KLIMA 2050 BASQUE COUNTRY
ekintzak - acciones

Climate Change Adaptation Guide for Organisations

KLIMA 2050 BASQUE COUNTRY
ekintzak - acciones

Climate Change Adaptation Guide for Organisations

ihobe
ingurumen hobekuntza
mejora ambiental

Herri-baltzua
Sociedad Pública del
EUSKO JAURLARITZA
GOBIERNO VASCO
INGURUMEN, LURRALDE PLANGINTZA
ETA ETXEBIZITZA SAILA
MINISTRY OF THE ENVIRONMENT
TERRITORIAL PLANNING AND HOUSING

PUBLISHED BY:
Ihobe, Environmental Management Agency
Ministry of the Environment, Territorial Planning and Housing
Basque Government

Alda. de Urquijo n.º 36-6.ª (Plaza Bizkaia)
48011 Bilbao

info@ihobe.eus I www.ihobe.eus
www.ihobe.eus
www.ingurumena.eus

EDITION:
April 2019

CONTENTS:
This document has been created by Ihobe in collaboration with the company IDOM, S.A.

Index

index of figures and tables

Figures

Tables

01

Introduction: climate change and adaptation

1.1. Definition

Climate change is the variation in the state of the climate which can be identified (for example, by means of statistical testing) through changes in the average value or the variability of its properties, and which persists for long periods of time, usually decades or even longer.

The science of climate change has traditionally sought to answer two questions: detection and attribution. Thus, detection seeks to show that climate change exists, while attribution aims to identify the causes of that change.

The first question, detection, has been answered in the Fifth Report of the Intergovernmental Panel on Climate Change (IPCC), published in 2014, which establishes that the *"warming of the climate system is unequivocal"*, as shown by the latest trends recorded.

As regards attribution, there are different causes that can alter the radiation balance of the Earth, such as the changes in the earth's orbit, changes to the solar energy received, volcanic eruptions (all of which are natural changes) and, as argued in current climate change approaches, changes in the atmosphere due to the emission of Greenhouse Gases (GHG) caused by human activity. In this regard, the IPCC Fifth Report states that *"most of the observed increases in global average temperatures since the mid-20th century is very likely due to the increase in anthropogenic greenhouse gas concentrations"*. This statement is based on the use of climate models, which are not able to model current climate changes if the anthropogenic GHG emissions are not considered.

The effects of climate change result in a series of impacts that will affect the Basque Autonomous Community (BAC) in different fields. In this regard, the approach to climate change has two dimensions: *mitigation*, which acts on the causes of global warming, and *adaptation*, which seeks to prevent and combat its possible effects.

Climate change adaptation is defined by the *Intergovernmental Panel on Climate Change* (IPCC) as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harms or exploits beneficial opportunities.

Some consequences are already inevitable regardless of the efforts to cut GHG emissions. Therefore, climate change adaptation is an issue that is growing in importance worldwide and where the aim is to address it from a holistic approach in this guide.

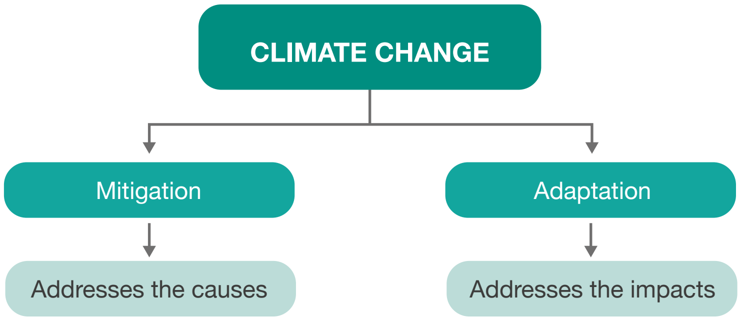

Figure 1. Dimensions of climate change. Source: Prepared by the authors.

1.2. Main climate change adaptation concepts

Since adaptation to climate change is dependent on several variables (Figure 2), response to this may also vary.

The recent IPCC Assessment Report defines risk as an interaction between vulnerability, exposure and threat (or danger) as shown in figure 2.

Currently, the majority of the report and leading authors on climate change differentiate between threats, impacts, vulnerability and risk. The most recent literature highlights risk as the result of a series of complex interactions between societies or communities, ecosystems and threats arising from climate change. The differentiation of those aspects is an important improvement on the *IPCC Fourth Assessment Report* (AR4), as it presents social construction of the risk through the concept of vulnerability[1].

Therefore, climate change is not a risk per se, climate changes and their related threats interact with the vulnerability and exposure of the system to lead to the different risk levels.

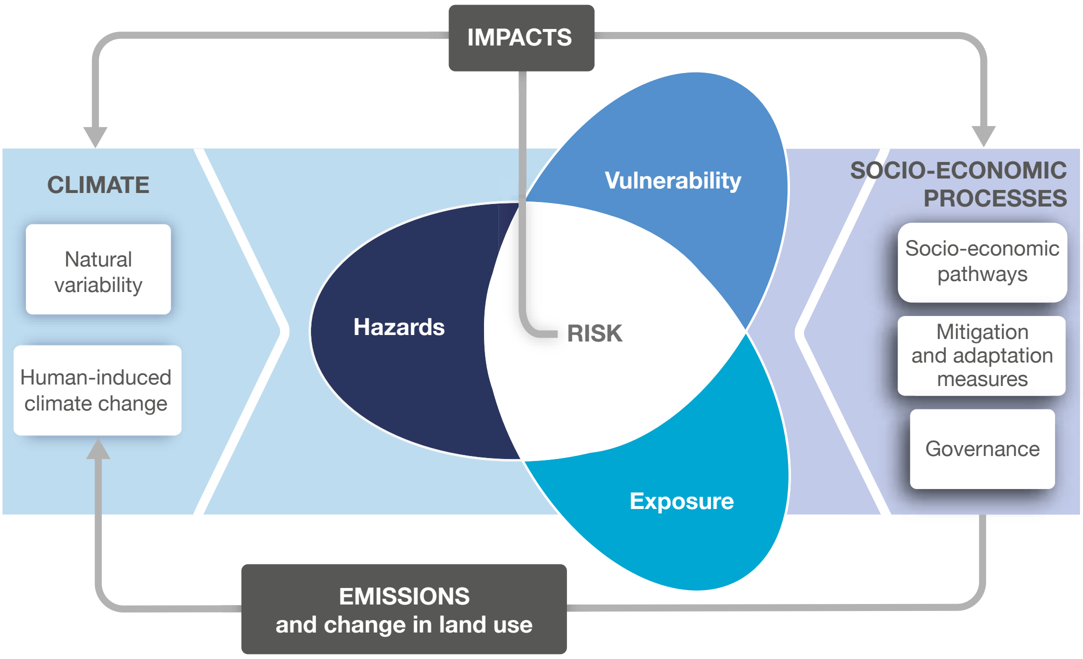

Figure 2. Conceptual framework for the assessment of the climate risk. Source: IPCC, 201.

[1] IPCC, 2012 - The IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.

- **Climate threat or variable**: prolonged variation in the climate which is likely to affect the activities of a company in specific places.
- **Capacity to adapt:** capacity of a company to adjust to climate change in order to mitigate potential damage, take advantage of positive consequences, or withstand negative consequences.
- **Exposure:** presence of infrastructure or economic assets that may be negatively affected by climate variables.
- **Climate impact:** consequences of climate change on the activities of a company. Subject to adaptation of the system.
- **Climate change:** extent to which an organisation may be affected in a critical manner by climate change, according to exposure and vulnerability.
- **Sensitivity:** extent to which an organisation may be affected, positively or negatively, by climate stimuli.
- **Vulnerability:** predisposition of an organisation to be affected negatively, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Adapted from the AR5, IPCC 2014.

1.3. Main impacts of climate change in the Basque Country

The impacts of climate change are the effects on anthropogenic and natural systems caused by extreme climate and meteorological phenomena of climate change. In general, impacts refer to the effects on livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or climate threats that occur within a specific time period and the vulnerability of an exposed system or society. The impacts are also related to the consequences and the results.

Climate change impacts sectors such as agriculture, forestry, energy production, tourism and infrastructures in general, with the majority of the impacts envisaged in Europe being adverse. The following should be included in the European regions, including urban zones, which are particularly vulnerable to climate change[2]:

- Southern Europe and the Mediterranean basin;
- Mountainous areas;
- Coastal areas, deltas and flood plains.

Therefore, adaptation is required that anticipates the effects of climate change and that adopts the appropriate measures to prevent or minimise the impacts.

Regional climate models developed so far, when the guidelines defined for the BAC can be identified, forecast certain changes on climate conditions[3].

Even though the majority of the impacts are negative, some can have beneficial consequences for certain sectors, such as the extension of the summer tourist season as a result of the lower rainfall in summer and the rise in average temperatures.

The impacts of climate change are the effects on anthropogenic and natural systems caused by extreme climate and meteorological phenomena of climate change.

The effects are not uniform for the agricultural sector in the BAC. Irrigation requirements are expected to increase due to a rise in temperatures, along with an increase in the incidence and appearance of new pests and diseases. The rise in extreme events may influence the erosion and fertility of the soil affecting the availability of nutrients in the soil and causing significant soil losses.

With respect to the livestock sector, variations in temperatures and precipitations will affect the reproduction and metabolism of animals, as long as the spatial distribution of parasite diseases. Furthermore, a decrease in the carrying capacity of the mountain pastureland is expected leading to less grass.

The sea level rise may lead to a flood risk due to a rise in the sea level affecting up to 250 ha of the Basque coastline, with 45% of them being areas that can be

[2] European Environmental Agency 2017 – Climate Change Adaptation.

[3] Basque Government, 2014 – Strategic focus to prepare the Basque Climate Change Strategy.

developed. Furthermore, the sea level rise may generate shrinkage of between 34% and 100% of the total width of the beaches with the ensuing loss of dune vegetation.

The impacts on the forestry sector are diverse, from lower forest growth due to higher temperatures and more frequent extreme events that, consequently, will increase the atmospheric concentration of CO_2, along with more pests and their diseases or greater forest flammability, therefore increasing the frequency, intensity and magnitude of forest fires.

In the energy and industry sector, physical damage is mainly expected to the infrastructures due to extreme precipitations and flood, high electricity consumption caused by heat wave, as well as affecting machineries and facilities, along with the motors being less efficient or water stress in cooling systems.

Finally, one of the most affected sectors, along with the agricultural sector, may be that of the linear transport infrastructures such as roads or railway tracks. Heat waves may cause deformities, cracks and bucklings in the infrastructures. Furthermore, the increase in rainfall and extreme waves may cause flooding (approximately 12% of the road and railway network of the BAC runs through potentially floodable areas), landslides and mudslides causing a possible increase of the accident rate and physical damage to the infrastructures of the BAC.

02

Background and context in the Basque Country

2.1. International context

In 1988, the United Nation's Intergovernmental Panel on Climate Change (IPCC) was set up in order to clarify the effects of climate change and its sources and foster an international institutional and legal framework to reduce GHGs in the atmosphere. The IPCC was set up as an *international group made up of multidisciplinary experts*. Its function is to issue report to assess the causes and effects of global climate change and the possible measures to be implemented. The results of the latest report (IPCC Fifth Assessment Report) were published in 2014.

In 1992, the conclusions of the IPCC urged governments to approve the *United Nations Framework Convention on Climate Change* (UNFCCC) incorporating a very important line of one of the multilateral environmental treaties that has been the most successful in history: the 1987 Montreal Protocol, by virtue of which the Member States are bound to act in the interests of human safety even in the face of scientific uncertainty. At present, a total of 197 countries have ratified and signed up to the UNFCCC[4], and have undertaken to comply with its objectives and regularly meet at the Conference of the Parties (CoP) to annually assess the progress made and pose new decisions and strategies of action.

In 1997, the Kyoto Protocol, the international benchmark policy, was signed. This protocol came into force in 2005 in order to reduce the emissions of six greenhouse gases that cause global warming and established that that reduction had to be achieved by means of the binding emission reduction targets and recognising the 37 industrialised countries and the European Union as primarily responsible for the high levels of GHG emissions that are currently in the atmosphere. In this regard, the Protocol has a central principle: that of the "common but differentiated responsibilities".

The Copenhagen Summit (also known as the Conference of the Parties 15 – COP 15), held in 2009, specified the global target even further: to limit the rise in temperature to a maximum of 2 ºC what is the same, keep the GHG concentration in the atmosphere at under 450 ppm of CO_2e.

After the end of the Kyoto period, the Doha Summit (CoP18), held in 2012, ended with a resolution to extend the commitment period until 2020, but some of the major GHG emitters such as the USA, China, Russia, Japan and Canada did not sign the agreement

The COP20, summit held in Lima (Peru), from 1 to 14 December 2014, aimed to lay the foundations of a new global climate change agreement, which was reflected in

4 United Nations, 2017 - Framework Convention on Climate Change.

the *"Lima Call for Climate Action"*. The Lima conference was successful and thus, in December 2015, at the CoP21 in Paris France, the Paris Agreement was signed, which will replace the Kyoto Protocol from 2020.

The Paris Agreement is based on six principles:

1. differentiated,
2. fair,
3. ambitious,
4. lasting,
5. balanced
6. and legally binding.

The "legally binding" principle is only limited to the review mechanism of the reduction commitments, with no sanctions for not meeting the targets.

> The Basque Country has taken significant steps in its climate change policy and has managed to begin to get mitigation and adaptation in the main sectoral plans of the Basque Government, of the Provincial Councils and of the municipalities.

This agreement sets the target of keeping the increase in global average temperature to 2 °C by the end of the century, recognising the need to strive to keep the increase to below 1.5 °C. On the other hand, it is the first time that an adaptation qualitative target is included, which consists of increasing the adaptive capacity, strengthening resilience and reducing vulnerability to climate change. The aim is to protect people, livelihoods and ecosystems, taking into account the urgent and immediate needs of the most vulnerable countries. Furthermore, the agreement encourages the countries to periodically report on adaptation problems and progress.

In the same vein, the recent CoP22 in Marrakech concluded by establishing a timetable of actions and the signing of the *"Marrakech Action Proclamation"*, a declaration of intent that reflects the international commitment to slow down global warming and notes the willingness of the participating countries regarding the actions relating to mitigation, adaptation, transparency, transfer of technology, capacity building, losses and damages as regards climate change.

2.2. Background and context in the Basque Country

The Basque Country has taken significant steps in its climate change policy and has managed to begin to get mitigation and adaptation in the main sectoral plans of the Basque Government, of the Provincial Councils and of the municipalities.

The *Sustainable Development Environmental Strategy of the Basque Country 2002-2020*, the different Environmental Framework Programmes, along with the Basque Plan to Combat Climate Change 2008-2012 (PVLCC), were the origin of different mechanisms, measures and actions that have effectively contributed to positioning the Basque Country among the most advanced European regions in climate policies, significantly containing greenhouse gas emissions and beginning to lay the foundations to adapt to the impacts of climate change.

In 2015, the *Climate Change Strategy of the Basque Country-KLIMA2050* was published, which is the planning instrument to that will steer the policy of the Basque Country up until 2050, with intermediate targets for 2020 and 2030, both for climate change mitigation and adaptation.

The strategy defines two main targets:

- Reduce the GHG emissions of the Basque Country by at least 40% by 2030 and by at least 80% by 2050, compared to 2005 and achieve renewable energy consumption of 40% out of the final consumption by 2050.
- Ensure the resilience of the Basque territory to climate change.

The aforementioned strategy consists of 70 specific actions on the timeline to 2050 as can be seen in Figure 3.

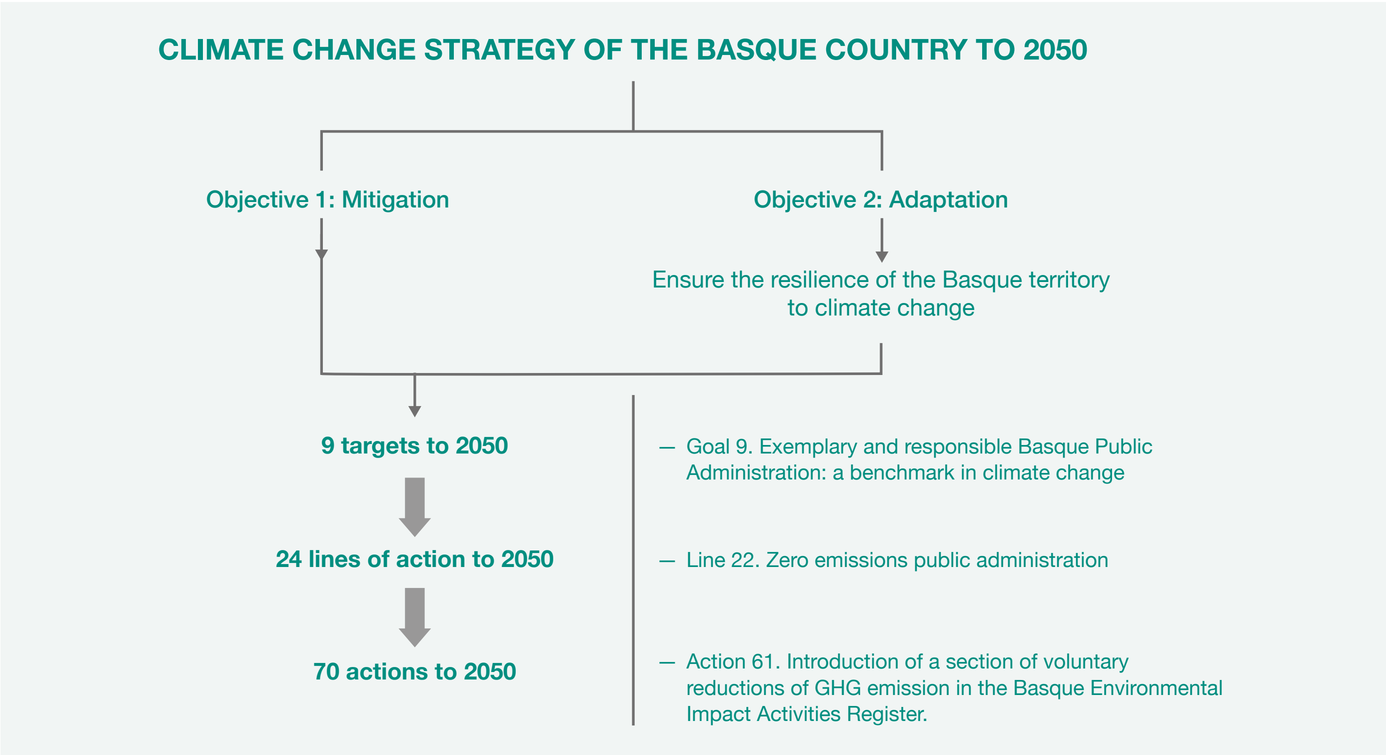

Figure 3. Structure of the Climate Change Strategy of the Basque Country to 2050-KLIMA2050. Source: Prepared by the authors.

2.3. Integration in other management systems

The risk assessment and prioritisation of climate change adaptation process does not seek to be an isolated procedure in the activities of each organisation. In this regard, including adaptation of the management systems of each organisation is a very appropriate option for the following reasons[5]:

— There are many institutional limitations preventing adaptation from occuring as an independent activity, even if the climate risk is perceived as high. In this regard, incorporating adaptation into the existing management system may provide a means to overcome those limitations.

— The impacts arising from climate change may affect different areas of the activity of the organisation and they are likely to involve complex interactions. Therefore, the cross-cutting approach offered by a management system is very appropriate.

— Adaptation seeks to respond at any time to the impacts produced by climate change and continuous improvement is likewise a cornerstone of all management systems.

— Defining what a successful outcome is in terms of climate change adaptation is very complex as the impacts and responses to it are closely linked to the local context. In this regard, good climate change adaptation can only be defined in terms of process in the same way as with management systems

Table 1 identifies certain management systems and registers when climate change adaptation could be integrated. Even so, the overview of standards is changing rapidly and new systems or standards can therefore emerge that have synergies with climate

[5] BSI, 2011 - Climate Change Adaptation. Adaptating to Climate Risks Using ISO 9001, ISO 14001, BS 25999 and BS 31100.

Management system	Details
ISO 14001	Environmental management system pursuant to the UNE-EN ISO 14001 international standard
ISO 9001	Quality management system pursuant to the UNE-EN ISO 9001 international standard
EMAS Register	Voluntary tool designed by the European Commission for the registration and public recognition of those companies and organisations that have an environmental management system implemented
GRI standards	Standards that represent global best practices to publicly report on the social, environmental and economic impacts of an organisation
ISO 31000	Risk management system pursuant to the UNE-EN ISO 31000:2010 international standard

Table 1. Compilation of some management systems and registers in organisations.

change adaptation. Furthermore, there is a trend towards integrated management systems, particularly within larger organisations. It may therefore also be a good practice to include climate change adaptation there.

The work involved regarding climate change adaptation in an organisation must be defined internally and often begins with the person having greatest responsibility in the environmental area of the company or the person tasked with improving the efficiency of the resources or reducing the carbon footprint. The expertise and experience provided by that person will be important, but if adaptation is being integrated in the risk, quality or management of the continuity of the business, it may be recommendable to allocate the main duty to the manager in charge of this business function.

Robust risk management and improving the response capacity of the company are required for climate change adaptation to be efficient.

In this regard, climate change adaptation may be integrated in a management cycle at any stage as part of the continuous improvement process of the management system. However, in order to avoid disruptions, it may be preferable to do so:

— When the system is implemented for the first time.

— During a review phase of the management system.

— After an initial scoping study conducted as an independent exercise.

A best practice may be to develop an approximate timeline of the key processes in the planning of climate change adaptation and adapt them to the current management system of the organisation, taking into account, for example, the key meetings of the committee or of the board, or the relevant publications with information on new interactions between different processes of the organisation.

In general, the 5 stages of a management system can be associated with the climate change adaptation process by means of the following recommendations:

1. **Initial diagnosis:** The first step in any management system is to conduct an initial diagnosis of the organisation in order to prioritise a list of key components. In this regard, the risks and opportunities assessment detailed in this Guide (See Section 5) can be part of that initial integral reflection on the operations of the organisations.

2. **Objectives and planning:** The list of prioritised measures (see Section 6) and the result of the risks and opportunities assessment of the initial diagnosis will be the basis to establish climate change adaptation objectives. In a similar way to the other objectives that the organisation sets in each implementation cycle, achieving the objectives or measures linked to climate change adaptation must also be structured around a programme that defines what, who, how, when and what monitoring and result indicators to be used.

3. **Implementation:** integration in the already consolidated processes of the organisations is also recommended to implement the measures. Employees' skills may need to be extended by training or acquiring new skills by means of external sub-contracting.
4. **Monitoring and assessment:** Indicators that allow the quantification and monitoring of the prioritised measures such as reducing the climate risk, compliance of legal requirements associated with climate change adaptation or the cross-cutting performance of the organisation in the field of climate change (calculating the carbon footprint, green procurement, communications, etc.) should be integrated in the indicators of the scorecard of the management system,
5. **Communication:** IIntegrate climate change adaptation in the communication strategy and the communication channels established in the management system. Both internal communication, informing the workers of the decision to integrate climate change adaptation as a further decision-making variable in the organisation, and external communication, announcing the initiative and results achieved to the public.

Finally, different parts of the organisation may start with very different knowledge levels and therefore a phased approach may be a practical way of beginning the adaptation. In this regard, it is recommendable to begin with a rapid scoping review such as the one set out in this guide to provide an overview of the status and possible responses. A second phase could be to allocate greater resources to working on a detailed study of the priority areas pinpointed by this initial assessment.

03

Why adapt to climate change?

Increasingly more experts are recognising that, even in the most ambitious scenario, it will still be necessary to adapt to the adverse effects of climate change. Adaptation measures seek to reduce the risk of negative climate impacts and maximise the opportunities that may emerge.

Many of the impacts of climate change are already affecting the organisations and more experience in adaptation practices is being increasingly accumulated. However, in the majority of cases, climate change adaptation is still included in the activities of the organisation.

The majority of organisations are currently exposed, either directly or indirectly, to the limitation of natural resources, to manufacturing or logistic disruptions and to financial or economic crises as the consequence of climate change[6]. The level and type of response will greatly depend on the vulnerability of the organisation and whether its exposure is to direct risks for its main activities or to indirect risks through the value chain.

The long-term feasibility of an organisation is also based on its economic and social environment, in other words, access to reliable infrastructure services, secure financial systems or a proactive population, all of which may be likewise affected by climate impacts.

Successful organisations are those that best adapt to a continuously changing market environment, regardless of whether those changes are environmental, social or economic. Those organisations that develop and maintain competitive advantages tend to be characterised by their forecasting ability, an informed position, along with a great capacity for change and commitment to invest in future performance.

On the other hand, not falling into the so-called “poor adaptation” during the adaptation process must be taken into consideration. This refers to an action or process aimed at reducing the vulnerability to climate change related impacts, yet, however, increases it.

Poor adaptation practices and processes usually include planned development measures and policies that focus on short-term benefits and economic gains, but which lead to greater vulnerability in the medium and long term.

[6] PwC, 2011 - Why must companies lead climate change adaptation?

04

Climate risk assessment tool and prioritisation of climate change adaptation measures

In the framework of the *Climate Change Strategy of the Basque Country-KLIMA 2050*, a tool has been created to help organisations assess their climate risks and to prioritise adaptation measures that help to reduce the consequences of the adverse impacts arising from climate change to which they are exposed (see Figure 4).

The following chapters will set out step by step the methodology to perform a climate risk assessment, along with a section explaining its application in the tool.

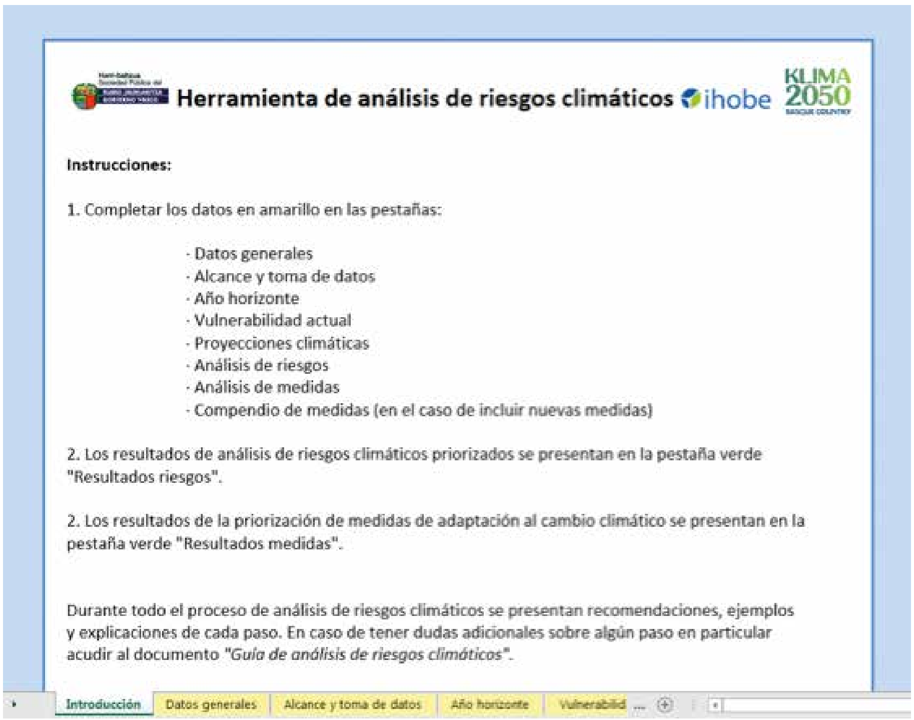

Figure 4. Screenshot of the climate risk assessment tool.

Structure of the tool

The tool is programmed in a Microsoft Excel spreadsheet.

In general, the data to be introduced in the tool for it to be updated appear in the light yellow cells.

An information sheet is included as the **"Introduction"**. This sheet includes an introduction to the tool (see Figure) and the steps required to use the tool. Apart from this initial "Introduction" tab, the tool has 3 types of worksheets:

1. **Inputs:** yellow tabs that include yellow boxes and which therefore need to be filled in for the tool to run correctly.
   - General data: it includes the basic identification details of the organisation, of the risk assessment manager, along with the year in which the assessment takes place.
   - Date scope and gathering: defined in Section 5.3.
   - Horizon year: defined in Section 5.4.
   - Current vulnerability: defined in Section 5.5.
   - Climate projections: defined in Section 5.6.
   - Risk assessments: defined in Section 5.7.
   - Measures assessments: defined in Section 6.1.
   - Compendium of measures: it includes a compendium of generic climate change adaptation measures. There is the possibility of including new more specific adaptation measures for each organisation.
2. **Results:** Green tabs that include and summarise the results of the calculat.
   - Risk results: results of the climate risk assessment See Section 5.8.
   - Measures results: results of the prioritised measures.
3. **Data:** Blue tabs that include the necessary parameters and data for the tool to run correctly. No input required.
   - Tables.
   - Additional data.

05

Climate risk assessment methodology

5.1. Standards contemplated

Different international standards have been reviewed in the risk assessment and contemplated in the methodology, and include:

There is currently no single strategy for assessing climate risks. Therefore, all the standards contemplated in Table 1 have been considered when defining the methodology, along with other guides, forums and initiatives to be taken into account, such as Mayors Adapt or more local ones such as *Udalsarea 21 - the Basque Network Municipalities for Sustainability or the Climate Change Strategy 2050 of the Basque Country*.

Institution	Year	Standard
IPCC (Intergovernmental Panel on Climate Change)	**2014**	Fifth Assessment Report. Working Group II: Impacts, Adaptation and Vulnerability
BSI (British Standards Institution)	**2011**	Climate Change Adaptation. Adaptating to Climate Risks Using ISO 9001, ISO 14001, BS 25999 and BS 31100
UKCIP	**2013**	The UKCIP Adaptation Wizard
Australian Government	**2006**	Climate Change Impacts & Risk Management. A Guide for Business and Government

Table 2. Standards envisaged in the climate risk assessment.

5.2. Adopted methodology

The methodology adopted is in line with that proposed in the recent Intergovernmental Panel on Climate Change Assessment Report, adapted to habitual risk management in organisations based on the consequences and likelihood. See figure 5.

In this regard, the principal concepts of climate change adaptation are summarised below:

— The **probability** consists of the likelihood that a specific result occurs, when it may be estimated probabilistically.

— The **consequences** are the effects on the human or natural systems. They are the result of the interaction between climate threats that occur in a specific time period and the vulnerability of an exposed system.

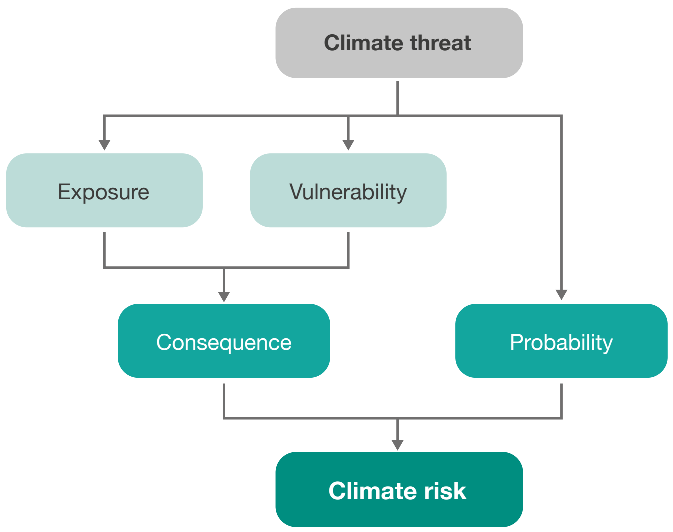

Figure 5. Variables that make up climate change adaptation. Source: Prepared by the authors.

— **Vulnerability** is the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity (susceptibility to harm) and lack of capacity to cope and adapt.

— **Exposure** is the presence of persons, infrastructures, social or economic assets, etc., in areas that may be adversely affected.

— The **threat** is a cross-cutting interaction component with all the other variables. Climate threat is defined as a natural or human-induced event or trend related to its physical impacts that may cause loss of life, injuries or other health impacts, along with property damages and losses, infrastructures, livelihoods, provision of services, ecosystems and environmental resources.

The IPCC risk framework has been integrated in a more general framework to assess risks caused by climate change, which will act as the linchpin of the whole process (see Figure) 6. The necessary steps to prepare a climate risk assessment for an organisation are summarised below.

1. **Scope:** Definition of the operational and geographical limits that frame the assessment.
2. **Horizon year**: Definition of the operational and geographical limits that frame the assessment.
3. **Current vulnerability:** The vulnerability of the organisation is defined by means of a historical assessment of the threats that have affected the organisation. It will act as the baseline for the risk assessment.
4. **Climate projections:** Definition of which type of climate projection is going to be used for the risk assessment.
5. **Risk assessment:** it will determine the climate risk for each of the impacts identified by means of the traditional risk assessment framework that relates the frequency of the threat (associated to the probability) with the consequence (that qualitatively integrates vulnerability and exposure).

Figure 6. General steps for climate risk assessment. Source: own production.

5.3. Data scope and gathering

Figure 7. First step for the climate risk assessment. Source: Prepared by the authors.

The first step of the risk assessment process must be to establish the scope to which the organisation is going to be subject. In this regard, it is necessary to define, on the one hand, the geographical limits, and, on the other hand, the operational limits. Furthermore, this section seeks to be the work basis to underpin the whole process. Therefore, a general data gathering section of the organisation is included that may be useful in subsequent steps.

5.3.1. Geographical scope

It defines the geographical area being studied. The geographical scope defines the location where the tasks involved in each of the phases of the project are going to be implemented. The climate risks that will affect the selected area will directly depend on the selected geographical scope (for example, a facility far from the coast is not going to be affected by a rise in sea level).

The selection of the geographical scope will in turn depend on the type of activity in the organisation. It may be recommendable in organisations with many types of or geographically very disperse facilities (for example, organisations with linear facilities such as railways or highways) to conduct different assessments for each of them or to assess specific facilities of special interest for the organisation (economic, logistic, market, due to be historically very vulnerable to climate effects, etc.).

Therefore, when defining the scope of the organisation, it must be taken into account that the asset or facility within the BAC is considered as priority and consequently is the focus of the action.

The inputs required by the tool are defined in Table 3.

5.3.2. Operational scope

When defining the operational scope, it must be taken into account in which phases/tasks the main impacts due to climate threats occur in each organisation and establish the scope according to the levels that directly impact the organisation.

In general, the impacts can be categorised into three levels according to their impact level[7]:

1. **Basic operations:** climate change has direct consequences on the business production facilities and buildings.

   The physical structures may be impacted by exposure to extreme weather conditions that jeopardize the design or the integrity of the asset or simply damage it. On the other hand, climate change may likewise affect the

Province	
Town or city	
Address	
Name of the selected facility/ asset	
Description of the selected area	

Table 3. Geographical scope to be introduced in the tool.

[7] Adapted from: Frances G. Sussman, 2008 - Adapting to climate change: A business approach.

effectiveness or efficiency of the productions processes, cost of the operations, maintenance activities or the quality of a product. Include a detailed description of the process for each of the basic operations included within the scope.

2. **Consumption of raw materials and demand for products and services:** climate change may affect the quality or amount of consumables in production or the demand for a product or service. For example, the demand for cooling is likely to increase in summer months or the demand for direct interaction products with the customer during winter may decline in some areas.
3. **Value chain:** disruption to public services that may affect the supply chain such as electricity grids, water supply or sewage systems, product delivery logistic, consumable supply networks, etc.

The levels must be selected by their level of relevance for the organisation. Usually, the level of basic operations is the one where they suffer most impact during their lifecycle. In this regard, the different basic operations implemented in each organisation must start from the first level selected in detail.

Once all the basic operations considered relevant have been described in detail, whenever deemed necessary, the operational scope can continue to be expanded by means of the second level (consumption of raw materials and demand for products and services) and third level (value chain).

The inputs required by the tool are defined in Table 4, where it is necessary to determine whether to include each of the proposed levels, along with their description, within the scope.

Basic operations		
Type	**Does it include?**	**Description**
Service or production process		
Consumption of raw and/or other materials		
Ancillary and maintenance services		
<Insert rows to add other types of processes>		
Consumption of raw and other materials and demand for products and services		
Type	**Does it include?**	**Description**
Consumption of electricity, water, fuel, etc.		
Consumo de materias primas y/o materiales		
Demand for products and services		
<Insert rows to add other types of processes>		
Value chain		
Type	**Does it include?**	**Description**
External transport infrastructures		
Logistics		
Supply of raw and other materials		
Supply of electricity, water, fuel, etc.		
<Insert rows to add other types of processes>		

Table 4. Operational scope to be introduced in the tool.

5.3.3. Data gathering

Once the operational and geographical scopes have been defined, the following task is to gather all the information that can help to begin to define, on the one hand, the current vulnerability of the system and, on the other hand, the assessment of future climate risks.

In this regard, it is basic information for the organisation with the general characteristics that they are data that can be geographically located to subsequently determine exposure to certain threats.

The inputs needed in the tool are defined in Table 5. The information or minimum distance of the location given in the scope needs to be reported for each of the variables indicated in the tool. In the case of having other locations with data or distances greater than the one initially reported, the tool also has the option to include them for information purposese

5.4. Defining the horizon year

Figure 8. Second step for the climate risk assessment. Source: Prepared by the authors.

The horizon year, that the organisation wishes to apply to the risk assessment study, must be considered according to different criteria which include the lifespan or the depreciation period of a facility or an infrastructure defined in the first step forward.

The horizon year will be used, among other aspects, to identify the benchmark periods in the available climate projections (Step 4).

Variable	Source	Description of location with greatest exposure	Minimum data (m)
Minimum distance to flood-prone area	Geoeuskadi > URA > Floodability layer		
Minimum distance to coastal body of water (m)	Geoeuskadi > URA > Surface water hydrographic layer > Bodies of coastal water of the BAC		
Minimum distance to a body of water in transition (m)	Geoeuskadi > URA > Surface water hydrographic layer > Bodies of water of transition of the BAC		
Elevation above sea level (m)	Geoeuskadi > Obtain elevation		
Distance to area subject to landslides (m)	Expert criterion		
Variable	**Source**	**Description of most vulnerable location**	**Description/detail of other locations**
Predominant type of land	Geoeuskadi > Environment > Geology > Lithology		<Include in the case of there being multiple locations>
Potential erosion of the study area	Geoeuskadi > Environment > Erosion > Potential erosion as per the RUSLE model		<Include in the case of there being multiple locations>

Table 5. Data gathering to be included in the tool.

In this regard, the periods to be selected are in line with the three future periods on which the IPCC structures its climate projections:

- Period of years between 2011 and 2040.
- Period of years between 2041 and 2070.
- Period of years between 2071 and 2100.

On the other hand, if the defined scope includes aspects of special importance for the organisation with differentelifespan to that of the full study area, you should also include them in the data table. The risk assessment process for elements with different horizon years is similar, with the difference being that if there is a different time horizon, the period to be reviewed in the climate projections will also be different.

The inputs needed in the tool are defined in Table 6, where the time period chosen and its justification need to be selected.

Scope selected	Time period considered (period of the IPCC projections)	Why have you chosen that horizon?
Study area		
Specific feature (specify)	Period of years between 2011 and 2040 Period of years between 2041 and 2070 Period of years between 2071 and 2100	
<Insert rows to add other features>		

Tabla 6. Horizon year to be entered in the tool.

The limits of the organisation: Befesa Zinc Aser

Befesa is an international company that offers specialised environmental services in the integral management of industrial waste.

Its operations to recover and recycle steel waste are concentrated at the Befesa Zinc Aser production facilities at Erandio (Vizcaya). At its Erandio plant, the only one in Spain with these characteristics, the powder generated at the steelworks using electric arc furnaces is recycled and the zinc and lead contained are subsequently recovered.

In this regard, the limits that Befesa has chosen to assess climate risks are:

Geographical scope

Office building and production facilities in a single complex located in the industrial area on the Carretera Asua-Plencia, No. 21 in the municipality of Asua-Erandio.

Operational scope

The following have been considered within the Befesa Zinc Aser basic operations:

- Office building: both the physical building itself and the computer and climate control equipment and their maintenance.
- Waelz furnace: both the casing of the furnace that can be affected by winds and low temperatures and their maintenance.
- Cooling process of the equipment and facilities.
- Leaching process.

Befesa Zinc Aser has likewise included within the assessment the electricity consumption associated to the office buildings and production facilities, water consumption in the different stages of its process and natural gas consumption in the combustion facilities such as the Waelz Furnace.

Finally, Befesa Zinc Aser has considered three aspects associated to the value chain within the assessment limits:

- The delivery logistics of materials and products associated to delays due to climate events.
- The supply of electricity, water and fuels associated to cuts in supply due to climate events.
- The supply of raw materials and materials needed for its production process.

Time line

The oldest buildings in the study area date back to 1987 and the maximum lifespan is estimated to be 50 years. On the other hand, the Waelz Furnace was installed in 2006 and is estimated to have a lifespan of 20 years.

In this context, Befesa has considered the period of years between 2016 and 2015 out of the three time horizons described as the most appropriate for the study.

The limits of the organisation: Euskotren-ETS

ETS, Euskal Trenbide Sarea/Basque railway network, is the public entity that the Basque Government created in September 2004 in order to reorganise the Basque railway sector and drive a new balance in means of transport.

Its main aim is to conserve, manage and administer the railway infrastructures depending on the Basque Autonomous Community. Furthermore, in order to guarantee a correct conservation of the existing railway network, ETS implements all the necessary actions related to the construction of new infrastructure assets, in order to modernise and improve the railway infrastructures and the telecommunications and safety facilities.

Euskotren, in turn, is the main transport operator in the Basque Country, with over 30 million travellers. It provides a public service that, based on quality, efficiency and safety, meets the mobility needs of the general public and guarantees greater freedom when transporting freight.

In this regard, in the framework of this project, both organisations conducted a joint risk assessment in order to encompass the comprehensive management framework, from the construction and conservation of the railway infrastructures to their operating.

Geographical scope

The geographical scope selected by Euskotren-ETS for the assessment was the section of the metre gauge railway line between Amorebieta and Iurreta, both of which are in Bizkaia. This section includes two railway stations and a section of approximately 9.16 km of railway structure.

Operational scope

On the one hand, the physical buildings of the Amorebieta and Euba station and the tangible assets of the 9.16 km of railway structure and, on the other hand, the safe upkeep of the track infrastructure were considered within the Euskotren-ETS basic operations.

Euskotren-ETS likewise included the electricity consumption associated to the circulation of the trains and estations, and the water consumption at the stations. The consumption of raw materials (ballast, sleepers, tracks, wiring, etc.) in the track maintenance work was likewise considered.

Finally, and associated to the value chain, Euskotren-ETS considered the electricity supply within the limits of the assessment.

Time line

Much of the railway structure and infrastructure assessed has been recently renewed. On the other hand, the lifespan of the rolling stock, renewed between 2016-2020, is approximately 30 years.

In this context, Euskotren-ETS has considered the period of years between 2046 and 2065 out of the three time horizons described as the most appropriate for the study.

5.5. Definition of the current vulnerability of the organisation

Figure 9. Third step for the climate risk assessment. Source: Prepared by the authors.

5.5.1. Exposure to geographically located threats

As has been previously defined, exposure is the presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructures and cultural, social and economic assets that could be adversely affected.

Exposure is related to vulnerability, defined in turn by the IPPC as the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt and the exposure.

Therefore, if a system is more exposed to a certain risk, its vulnerability will increase, in the same way as if its exposure is low, it vulnerability will also be. A relevant aspect of this concept is that the exposure of a certain risk may be zero (for example, a facility or asset is at a considerable distance from the coast and will therefore not be affected by a rise in sea level), its vulnerability to climate change will be the same and it will therefore not be necessary to conduct the risk assessment process for this specific risk.

For an exposure to be classified as zero, the evidence must be clear, such as the one set out in the above example. If that is not the case, it is preferable to also perform the risk assessment for that risk. Exposure acts as a filter according to the distance to different possible threats. In this regard, exposure to the threats that are geographically localised, such as flooding due to rivers bursting their banks (waterways), coastal flooding, sporadic landslides, etc. can only be assessed.

In the tool (see Table 7), this section is supplied by the information gathered in the first step of the process and helps to establish the selected study area, along

Threats	Potential impacts	Variable	Criterion	Minimum distance to	Is it considered for the risk assessment?
Intense rainfall	River flooding	Distance to the flood-prone area	Not considered a potential risk when at more than 500 metres from a flood-prone area	0	
Coastal storms	Coastal floods	Distance to the coast	Not considered a potential risk when at more than 500 metres from the coast	0	
Sea level rise	Coastal floods	Distance to the coast or body of water connect to the sea	Not considered a potential risk when at more than 500 metres from the coast or tidal body of water (connected to the sea)	0	
		Height above sea level	Not considered a potential risk when over 20 metres above sea level		
Intense rainfall	Landslides	Distance to an area that is highly susceptible to landslides	Not considered a potential risk when at more than 200 metres from an area not susceptible to landslides	0	

Table 7. Exposure to geographically located threats to be entered in the tool.

with the potential risks that may affect the organisation. According to the criteria associated to each threat, it will be established whether an organisation needs to assess that threat or, on the contrary, it is not exposed and the assessment is not necessary. Furthermore, the tool offers the option of entering other specific threats for the organisation that can be located geographically.

5.5.2. Historical threat assessment

This section seeks to contrast the climate risk assessment process.

Even though climate projections are not met, many of the impacts of climate change are already affecting the organisations. Therefore, it is particularly relevant to know the threats and risks that each organisation is facing today. The main objectives of this process include providing the necessary knowledge to help to consider how climate change could affect your organisation.

The focus must be on the consequences that those events generated in the organisation and the way of solving them. This exercise does not require extensive resources or technical experience, however it offers additional benefits such as helping to identify possible critical thresholds (for example, maximum temperature for the machinery to operate correctly, water level at which a river bursts its banks), to identify possible improvements based on the response to previous threats or prioritise certain areas of the organisation over others.

The main resources needed for the planning processes are, therefore, information and human resources, in the form of time, skills, knowledge and experience. Similarly, the physical resources will not be significant, including, for example, rooms and equipment for meetings.
The historical threat assessment must not only focus on historical milestone records of extreme events, but also on the expertise of all the workers of the organisation (for example, continuing with an earlier example, a problem in the machinery due to a heat wave that does not necessarily have to appear in records of historical milestones of extreme events).

It is recommendable at this point of the process to begin to set up a multidisciplinary work team with broad understanding of the systems, processes and vulnerabilities of the organisation that will work throughout the climate risk assessment process.

The analysis of the climate information may benefit from the experience of a wide range of people. Similarly, due to the cross-cutting nature of the impacts, it is probable that a wide range of people are ultimately responsible for implementing any adaptation measure. The involvement of these people in the planning process will help to ensure that they duly committed and informed to assume responsibility for the adaptation actions.

In this regard, the three following steps are proposed for this process:

1. Pinpointing the historical events that have affected each organisation to a greater or lesser extent. This can therefore involve accessing the internal records of the organisation, the experience of the workers themselves or existing bibliography related to extreme climate events that have affected an area close to the organisation as can be seen in the Table 8.

2. Identifying the potential impacts that the extreme event caused to the organisation. The methodology is similar to the previous step. Using its own expert criteria or the records of the organisation, the working group must be able to identify the potential impact that it suffered.

Historical climatology data in The Basque Country	
Year on year	http://www.euskalmet.euskadi.eus/s07-5853x/es/contenidos/informacion/cli_2015/es_clieus/es_2015.html
Seasonal	http://www.euskalmet.euskadi.eus/s07-5853x/es/contenidos/informacion/cli_2016/es_clieus/es_es2016.html
Month on month	http://www.euskalmet.euskadi.eus/s07-5853x/es/contenidos/informacion/cli_2016/es_clieus/es_me2016.html

Table 8. Historical climatology data in the Basque Country Source: Euskalmet.

The identification process may often begin at this second point, for example, by identifying a flood in the past or a total disruption to the service. In those cases, wherever possible, it is recommended to associate a posteriori which extreme event was the one causing the impact (for example, if offices were flooded, the extreme event would be extreme precipitations over one or more days).

3. Detailing the consequences that each impact had on the organisation. The line dividing the impact from its consequences is often blurred. Even so, the consequences of the impacts may be easily estimated, for example, by analysing the sales records in the extreme event or comparing electricity bills between different years to check if consumption associated to the cooling system had increased.

The consequences are not always measured in terms of costs, for example, the number of workers absent from work over a period of time or the number of complaints from the workforce about the uncomfortable working conditions may also help to qualitatively define the consequences of each impact.

The inputs required by the tool are defined in Table 9. The two first rows are given as an example.

Threat that has affected the organisation	Details	Date	Impact generated by the threat	Consequences of the impact
Extreme precipitation	Extreme precipitation event	Winter 2011	Flooding in the offices	No access to the office The main activities of the organisation came to a standstill
Wind speed	High wind event up to 200 kph	October 2013	Crane operations stopped for safety reasons	Construction stopped for 2 days. Impossible to finish the work on time Penalties increase costs

Table 9. Historical assessment to be added to the tool.

Current vulnerability: Metro Bilbao

metro bilbao

Metro Bilbao is the company that runs the over and underground railway network serving Bilbao and its metropolitan area, Gran Bilbao, an area extending along both banks of the Bilbao river estuary and which is home to approximately one million inhabitants.

From the perspective of geographical location in terms of climate threats, Metro Bilbao has been able to rule out exposure to coastal storms as the section of the underground line being studied is over 10 kilometres from the coast. However, it is an area that is between flood-prone district and next to the River Nervion estuary, an tidal stretch of water and there is therefore the possibility of it being affected by rises in sea level and intense precipitation.

On the other hand, in the current vulnerability assessment, Metro Bilbao identified two main threats that have generated different impacts in recent years.

The most frequently were the extreme precipitations. This type of events were identified between 1983 and 2013, which caused rock falls on the tracks and flooding of the facilities, occasionally resulting in the service having to be shut down for a time.

On the other hand, the wind speed is another of the threats for which Metro Bilbao has historical records. This threat has repeatedly caused objects to fall on the tracks, causing the facilities to fail or shutting down the supply.

This assessment has allowed Metro Bilbao to put the climate assessment of its organisation into context, establishing in greater detail its current climate vulnerability and similarly allowing the focus on be on the trend of the most recurrent threats to the present.

5.6. Climate projections

Figure 10. Fourth step for the climate risk assessment. Source: Prepared by the authors.

The latest report of the Intergovernmental *Panel on Climate Change* (IPCC, AR5) overwhelmingly establishes the clear relationship between anthropogenic emissions to the atmosphere and climate changes seen in different areas of our planet.

These climate changes, which will affect precipitations, temperature and frequency of extreme meteorological events, will not be geographically uniform and will likewise continue to show an annual, year-on-year and even ten-year high variability.

In the regard, the IPCC developed 4 types of climate projections that describe how emissions can evolve according to different socio-economic scenarios and are an appropriate instrument to analyse in which way the determinant forces will include future emissions and to assess the margin of uncertainty of that analysis.

Those scenarios, known as *Representative Concentration Pathways* (RCP), are as follows:

— RCP2.6: is for radiative forcing of 2.6 W/m² in 2100.

— RCP4.5: is for radiative forcing of 4.5 W/m² in 2100.

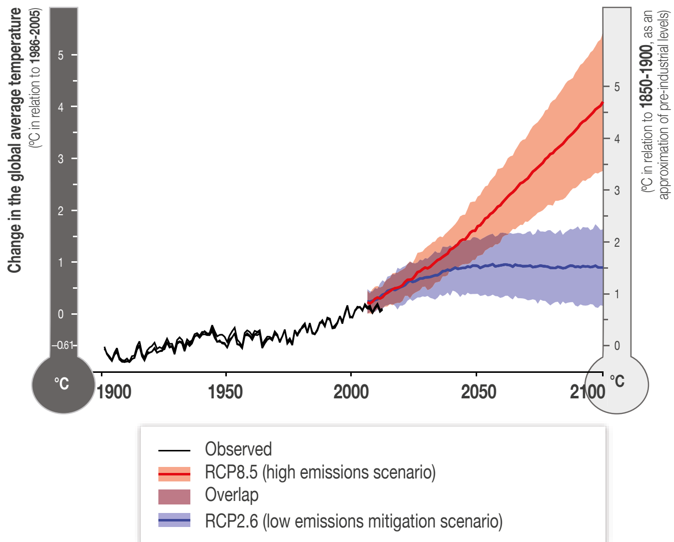

Figure 11. Change in the global temperature according to RCP. Source: IPCC Fifth Report, 2014.

— RCP6.0: is for radiative forcing of 8.5 W/m^2 in 2100.

— RCP8.5: is for radiative forcing of 8.5 W/m^2 in 2100.

Each RCP is coupled to a high resolution spatial database of emissions of pollutant substances (classified by sectors), of greenhouse gas concentrations and emissions and of land use up to 2100, based on a combination of models of different complexity of the atmospheric chemistry and of the carbon cycle. In turn, those scenarios are structured into three future periods set out in Section 2.

These projections are global and therefore their resolution is low and only allows synoptic phenomena to be modelled. In this regard, using more local climate projections allows a much more appropriate resolution to be obtained that correctly represents the natural features of the Basque Country and, consequently, the local effects of climate change.

The Basque Government currently has regionalised climate projections, with a 1kmx1km resolution and with two available scenarios that, therefore, are the ideal source of information to implement the risk assessment process. Those scenarios can be consulted in *Geographic Information System* (GIS) through the following link:

http://www.geo.euskadi.eus/s69-bisorea/es/x72aGeoeuskadiWAR/index.jsp

Further information is available in Annex I.

The selection of the emissions scenario to be used must be a strategic decision of the organisation taking into account the risk it wishes to assume.

In any event, the selection of an intermediate scenario (RCP 4.5) is recommended for the following reasons:

— There is low emissions dispersion for nearby time horizons (until 2050).

— There are regionalised scenarios projections for the BAC with the RCP 4.5 and RCP 8.5 scenarios.

— The RCP 4.5 scenario currently seems to be the most realistic given the international context.

The input needed in the tool is defined in Table 10 and is focused on selecting the emissions scenario.

5.7. Risk assessment

Figure 12. Fifth step for the climate risk assessment. Source: Prepared by the authors.

Many of the potential impacts that an organisation will have to face in future will be insignificant and, therefore, its action is not worthwhile at least in the short term. Only the significant impacts need to be prioritised for the response to the adaptation to climate change to be proportionate and effective.

The two processes involved in prioritising risks and significant impacts are therefore described in this section:

1. Identification of possible future impacts.
2. Assessment of the identified impacts.

Selection of the emissions scenario
RCP4.5
RCP2.6
RCP4.5
RCP6.0
RCP6.5

Table 10. Selection of the emissions scenario in the tool.

5.7.1. Identifying impacts: qualitative analysis

The impacts are the effect on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructures due to the interaction of climate changes and to the vulnerability of the exposed elements. A risk existing does not guarantee that the impact is going to occur, but it does indicate that the probability does exist that it could occur.

The possible impacts and opportunities for all the functions of the organisation within the previously defined scope need to be identified in order for the organisation to become well adapted to future climate risks.

The methodology applied to identify climate change impacts and opportunities is based on a conceptual model that relates each threat with the potentially affected impacts and receptors, in a similar way to the models used in the environmental impact and risk assessments.

In this regard, the following guidelines will help to ensure that no relevant impact is overlooked:

— It is recommended to continue with the working group defined during the Historical threat assessment involving as many people as possible. In some cases, external stakeholders should also be involved as they may be likewise exposed to climate risks (logistics, market etc.).

— Make sure that all the possible consequences of each impact have been identified taking into account the interrelations between different activities, the sensitivity of different activities or functions and their capacity to adapt to a changing climate.

— Begin working on the threats already identified as potential in the Historical Threat Assessment section, taking into account the exposure, sensitivity and adaptive capacity of the system.

The conclusions of this brainstorming must be embodied in the risk assessment tool, eliminating the duplicates and including a clear description of the impacts and their consequences.

In this regard, the inputs needed in the tool are defined in Table 11. The two first rows are given as an example.

Numbering	Threats that can affect the organisation in the future (Table 1)	Has the event occurred in the past? (see Current Vulnerability)	Projected changes in the future (see Climate Projections)	Negative impacts	Positive impacts and opportunities	Recipient	Recipient details (Table 2)	Consequences of the impact
–	Average temperature	Yes	The projections suggest that there will be an average temperature increase of between 1.5°C and 6°C	Excessive temperatures in the offices	More flexible timetable means that the office will be open longer and therefore support customers for longer	Basic operations	Building Production economy	Uncomfortable working conditions. Increased climate control costs
–	Extreme precipitation	Yes	Intense precipitations increase by around 10% in the study area	Flooding in the offices	–	Basic Operations	Production/ operation building Production economy	No access to the office. The main activities of the organisation come to a standstill Cost of cleaning and repairs
1								
2								
3								

Table 11. Qualitative analysis to identify impacts in the tool.

5.7.2. Assessment of negative impacts: quantitative analysis

The assessment of the negative impacts identified in Section 5.7.1 will be based on a traditional risk assessment, which relates the frequency of the threat (associated to the probability of the threat), with the consequence (which integrates vulnerability and exposure).

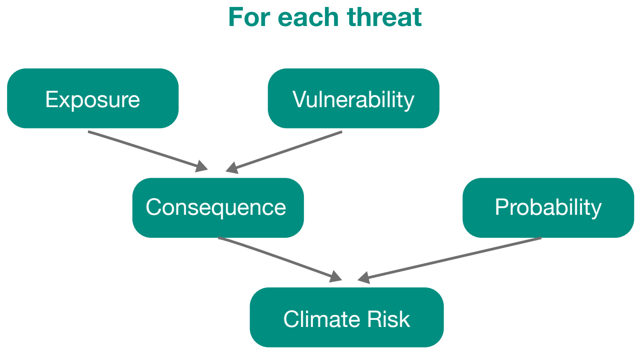

Figure 13. Negative impact assessment framework. Source: Prepared by the authors.

The risk is defined as the possibility of consequences when something of value is at play represented as the probability of occurrence multiplied by its consequences.

Risk = Probability x Consequence

Due to the uncertainty inherent to the future impacts arising from climate change, as they are based on climate projections, the two variables making up the risk need to be described.

Probability

Probability consists of the likelihood that a specific result occurs, when it may be estimated probabilistically. In this regard, probability is classified into 5 categories according to its degree on a scale from improbable to very probable.

Consequences

The consequences are the effects on the human or natural systems. They are the result of the interaction between climate threats that occur in a specific time period and the vulnerability of an exposed system. In this regard, the proposal is to classify the consequences into 6 categories according to their degree, on a scale from none to very serious. The new category of none.

Impacts may generate consequences on different receptors. Therefore, in addition to the gradual classification, they are divided into a further 6 categories:

— **Health and Safety:** related to accidents at work and occupational diseases of the employees.

— **Building/facilities:** impacts on the building or the physical facilities of the organisation.

— **Economy:** direct or indirect impacts on the economic activities of the organisation.

— **Production/equipment:** impact on the production system and equipment of the organisation.

— **Market:** impact on the market system by direct stakeholders such as consumers, producers, etc., to suppliers of products and services.

— **Logistics:** impacts on the set of measures and methods needed to carry out the organisation of a company or a service, particularly distribution.

Degree	Recurring impacts
Very probable	It is very likely that it happens or may happen several times a year
Quite probable	It is likely that it happens or may happen once a year
Probable	It is as likely that it does or does not happen or it may occur once every 10 years
Not very probable	It is unlikely that it happens or it may occur once every 25 years
Improbable	It is very unlikely that it will happen in the coming 25 years

Table 12. Degree of probability of climate impacts. Source: Prepared by the authors.

Degree	Health and Safety	Building/ facility	Economy	Production/ equipment	Market	Logistics
Very serious	Fatalities or very serious injuries	Very serious implications (closure or total refurbishment)	Very serious implications (closure or total refurbishment)	Very serious implications. Full shutdown of production/services	Long-term feasibility of the business affected	Loss of raw material sources or distribution channel that threatens the business
Serious	Serious injury	Serious implications (the possibility of closure considered)	Serious implications (the possibility of closure considered)	Serious implications. Long shutdown of production/services	Measures are required for the feasibility of the business	Disruption to the raw material sources or distribution channel that affects the business
Significant	Significant injuries	Significant implications	Significant implications	Significant implications. Shutdown of production/services lasting several days	No business growth	Components of the supply chain require attention
Minor	Minor injuries	Assumable implications	Assumable implications	Assumable implications	The business may grow slowly	Easily solved isolated difficulties in the supply chain
None	No injuries	No implications	No implications	No implications	No impact on business growth	No impact on the supply chain

Table 13. Degree of the consequences of climate impacts. Source: Prepared by the authors.

In order to assess the consequences quantitatively, the Impact Identification: Qualitative Assessment section, where the consequences have already been defined and, therefore, their scope is known. According to the receptor affected by the impacts, one category or other of the table of consequences should be used. If the impacts generate consequences on several receptors, all of them must be assessed and the most adverse case reported.

It should be pointed out that parameterization consequences and standard probability are presented here. If deemed appropriate, these could be modified by each organisation to adapt them to the specific characteristics of each case. For example, if this climate risk assessment process is to be incorporated in a specific management system of the organisation, those parameters may be adjusted by adopting those of the management system.

Therefore, the inputs needed in the tool are defined in Table 14, focusing on the characterisation of the negative impacts in terms of probability and consequences. In this regard, this section of the tool is supplied with the negative impact and threat definitions in Section 5.7.1.

Numbering	Threats that can affect the organisation	Probability of the threat based on climate projections (Table 3)	Negative impacts	Consequences of the impacts (Table 4)
1	0	Very probable	0	
2	0	Quite probable	0	
3	0	Probable	0	
4	0	Not very probable	0	
5	0	Improbable	0	

Table 14. Quantitative assessment of impacts in the tool.

5.8. Risk results

Una vez definidas las dos variables del riesgo, estas se Once the two variables of the risk have been defined and are correlated in a matrix where the resulting value of the risk is obtained as can be seen in Table 15, classified in 6 categories from none to very high.

Description:

- **Very high risk:** requires immediate action.
- **High risk:** requires action.
- **Medium risk:** action recommended to reduce the risk.
- **Low risk:** its monitoring is recommended, rather than direct action.
- **Very low risk:** neither monitoring nor action regarding the impact is required.
- **No risk:** there is no risk at all.

Risk		Consequence					
		None	Minimum	Moderate	Significant	Serious	Very Serious
Probability	Improbable	None	Very low	Very low	Low	Low	Medium
	Unlikely	None	Very low	Low	Low	Medium	High
	Probable	None	Low	Low	Medium	High	High
	Quite probable	None	Low	Medium	High	High	Very high
	Very probable	None	Medium	High	High	Very high	Very high

Table 15. Risk matrix. Source: Prepared by the authors.

Climate risk assessment: Metro Bilbao

metro bilbao

Starting from the assessment of the current vulnerability, Metro Bilbao has quantified the climate risks that it will have to face in the future.

Reviewing the regionalised climate projections for 2041-2060 (selected as the horizon year simulating the lifespan of the Metro Bilbao rolling stock), it can be seen how, in the study area established by Metro Bilbao (section of the underground line from the Sarriko station to the Lutxana station), an increase of the average maximum temperature is expected of 1.59 ºC, mainly concentrated in the final area of the section near to Lutxana station.

Climate projections implicitly have certain uncertainty and, in particular, those relating to extreme precipitation given that the climate scenarios are directly related to the temperature variables, but not to the precipitation variable. In this regard, the daily maximum average precipitation associated to a 10-year return period was taken as a key variable to determine the extreme precipitations. This variable yields a maximum increase of the daily maximum average precipitations of 2.1% in the study area.

In this regard, the results of the assessment of the climate risks are in line, on the one hand, with the assessment of the vulnerability and, on the other hand, with the observations of the climate change projections. The main climate risk assessed are the extreme precipitations that would generate serious consequences such as flooding in stations, sub-stations and stretches of track. Second, heat waves were found whose consequences would be minor, mainly leading incidents to the circulation.

The main risks assessed established the priorities for action regarding the following step to assess climate change adaptation measures.

06

Methodology to prioritise climate change adaptation measures

Prioritisation of adaptation measures

Once the main impacts to which an organisation is exposed are known, the following step consists of selecting specific climate change adaptation measures which allow the adaptive capacity levels of the organisation to be strengthened and, therefore, reduce the consequences of the impacts with a greater risk index.

Each of the impacts assessed may not require any action, may require action with an adaptation measure or even require action with several complementary adaptation measures. In this regard, the impacts with a greater risk index should be the priorities of action.

A good strategy to begin this exercise is to establish the risk that the organisation is capable of assuming, and that, therefore, all the impacts over this establish risk limit must be assessed. However, that strategy may not be valid in all the cases when, for example, a specific impact for an organisation is priority for other reasons and it wants to take action despite the risk not being high.

The tool has on one hand a compendium of generic climate change adaptation measures filtered by type of threat and, on the other hand, there is the possibility of including new more specific adaptation measures for each organisation.

Both the selection of generic adaptation measures and the new measures proposed must meet the needs of the organisation (economic, strategic, competitiveness, etc.). In this regard, a good practice consists of selecting and including no-regret measures, in other words, measures that are beneficial even when the foreseen consequences of climate change do not occur or do so in a different way.

Climate change mitigation and adaptation are strategies that go hand in hand to combat climate change and they therefore should not impede each other. Therefore, when including new adaptation measures, the environmental impact generated by that new action, which must be none or the minimum possible, must be taken into account.

Furthermore, the tool offers the option to include five types of measures:

— **Not scheduled:** measures that are still not within the plans of action of the organisation, but which reduce the climate risk.

— **Being planned:** measures that are already within the plans of action of the organisation and which reduce the climate risk.

— **Being implemented:** measures already being implemented by the organisation and which reduce climate risk.

— **Undertaken:** measures already undertaken by the organisation and which are reducing the climate risk.

— **Not feasible:** measures that, even though they have been prioritised in the previous step, are not feasible to be implemented by the organisation.

Once the actions to be considered by each organisation have been defined, an assessment process has to be conducted in order to be able to prioritise them according to the situation of each organisation and discard any that are not feasible. In this regard, prioritising actions has to be based on a multicriteria assessment, considering a variable number of criteria to support the decision making when selecting the most appropriate solution.

The variables used in the multicriteria assessment are as follows:

1. Potential to reduce the climate risk.
2. Technical feasibility.
3. Co-benefit contribution (environmental, social, etc.)
4. Economic feasibility.

Variable	Percentage share
Potential to reduce the climate risk	30%
Technical feasibility	15%
Co-benefit contribution (environmental, social, etc.)	15%
Economic feasibility	40%

Table 16. Percentage distribution of the multicriteria assessment variables. Source: Prepared by the authors.

Each one of the variables has a share of the total as indicated below (Table 16).

On the other hand, each of the variables must be rated from 1 point (minimum) to 5 points (maximum) to obtain the final score for each measure in order to prioritise them and be able to compare them. In this regard, Table 17 sets out the score for each variable.

Variable	Score	Description
Potential to reduce the consequences of the impact	1	Does not generate reduction of the consequences of the impact
	2	Minimally reduces the consequences of the impact
	3	Moderately reduces the consequences of the impact
	4	Significantly reduces the consequences of the impact
	5	Completely reduces the consequences of the impact
Technical feasibility	1	Not technically feasible
	2	There are important technical barriers
	3	There are moderate technical barriers
	4	There are minimum technical barriers
	5	It is totally technically feasible
Co-benefit contribution (environmental, social, etc.)	1	It does not generate environmental or social benefits
	2	It generates moderate environmental or social benefits
	3	It generates moderate environmental and social benefits
	4	It generates important environmental or social benefits
	5	It generates important environmental and social benefits
Economic feasibility	1	It is not economically feasible
	2	There are important economic barriers
	3	There are moderate economic barriers
	4	There are minimum economic barriers
	5	It is totally economically feasible

Table 17. Methodology to prioritise climate change adaptation measures.

The tool in this section is supplied by the results of the prioritised risks (see Table 18). In this regard, you must decide whether or not each of the prioritised risks requires action. If you select yes, the tool will modify the cell format to discern between the data that are necessary and those that are not. Finally, dropdown menus are used to select the measure associated to the risk, along with scoring the variables to prioritise them.

			Variables (score of 1 to 5) Table 6				
Associated risk (result of the climate risk assessment)	**Is action required?** (Up to 3 measures per impact)	**Measures** (see Measures Compendium)	**Potential to reduce the consequences of the impact**	**Technical feasibility**	**Co-benefit contribution (environmental, social, etc.)**	**Economic feasibility**	**Prioritisation result**
			Contribution (%)				
			30%	**15%**	**15%**	**40%**	
	Yes						0
	Yes						0
	No						0
	Yes						0
	No						0
	No						0
	Yes						0
	Yes						0
	Yes						0

Table 18. Selecting and prioritising adaptation measures in the tool.

Prioritising adaptation measures: Euskaltel

Euskaltel is the leading convergent telecommunications group in northern Spain. It remains strongly committed to and established in the Basque Country and Galicia, markets where it operates through Euskaltel and R. The telecommunications group offers its services to a market of 5 million people, serving over 715,000 company and residential customers.

In this regard, in the framework of this project, Euskaltel decided to assess the climate risks of the building of its IZADI headquarters in the Bizkaia Science and Technology Park.

Based both on the definition of the current vulnerability and calculating the future climate risk, Euskaltel has defined three adaptation measures that are in line with the needs of the organisation and which have reduced or are currently reducing the climate risk:

- **Environmental education and awareness-raising regarding climate change:** Euskaltel already has an awareness-raising and internal communication plan to foster more efficient energy consumption that is currently being implemented. In this regard, the Plan is currently reducing the consequences of the impacts that generate different threats for the organisation, such as the increase in the average temperature, the heat waves and cold snaps.
- **Remote working:** It consists of working at a place away from the main offices or the production facilities, by means of using the new information and communication technologies (ICT). In this regard, Euskaltel is beginning to implement this type of initiatives that would avoid travelling to the workplace mainly during cold snaps, thus reducing the risks of accidents during the in itinere journey, and decreasing the climate control needs of the offices.
- **Adapting buildings using energy efficiency criteria:** it is a measure that has already been undertaken at the Data Processing Centre of the building to be assessed by means of improving the cooling system by increasing its less energy intense cooling capacity. This measure is currently reducing the consequences of the impacts that generate different threats, such as the increase in the average temperature or heat waves. Similarly, it is considered as a measure that could be applied to other areas of the building that require cooling systems.

Prioritising adaptation measures: **Euskotren-ETS**

Based both on defining the current vulnerability of the railway network and on calculating the climate risk, Euskotren and ETS have defined four adaptation measures that are adjusted to the needs of both organisations and which reduced or are currently reducing the climate risk:

- **Emergency contingency plan:** ETS already has a self-protection plan that alerts to the main emergencies, in order to protect and offset damage to travellers, buildings and infrastructures. This is integrated in the Emergency Response Plan. In this regard, the Self-Protection Plan is currently reducing the consequences of the impacts that generate different key threats for both organisations, such as the extreme precipitations, heat waves, cold snaps and snow.
- **Early warning system:** ETS already has a centralised warning system with the control centre (under the Basque Government's Emergency Response Division) which had led to the response protocols for adverse meterological phenomena. This is integrated in the Emergency Response Plan. In this regard, the early warning system is currently reducing the consequences of impacts such as fallen trees on roads and the pantographs getting hooked on the cantenaries caused by high wind speeds.
- **Adaptation of the infrastructure design, maintenance and operating standards:** it is a measure that ETS has part planned in the multi-annual plans to removed hazardous trees and in the Emergency Response Plan. In this regard, this measure will reduce the consequences of the impacts that generate different key threats for both organisations, such as the extreme precipitations, heat waves, cold snaps, snow and the speed of the wind. On the other hand, they are also considering adding climate projections to the planning and new design of future railways.
- **Slope stabilisation measures:** it is a measure that has already been undertaken in some areas adjacent to the tracks where there has been flooding to extraordinary river levels by means of stabilising earth on unstable slopes and riverbanks. Furthermore, it is seen as a measure that could be applied to areas where a decrease in the return periods of rain and river flooding is expected.

Annex I

Emissions scenarios

Generating climate scenarios with an adequate spatial resolution is the initial step required to improve climate change awareness and advance in identifying and assessing impacts, weaknesses and possible adaptation channels.

The following documents have been produced in the Basque Country as part of KLIMATEK projects:

— A climate atlas (daily data for 1971-2015) with a high spatial resolution (1 km x 1 km) of the following basic variables.
  - Average temperature.
  - Maximum temperature.
  - Minimum temperature.
  - Annual precipitation.
  - Evapotranspiration.
  - Number of wet days a year (precipitation over 1 mm).
  - Maximum average precipitation associated to a 10-year return period.

— Climate change projections for the 21st century (2011-2040, 2041-2070, 2071-2100), with high spatial resolution (1km x 1km) generated for the RCP4.5 and RCP8.5 scenarios, using RCM simulations as part of the Euro-CORDEX project.

In this regard, the steps are summarised in the following to see the climate projections of the basic variables and the benchmark values for each geographical area of the Basque Country.

Steps to see the climate projections for the Basque Country

1. Enter the online visor using the following link:
   http://www.geo.euskadi.eus/s69-bisorea/es/x72aGeoeuskadiWAR/index.jsp

2. Choose the Environment category from the List of Layers (left-hand menu).

3. Select the Climate Change sub-category within the Environment Category.

4. Select the basic variable for which you want to obtain climate projections. There are three categories for each basic variable:
   a. Historical: Average for the period 1971-2000.
   b. Projections: average of the models.
   c. Projections: standard deviation of the models.

5. There are two scenarios for each of the projection categories:
   a. RCP 4.5 scenario.
   b. RCP 8.5 scenario.

6. There are three timeline scenarios for each of the scenarios:
   a. 2011-2040.
   b. 2041-2070.
   c. 2071-2100.

7. Finally, select the “Information on the Point” icon and click on the map at the desired point to obtain information in the area of interest.

EUSKO JAURLARITZA
INGURUMEN, LURRALDE PLANGINTZA
ETA ETXEBIZITZA SAILA

GOBIERNO VASCO
MINISTRY OF THE ENVIRONMENT,
TERRITORIAL PLANNING AND HOUSING

www.ihobe.eus

www.ingurumena.eus