The main objective of the background & methodology stage was to gain a general understanding of climate adaptation including its political implications and critical success factors, and more specifically, the process by which adaptation actions plans are developed.

Next, six adaptation action plans from Cascais, Leiria and Loulé in Portugal; Dublin, Ireland; Barcelona, Spain; and Kristianstad in Sweden were used as case studies to gain a better understanding of potential actions, and assess the use of action plans and how these plans are presented in municipalities with comparable adaptation challenges.

The final two stages of the research approach involved nine semi-structured interviews with municipalities; regional authorities, universities and consultants; and local stakeholders such as a water company and pulp producer. Before and after the interviews, informal discussions were

held with Henrique Simões to gain additional context into the stakeholder's roles and responsibilities, and to clarify responses.



Figure 2: Research process

2. The Adaptation Process

In the process of institutionalising climate change adaptation, Figueira has followed the methodology of the Urban Adaptation Support Tool (UAST) provided by the Covenant of Mayors for Climate & Energy. This tool serves as a practical guidance for the adaptation process in urban areas and outlines six steps as shown in Figure 3 [9].



Figure 3: Urban Adaptation Support Tool Process

As the first step, Figueira built the foundation for the adaptation process by assigning the responsibility of coordination to the Urban Planning Department, identifying relevant stakeholders and obtaining high level political support from the city's counsellors.

In step two, the main climate risks and vulnerabilities were assessed (see Table 1). These include strong waves and sea level rise, which can cause coastal erosion and damage to infrastructure and vegetation; increased temperatures and heat waves, which increase the likelihood of forest fires and threaten biodiversity and human health; excessive precipitation, which can create flooding and mudslides; and strong winds, which can cause property damage [8].

Table 1: Climate risk assessment for Figueira [8]

Main events/climate impacts	Climate risk		
	Current	Medium term (2041-2070)	Long term (2071-2100)
Strong waves/Sea level rise	4	9	9
High temperatures/Heat waves	4	9	9
Excessive precipitation (flooding)	2	6	6
Excessive precipitation (mudslide)	1	2	4
Strong winds	4	3	3

Based on these risks, adaptation options were identified in step three and assessed and prioritised according to several criteria in step four. As a result, thirty adaptation options ranging from broader options such as Improvement of the rain runoff systems in critical areas to more specific options such as Artificial feeding of the beaches in the south of the county through the dredging of the Mondego River in the port channel of Figueira were selected and integrated in the adaptation strategy. The adaptation options mostly addressed spatial planning, forest and agriculture as well as information and awareness.

The implementation of adaptation actions in step five is usually guided by the strategy and specified in an action plan. Despite the lack of a formal action plan, Figueira has already identified flood risk zones and included adaptation considerations in the Municipal Master Plan, revised forest fire resistance and resilience regulation, and is currently separating the storm drainage system from its sanitary sewer system. Nevertheless, an action plan – describing what needs to be done to put the chosen adaptation options into practice – is now needed. This plan should be informed by the outcomes in steps 1-4, but is not limited to the strategy's adaptation options. Figure 4 visualises the relationship between the strategy and the action plan showing that the considerations of the strategy are part of the action plan.

The final step of monitoring and evaluation is necessary to assess both the status of implementation of actions and whether the objectives of the actions have been achieved. While doing so, it is necessary to understand what and how frequently something needs to be monitored. Relevant data that is already being measured can be identified and integrated into this step. Furthermore, it is important to decide if the results of this step should just be internally accessible or available to the public.

Two types of indicators are generally used for monitoring [11]. Process-based indicators are used to measure the progress of the action and can be as simple as indicating if the action has been carried out or not. On the other hand, outcome-based indicators are used to measure the effectiveness in achieving the intended outcome. For example, an outcome-based indicator to monitor beach feeding could be an annual increase in beach width, while a process-based indicator could be the number of times feeding was carried out annually. Based on the findings in this step, the strategy and action plan may be revised, and the indicators modified if needed.

Thus, the adaptation process is iterative and requires regular engagement of staff and stakeholders.



Figure 4: Relating Adaptation Strategy and Action Plan [9,10]

3. Challenges in Figueira

When it comes to moving from the climate adaptation strategy to action (step five), Figueira faces several challenges. The first one originates from within the municipality. Currently, Figueira does not have a dedicated team working on climate adaptation. Instead, employees are expected to work on this topic in addition to their regular workload. Besides the difficulty of taking on more responsibilities, for many municipal employees it is unclear as to what their exact responsibilities would be in relation to climate adaptation, considering the action plan has not yet been developed. In some cases, there is also a need to further awareness about departmental actions that fall under the umbrella of climate adaptation. [12]

Progress in the implementation of climate adaptation options also faces financial constraints. Figueira is a small municipality with a limited budget for climate adaptation [13]. The adaptation strategy was developed with a grant from the European Economic Area and the Portuguese Carbon Fund. Figueira plans on applying to EU calls to fund future projects, but without an action plan it is ineligible for many of these grants.

In addition, most EU grants cover only a share of the total cost of a project, so Figueira should be able to demonstrate it has sufficient funds to cover the remaining cost. At the political level, ongoing changes in Portugal to promote further decentralisation will increase budgetary and staff pressures for municipalities [14], as they have to take on more responsibilities in areas like education, health, and transport, among others.

The engagement with external stakeholders is another area that could be improved. During the drafting of their climate strategy, Figueira worked in close coordination with a wide variety of public and private actors in the prioritisation of their adaptation options. Together, they identified possible partners for future work and created five working groups: Water Resources; Tourism and Green Areas; Energy, Health and Buildings; Coastal Areas; Agriculture and Forest; with the last two groups being the most active. It is worth noting that in the absence of an adaptation action plan, keeping stakeholders engaged in a consistent and meaningful way becomes even more challenging.

The organisational issues, budgetary pressures, and difficulties with engaging stakeholders described above have already caused some delays in the timeframes envisioned in implementing Figueira's climate adaptation options. The following section presents a brief overview of best practices in the formulation and implementation of adaptation action plans found during our research process. The intent is to provide information on the approaches that have proven successful for other municipalities, and that Figueira could incorporate into their own context.

4. Best practices

Based on the reviewed literature, the chosen case studies, and interviews with other municipalities, a number of general best practices for enabling effective adaptation action were identified. In the following section, we provide a summary of these best practices pertaining to organisation, communication, and engagement issues.

4.1. Internal organisation

In order to institutionalise climate adaptation within the municipality, most cities in the case studies put together a team exclusively working with this issue [15,16,17,18]. This would be the best-case scenario for Figueira to make progress on climate adaptation, but under current budgetary and staffing pressures, it seems rather complicated. The municipality could instead resort to alternative solutions for filling the staff gap, such as hiring interns or obtaining funding to employ people on a project basis.

Furthermore, the interdepartmental support and collaboration was highlighted as a success factor [15,17]. When it comes to increasing interdepartmental engagement with the adaptation strategy, the development of the action plan will help clarify responsibilities. Internal awareness campaigns and workshops could help to further improve understanding of the link between climate adaptation and the work of different departments.

Moreover, it is advisable to establish a formal interdepartmental climate adaptation task force with regular meetings (e.g. bimonthly) to promote communication and coordination between municipal departments. This will further enable effective planning of strategies and actions related to climate change by integrating the expertise of different staff members. The formation

of this task force should be politically demanded and all departments that are somehow involved with climate issues should name a representative member and a substitute to be part of it.

4.2. Stakeholder involvement

Stakeholder involvement is a key success factor when developing an effective climate adaptation action plan [10,11,15,17,18,19]. Local stakeholders should be involved in planning processes that affect their own lives or work [1]; in cases where they are involved in such planning, impacts on the adaptation outcomes have been positive [20]. Thus, by jumpstarting the development of the climate adaptation plan for Figueira, the municipality has the chance to reinvigorate the engagement of external stakeholders.

The most common way of integrating stakeholders in the adaptation action plan development process is by setting up workshops and meetings in smaller groups for specific topics. For this, key stakeholders should be identified for example based on their salience [11, 21]. The general public is usually involved at a later stage when actions are more tangible and specific. During these workshops and meetings, the municipal staff can provide the stakeholders with an initial set of proposed adaptation actions, instigating discussions and leading the way to new adaptation action ideas. This process enables a feeling of ownership for the actions amongst the stakeholders and may even result in stakeholders taking responsibility and leadership for a portion of them.

Following the development of the action plan, it is important that the municipality works closely with all relevant actors during its implementation, monitoring, and evaluation. As in the case of the internal stakeholders, having an action plan will also help external stakeholders get a clearer picture of their roles.

4.3. Public awareness

Next to the support of the mayor, public awareness was often mentioned as a key driver for climate adaptation during interviews [10,15,16,22]. Thus, to enhance public awareness and support for adaptation, Figueira could implement practices that have proven successful in other municipalities.

4.3.1. Create an adaptation brand

In Loulé, creating a common brand for activities related to climate adaptation has improved internal and external communication [16]. A simple and clear brand logo can increase public recognition of climate action in the municipality and improve engagement and awareness amongst stakeholders. Furthermore, this brand could integrate activities of different municipal departments as well as external stakeholders under the common umbrella of adaptation. This

applies to activities that have already been completed, those currently carried out, and those planned for future implementation.

4.3.2. Link adaptation actions to the SDGs

The SDGs have become increasingly well-known and used by stakeholders to understand and assess their commitment towards sustainability. Hence, linking both climate adaptation options and actions to the relevant SDGs would not only make it easier to visualise and communicate the benefits of an action, but also understand other climate impacts or areas addressed by the action [15].

4.3.3. Focus on actions with tangible results first

A success factor in other municipalities is the prioritisation of actions that are easy to implement, commonly referred to as low hanging fruits [15,16,22]. To gain public support, municipalities also focus on actions that carry tangible and visible outputs or benefits for citizens, as in the case of health. One example in Figueira is the installation of drinking water fountains to combat dehydration due to increasing heat waves. In Loulé, the municipality has set out to define and implement a program related to the impact of climate change in human health.

Besides the link between climate change adaptation and health, social considerations have also come up in some case studies. For instance, Barcelona has grant programs to improve thermal insulation in housing, with a focus on families in vulnerable situations. In Leiria, the assessment of heat wave resilience for housing prioritises the most vulnerable social groups. By establishing these types of linkages between climate change and issues that are more tangible to the general public, adaptation becomes more accessible for stakeholders.

5. Implementing adaptation

The application of general best practices is helpful to enable the whole process of climate adaptation. The following section provides an overview on the next steps for the development of an action plan. Recommendations regarding the strategy, the actions layout, and the division of working groups are elaborated upon. The consulting team suggestions span 8 adaptation options from the 30 adaptation options provided in Figueira's strategy document, which were chosen based on the existence of similar examples found in research and case studies. The team suggests a total of 29 actions for the selected adaptation options. Our intent is for these proposed actions to serve as a starting point of discussion in the development of Figueira's adaptation action plan and should not preclude Figueira from pursuing the other adaptation options.

5.1. Revisiting the strategy

As described in chapter 2, the analysis that has been conducted as part of the strategy is an integral part of the action plan. However, since the strategy was established three years ago, it is necessary to check whether the outcomes of the analysis are still relevant. The identification and evaluation of risks and vulnerabilities as well as the modelling of climate scenarios, for example, might need to be updated according to new scientific findings such as the latest Intergovernmental Panel on Climate Change (IPCC) reports.

Moreover, the adaptation options should be revisited and potentially revised, if needed. Some adaptation options may already be specific enough and can instead serve as an action under a broader adaptation option in order to facilitate the action planning process. New adaptation options could also be added according to new circumstances or needs of the community. Thus, the revision and updating of adaptation options should be considered before serving as a base for the action plan.

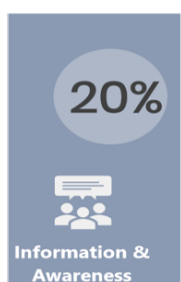
To facilitate the transition from strategy to action, we suggest the reorganisation of the current stakeholder working groups based on five predominant themes found in the adaptation options (see Figure 5). Under the proposed restructuring, the Coastal Protection as well as the Forest and Agriculture groups remain, but three new groups are suggested: Spatial Planning and Development, Water Management, and Information and Awareness. The suggested reorganisation of the working groups could make it easier for Figueira to link the different stakeholders with specific adaptation actions to work on, facilitating stakeholder engagement. The distribution of the adaptation options from the strategy, according to the proposed thematic areas can be found in Figure 5. A suggested distribution of stakeholders per thematic working group is also provided in Annex II.



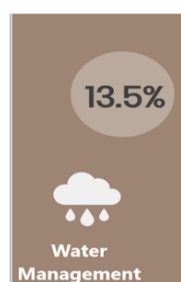
- Elaboration of Morradeira (wetlands) management plan (1)
- Promote "soft mobility" in urban areas through biking and pedestrian networks (18)
- Implementation of good practices for energy efficiency (20)
- Creation of urban gardens (21)
- Defend and promote protected and classified areas (23)
- Utilization of alternative energies: solar, wind and tidal (24)
- Awareness of stock land available in the municipality to maximize the use of abandoned land (25)
- Creation of a rural land register (26)
- Reordering of public spaces, with the introduction of less water demanding native and adapted plant species (27)
- Introduction of good practices in the planning and management of public trees (28)



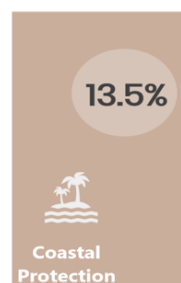
- Creation and improvement of water retention infrastructure for agricultural irrigation (3)
- Reordering of agricultural land (8)
- Increase forest resistance and resilience to forest fires and adaptation of the Municipal Plan for the Protection against forest fires (9)
- Promote the harnessing of forest biomass (10)
- Awareness to introduce good agricultural and forest practices (11)
- Reforestation to avoid the erosion of areas at risk of hydric erosion of the soil and unstable slopes (12)



- Creation of a municipal system to detect and manage climate events (15)
- Promote training and awareness sessions on the options/climate adaptation options and risks amongst the population, the Municipal Chamber of Figueira da Foz (CMFF), and institutions (16)
- Integration of a multidisciplinary team to study/plan strategies related to climate change and its consequent risks (17)
- Improve the knowledge about vulnerable groups (19)
- Creation of a Commission that includes key actors representing civil society and institutions, to work jointly in the promotion, follow-up and monitoring of the EMAAC (29)
- Periodic holding of a participative workshop (open to the local community) to present and discuss the work and results achieved in the EMAAC (30)



- Optimization and creation of good municipal practices for irrigation systems (2)
- Create incentives for sustainable water use (4)
- Improvement of the rain runoff urban systems in critical areas (5)
- Increase water access points for human consumption in urban areas, particularly in the areas with the highest population concentration (7)



- Municipal specific regulation for potential flooding and coastal erosion zones (6)
- Artificial feeding of the beaches in the south of the county through the dredging of the Mondego River in the port channel of Figueira da Foz (13)
- Introduction of a progressive setback of coastal areas considering criteria like low elevation to justify and define "no-construction" areas (14)
- Creation of an observatory of coastal areas' evolution (22)

Figure 5: Reorganisation of adaptation options per theme

5.2. Initiating the action plan

After revisiting the strategy, the development of actions can be addressed. With regard to the actual action plan, it is equally important that it provides a set of actions under each adaptation option while also aiding the decision maker on how to implement them. Therefore, we propose the use of a template describing various aspects outlined in the UAST for each identified action (see Table 2).

Table 2: Proposed action template

Action	X.X Name of action
Adaptation option	X. Name of adaptation option
Climate risk	Select from: Sea level rise and strong waves/High temperatures and heat waves/Excessive precipitation/Strong winds
Goal addressed	Name of overall goal/objective addressed by the action
Description	Detailed description of the action <ul style="list-style-type: none"> ➤ Why this action? ➤ What needs to be done? ➤ Potential synergies with actions within the same adaptation option
Leadership	E.g. Municipal department/Company + Name of responsible person (if possible)
Partners	Names of companies/NGOs/Universities
Timeframe	Number of years needed for implementation
Investment	Estimate € - €€€
Funding	Potential source of funding e.g. Municipal/National/EU/Private
Indicator	Example of indicator measuring the success of the action
Synergies	(process-based and/or outcome-based)

The proposed template first provides an overview of each action in terms of the climate risk(s) addressed and a short description involving its justification, how it can be implemented, and potential links to other actions that fall under a specific adaptation option. Then, a key leader and corresponding partners are defined, to help enable the effective monitoring and coordination of the action.

Further aspects crucial for implementation, such as an estimated timeframe and investment are provided along with the potential sources for funding. Here, euro signs indicate the magnitude of investment required, with one being a low investment and three being a large-scale investment. This is targeted at overcoming the barrier of reduced knowledge on funding sources amongst decision makers. Next, every action is paired with an indicator in order to ensure effective monitoring. Finally, other adaptation options impacted by the action, if any, are described under synergies.

In the following section we provide an introduction and a set of suggested actions for the five thematic areas. Detailed information for each adaptation action using the proposed action

template can be found in Appendix I. In many cases, the source of inspiration for the action suggested is provided between brackets [No.] in the description, with a number indicating the source in the reference list. Our intent is that the proposed actions serve as a starting point for stakeholder discussions as a way to develop Figueira’s action plan. While all actions are expected to contribute to SDG 13 Climate Action, other relevant SDGs addressed by the thematic areas are presented as well.

5.2.1. Spatial Planning and Development

Integrating and mainstreaming climate change considerations into spatial planning and development will play a crucial role in enhancing urban climate resilience within Figueira, creating a city that is resistant to future climate risks. The early integration of adaptation needs into planning (e.g. urban, water management) and regulation (e.g. building standards) can provide co-benefits that help avoid costs for adaptation by reducing the need for larger investments later on [23]. Other SDGs addressed by this thematic area would include:



The actions proposed under this theme (see Table 3) focus on improved awareness, mainly targeting the development of energy efficient infrastructure and the management of public trees.

Table 3: Proposed actions in Spatial Planning and Development

Adaptation Options	Proposed Actions
20. Implementation of good practices for energy efficiency	20.1 Install solar panels to power heat pumps/inverters for increased thermal comfort. 20.2 Establish requirements for thermal comfort and energy efficiency in buildings
28. Introduction of good practices in the planning and management of public trees	28.1 Inventory existing tree and plant species in municipality 28.2 Introduce heat-related reduction interventions in important urban spaces 28.3 Create a municipal tree/green space guide 28.4 Engage residents and children to participate in voluntary, tree planting programs

5.2.2. Forest and Agriculture

Increasing heat waves and corresponding decreases in water availability are the two main climate risks impacting the forest and agriculture sector. In light of the recent occurrences of forest fires in Figueira, improving forest resilience is crucial. Other SDGs addressed by this thematic area would include:



The actions proposed under this theme (see Table 4) aim to enhance forest resilience through better awareness of best practices and funding options.

Table 4: Proposed actions in Forest and Agriculture

Adaptation Options	Proposed Actions
9. Increase forest resistance and resilience to forest fires and adaptation of the Municipal Plan for the Protection against forest fires	9.1 Create a municipal forest manual 9.2 Explore EU Life Programmes for forest resilience projects and funding 9.3 Institute awards for best forest(s) of the year 9.4 Consider financial/tax measures to encourage good practices 9.5 Promote volunteer programs especially for children and teenagers

5.2.3. Information and Awareness

The dissemination of information on climate impacts and the need for adaptation through awareness campaigns, training or workshops is the backbone for all of Figueira's climate adaptation initiatives. This is crucial in ensuring active stakeholder and public involvement through the adaptation process. Other SDGs addressed by this thematic area would include:



The actions proposed under this theme (see Table 5) aim to increase public awareness and understanding of climate adaptation and risks.

Table 5: Proposed actions in Information and Awareness

Adaptation Options	Proposed Actions
16. Promote training and awareness on climate adaptation and risks	16.1 Set up a brand and website for climate action communication 16.2 Establish annual workshop with members of different departments within CMFF 16.3 Provide an informational brochure to general public 16.4 Reinforce emergency preparedness at public institutions 16.5 Organise competitions around climate change topic

5.2.4. Water Management

Effective water management is important for Figueira for many reasons. On the one hand, increasing temperatures and more recurring heat waves could potentially threaten the availability of drinking water and have negative health impacts, especially among vulnerable populations. On the other hand, more frequent and intense precipitation could cause flooding, overwhelm the drainage system, and pollute water deposits. Other SDGs addressed by this thematic area would include:



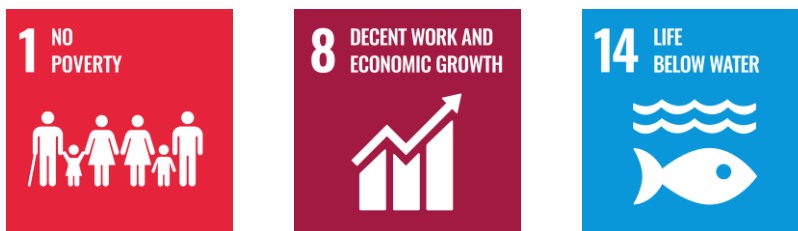
The actions proposed under this thematic area (see Table 6) focus on raising awareness around the rational use of water, while suggesting some improvements to the water and stormwater infrastructure.

Table 6: Proposed actions in Water Management

Adaptation Options	Proposed Actions
2. Optimization and creation of good municipal practices for irrigation systems	2.1 Create synergies for the use of greywater in private and public green areas 2.2 Gradual phase out of green gardens for Mediterranean style gardens or art spaces in Figueira
4. Create incentives for sustainable water use	4.1 Establish requirements for the reuse of greywater in the construction sector 4.2 Install water-saving faucets and taps in public buildings 4.3 Develop a Contingency Plan for Municipal Water Supply
5. Improvement of the rain runoff urban systems in critical areas	5.1 Integrate stormwater retention into urban planning 5.2 Create rain gardens 5.3 Improve awareness of rainwater harvesting 5.4 Clean and maintain pipes

5.2.5. Coastal Protection

Figueira's position as a coastal community makes it extremely prone to flooding and coastal erosion due to rising sea levels. Thus, building coastal resilience and preserving shorelines is crucial from both climate adaptation and recreational perspectives. Other SDGs addressed by this thematic area would include:



The actions proposed under this thematic area (see Table 7) focus on short-term and long-term solutions, integrated with improved awareness and engagement amongst vulnerable groups. In this case, adaptation option 13 from the strategy was originally artificial beach feeding. However, since it is highly specific, we suggest integrating it as an action under a broader option, Preserving shorelines. This is an example of how the adaptation strategy can be revised prior to designing the action plan.

Table 7: Proposed actions in Coastal Protection

Adaptation Options	Proposed Actions
13. Preserving shorelines	13.1 Spread awareness of coastal risks and shoreline management 13.2 Artificial feeding of the beaches in the south of the county 13.3 Strengthen dunes 13.4 Develop an integrated coastal management plan

6. Funding

A study evaluating a number of adaptation plans from Australia, the UK and the US, found that most plans neglected the capital needs for effective adaptation [24]. This is considered a critical weakness and significantly decreases climate change preparedness. Since adaptation measures can require large, initial investment costs without providing short-term financial returns, it is important to look into possible funding options for developed nations and for Portugal in particular.

Generally, there are three main potential sources for financing local adaptation measures in Figueira [23]:

- Government grants (EU, national, municipal)
- Bank/Financial loans or guarantees
- Private stakeholder funding such as direct investment, crowdfunding or green bonds

6.1. Public funding

The interviews with other municipalities provided evidence that governmental funding from the national or European level is by far the most employed financing within climate adaptation in Portugal.

The EU provides several funding mechanisms. The member states agreed to spend 20% of the EU's long-term budget 2014-2020 (Multiannual Financial Framework 2014-2020) on climate change action, which includes mitigation and adaptation [23]. The funds with the highest budgets for climate adaptation from the EU are organised within the European Structural and Investment Funds (ESIF). More than 114 billion Euro of the ESIF are earmarked for climate change mitigation and adaptation [25]. The respective funds within the ESIF are [26]:

- European Regional Development Fund (ERDF)

- Cohesion Fund (CF)
- European Social Fund (ESF)
- European Agricultural Fund for Rural Development (EAFRD)
- European Maritime and Fisheries Fund (EMFF)

The allocation of the budget of these funds is negotiated and then managed by the respective member states via partnership agreements. For Portugal, this materialises in the Portugal 2020 fund, which has a budget of 25 billion Euro to spend until 2020 from ESIF (mostly the ERDF, the ESF and CF) out of which around 1 billion Euro is specifically reserved for the thematic objective of climate change adaptation [27]. 64% of that money for adaptation is derived from the EAFRD followed by the Cohesion Fund with a share of 34% (see Figure 6). So far, only 71% of the total budget of the Cohesion fund and 81% of the EAFRD's budget have been decided [28]. Overall, 88% of Portugal's ESIF budget has been decided. Since this budget needs to be allocated by the end of 2020, this may increase the number of project approvals next year.

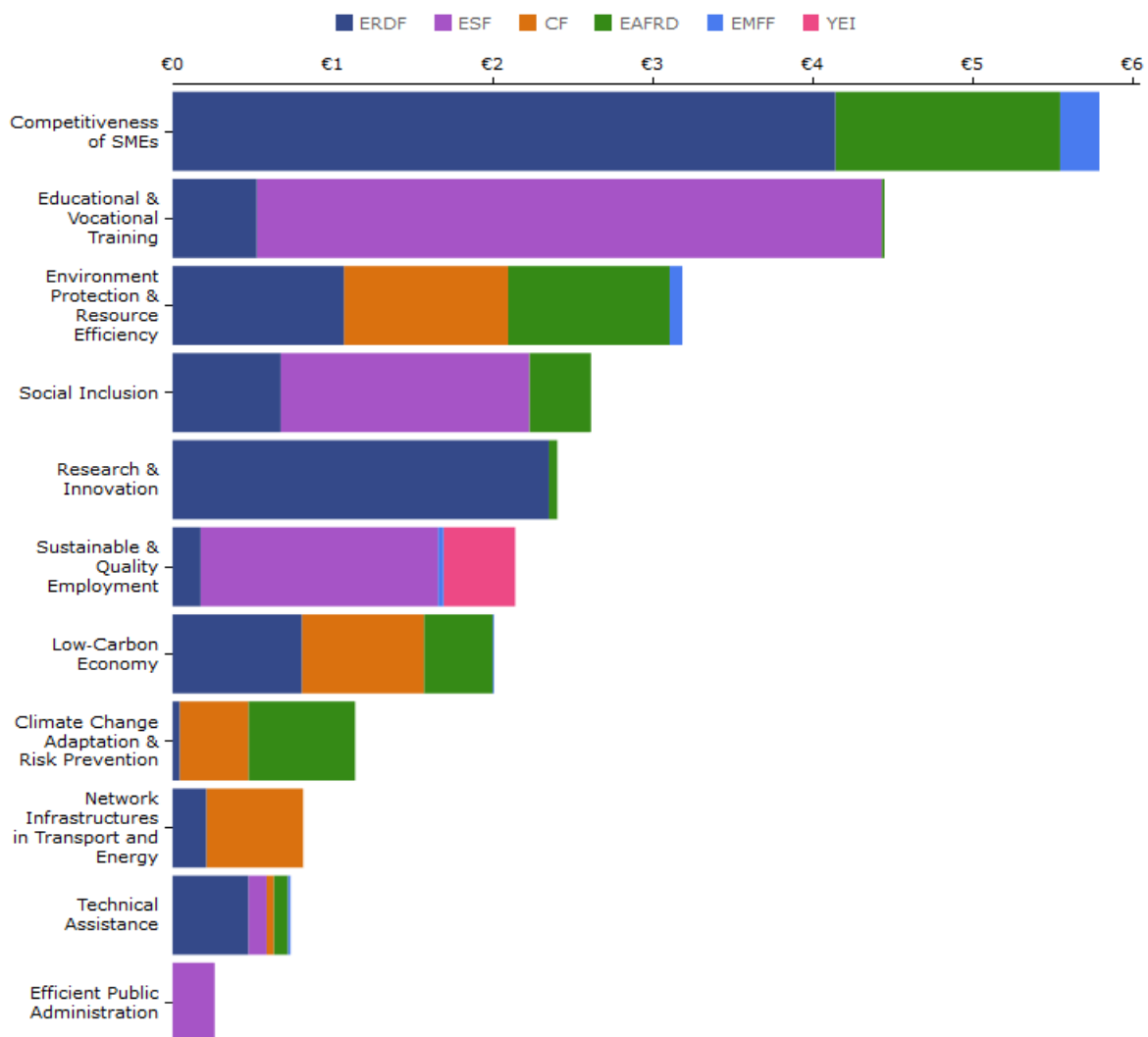


Figure 6: Total Budget by Theme - Portugal, EUR Billion [28]

However, case studies have shown that many successful financing initiatives use a portfolio of financing options combining funding from different sources and governmental levels. The finance used often does not mention adaptation in particular but targets other sectors that are related to climate-resilient infrastructure [24]. Hence, the focus should not only be on pursuing funds that are solely designed for adaptation but other types of funds as well that align with and support the adaptation actions.

Moreover, there are other funds that sponsor adaptation measures such as the EU's LIFE programme for the Environment and Climate Action, which "provides co-financing for best practice, pilot and demonstration projects that contribute to supporting efforts leading to increased resilience to climate change" [26]. Other programmes make money available for research like Horizon 2020 and Climate-KIC. Next to these grants, there are loans available by the European Investment Bank to enable climate adaptation.

All these funds have specific goals and finance different adaptation measures with varying co-financing rates. Thus, it requires knowledge and human resources to make use of these funds, which are often lacking in smaller municipalities. Nevertheless, it is key for a municipality to develop the capacity to identify financing opportunities, to apply for them and to negotiate the terms. Initiatives by the European Investment Bank or the EU's LIFE programme have started to address this problem by providing capacity-building and technical support to cities and municipalities. [24]

The negotiations for the EU's long-term budget 2021-2027 are ongoing, but it is expected to increase in the period 2021-27 and the share of climate-related spending might increase from 20% to 30%. Thus, it is key for Figueira to acquire knowledge on these funding mechanisms and their application requirements to qualify for such financing opportunities.

Portugal has an additional funding mechanism to make money available for climate adaptation, which is called "Fundo Português de Carbono" (FPC). Despite its initial focus on mitigation measures, it has also funded adaptation measures since 2014. However, to make environmental policy more effective, the resources of existing funds - including the FPC - have been organised in a single Environmental fund (Fundo Ambiental). The total budget is set per year and added up to 1 million Euro in 2019. The maximum co-financing rate is 85% and cannot exceed 200.000 € per project. The application deadline is 30th September of the respective year and projects that have previously been the subject of national or community public funding (e.g. Portugal 2020) are not supported [29].

6.2. Private funding

Financing adaptation measures via bank loans or private investments is uncommon thus far because the measures usually do not provide short-term financial returns. One strategy to increase private investment or public-private partnerships (PPP) could be to stress the immediate benefits and/or co-benefits of adaptation measures for affected sectors and groups. One related example of a successful PPP can be found in Bilbao, where a PPP was set up in 2016

to enable building a new floodproof district. A large group of landowners of all sizes joined the PPP and agreed to pay for the ground level elevation and public green spaces while the City Council and the Basque Country financed the opening of the canal, new bridges, a flood protection barrier and the stormwater tanks. [30]

Another promising instrument to fund climate adaptation projects are green bonds. In simple terms, the bonds are a promise to lenders that the borrower will repay the capital and interest generated after a certain time. They can be issued by government authorities at the national or local level as a way for them to access low-cost capital for the financing of projects that create environmental benefits [31]. Projects financed by green bonds span areas like renewable energies and energy efficiency, clean transportation, sustainable forestry and agriculture, sustainable waste management, among others [32]. Besides the environmental benefits, the projects should have a clear business case to be able to repay the capital borrowed and interest accrued [33].

The type of Investors interested in green bonds place value on the financial performance of their investments but also on environmental, social, and governance (ESG) aspects. This is the case, as an example, for pension funds and insurance companies. All over the world, green bonds have been issued to finance projects that create environmental benefits. For instance, water piping projects in the U.S., photovoltaic cells in Chile, and energy efficient social housing in France. There are two main voluntary certification schemes for green bonds, the Green Bonds Principles, issued by the International Capital Market Association, and the Climate Bonds Standards (CBS) rating, issued by the Climate Bonds Initiative. Thus, it could be worthwhile for Figueira to gain economic knowledge to utilise these alternative funding opportunities.

7. Conclusion

In recent years, climate change mitigation and adaptation have become increasingly important issues on the global agenda. However, our month-long journey into climate adaptation and collaboration with Figueira has taught us that while climate change is global, adaptation is local. For instance, adaptation actions undertaken by one community to protect itself from coastal erosion may differ significantly from another community situated only a short distance away along the same coast.

In the case of Figueira, substantial strides have already been made through the adoption of an adaptation strategy. Still, as a signatory to the Covenant of Mayors and as a community that has experienced devastating climatic events in recent years, Figueira is committed to taking the next step in its preparations.

We have highlighted three key areas for future success in Figueira's development of an action plan: close collaboration with internal and external stakeholders, ongoing communication and awareness, and knowledge development surrounding funding opportunities for climate adaptation.

There is certainly a lot left to do to make the municipality of Figueira a more resilient and sustainable community. Political will and progress are present in certain instances and we are confident that by combining this momentum with our recommendations, the community can secure the capacity to move from strategy to action and become a leader in climate adaptation in the years to come.



Consulting Team with Members of the City Hall in Figueira da Foz at the Final Presentation

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Annex I: Detailed Actions

1. Thematic area: Spatial Planning and Development

Adaptation Option 20

Action	20.1 Install solar panels to power heat pumps/inverters for increased thermal comfort
Adaptation option	20. Implementation of good practices for energy efficiency
Climate risk	High temperatures and heat waves
Goal addressed	<p>III. Defining ways to integrate adaptation instruments with municipal territorial management</p> <p>IV. Training municipal technicians and key actors to deal with climate change adaptation</p> <p>VII. Explore potential opportunities linked to climate change, highlighting potential socio-economic benefits</p>
Description	<p>Energy poverty is an issue that many Portuguese homes face. Traditionally ,the focus area of energy poverty has been thermal comfort, usually understood as the ability to keep buildings warm [41].However, in light of increasing temperatures and more frequent heat waves there is also the preoccupation about the ability to keep homes comfortably cool during extended, record-hot summers.</p> <p>The focus of this action would be in increasing the conditions for thermal comfort both for low and high temperatures through the use of heat pumps/inverters for increased thermal comfort. It is suggested to start out with establishing a baseline on current thermal vulnerability.</p> <p>To determine current thermal vulnerability, the municipality and stakeholders could choose to focus on the public buildings with the most influx of people or where urban heat island effect is felt the most (measurements of temperature in different areas of the city would be necessary to determine that).</p> <p>The focus could also be public buildings with vulnerable populations like schools and hospitals, or in habitational units where vulnerable populations live (elderly, children).</p> <p>Once the target is selected, a pilot project could be implemented to assess its suitability to Figueira's context. If the target was municipal buildings/schools, it would be advisable that the spaces could double as shelters in contingencies related to extreme heat events. If the target is habitational units, the municipality could explore the option of leasing or buying the equipment; and giving it to the population for free, for a discounted amount, or in monthly instalments. Another option could be to invite companies to participate and offer lease-schemes to consumers.</p> <p>This action was inspired by the case of Barcelona [18].</p>

Leadership	CMFF, Civil Protection, Portuguese Environmental Agency
Partners	Parish Councils
Timeframe	Est. 5-10 years
Investment	Est. €€-€€€
Funding	Municipal funds, private funds, PO SEUR, European Social Fund (5% of the fund is allocated to energy efficiency and sustainable urban mobility), the Cohesion Fund (supporting energy efficiency, smart energy management, and renewable energy use in public infrastructure, public buildings and in the housing sector is investment priority iii of the Fund)
Indicator	<ul style="list-style-type: none"> • # of heat pumps/inverters installed per year • # of direct beneficiaries from the heat pumps/inverters
Synergies	<u>Adaptation options</u> : Improve the knowledge about vulnerable groups (19); Utilization of alternative energies: solar, wind and tidal (24)

Action	20.2 Establish requirements for thermal comfort and energy efficiency in buildings
Adaptation option	20. Implementation of good practices for energy efficiency
Climate risk	High temperatures and heat waves
Goal addressed	III. Defining ways to integrate adaptation instruments with municipal territorial management IV. Training municipal technicians and key actors to deal with climate change adaptation VII. Explore potential opportunities linked to climate change, highlighting potential socio-economic benefits
Description	<p>The more frequent occurrence of extreme temperatures linked to climate change makes it important to have buildings designed for thermal comfort and maximum energy efficiency. In order to make this a reality in Figueira, the suggested approach is the following:</p> <p>Gather relevant actors to discuss what elements to incorporate into the requirements for thermal comfort and energy efficiency, drafting them together with stakeholders. It is suggested to reunite a combination of public and private sector stakeholders, as well as civil society representatives. More than individual owners, the requirements could amplify their effect by targeting real estate agencies and construction businesses.</p> <p>Additionally, public guidelines on green buildings could be followed; including the incorporation of other requirements, like water efficiency and end of life.</p> <p>The use of the requirements for new buildings could be voluntary for a limited period, and then gradually become mandatory from year three onward; both for public projects, private projects, and habitational units.</p> <p>In the case of existing buildings, Figueira could incorporate thermal comfort and criteria requirements for future remodelling/maintenance projects, focusing on those facilities that receive the greatest number of members of the public as the first step.</p> <p>This action was inspired by similar actions in Leiria and Barcelona [35, 18]</p>
Leadership	CMFF (Urban Department)
Partners	Civil Protection, Portuguese Environmental Agency, Parish Councils, Trade and Industrial Association
Timeframe	Est. 5-10 years
Investment	Est. €-€€
Funding	Private, PO SEUR, European Social Fund (5% of the fund is allocated to energy efficiency and sustainable urban mobility), the Cohesion Fund (Supporting energy efficiency, smart energy management, and renewable energy use in

	public infrastructure, public buildings and in the housing sector is investment priority iii of the Fund)
Indicator	<ul style="list-style-type: none"> • Existence of thermal comfort and energy efficiency criteria for buildings (YES/NO) • # of new buildings incorporating thermal comfort and energy efficiency criteria per year • # of remodelling projects incorporating thermal comfort and energy efficiency criteria per year
Synergies	<u>Adaptation options:</u> Utilization of alternative energies: solar, wind and tidal (24)

Adaptation Option 28

Action	28.1 Inventory existing tree and plant species in municipality
Adaptation option	28. Introduction of good practices in the planning and management of public trees
Climate risk	High temperatures and heat waves
Goal addressed	I. To increase the knowledge of the municipality about the predisposition to extreme climate events and the adverse impacts on people's safety and property III. Defining ways to integrate adaptation instruments with municipal territorial management V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>In this action, trees (and plants) within the municipality are to be inventoried to provide future guidance on planting guidelines, act as a baseline for a municipal tree/plant manual, promote biodiversity, and reduce fire risks and emissions. Sub-actions could entail cataloguing tree species and their capacity to withstand heat and extreme weather as well as ability to offer ecosystem benefit. Consideration could be given to involving the public in such inventorying exercises as a way to increase awareness, engagement and reduce municipality effort and costs.</p> <p>This action may also contribute to 28.2 and 28.3, especially if noting the location of the catalogued species.</p> <p>This action is inspired by similar actions in Leiria, Cascais, Dublin, Barcelona, and an interview with a Nature-based Solutions researcher [15,17,18,22,42].</p>
Leadership	CMFF
Partners	Institute for Nature Conservation and Forests, Central Regional Directory for Agriculture and Fishing
Timeframe	Est. 2 years
Investment	Est. €€
Funding	Municipality
Indicator	<ul style="list-style-type: none"> # of tree/plant species recorded
Synergies	<u>Adaptation options</u> : Awareness to introduce good agricultural and forest practices (11); Creation of urban gardens (21)

Action	28.2 Introduce heat-related reduction interventions in important urban spaces
Adaptation option	28. Introduction of good practices in the planning and management of public trees
Climate risk	High temperatures and heat waves
Goal addressed	<p>I. To increase the knowledge of the municipality about the predisposition to extreme climate events and the adverse impacts on people's safety and property</p> <p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>III. Defining ways to integrate adaptation instruments with municipal territorial management</p> <p>VII: Explore potential opportunities linked to climate change, highlighting potential socio-economic benefits</p>
Description	<p>Here the action is meant to reduce high temperatures and heat effects in (high density) urban spaces to improve the comfort and health of residents, while potentially adding value to recreational areas. Figueira is to identify important urban spaces prone to heat risks (e.g. city centre, schools, assisted living) and introduce new green spaces, trees for shading, and complementary, natural water solutions. Furthermore, the exercise could be extended to include industrial areas and other known heat islands.</p> <p>This action may contribute to 28.3, by highlighting areas especially critical to high temperatures and drought.</p> <p>This action is inspired by similar actions in Leiria, Cascais, and Kristianstad [15,19,22].</p>
Leadership	CMFF
Partners	-
Timeframe	Est. Up to 10 years [19]
Investment	Est. at least 100K € per year [19]
Funding	Municipality, Portugal 2020
Indicator	<ul style="list-style-type: none"> • # of important areas updated/rehabilitated
Synergies	<u>Adaptation options</u> : Improve the knowledge about vulnerable groups (19); Creation of urban gardens (21); Reordering of public spaces, with the introduction of less water demanding native and adapted plant species (27)

Action	28.3 Create a municipal tree/green space guide
Adaptation option	28. Introduction of good practices in the planning and management of public trees
Climate risk	High temperatures and heat waves
Goal addressed	<p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>IV. Training municipal technicians and key actors to deal with climate change adaptation</p> <p>V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change</p>
Description	<p>The purpose of this action is to develop a best practices manual for existing and new green space projects, along with implementation guidelines. Such information could include guidance on specific public trees/plants recommended for planting along with maintenance requirements, along with natural water-related solutions including rehabilitation of riverbeds, ponds, etc. Consideration should be given as to whether the guide is targeted at private or public spaces, or both.</p> <p>This action is inspired by similar actions in Leiria, Cascais, Dublin and Barcelona [15,17,18,22].</p>
Leadership	CMFF
Partners	-
Timeframe	Est. 2-3 years
Investment	Est. €€
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • % species identified in the manual against all local species • # of manuals distributed to residents with green spaces
Synergies	<p><u>Actions</u>: Potentially 9.1 (depending on the feasibility of merging forestry manual with a green space guide)</p> <p><u>Adaptation options</u>: Improvement of the rain runoff urban systems in critical areas (depending on target species and ability to hold water) (5); Awareness to introduce good agricultural and forest practices (11); Creation of urban gardens (21)</p>

Action	28.4 Engage residents and children to participate in voluntary, tree planting programs
Adaptation option	28. Introduction of good practices in the planning and management of public trees
Climate risk	High temperatures and heat waves
Goal addressed	I. To increase the knowledge of the municipality about the predisposition to extreme climate events and the adverse impacts on people's safety and property V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>With this action, Figueira may engage the public in tree planting programs throughout the city and encourage volunteers and residents to learn about and implement good green space and tree practices. Specifically, local educational and awareness raising programs including field trips, communications, and online media tools focused on the importance of trees can complement the action. Likewise, a voluntary tree team for the younger audience could be established.</p> <p>This action is inspired by similar actions in Loulé [16].</p>
Leadership	CMFF
Partners	Educational Department, Zoomarine
Timeframe	Ongoing/Annually
Investment	Est. €
Funding	Municipality or Environmental Fund of the Ministry of Environment & Transition (depending on project focus)
Indicator	<ul style="list-style-type: none"> # of annual volunteers
Synergies	<p>Actions: 9.5</p> <p><u>Adaptation options</u>: Awareness to introduce good agricultural and forest practices (11); Promote training and awareness sessions on the options/climate adaptation options and risks amongst the population, the Municipal Chamber of Figueira da Foz (CMFF), and institutions (16)</p>

2. Thematic area: Forest and Agriculture

Adaptation Option 9

Action	9.1 Create municipal forest manual
Adaptation option	9. Increase forest resistance and resilience to forest fires and adaptation of the Municipal Plan for the Protection against forest fires
Climate risk	High temperatures and heat waves
Goal addressed	<p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>IV. Training municipal technicians and key actors to deal with climate change adaptation</p> <p>V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change</p>
Description	<p>The purpose of this action is to take a preventive approach toward helping the municipality protect itself against forest fires that stretches beyond the contents of the Municipal Defence Plan and currently available public forest information. The contents of the forest manual could include listings of hazardous trees (susceptible to fires), valuable/native species that offer more resiliency, and maintenance information on species including water content and soil moisture requirements. The manual could also identify biomass and forest fuel reduction practices, areas more prone to forest fires and instructions for replacing invasive/susceptible species in existing burnt areas. The manual could also be distributed to private forest managers.</p> <p>This action may also contribute to action 9.3, by providing private forest managers with the required information to employ good forest management practices.</p> <p>This action is inspired by similar actions in Leiria, Cascais, Barcelona, and EU Life Programme [15,18,22,37,38].</p>
Leadership	CMFF
Partners	Municipal Civil Protection and Firefighters Services, Institute for Nature Conservation and Forests, Central Regional Directory for Agriculture and Fishing, Forestry Technical Offices (Florestal)
Timeframe	Est. 2-3 years
Investment	Est. €€
Funding	Municipality, PO SEUR (as for risk mapping of areas)
Indicator	<ul style="list-style-type: none"> # of manuals distributed across forest owners

Synergies

Adaptation options: Promote the harnessing of forest biomass (10); Awareness to introduce good agricultural and forest practices (11); Creation of a rural land register (as it relates to engaging private forest owners) (26); Introduction of good practices in the planning and management of public trees (manual could be combined with such information as a possibility) (28)

Action	9.2 Explore EU Life Programmes for forest resilience projects and funding
Adaptation option	9. Increase forest resistance and resilience to forest fires and adaptation of the Municipal Plan for the Protection against forest fires
Climate risk	High temperatures and heat waves
Goal addressed	<p>I. To increase the knowledge of the municipality about the predisposition to extreme climate events and the adverse impacts on people's safety and property</p> <p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>IV. Training municipal technicians and key actors to deal with climate change adaptation</p>
Description	<p>With this action, the EU Life programme is meant to improve forest fire protection and decision making. The programme can help leverage additional forest management expertise and insights from other programme/project partner regions to gain new scientific insights into local forest conditions. This new information can then be used to develop new Decision Support Systems to be used by local forest managers, while sharing new information with other municipalities or regions within Europe.</p> <p>Other EU Life projects have also combined/developed local heat alert systems, fire department training, and educational/communications targeted at the public under a single project umbrella.</p> <p>This action is inspired by similar actions in existing EU Life Programme projects [37,38,39,40].</p>
Leadership	CMFF
Partners	Municipal Civil Protection and Firefighters Services, Institute for Nature Conservation and Forests, Central Regional Directory for Agriculture and Fishing, Forestry Technical Offices (Florestal), EU Life Programme & other partners
Timeframe	Est. 1-3 years (depending on project) [37,38,39,40]
Investment	Est. Up to 1M € but spread across 2-3 participating regions/countries [38,39,40]
Funding	EU Life Programme (est. 1-2M €), Municipality
Indicator	<ul style="list-style-type: none"> • % increase in sustainable biomass production • % reduction in forest fire hazards • % increase in forest resilience to withstand droughts
Synergies	<u>Adaptation options</u> : Promote the harnessing of forest biomass (10);

	Awareness to introduce good agricultural and forest practices (11); Promote training and awareness sessions on the options/climate adaptation options and risks amongst the population, the Municipal Chamber of Figueira da Foz (CMFF), and institutions (16)
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Action	9.3 Institute awards for best forest(s) of the year
Adaptation option	9. Increase forest resistance and resilience to forest fires and adaptation of the Municipal Plan for the Protection against forest fires
Climate risk	High temperatures and heat waves
Goal addressed	<p>I. To increase the knowledge of the municipality about the predisposition to extreme climate events and the adverse impacts on people's safety and property</p> <p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>III. Defining ways to integrate adaptation instruments with municipal territorial management</p> <p>V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change</p>
Description	<p>This action is meant to encourage e.g. private forest owners to establish good forest management practices, including fire protection, through public recognition incentives. Specifically, an award program will be established recognising those private landowners exhibiting exceptional commitment/effort towards good forest practices.</p> <p>This action may work in combination with 9.1</p> <p>This action is inspired by similar actions in Leiria [22].</p>
Leadership	CMFF
Partners	Institute for Nature Conservation and Forests, Central Regional Directory for Agriculture and Fishing
Timeframe	Ongoing
Investment	Est. €
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • % forest owners participating in award program
Synergies	<p><u>Adaptation options</u>: Promote the harnessing of forest biomass (10); Awareness to introduce good agricultural and forest practices (11)</p>

Action	9.4 Consider financial/tax measures to encourage good practices
Adaptation option	9. Increase forest resistance and resilience to forest fires and adaptation of the Municipal Plan for the Protection against forest fires
Climate risk	High temperatures and heat waves
Goal addressed	<p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>III. Defining ways to integrate adaptation instruments with municipal territorial management</p> <p>VII: Explore potential opportunities linked to climate change, highlighting potential socio-economic benefits.</p>
Description	<p>The purpose of this action is to financially incentivise e.g. private forest owners to establish good forest management practices, including fire protection. The municipality could provide financial/fiscal support to forest owners to promote forest resiliency and/or the replacement of invasive with native species along with biodiversity.</p> <p>The action could also be integrated with 9.3, if the type of award is determined to be monetary in nature.</p> <p>This action is inspired by similar actions in Leiria [22].</p>
Leadership	CMFF
Partners	Central Regional Directory for Agriculture and Fishing
Timeframe	Ongoing
Investment	Est. €€
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • % financial support given • % forest owner enrollment
Synergies	<p><u>Adaptation options</u>: Promote the harnessing of forest biomass (10);</p> <p>Awareness to introduce good agricultural and forest practices (11)</p>

Action	9.5 Promote volunteer programs especially for children and teenagers
Adaptation option	9. Increase forest resistance and resilience to forest fires and adaptation of the Municipal Plan for the Protection against forest fires
Climate risk	High temperatures and heat waves
Goal addressed	I. To increase the knowledge of the municipality about the predisposition to extreme climate events and the adverse impacts on people's safety and property V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>Here the action is meant to encourage volunteers and residents to learn about the importance of implementing good forestry and green spaces practices in the face of climate change. Types of programs established could include the development of a young forestry volunteer team and educational activities (e.g. good afforestation practices, removal of invasive species, managing biomass). Additionally, the incorporation of field trips and online media tools could be leveraged to further knowledge.</p> <p>This action is inspired by similar actions in Loulé [16].</p>
Leadership	CMFF
Partners	Educational Department
Timeframe	Ongoing/Annually
Investment	Est. €
Funding	Municipality or Environmental Fund of the Ministry of Environment & Transition (depending on project focus)
Indicator	<ul style="list-style-type: none"> # of annual volunteers
Synergies	<p><u>Adaptation options</u>: Promote the harnessing of forest biomass (10); Awareness to introduce good agricultural and forest practices (11); Promote training and awareness sessions on the options/climate adaptation options and risks amongst the population, the Municipal Chamber of Figueira da Foz (CMFF), and institutions (16); Introduction of good practices in the planning and management of public trees (28)</p>

3. Thematic area: Information and Awareness

Adaptation Option 16

Action	16.1 Set up a brand and website for climate action communication
Adaptation option	16. Promote training and awareness on climate adaptation and risks
Climate risk	All
Goal addressed	V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>Creating a common brand and website for activities related to climate adaptation has shown to enhance internal and external communication in other municipalities. A simple and clear brand logo can help improve engagement and awareness amongst stakeholders and integrate activities across different municipal departments under the common umbrella of adaptation. Furthermore, the brand could also potentially include cooperative projects with industry and companies in order to keep an overview on all actions taking place in the municipality.</p> <p>The brand and website should be set up by a PR agency, but the municipality has to start collecting data on past, ongoing and planned projects both from the municipality as well as from private companies to include under this brand.</p> <p>This action is inspired by similar actions in Loulé, Leiria, Cascais and Dublin [15,16,17,22,34,35,36].</p>
Leadership	CMFF
Partners	-
Timeframe	Est. 1-2 years
Investment	Est. €
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • Initial brand and website set up • % of people recognizing the brand (e.g. in an internet survey) • # of visits to website
Synergies	-

Action	16.2 Establish biannual workshop with members of different departments within CMFF
Adaptation option	16. Promote training and awareness on climate adaptation and risks
Climate risk	All
Goal addressed	V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>This action's objective is to create and nurture a common understanding of the importance of climate change adaptation and promote the mainstreaming of adaptation in planning and policy amongst staff members in different departments in the municipality. It can create awareness for the actions that are already undertaken and potentially mobilise staff members for collaboration and gather new ideas for actions.</p> <p>This action may contribute to 16.1, by using biannual workshops as a source for projects.</p> <p>This action is inspired by similar actions in Dublin, Cascais, and Kristianstad [15,17,19,34].</p>
Leadership	CMFF
Partners	-
Timeframe	Ongoing
Investment	Est. €
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • # of workshops held annually • # of attendees at workshops
Synergies	-

Action	16.3 Provide an informational brochure to general public
Adaptation option	16. Promote training and awareness on climate adaptation and risks
Climate risk	All
Goal addressed	V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>The information brochure is an instrument to share knowledge on current actions within climate change adaptation with a broad range of public actors. To make it more relevant to the reader, it should include practical knowledge on how to help mitigate climate change and how to minimise personal risks due to climate change. It would be beneficial to also provide a section on vulnerable groups such as the elderly or kids in order to highlight special needs and actions required for these groups. Additionally, brochures and educational campaigns could also include specific issues related to Figueira's adaptation options, like sustainable water use and promotion of energy efficiency.</p> <p>This action is inspired by similar actions in Loulé [16].</p>
Leadership	CMFF
Partners	Health organisations
Timeframe	Est. 2 years
Investment	Est. €
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • # of brochures published
Synergies	-

Action	16.4 Reinforce emergency preparedness at public institutions
Adaptation option	16. Promote training and awareness on climate adaptation and risks
Climate risk	All
Goal addressed	V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>With this action, attention should be raised for the importance of emergency preparedness within public institutions such as schools or municipal companies. It should be guaranteed that public institutions show an emergency preparedness plan outlining the roles of employees in different emergencies, the actions needed to be carried out, and how employees will practice and be trained on these actions.</p> <p>Ensuring emergency preparedness can avoid casualties in case of an emergency, which is becoming more important with the increasing likelihood of extreme weather events due to climate change.</p> <p>This action is inspired by similar actions in Dublin and Kristianstad [17,19].</p>
Leadership	CMFF
Partners	Schools, other public institutions
Timeframe	Ongoing
Investment	Est. €
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • % coverage of emergency/safety drills conducted in public institutions • % coverage of emergency plans amongst public institutions • # of trainings held in public institutions
Synergies	-

Action	16.5 Organise competitions around climate change topic
Adaptation option	16. Promote training and awareness on climate adaptation and risks
Climate risk	All
Goal addressed	V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	<p>The purpose of this action is to increase the awareness for climate change and its impact on Figueira da Foz amongst the general public by making awareness-raising activities fun. Engaging citizens and/or internal departments in competitions on e.g. developing new ideas or on how to best communicate climate change to foster long-lasting interest around the specified topics.</p> <p>A Sustainability Prize could be awarded to public institutions, private actors and service providers for their good performance in categories like "reduced/efficient water use", "improvements to energy efficiency", and "utilization of alternative energies" like solar panels.</p> <p>This action is inspired by similar actions in Cascais and Loulé [15,16,34,36].</p>
Leadership	CMFF
Partners	Schools, Companies
Timeframe	Est. 2-4 years
Investment	Est. €-€€
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • # of participants in competitions
Synergies	<u>Actions</u> : 2.2, 4.2 and 9.3

4. Thematic area: Water Management

Adaptation Option 2

Action	2.1 Create synergies for the use of greywater in private and public green areas
Adaptation option	2. Optimization and creation of good municipal practices for irrigation systems
Climate risk	High temperatures and heat waves
Goal addressed	IV. Training municipal technicians and key actors to deal with climate change adaptation
Description	<p>Figueira da Foz has tried to utilize greywater for the watering of public green spaces. However, this alternative creates many challenges: the water treatment plant of Águas de Figueira is far away from the city; the greywater has to be transported in a motor vehicle, which is expensive and creates emissions; and the systematic use of this option would require the use of a dedicated unit to transport only greywater due to current water sanitation regulations. The proposal is to create synergies for the use of greywater to water both private and public green areas.</p> <p>The first step is to map the most significant sources of greywater in Figueira and their locations. This work should be carried out by the Municipality along with Águas de Figueira and local stakeholders. A threshold for what to consider significant should be established with all involved actors. It might be that at this step, potential sources of greywater are identified but they would need further treatment to become useful; in which case the municipality should evaluate pilot projects for the installment of on-site water treatment plants.</p> <p>The second step is to map out the needs for greywater, both for private and public actors, including construction projects along with the location of those spaces.</p> <p>The third step would be to identify possible “matches” between those emitting greywater and those in need of greywater. It is advised that distance from the source would be an important criterion to consider.</p> <p>Throughout this process, the role of the municipality would be to assist stakeholders in finding the most suitable solutions for the use of greywater. If suitable synergies for the use of greywater are identified, it would be necessary to evaluate the potential costs of short-distance piping or the pertinence of utilizing a truck for the exclusive transport of greywater.</p> <p>This action is inspired by similar actions in Cascais and Leiria [15, 34, 35, 36]</p>
Leadership	CMFF, ACIFF Trade and Industrial Association
Partners	Terrestrial Beira Industrial Pulp (Celbi), Águas de Figueira

Timeframe	Est. 1-5 years, it is suggested to begin with pilots [15, 43]
Investment	Est. €-€€
Funding	Combination of Municipal and Private funds
Indicator	<ul style="list-style-type: none"> • # of liters of greywater redirected for the watering of green spaces under the Municipality's synergy program
Synergies	<u>Adaptation options</u> : Create incentives for sustainable water use (4); Optimization and creation of good municipal practices for irrigation system (2); Introduction of good practices in the planning and management of public trees (28)

Action	2.2 Gradual phase out of green gardens for Mediterranean vegetation/less water intensive vegetation, and the inclusion of art spaces representing Figueira's history and heritage
Adaptation option	2. Optimization and creation of good municipal practices for irrigation systems
Climate risk	High temperatures and heat waves
Goal addressed	IV. Training municipal technicians and key actors to deal with climate change adaptation
Description	<p>The maintenance of the current green gardens in Figueira da Foz is a water-intensive process. The suggested measure will phase out traditional green gardens and replace them with low water consumption plants (Mediterranean flowers, bushes, and shrubs), status, and art works.</p> <p>The first step would be to make an inventory of the green spaces maintained by the municipality, including the annual costs incurred in the watering and maintenance of these spaces.</p> <p>The second step would be to select what green areas in the city to prioritize for the replacement of traditional green gardens for less water intensive options. A recommendation is to target first the most expensive green areas to maintain.</p> <p>In order to further public acceptance of the project, the third step would be to communicate to the population the intention to redesign the gardens. It is recommended that the messages emphasize the municipality's aim to save water that people need during heat waves, while saving money for more urgent needs. Another benefit is promoting the use of plants native to Figueira.</p> <p>To decide the new designs, the municipality could hold a competition on garden design proposals with the requirement of saving water, introducing native species, and highlighting the local history so that the green spaces can become a tourist attraction.</p> <p>This adaptation action is inspired by similar measures taken in Cascais [15].</p>
Leadership	CMFF (Urban/Land planning), ACIFF Trade and Industrial Association
Partners	Terrestrial Beira Industrial Pulp (Celbi), Scout Groups of Vila Verde, Terrestrial Scout Groups of Tavadre, Parish Councils
Timeframe	Est. 2-5 years
Investment	Est. €-€€
Funding	The funds could come from those already allocated to the maintenance of municipal green spaces. The municipality could also find partners to "adopt" green public spaces in exchange for a "thank you plate/brick" on site.

Indicator	<ul style="list-style-type: none"> • # of green gardens reconverted to water-saving gardens • # of liters of water saved per reconverted garden per year • Maintenance and irrigation monetary savings per reconverted garden per year • # of green public spaces "adopted" by companies
Synergies	<u>Adaptation options:</u> Create incentives for sustainable water use (4); Optimization and creation of good municipal practices for irrigation system (2); Creation of urban gardens (21); Reordering of public spaces, with the introduction of less water demanding native and adapted plant species (27)

Adaptation Option 4

Action	4.1 Establish requirements for the reuse of greywater in the construction sector
Adaptation option	4. Create incentives for sustainable water use
Climate risk	High temperatures and heat waves
Goal addressed	III. Defining ways to integrate adaptation instruments with municipal territorial management IV. Training municipal technicians and key actors to deal with climate change adaptation VII. Explore potential opportunities linked to climate change, highlighting potential socio-economic benefits
Description	<p>The construction sector is a resource intensive sector, including the use of water. Thus, the use of greywater could help decrease its water consumption. The proposed actions to start out the use of greywater could be implemented first as voluntary commitments and then become mandatory requirements. It would be necessary to:</p> <p>Get together all relevant stakeholders related to the construction sector; businesses generating greywater, and municipal authorities. The idea would be to discuss the current water use of the construction sector, and the potential for collaboration between actors. In this sense, it would be useful to map out potential sources of greywater, as well as ongoing and future construction projects where water could be recycled on site.</p> <p>As a first stage, the municipality could promote that stakeholders agree to the voluntary use of greywater in specific construction projects. To incentivise more actors to join, the municipality could grant longer implementation timeframes for early adopters of the greywater and water recycling schemes when it comes to complying with mandatory requirements for the use of greywater use.</p> <p>The specific requirements for the use of greywater or recycled water could be jointly developed by the municipality, Águas de Figueira, and relevant stakeholders in the construction sector. It is suggested that once the requirement becomes mandatory, the implementation is gradual. For example, start out with utilizing greywater in at least 20% of the total projects in a given year or 20% of a given project.</p> <p>This adaptation action is inspired by use of greywater measures in Cascais and Leiria [15, 34, 35, 36]</p>
Leadership	CMFF (Land/Urban Department), Águas de Figueira
Partners	Parish Councils, ACIFF Trade and Industrial Association
Timeframe	Est. 1-5 years

Investment	Est. €-€€
Funding	Private actors
Indicator	<ul style="list-style-type: none"> • % construction projects out of total construction projects utilizing greywater per year • # of liters of greywater re-directed for use in the construction sector per year
Synergies	<u>Adaptation options</u> : Create incentives for sustainable water use (4)

Action	4.2 Install water-saving faucets and taps in public buildings
Adaptation option	4. Create incentives for sustainable water use
Climate risk	High temperatures and heat waves
Goal addressed	II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires IV. Training municipal technicians and key actors to deal with climate change adaptation
Description	<p>The maintenance of municipal buildings includes covering for the costs of water use. Therefore, it is in the interest of the Municipal finances and of Figueira's water management to save water. This adaptation action focuses on installing water-saving faucets and taps in municipal buildings. In order to prioritize the installation of these devices, the following steps are suggested:</p> <p>Review the water consumption of the public buildings in Figueira to assess current levels of consumption, and if there is evidence of leaks in the building's inner water infrastructure (pipes, faucets, toilet tanks).</p> <p>Identify where water taps could be replaced by water-saving ones. Some criteria to consider and prioritise as to where to target the replacement efforts is the number of permanent staff and users a building receives, the total water consumption, and the potential to address existing leaks/inefficiencies. The scope could also be expanded to include water-saving toilet tanks.</p> <p>Municipal criteria could be established so that new public projects have to utilize water-saving faucets/taps from a set date and onwards.</p> <p>To demonstrate the importance of the measure, Figueira could provide an estimate on how many liters of water a year are saved by switching to water-saving taps as compared to the consumption with conventional water taps.</p> <p>This adaptation action is inspired by similar measures in Leiria and Barcelona. [18,35]</p>
Leadership	CMFF, Águas de Figueira
Partners	Parish Councils, School Associations
Timeframe	Est. 1-5 years
Investment	Est. €-€€
Funding	Municipality
Indicator	<ul style="list-style-type: none"> # of water-saving taps/faucets installed
Synergies	<u>Adaptation options</u> : Create incentives for sustainable water use (4)

Action	4.3 Develop a Contingency Plan for Municipal Water Supply
Adaptation option	4. Create incentives for sustainable water use
Climate risk	High temperatures and heat waves, excessive precipitation (flooding)
Goal addressed	<p>I. To increase the knowledge of the municipality about the predisposition to extreme climate events and the adverse impacts on people's safety</p> <p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>VI. Ensure the sustainability of nature tourism, beach structures and sand, and the dynamic of existing and potential economic activities in the context of the growing impacts derived from climate change</p>
Description	<p>The Municipality of Figueira's water supply is vulnerable to increasing temperatures, heat waves, and floods. The current emergency water reserves would last for 2 days if needed, and in case of prolonged drought the groundwater deposits would run out of water in 4-5 years. In the event of flooding, the water pumps could be damaged and water deposits could become contaminated. Therefore, Figueira needs to develop a Contingency Plan for Municipal Water Supply. In order to do so, the following is suggested:</p> <p>Gather representatives from stakeholders' groups and map out their existing and projected water use needs for the next one, three, five, and ten years. With this information, the projected water needs of all actors could be compared against projections for water supply as affected by variables like rain, replenishment of groundwater deposits/consumption rate, elevated temperatures, etc. In this regard, Figueira would preferably need to recruit specialists in hydric resources and modelling of water availability and conditions. These projections would need to be updated periodically; potentially with every IPCC report.</p> <p>The next step would be to develop contingency plans for different scenarios, together with private stakeholders, municipal authorities and civil protection. It is recommended that the development of contingency plans considers worst-case scenarios. Among other things, a contingency plan would need to identify the criteria to declare an emergency, how to identify and tend to the population more at risk (children, elderly, pregnant women, ill-people) in case of water shortage, the contingency actions to take, and the allocation of responsibilities. It would also be necessary to set aside funding for emergencies and establish alert systems to notify the population. Additionally, the municipality could carry out informational awareness campaigns about the contingency protocol for citizens in the event of water scarcity caused by high temperatures, drought or broken pumps due to flooding.</p> <p>In the events of flooding, the pumps and the water deposits could be affected. The pumps most vulnerable to malfunctioning/breakdown due to flooding could be identified based on the height at which they are set; their location and flooding projections/records for that area. Based on this information, Figueira could determine the next steps. For example, to establish a minimum safe height level for the pumps to operate at, and</p>

	<p>gradually start moving those that operate under the minimum safe height. Of equal importance is to estimate if there are enough back-up pumps in case the regular pumps fail, and if not develop a plan for their installation.</p> <p>This measure was inspired by actions and plans in Kristianstad [19]</p>
Leadership	CMFF, Águas da Figueira, Civil Protection
Partners	CELBI, Parish Councils, ACIFF Trade and Industrial Association, Figueira Beach Society, Figueira Gastronomic Association, Portuguese Red Cross, Voluntary Firefighters, Municipal Firefighters
Timeframe	Est. 1-3 years
Investment	Est. €-€€
Funding	Municipality, Águas de Figueira, potentially national funding
Indicator	<ul style="list-style-type: none"> • Existence of a Municipal Water Supply Plan (Yes/No) • # of training sessions to public workers about the Municipal Water Supply Plan and contingency measures
Synergies	<p><u>Adaptation options</u>: Optimization and creation of good municipal practices for irrigation system (2); Create incentives for sustainable water use (4); Improvement of the rain runoff urban systems in critical areas (5); Creation of a municipal system to detect and manage climate events (15); Promote training and awareness sessions on the options/climate adaptation options and risks amongst the population, the Municipal Chamber of Figueira da Foz (CMFF), and institutions (16); Integration of a multidisciplinary team to study/plan strategies related to climate change and its consequent risks (17)</p>

Adaptation Option 5

Action	5.1 Integrate stormwater retention into urban planning
Adaptation option	5. Improvement of the rain runoff urban systems in critical areas
Climate risk	Excessive precipitation
Goal addressed	III. Defining ways to integrate adaptation instruments with municipal territorial management VII. Explore potential opportunities linked to climate change, highlighting potential socio-economic benefits
Description	<p>This action can be done through low impact development: a design strategy that enables engineered and natural water retention on site. First, studies need to be conducted on different types of methods such as permeable pavements, curbless streets, swales and subsurface retention structures. Likewise, a cost benefit analysis comparison should be carried out across methods reviewed. Also, it should be considered that some methods can be integrated with others, like permeable pavements with subsurface retention structures. Lastly, vulnerable areas need to be identified and pilot projects are necessary prior to upscaling any solutions.</p> <p>This action is inspired by relevant research [44].</p>
Leadership	CMFF (Urban Department)
Partners	Designers, Architects, Citizens
Timeframe	Est. 1-3 years
Investment	Est. €€
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • # of swales constructed • Length of permeable pavements
Synergies	-

Action	5.2 Create rain gardens
Adaptation option	5. Improvement of the rain runoff urban systems in critical areas
Climate risk	Excessive precipitation
Goal addressed	III. Defining ways to integrate adaptation instruments with municipal territorial management VII. Explore potential opportunities linked to climate change, highlighting potential socio-economic benefits
Description	<p>This action pertains to rain gardens, or bioretention facilities that store runoff from urban areas like pavements and roads. These solutions contain vegetation and soil that have high retention capacities while helping to filter out pollution. However, research needs to be conducted ahead of time to determine suitable native plant species. Furthermore, workshops can be conducted with residents to help them create and maintain their own rain gardens, which can be easily retrofitted into available urban spaces. Regular monitoring and maintenance are required.</p> <p>This action is inspired by relevant research [17].</p>
Leadership	CMFF
Partners	Institute for Nature and Forest Conservation
Timeframe	Est. 2-5 years
Investment	Est. €€ (approx. 2-3€ per square foot/ 929 square cm.)
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • # of rain gardens implemented
Synergies	<u>Adaptation options:</u> Creation of urban gardens (21)

Action	5.3 Improve awareness of rainwater harvesting
Adaptation option	5. Improvement of the rain runoff urban systems in critical areas
Climate risk	Excessive precipitation
Goal addressed	V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change
Description	The purpose of this action is to spread awareness of and install rainwater harvesting infrastructure to improve rainwater retention in urban areas. Specifically, the municipality, in collaboration with the water company, can spread such awareness through free local workshops and school programs. Residents should also be made aware of how to harvest rainwater by installing equipment at homes. Furthermore, subsidies could be utilized to incentivise residents to make the switch to such systems, and longer-term, such systems could be integrated into regulation so as to make them compulsory in residential buildings.
Leadership	CMFF
Partners	Águas da Figueira
Timeframe	Est. 1-2 years
Investment	Est. €€
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • # of houses with rainwater harvesting systems
Synergies	<u>Adaptation options</u> : Create incentives for sustainable water use (4)

Action	5.4 Clean and maintain pipes
Adaptation option	5. Improvement of the rain runoff urban systems in critical areas
Climate risk	Excessive precipitation
Goal addressed	II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires
Description	<p>Here, an assessment of piping infrastructure needs to be carried out, followed by the cleaning and declogging of pipes to remove debris and obstructions. Residents can also be made aware to check and remove obstructions from stormwater openings near the roadside in front of their dwellings. Regular monitoring mechanisms should be established.</p> <p>This action is inspired by similar actions in Leiria [35].</p>
Leadership	CMFF
Partners	-
Timeframe	Est. 1-2 years
Investment	Est. €
Funding	Municipality
Indicator	<ul style="list-style-type: none"> • # of pipes unclogged or replaced
Synergies	-

5. Thematic area: Coastal protection

Adaptation Option 13

Action	13.1 Spread awareness of coastal risks and shoreline management
Adaptation option	13. Preserving shorelines
Climate risk	Sea level rise and strong waves
Goal addressed	V. Enable education and awareness of the population with regards to the impacts and risks from events related to climate change VI. Ensure the sustainability of nature tourism, beach structures and sand, and the dynamic of existing and potential economic activities in the context of the growing impacts derived from climate change
Description	Raising public awareness on rising sea levels and their impacts is important for improved local engagement. With this action, vulnerable groups and other relevant stakeholders like NGOs and private companies need to be first identified and then involved via surveys, participatory workshops, or mass media. It is also important to have a tailored communication strategy for every group e.g. school kids and youngsters can be targeted through apps and social media. Collaboration with the Specialized Committee on Coastal and Sea Areas (CEZCM) for training and research can be considered as well. This action may also contribute to other actions under this adaptation option, as improved awareness can lead to better stakeholder involvement.
Leadership	CMFF
Partners	Figueira Beach Society, Surf Association, Port Captaincy, Specialized Committee on Coastal and Sea Areas
Timeframe	Est. 1-2 years
Investment	Est. €
Funding	Municipality
Indicator	<ul style="list-style-type: none"> # of programs conducted
Synergies	<u>Adaptation options</u> : Promote training and awareness sessions on the options/climate adaptation options and risks amongst the population, the Municipal Chamber of Figueira da Foz (CMFF), and institutions (16); Improving the knowledge about vulnerable groups (involving awareness campaigns specific to sea level rise and coastal resilience to identify vulnerable groups and understand how they can get involved in adaptation actions (19)

Action	13.2 Artificial feeding of the beaches in the south of the county through the dredging of the Mondego River in the port channel of Figueira da Foz.
Adaptation option	13. Preserving shorelines
Climate risk	Sea level rise and strong waves
Goal addressed	II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires VI. Ensure the sustainability of nature tourism, beach structures and sand, and the dynamic of existing and potential economic activities in the context of the growing impacts derived from climate change
Description	<p>This action pertains to the importance of artificial feeding of the beach for maintaining the beach width both for coastal protection and recreational purposes. Specific actions to be undertaken include the evaluation of different feeding scenarios via coastal management software, performing topographic surveys before and after feeding operations, and potentially creating a coastal monitoring observatory to monitor shoreline evolution and estimate refeeding frequency. In terms of costs, both short-term and long-term expensive should be evaluated based on different feeding options such as mega-nourishment (e.g. the use of sand motors as performed in Holland). Collaboration with other municipalities through the Ovar-Marinha Grande Coastal Program can be considered.</p> <p>This action may also contribute to 13.5, as part of a larger, integrated coastal management plan.</p> <p>This action is inspired by similar actions in Leiria [35] and by research [35,45,46]</p>
Leadership	CMFF
Partners	Portuguese Environmental Agency, CEMAR Center for Sea and Navigation Studies, Coimbra University, University of Aveiro (Carlos Coelho)
Timeframe	Est. 2-5 years
Investment	Est. €€ (4-6€ per cubic meter of sand or 2.5€ per cubic meter for sand motor) Est. €€€ 21,600,000 per Leiria estimate
Funding	PO SEUR, EU Life Programme, Municipality
Indicator	<ul style="list-style-type: none"> • Increase in beach width or surface area
Synergies	<u>Adaptation options</u> : Creation of an observatory of coastal areas' evolution (22)

Action	13.3 Strengthen dunes
Adaptation option	13. Preserving shorelines
Climate risk	Sea level rise and strong waves, strong winds
Goal addressed	<p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>VI. Ensure the sustainability of nature tourism, beach structures and sand, and the dynamic of existing and potential economic activities in the context of the growing impacts derived from climate change</p>
Description	<p>Sand dunes face erosion due to waves as well as strong winds and need to be strengthened and protected. This can be done by various methods including: planting vegetation (certain species resistant to salinity and strong winds can be planted on dunes, acting as erosion barriers. Research on species and regular replanting and monitoring is necessary); dune fencing (wave protection by installing structures like e.g. wooden cords or fences depending on the type of dune areas.</p> <p>Additionally, feasibility of methods needs to be evaluated through stakeholder consultations. This can also be integrated with other coastal protection methods and requires regular monitoring.</p> <p>This action may also contribute to 13.5, as part of a larger, integrated coastal management plan.</p> <p>This action is inspired by relevant research [47]</p>
Leadership	CMFF
Partners	Portuguese Environmental Agency, CEMAR Center for Sea and Navigation Studie, IMAR Sea Institute at Coimbra University
Timeframe	Est. 1-5 years
Investment	Est. €€ (250-2500€ per 100m length for dune grass planting; 500-2500€ per 100m length for dune fencing)
Funding	Municipality, PO SEUR
Indicator	<ul style="list-style-type: none"> • # of dune areas strengthened • # of fences built • Area of vegetation planted • Changes in beach width
Synergies	-

Action	13.5 Develop an Integrated Coastal Management plan
Adaptation option	13. Preserving shorelines
Climate risk	Sea level rise and strong waves
Goal addressed	<p>II. Adaptation to increasingly recurrent events associated with climate change like droughts, floods, and forest fires</p> <p>III. Defining ways to integrate adaptation instruments with municipal territorial management</p> <p>VI. Ensure the sustainability of nature tourism, beach structures and sand, and the dynamic of existing and potential economic activities in the context of the growing impacts derived from climate change</p>
Description	<p>Integrated coastal management plans combine different methods to enhance coastal resilience. Here, a thorough review of existing methods needs to be conducted such as hard methods like the use of dykes, seawalls and groins, dune strengthening, coastal setbacks, beach feeding and land use policies. Cost benefit analysis should also be used to evaluate the best combination of methods. Furthermore, stakeholder involvement is key, and workshops with coastal management experts can be conducted prior to drafting the plan. Continuous monitoring should be adhered to as well.</p> <p>This action is inspired by relevant research [48].</p>
Leadership	CMFF
Partners	Portuguese Environmental Agency, CEMAR Center for Sea and Navigation Studie, IMAR Sea Institute at Coimbra University
Timeframe	Est. 2-5 years
Investment	Est. €€
Funding	Municipality, PO SEUR, Horizon 2020
Indicator	<ul style="list-style-type: none"> • Development of an integrated coastal management plan
Synergies	<u>Adaptation option</u> : Creation of an observatory of coastal areas' evolution (22)

Annex II: Stakeholders distribution

1. Thematic area: Spatial planning and development

- Saint-Gobain Mondego- Glass
- CIE Plasfil Plástico da Figueira
- Microplásticos
- ACIFF Trade and Industrial Association
- EcoGestus Environment Engineering and Consultancy
- ICNF Institute for Nature and Forest Conservation- Central Region
- Parish Councils
- District Hospital Figueira da Foz
- Health Center of Figueira da Foz Buarcos
- APA Portuguese Environmental Agency
- Civil Protection
- Secondary Schools
- School Association of Figueira Mar
- Beira Industrial Pulp (Celbi)
- Lusiaves Industry and Agri-food Commerce

2. Thematic area: Forest and agriculture

- DRAP Regional Direction of Agriculture and Fishing
- Ernesto Morgado (Rice)
- Mondego Valley Agricultural Cooperative
- Terrestrial Scout Groups
- ICNF Institute for Nature and Forest Conservation- Central Region
- GNR- National Republican Guard, Coastal Control
- PSP- Police and Public Security
- Municipal Firefighters
- Civil Protection
- Humanitarian Association Voluntary Firefighters Figueira da Foz
- National Bussaco Forest Foundation (forestry conservation, research, leisure and tourism)
- Association of Forest Producers of Lower Mondego
- Mondego Forest Intervention Area
- Beira Industrial Pulp (Celbi)
- APA Portuguese Environmental Agency
- United Resins
- District Hospital Figueira da Foz
- Health Center of Figueira da Foz Buarcos
- Lusiaves Industry and Agri-food Commerce

- MARE- Marine and Environmental Sciences Centre at Coimbra University
- EcoGestus Environment Engineering and Consultancy

3. Thematic area: Information and awareness

- IMAR- Sea Institute at Coimbra University
- MARE- Marine and Environmental Sciences Centre at Coimbra University
- Technological and Professional Institute of Figueira da Foz
- APA Portuguese Environmental Agency
- Marefoz Lab
- EcoGestus Environment Engineering and Consultancy
- CEMAR Center for Sea and Navigation Studies
- CCDRC Coordination and Development Commission for the Central Region
- SEF Foreign and Border Service
- District Hospital Figueira da Foz
- Health Center of Figueira da Foz Buarcos
- Portuguese Red Cross
- Humanitarian Center of Lower Mondego
- Holy House of Mercy of Buarcos
- School Association of Figueira Mar
- Secondary Schools
- Newspapers
- Elementary School Joao de Barros
- School Association Training Center Beira Mar
- Professional School of Figueira da Foz
- Parish Councils

4. Thematic area: Water management

- Barrio Novo Merchants Association
- Figueira Gastronomic Association Com Sabor a Mar
- Interagua- Technology and Water Management
- Águas da Figueira (Water of Figueira)
- Lena Ambiente (Waste Management, Water, and Sanitation)
- APA Portuguese Environmental Agency
- Beira Industrial Pulp (Celbi)
- DRAP Regional Direction of Agriculture and Fishing
- Ernesto Morgado (Rice)
- Civil Protection
- School Association of Figueira Mar
- Secondary Schools
- Parish Councils

5. Thematic area: Coastal protection

- Professional Fishing and Sea School FOR-MAR
- Empresa Figueirense de Pesca (Fish)
- CANAS- Aquaculture
- COFISA Fish Preserves
- BRIOSA Preserves (fish)
- DRAP Regional Direction of Agriculture and Fishing
- Mondego Shipyards
- Docapesca Entity for the Management of the Commercial Port
- The Navigator Company (Portucel Soporcel Group)
- Port Captaincy Figueira da Foz
- Maritime Scout Groups
- CEMAR Center for Sea and Navigation Studies
- Development Association "Mais Surf"
- Bodyboard Association "Foz do Mondego"
- Naval Association 1º de Maio
- SOS Cabedelo (Surf Association)
- APA Portuguese Environmental Agency
- Figueira Gastronomic Association Com Sabor a Mar
- IMAR- Sea Institute at Coimbra University
- Figueira Beach Society (Casino)
- MARE- Marine and Environmental Sciences Centre at Coimbra University
- ICNF Institute for Nature and Forest Conservation- Central Region