

 **the climate is changing**

Climate change mitigation  
and adaptation strategy  
for the Emilia-Romagna Region

Summary document

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## Scientific evidence, awareness and action

### More resilient and more sustainable

Today, climate change is a priority issue that involves science, society and politics. In recent years, there has been increasingly strong scientific evidence of the extent of global warming and a growing awareness that it is caused by greenhouse gas emissions deriving from the use of fossil fuels and unsustainable use of land and natural resources. At the same time, people have become more aware of the need to implement global policies to drastically reduce emissions and to mitigate rising temperatures (mitigation), as well as adaptation strategies to limit the impact of climate change that will occur in any case. International milestones on these fronts include the 2013 EU Strategy on Adaptation to Climate Change and, more recently, the 2015 Paris Agreement.

In our Region, the study of climate change and the development of mitigation and adaptation policies have witnessed significant milestones and developments in recent years.

In 2015, we signed the Under2 Memorandum of Understanding, which commits the Region to an 80% reduction of its emissions by 2050, and we defined the *Mitigation and adaptation strategy for the Emilia-Romagna Region*, marking the start of a journey of a process of knowledge, integration and strengthening of regional policies for mitigation and adaptation that will go far beyond what is required by the directives and regulations of the European Commission.

The Emilia-Romagna Region is aware that climate change necessitates significant economic and social choices, as well as behavioural changes. In every sector. Without exception. This is not alarmism, but common sense.

It is a necessity. It is an obligation. Not just in economic terms, but also socially and morally. The issue of climate change is not necessarily negative: it is also – although it is never sufficiently characterized as such – an opportunity.

There is in fact huge potential to create development and work opportunities, increasing the resilience of our cities, developing new production methods and enhancing the land.

The Emilia-Romagna Region believes this and is ready to do its part.

The Mitigation and adaptation strategy for the Emilia-Romagna Region therefore represents the start of a journey towards integrated management of its own policies and resources, distinctive characteristics and value for a more resilient and sustainable society.

**Paola Gazzolo**

Councillor for the conservation of soil and the coast,  
civil protection and environmental and mountain policies

## Vulnerability, analysis and strategy

This document is a summary of the longer “Mitigation and adaptation strategy for the Emilia-Romagna Region” document, approved by Assembly Resolution no. 187 of 29 December 2018.

The complete document, which can be downloaded from <http://ambiente.regione.emilia-romagna.it/it/cambiamenti-climatici>, contains, in addition to a thorough assessment of the regional emission profile and of future and current climate change scenarios, a sectoral analysis of the main regional vulnerabilities, which is summarized here. For every physical/environmental and economic sector, the document also specifies the actions that the Emilia-Romagna Region is already taking and/or are included in the plans, programmes and laws in force. For each of the sectors, the document identifies measures and actions – divided into categories of mitigation and adaptation – that it will be necessary to include in future planning for the sector.

In order to make this information more readable, it was deemed necessary to prepare a ‘summary’ version containing the main aspects of the original document, which can be consulted for further details.



## 1. The regional joint strategy

With the **2030 Agenda**, the international community has dedicated attention to climate change, including within the Sustainable Development Goals (SDGs) for 2015-2030, which includes goal 13, “*Take urgent action to combat climate change and its impacts*”, to which national and local governments are required to contribute in various ways.

At the European level, the European Union (EU) is approving very clear and specific policies for both mitigation and adaptation.

In terms of mitigation, with the so-called “climate and energy package”, the EU has finally set a concrete and binding goal for its member states: a) by 2020, to reduce its greenhouse gas emissions, measured in CO<sub>2</sub> equivalent, by 20% compared to 1990 levels, b) to reduce energy consumption by 20% compared to a business-as-usual scenario, and c) to produce energy from renewable sources for at least 20% of final energy consumption.

Given that the 2020 target date is too close to solve problems related to the impact of climate change, the European Commission has already begun to explore the different scenarios on the post-2020 horizon. With communication COM (2011) 112, “A roadmap for moving to a competitive low-carbon economy in 2050”, the Commission states that this transition will consist of a series of stages that provide for the reduction of greenhouse gas emissions by 25% by 2020, 40% by 2030, 60% by 2040 and 80% by 2050 compared to 1990 levels.

With regard to adaptation, in 2013 the European Union achieved a major milestone by adopting its own Strategy on Adaptation to Climate Change, in which it defined three main goals: to promote and support action by member states; to promote adaptation in particularly vulnerable sectors, increasing

the region's structural resilience and also involving the private sector in support of the joint action; to ensure informed decision-making processes, filling knowledge gaps in relation to adaptation.

More recently, in July 2015, with the approval of the National Climate Change Adaptation Strategy (SNACC), through adoption of the decree of the Ministry for Environment, Land and Sea Protection, and with the approval, in November 2017, of the National Energy Strategy (SEN), Italy has bridged the gap with the most advanced European regions, which, for some time, have prepared plan documents and strategies for adaptation and mitigation. At national level, the National Plan for Adaptation to Climate Change (PNACC), which should represent the SNACC implementation document, is at approval stage, along with the Integrated Energy and Climate Plan (PNIEC), as required by Regulation 2016/0375 of the European Parliament and of the Council.

The regions are required to make a contribution to emission mitigation, adopting the European and international commitments, even though it remains a global and international goal; above all, they can and must act in terms of adaptation, increasingly including climate change scenarios in the definition of plans, programmes and sizing choices of infrastructure works, with a time horizon of 2030 and 2050.

Since November 2015, the Emilia-Romagna Region has taken part in the *Under2 Coalition* following the signing of the *Subnational Global Climate Leadership Memorandum of Understanding, Under2MoU*. Local governments that are members of the Under2MoU are committed to reducing, by 2050, greenhouse gas emissions by between 80% and 95% compared to 1990 levels, or to a quota of 2 tonnes of CO<sub>2</sub> equivalent per capita.

The goals for the Emilia-Romagna Region identified in the Memorandum of Understanding call for a 20% reduction in emissions by 2020 compared to 1990 levels, and a target of -80% by 2050.

It is in this context of national and international policies and commitments that the Emilia-Romagna Region has defined its Climate

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1 <https://sustainabledevelopment.un.org/sdg13>

change mitigation and adaptation strategy, with the aim of “holding together” these two aspects in the fight against climate change which are seemingly disconnected, but in fact strongly interconnected in natural and man-made, as well as complex and varied environments.

The regional joint mitigation and adaptation strategy is above all the result of a process that has actively involved many representatives, sectors affected by regional policies and regional system agencies through the establishment of an intersectoral working group with Council Resolution no. 570/2016.

The regional strategy goals can therefore be summarized as follows:

- ♣ to enhance the actions, plans and programmes of the Emilia-Romagna Region in terms of mitigation and adaptation to climate change by mapping the actions already in place at regional level to reduce greenhouse gas emissions and adapt to climate change;

- ♣ to define monitoring indicators (among those already in use by the various plans for both the SEA (Strategic Environmental Assessment) and VALSAT (Environmental and Territorial Sustainability Assessment) and for the operational programmes of the 2014-2020 Structural Funds);
- ♣ to design and implement a regional and local policy implementation observatory;
- ♣ to identify further measures and actions that should be implemented for the various sectors, in relation to existing sector plans, helping to coordinate regional planning with reference to the mitigation and adaptation goals;
- ♣ to identify and promote a participatory process involving local stakeholders in order to integrate the issue of adaptation and mitigation into all regional and local sectoral policies;
- ♣ to coordinate with local mitigation and adaptation initiatives.

		CURRENT STATE IN 2017	2030 GOAL	2050 GOAL
CO2 emissions	Kton CO2	39.000	-40%	-80%



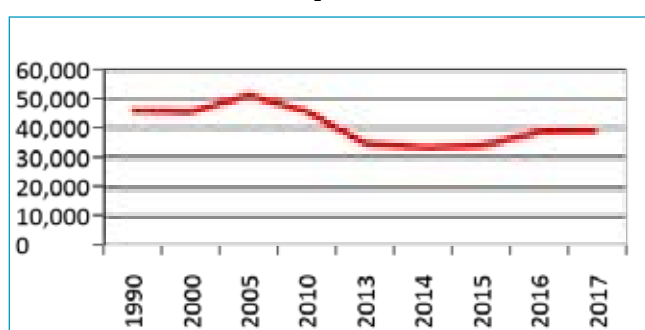
## 2. Observing and predicting climate change in Emilia-Romagna

### 2.1 Regional emissions trend

The time series of total greenhouse gas emissions calculated in CO<sub>2</sub>eq, including contributions from removals, shows a downward trend that has sharpened since 2010.

The decreasing greenhouse gas emissions trend shows a reduction peak in 2014 due to both the economic and productive crisis and to particularly mild winter temperatures that led to a reduction in heating-related consumption (figure 1).

Figure 1 CO<sub>2</sub> eq emissions



Greenhouse gas emissions by sector have been calculated since 2013 (table 1).

Regional emissions, partly due to the significant quantity of infrastructure spread across the Region, include relatively high levels of greenhouse gas emissions, particularly when compared to the national average. The pre-

sence of a widespread industry and a road network connecting Northern and Central Italy, together with significant human activity in the region, results in emissions that can only be partially contained, although over the years great progress has been made in terms of reducing emissions.

Table 1 CO<sub>2</sub> eq (kt) emissions by sector

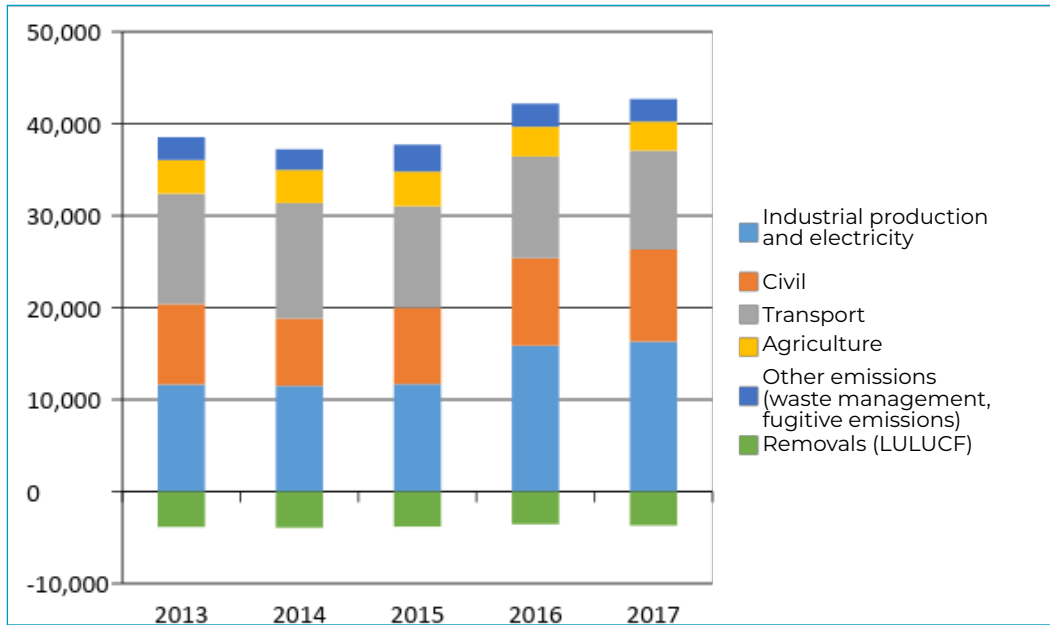
	2013	2014	2015	2016	2017
Industrial production and electricity	11.646	11.504	11.699	15.850	16.318
Civil	8.765	7.329	8.297	9.573	9.975
Transport	11.992	12.551	11.043	11.057	10.796
Agriculture	3.656	3.595	3.758	3.230	3.148
Other emissions (waste management, fugitive emissions)	2.485	2.244	2.928	2.516	2.452
Removals (LULUCF)	-3.843	-3.920	-3.806	-3.546	-3.689
<b>Industrial production and electricity</b>	<b>34.701</b>	<b>33.304</b>	<b>33.919</b>	<b>38.642</b>	<b>39.000</b>



The largest contribution to emissions is due to transport and civil heating (residential and tertiary). Less significant contributions are made by industry (which has seen significant improvements in its emissions performance

in recent years) and fossil-fueled electricity generation plants, although the contributions of the latter have been increasing in recent years due to the recovery of natural gas power production (figure 2).

Figure 2 Graph CO<sub>2</sub> eq (kt) emissions by sector



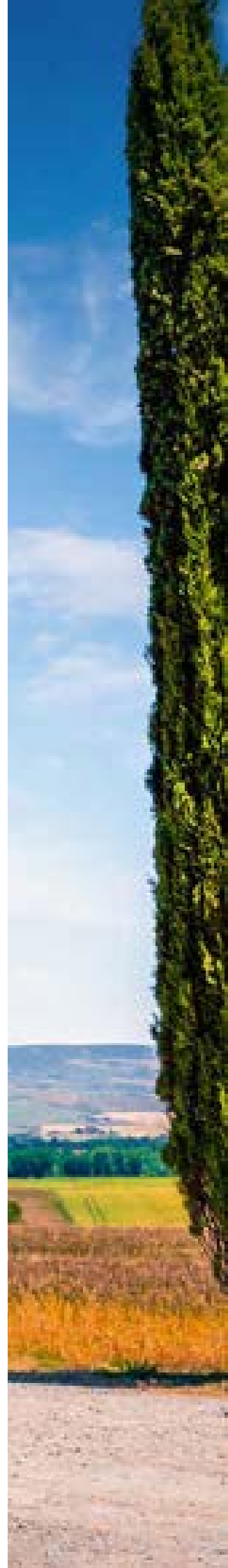
CO<sub>2</sub> emissions are proportional to energy consumption; over the last decade, energy consumption by primary source in the Emilia-Romagna Region has undergone a change that has led to a reduction in the consumption of petroleum products in favour of natural gas, renewable sources and electricity.

Demand and consumption of electricity is constantly increasing, particularly during the summer to meet the demand for air conditioning in buildings. This leads to a significant increase in emissions from the electricity production sector.

The emissions from the civil sector are due to the demand for thermal energy for heating and are therefore influenced by the year's climate.

The transport sector shows a slight constant drop in emissions mainly due to the renewal of the vehicle fleet.

Despite the continuous increase in waste production, the total sent to landfill has decreased thanks to waste policies implemented in recent years. In particular, the increase in recovered methane has significantly contributed to reducing the sector's emissions.



## 2.2 Climate change trends on a global and local scale

The most consistent sign of ongoing climate change is **temperature**, for which, at a global level, observed data show a growth trend between 0.6 °C and 1.1 °C in the 1880-2012 period. Moreover, since 1950, ten-year and inter-annual temperature variability, as well as the **frequency and intensity of extreme events** (last report of the Intergovernmental Panel on Climate Change, www.ipcc.ch), has increased.

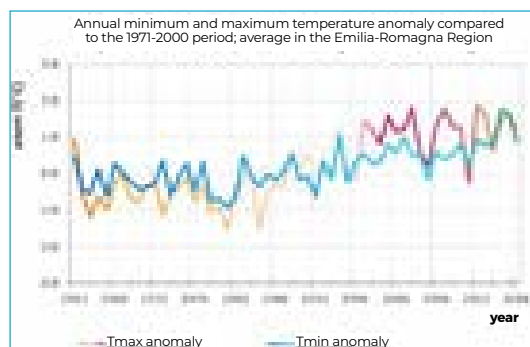
With regard to global precipitation, there is a more varied trend, with many regions of the globe having recorded positive trends (northern Europe and certain areas of northern and central Asia) or negative trends (Sahel and Mediterranean area) from 1951 to today, although these trends are not always significant.

**The Mediterranean Basin has been identified as a “hotspot” for climate change, a basin with annual trends of temperature rises and a marked reduction in the number of rainy days.**

### Climate anomalies in Emilia-Romagna

Between 1961 and 2016, a **significant increase in minimum and maximum temperatures, both at an annual and seasonal level**, was detected in *Emilia-Romagna*. The annual trend is more notable for the maximum temperatures ( $0.4^{\circ}\text{C per decade}$ ) than for the minimal temperatures ( $0.2^{\circ}\text{C per decade}$ ). The temporal trend of the annual temperature anomaly (Figure 3) shows a very high frequency of positive cases after 1990 (Eraclito

Figure 3



- ♣ Significant increases in annual and seasonal values of minimum and maximum temperatures; signs of a more intense increase in the maximum temperatures, especially during the summer.

5x5km date set). There are also very significant positive anomalies, especially for the maximum temperatures. In fact in the Region, in the 1991-2016 period, the maximum annual temperature recorded an average increase of about 1.5 °C compared to the 1961-1990 period (17.8 °C compared to 16.3 °C). At a seasonal level, there is a greater recorded increase during the summer, with a trend of  $0.6^{\circ}\text{C per decade}$  for maximum temperatures and of  $0.3^{\circ}\text{C per decade}$  for minimum temperatures.

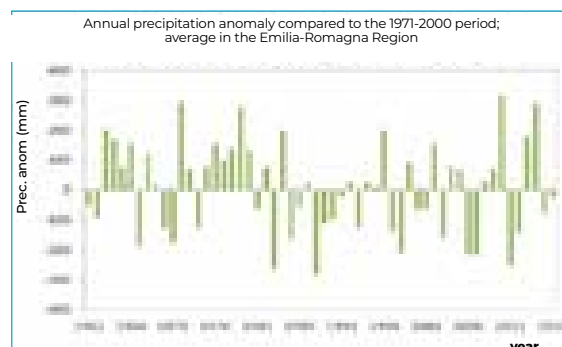
The increasing trend is confirmed by the trend of the **extreme temperature indicators**, namely by the increase in the duration of heatwaves and tropical nights during the summer and the decrease in the number of days with frost during the winter.

**With regard to annual and seasonal cumulative precipitation**, the trend shows a slight decrease, except in autumn, for which a positive trend is reported. Although there is no significant trend in cumulative precipitation, it is important to highlight the presence of years with significant anomalies, both negative and positive, especially after 1980 (Figure 4).

In the extreme precipitation values, a positive trend in the maximum consecutive number of days without precipitation has been observed, especially during the summer.

Locally, in the lowlands and in certain stations in the central Apennines, an increase in the frequency of heavy rain events has been noted.

Figure 4



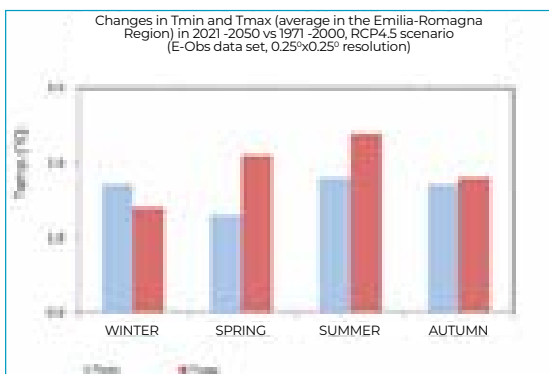
- ♣ Slight decrease in annual and seasonal cumulative precipitation averages, except in autumn, for which a positive trend is reported.

## Climate projections in Emilia-Romagna

The climate scenarios for the Region have been obtained through the statistical regionalization technique applied to the results of the global climate model of the *Euro-Mediterranean Center on Climate Change* (CMCC-CM) for the RCP4.5 emission scenario, which provides for a reduction over time in the concentration of greenhouse gases following the adoption of mitigation policies; the scenario corresponds to the 2 °C global warming goal, identified in the Paris Agreement (2015).

The climate scenarios for the Region show significant signs of change for the 2021-2050 period compared to the 1971-2000 reference period, in terms of both temperature and rainfall.

Figure 5



- ♣ For the 2021-2050 period, a probable increase in minimum and maximum temperatures of about 1.5 °C in winter, spring and autumn, and about 2.5 °C in summer.
- ♣ Probable increase in temperature extremes, in particular of heat waves and tropical nights.
- ♣ Probable decrease in the amount of precipitation, especially in spring (around 10%) and summer.
- ♣ Probable increase in total precipitation and extreme events in autumn (about 20%) and increase in the number of consecutive days without precipitation in the summer (about 20%).

There are similar temperature projections for the 2021-2050 period, including in the context of the RCP8.5 emission scenario.

Towards the end of the century, from 2071 to 2100, the projections show more intense changes in terms of both temperature and rainfall. With the RCP 4.5 scenario, the expected increase for maximum temperatures during the summer could be around 4.5 °C, while with the RCP 8.5 scenario, which considers the absence of mitigation policies and the increase in greenhouse gas emissions over time, summer temperatures could increase by as much as 8 °C.

## Future scenarios: the Special Report on Global Warming of 1.5 °C (2018)

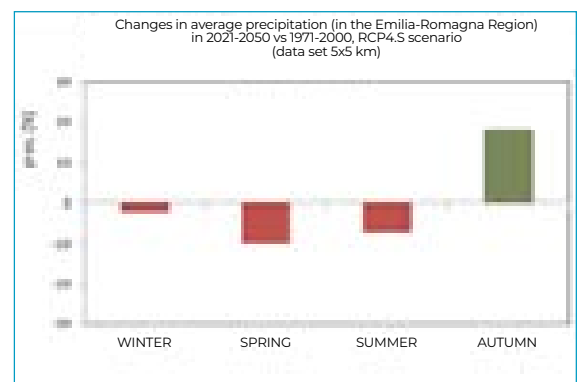
The Special Report on Global Warming of 1.5 °C (2018)

The projections indicate a probable regional average increase in minimum and maximum temperatures of around 1.5 °C in all seasons except summer, when the average regional increase for the maximum temperature is expected to be around 2.5 °C (Figure 5). Furthermore, possible increases in the duration of heatwaves and tropical nights are estimated.

With regard to precipitation, the scenarios show a likely decrease in the amount of precipitation in all seasons, except in autumn, when there may be a regional average increase of around 20% (Figure 6).

**As evidenced at a global level, even at regional level signs of change may vary in magnitude and be positive or negative depending on the different areas of the region.**

Figure 6



estimates that human activities have caused the global temperature to rise by about 1 °C compared to the pre-industrial period, and that, if this temperature rise trend continues at the current pace, global warming will increase by 1.5 °C between 2030 and 2052.

The same report emphasizes the fact that the temperature increase will vary according to geographic area, in other words there will be regions that will experience a greater increase and others where the increase will be smaller (<https://www.ipcc.ch/sr15/>).

*“Representative Concentration Pathways” (RCPs) refers to the pathways of concentrations of greenhouse gas emissions in the 21<sup>st</sup> century, with consequent and associated projections of radiative forcing levels on the ground, based on different scenarios of global economic growth, population variation, exploitation of energy and land resources and other socio-economic factors.*

In its fifth Assessment Report (AR5, 2014), the IPCC selected four reference RCPs: RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5. The numerical suffix, for example 2.6, represents the radiative forcing, measured in W/m<sup>2</sup>, estimated in the year 2100 compared to the pre-industrial era (1750), for the different pathways.

The RCP 2.6 scenario considers the adoption of policies to mitigate and reduce very high emissions; the RCP 4.5 scenario considers the stabilization of the concentration of greenhouse gases, or the adoption of measures for their significant reduction; the RCP 6.0 scenario is a stabilization scenario, with mild emission reductions; the RCP 8.5 scenario considers the presence of high emissions, or the non-adoption of mitigation policies (“BAU: business as usual”).

The RCP4.5 and RCP8.5 scenarios were taken into consideration in the strategy.

### 3. The regional vulnerabilities and risks associated with climate change

#### Vulnerability

Vulnerability is one of the risk components with respect to climate change. For an area, this is connected to its natural characteristics and level of human activity. The degree of vulnerability is determined by susceptibility to damage, by different sectors' adaptability and by the interrelations between *physical-biological* and *socio-economic* sectors, such as between water and agriculture, between air quality and human health, etc. Most of Emilia-Romagna is located in the geographical region belonging to the Po river basin district, the most important Italian area in geographical, economic and social terms, which is also extremely vulnerable to climate change, despite its abundant water resources.

Considering that climate change could alter the seasonal distribution and variability of precipitation in the area and reduce the extent and volume of alpine glaciers, there will be significant variations in water outflows, as already evidenced by hydrological and rainfall data.

In the rest of the region, the greatest vulnerability is also linked to the water cycle, namely to the increased frequency and intensity of extreme weather and climate events and to the variation in average annual water availability.

Indeed, since 2003, due to the increased demand from various human activities, there have been frequent water shortages.

#### Risks

The risks connected to climate change in the *physical-biological* and *socio-economic* sectors are related to the type of impact that the change can have and to the degree of resilience of the sectors themselves, which de-

pends both on their intrinsic characteristics and on the possibility (technical, economic and social) of intervening with adaptation measures.

As in the case of vulnerability, the physical-biological and socio-economic sectors are also interconnected in terms of risks and the impact of climate change for a given sector can affect others: for example, it is possible that the risk of subsidence in the coastal area is linked to the imbalance between groundwater withdrawals and recharge, due to the increased demand originating in other sectors.

The potential trend towards a significant increase in water demand, particularly for the irrigation sector, faced with reduced resource availability and unchanged infrastructure conditions, will lead, on the one hand, to the failure to meet water needs and, on the other, to heightened environmental problems, such as a decrease in the ecological and chemical quality of surface water bodies. The water deficit would cause a depletion of freshwater environments and their eutrophication, which would have a critical impact on hosted ecosystems and the most sensitive species.

Therefore, just as for the vulnerabilities, the greatest risks related to climate change will be associated with the water cycle and consequently with the availability of water resources.

Other risks directly or indirectly resulting from this, caused by climate change in the physical-biological and socio-economic sectors in Emilia-Romagna, are:

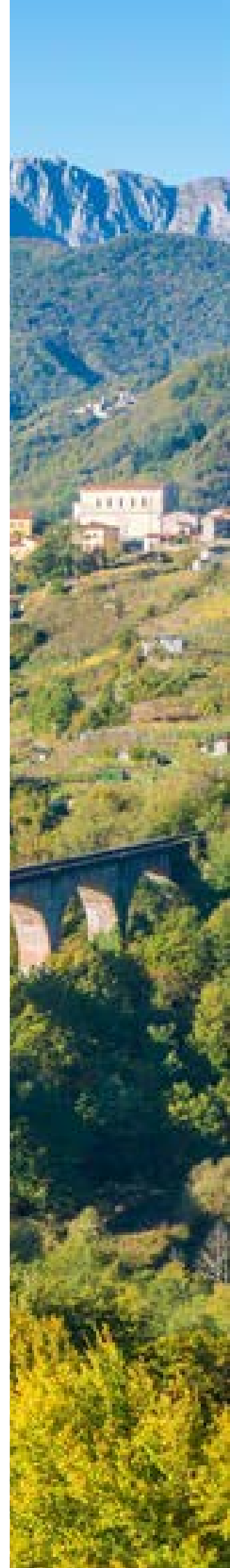
- ♣ forest fires,
- ♣ hydrogeological instability (landslides and floods) and subsidence,
- ♣ soil degradation and onset of desertification processes,
- ♣ loss of agricultural production,
- ♣ less availability and lower quality of water,
- ♣ coastal erosion,
- ♣ adverse effects on health,
- ♣ increased energy consumption,
- ♣ loss of biodiversity and ecosystem change,
- ♣ adverse effects on economic activities (industry, commerce and tourism),
- ♣ saltwater intrusion.

The following infographics, for each area in which the Emilia-Romagna Region has been divided, only schematically report **the main and major effects** that the risks identified above have on the physical-biological and socio-economic sectors.

Specifically:



- ♣ **Ridge area** (which includes municipalities at altitudes exceeding 800 metres above sea level)
- ♣ **Hilly area** (which includes municipalities at altitudes between 200 and 800 metres above sea level)
- ♣ **Lowland area** (which includes municipalities at altitudes lower than 200 metres above sea level)
- ♣ **Coastal area** (which includes municipalities facing the sea or less than 5 km away)
- ♣ **Urban areas** (which include municipalities with > 30,000 inhabitants)



For a more in-depth, detailed analysis of the individual sectors, please refer to the annexes of the complete document – *Climate change mitigation and adaptation strategy for the Emilia-Romagna Region* – which is available on [www.regione.emilia-romagna/ambiente/cambiamentoclimatico](http://www.regione.emilia-romagna/ambiente/cambiamentoclimatico)





**RISK AREA KEY**

 soil degradation and onset of desertification processes



 forest fires  
 coastal erosion

 hydrogeological instability  
 loss of biodiversity and ecosystem change



**tourism**

-  loss of environmental quality and safety
-  loss of tourist attractiveness
- fewer tourists in the winter tourist season
- increased management costs for winter sports facilities


**urban areas**

-  loss of economic value of buildings due to structural deterioration, reduced road access to settlements, increased insurance costs
- lower number of inhabitants and settlements
-  damage to buildings and infrastructure
- increased risks for people


**health**

-  increased health risks for people
-  increase in diseases related to climate variability



**transport**

-  damage and disruption to roads
- increased cost for infrastructure maintenance and repair

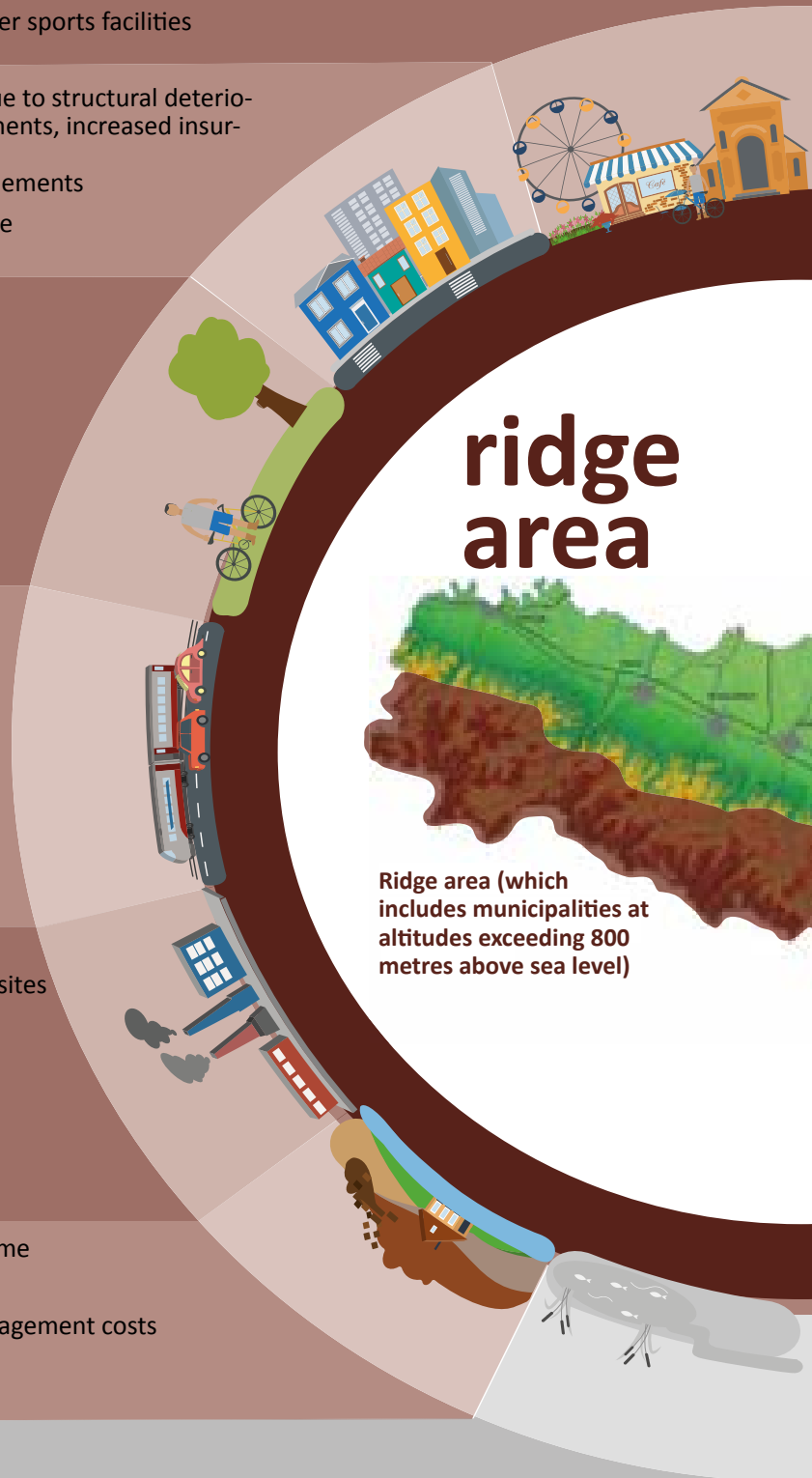
**production system**

-  reduced attractiveness of production sites due to loss of safety and accessibility
- increased site insurance costs

**land**

-  increased exposure of slopes to extreme events
- increased vulnerability
-  increased land maintenance and management costs

**inland waters**





adverse effects on economic activities



increased energy consumption



adverse effects on health



loss of agricultural production



saltwater intrusion



less availability and lower quality of water

air quality

fishing and aquaculture

coastal areas

biodiversity and ecosystems

agriculture

energy system

forests



production loss and increased management costs  
reduction in the typical amount of fish caught



alteration of the composition and balance of terrestrial flora and fauna and destruction of ecological sites and niches



loss of arable land



decline in the quantity and quality of local products



loss of productive soil layers



decrease in energy production from hydroelectric plants



increased energy demand due to management of winter sports facilities and to the presence of tourists in the summer



increase in the number and extent of areas impacted by fires increase in forest management and restoration costs decrease in timber production



destruction and alteration of forest ecosystems  
loss of forest ecosystem resilience

**RISK AREAS KEY**

⬆️ soil degradation and onset of desertification processes

🔥 forest fires

🌊 coastal erosion

🏠 hydrogeological instability

🌿 loss of biodiversity and ecosystem change

**tourism**

- 🔥 loss of environmental quality and safety
- 🏠 loss of attractiveness and fewer tourists

**urban areas**

- 🏠 loss of economic value of buildings due to structural deterioration, reduced road access to settlements, increased insurance costs
- 🔥 lower number of inhabitants and settlements
- 🔥 damage to buildings and infrastructure
- 🏠 increased risks for people

**health**

- 🔥 increased health risks for people
- 🌿 increase in diseases related to climate variability
- 🏠 increased risk for new diseases

**transport**

- 🏠 damage and disruption to roads
- 🔥 increased cost for infrastructure maintenance and repair

**production system**

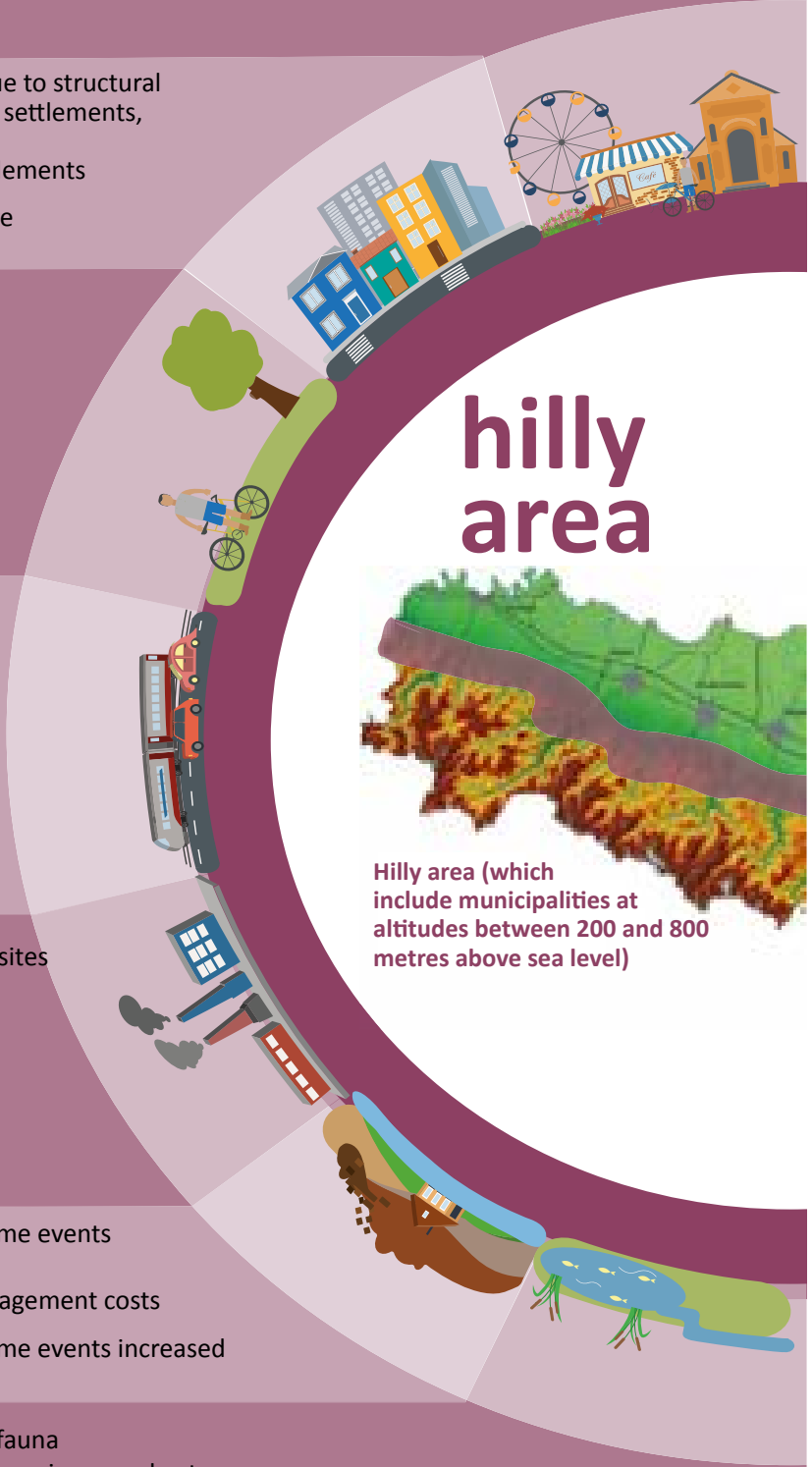
- 🏠 reduced attractiveness of production sites due to loss of safety and accessibility
- 🔥 increased site insurance costs

**land**

- 🔥 increased exposure of slopes to extreme events
- 🏠 increased vulnerability
- 🏠 increased land maintenance and management costs
- ⬆️ increased exposure of slopes to extreme events
- 🌿 increased soil vulnerability

**inland waters**

- 🌿 alteration of the balance of flora and fauna
- 🏠 increased health risks for people
- 🏠 increase in groundwater withdrawals







adverse effects on economic activities



increased energy consumption



adverse effects on health



loss of agricultural production



saltwater intrusion



less availability and lower quality of water

air quality

fishing and aquaculture

coastal areas

biodiversity and ecosystems

agriculture

energy system

forests



production loss and increased management costs  
reduction in the typical amount of fish caught



alteration of the composition and balance of terrestrial flora and fauna and destruction of ecological sites and niches



loss of arable land  
decline in the quantity and quality of local products



loss of productive soil layers and reduced arable land



increased production costs and reduced arable land



decrease in energy production from hydroelectric plants



increased cooling demand



increase in the number and extent of areas impacted by fires  
increase in forest management and restoration costs  
decrease in timber production






alteration of the composition and consistency of forest cover  
loss of forest ecosystem resilience





destruction and alteration of forest ecosystems  
loss of forest ecosystem resilience



**RISK AREAS KEY**

 soil degradation and onset of desertification processes





 forest fires  
 coastal erosion

 hydrogeological instability  
 loss of biodiversity and ecosystem change




**tourism**

-  loss of environmental quality and safety
-  loss of attractiveness and fewer tourists




**urban areas**

-  loss of economic value of buildings due to structural deterioration, reduced road access to settlements, increased insurance costs
-  lower number of inhabitants and settlements
-  damage to buildings and infrastructure
-  increased risks for people




**health**

-  increased health risks for people
-  increase in diseases related to climate variability
-  increased risk for new diseases





**transport**

-  damage and disruption to roads
-  increased cost for infrastructure maintenance and repair
-  reduction of the potential of inland navigation




**production system**

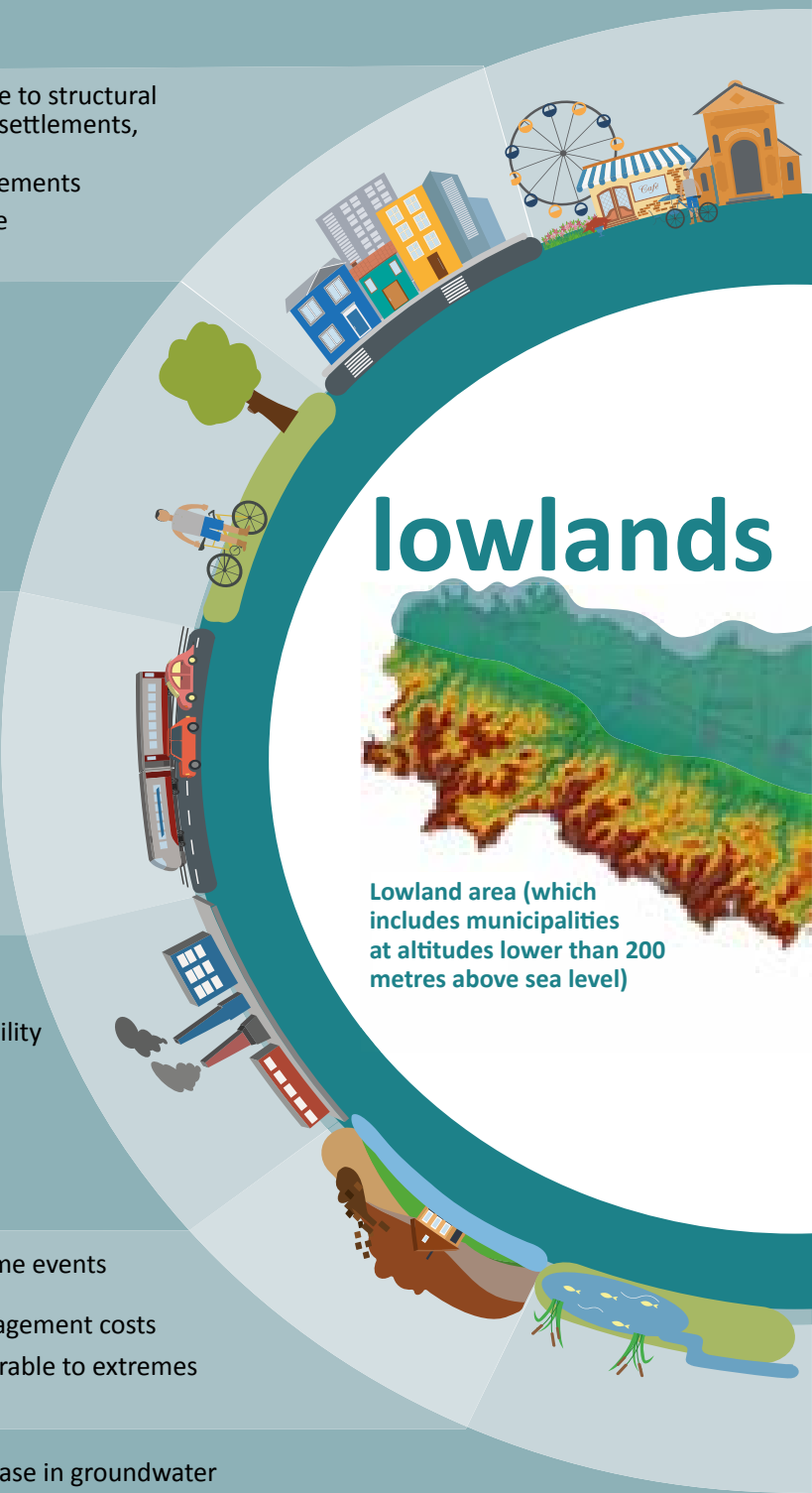
-   reduced attractiveness of production sites due to loss of safety and accessibility
-  increased site insurance costs

**land**

-  increased exposure of slopes to extreme events
-  increased vulnerability
-  increased land maintenance and management costs
-  increase in erosion and surfaces vulnerable to extremes events

**inland waters**

-  increased health risks for people
-  increase in groundwater withdrawals
-  increased sanitization and purification costs





adverse effects on economic activities



adverse effects on health



saltwater intrusion



increased energy consumption



loss of agricultural production



less availability and lower quality of water



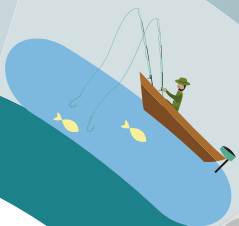
deterioration of air quality due to seasonal increase in short-term pollutants

air quality



production loss and increased management costs  
reduction in the typical amount of fish caught

fishing and aquaculture

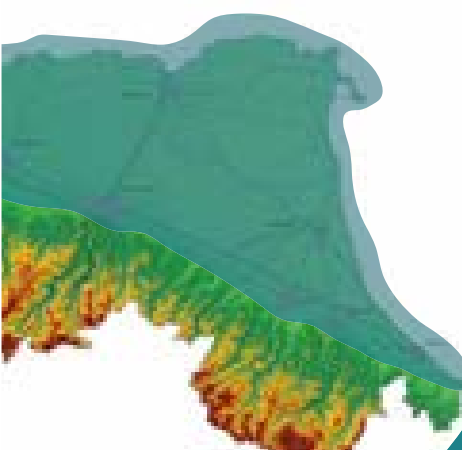


coastal areas



alteration of the composition and balance of terrestrial flora and fauna and destruction of ecological sites and niches

biodiversity and ecosystems



decline in quantity and quality



reduction of organic matter and reduction of productive surfaces



increased production costs and reduced arable land

agriculture

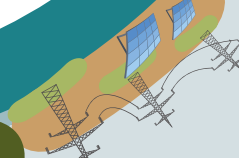


decrease in energy production from hydroelectric plants



increased cooling demand  
increase in blackouts

energy system



alteration and loss of resilience of residual forest ecosystems

forests



**RISK AREAS KEY**



soil degradation and onset of desertification processes



forest fires



coastal erosion



hydrogeological instability



loss of biodiversity and ecosystem change

**tourism**



loss of tourist attractiveness



loss of attractiveness and lower tourist numbers  
increased cost of management and safety of facilities

**urban areas**



loss of economic value of buildings due to structural deterioration and increased insurance costs



damage to buildings and infrastructure

**health**



increased health risks for people



increase in diseases related to climate variability and extremes and to air quality  
increased risk for new diseases  
increased costs for the health system

**transport**



damage and disruption to roads  
increased maintenance and repair cost  
loss of infrastructure

**production system**



loss of economic value and attractiveness of production sites due to a decrease or interruption in production



increased insurance costs



structural deterioration



damage to production facilities and loss of economic value of sites

**land**



increased maintenance, management and safety costs



increased vulnerability



increased maintenance and management costs



increase in erosion and surfaces vulnerable to marine ingression

**inland waters**



increased health risks for people  
increase in groundwater withdrawals  
increased sanitization and purification costs

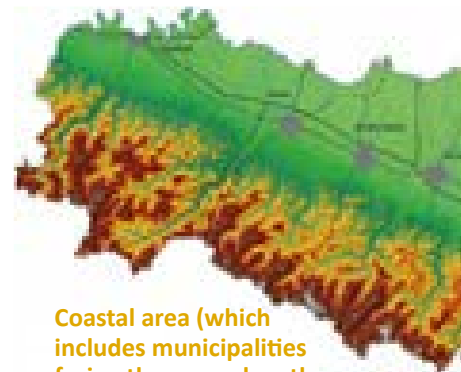


increased maintenance and management costs  
increased vulnerability



saltwater intrusion into aquifers  
increased sanitization and purification costs

**coastal area**



Coastal area (which includes municipalities facing the sea or less than 5 km away)



adverse effects on economic activities



adverse effects on health



saltwater intrusion



increased energy consumption



loss of agricultural production



less availability and lower quality of water



deterioration of air quality due to seasonal increase in short-term pollutants

air quality



production loss and increased management costs  
reduction in the typical amount of fish caught

fishing and aquaculture



failure to satisfy demand in the tourist season  
increased risk of conflict in the use of the resource  
and of groundwater drainage

coastal areas



loss of economic value of assets and structures  
loss or deterioration of morphological and  
functional characteristics | loss of attractiveness  
increased vulnerability to extreme events



damage to infrastructure and buildings



subsidence | marine ingression



alteration of the composition and balance  
of flora and fauna and destruction  
of ecological niches

biodiversity and ecosystems



decline in the quantity and quality of products



reduced arable land and increased  
production costs



reduced arable land and crop damage

agriculture



increased cooling demand  
increase in blackouts

energy system




alteration and loss of resilience of residual forest ecosystems


forests


**RISK AREAS KEY**

 soil degradation and onset of desertification processes




 forest fires

 coastal erosion



 hydrogeological instability

 loss of biodiversity and ecosystem change





**tourism**

-  loss of tourist attractiveness
-  loss of attractiveness and lower tourist numbers
-  increased cost of management and safety of facilities



**urban areas**

-  loss of economic value of buildings due to structural deterioration, reduced road access to settlements, increased insurance costs
-  damage to buildings and infrastructure




**health**

-  increased health risks for people
-  increase in diseases related to climate variability
-  increased risk for new diseases
-  increased costs for the health system


**transport**

-  damage and disruption to roads
-  increased cost for infrastructure maintenance and repair




**production system**

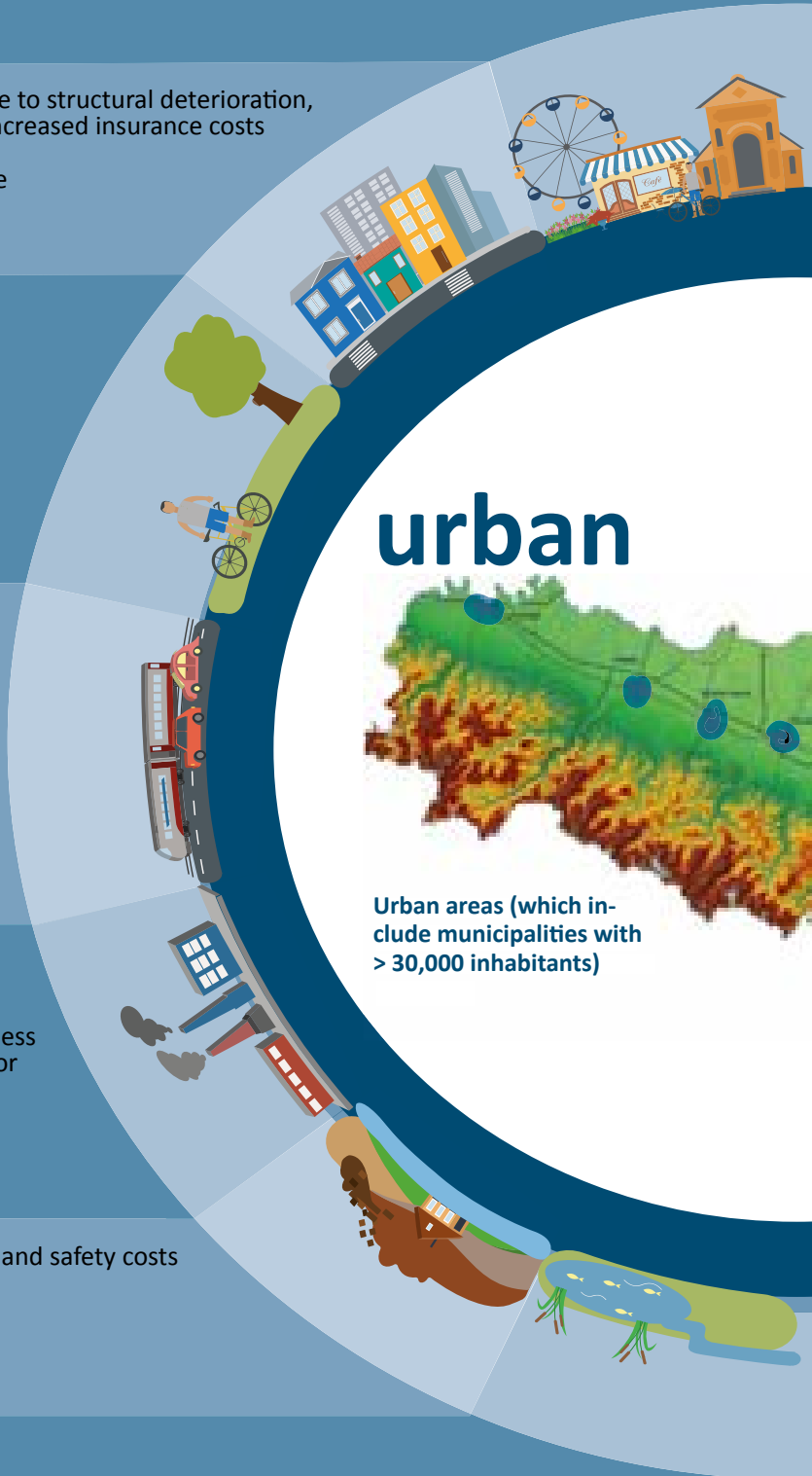
-  structural deterioration and increased insurance costs
-  loss of economic value and attractiveness of production sites due to a decrease or interruption in production
-  increased insurance costs

**land**

-  increased maintenance, management and safety costs

**inland waters**

-  increased health risks for people
-  increase in groundwater withdrawals
-  increased sanitization and purification costs



adverse effects on economic activities  
increased energy consumption

adverse effects on health  
loss of agricultural production

saltwater intrusion  
less availability and lower quality of water

deterioration of air quality due to seasonal increase in short-term pollutants

air quality

fishing and aquaculture

coastal areas

biodiversity and ecosystems

agriculture

energy system

forests

areas

increased cooling demand  
increase in blackouts

## 4. Actions: Intervention priorities

The following are some of the main interventions identified for certain sectors divided into short-term actions (by 2020), medium-term actions (by 2020) and strategic guidelines. For a more in-depth and complete version of this information, please refer to the *Mitigation and adaptation strategy for the Emilia-Romagna Region* document, approved by Assembly Resolution no. 187 of 29 December 2018.

### 4.1 Infrastructure and transport

The transport sector in Emilia-Romagna is extremely vulnerable to climate change: on the one hand, the settlement fragmentation that increases the demand for mobility of people and goods and makes the sector one of the most energy-intensive at a regional level, where the main energy source is fossil fuels, on the other hand, the increased frequency of extreme weather and climate phenomena that jeopardizes the regional infrastructure

network with consequent difficulties in managing mobility in urbanized areas.

This has negative repercussions in economic terms, linked to the cost of restoring infrastructure and services, and in terms of safety, linked to the safety of people who use this infrastructure for travel.

**The PRIT2025 outlines an integrated plan for mobility management:** from management of demand to organization of networks and services in the area, improving accessibility and incorporating the guidelines of the Climate change mitigation and adaptation joint strategy.

In particular, the **intervention priorities** concern mitigation measures, such as: promotion of electric mobility with alternative sources to fossil fuels; upgrading of electric outlets throughout the entire area; zero-emission conversion of public fleets (vehicles and buses); improvement of the railway electrification system and of rolling stock.

The table gives a detailed description of the actions to be implemented in the short and medium term and of the allocated resources.

Implementation period	Type of measure
<b>Short-term actions (by 2020)</b>	<p><b>Support for the transition of businesses and consumers to electric vehicles</b></p> <p>Incentives will be provided for the entire 2018 – 2019 – 2020 three-year period. Specifically, this consists of a contribution equal to the cost of three years of regional motor vehicle tax, up to a maximum amount of 191.00 euro for each year. Residents of the Region will be able to access the contribution and become the owner of a new petrol-electric hybrid vehicle</p>
	<p><b>Improvement of fast charging areas through:</b></p> <p>an allocation of over 2 million euro for the purchase of charging systems by local authorities, agencies and public transport companies</p> <p>The charging network is already undergoing further implementation thanks to agreements signed by the Region with the major cities and electricity distributors</p>
	<p>Signing of new agreements with the main electricity distributors for the installation of around 1,500 new facilities by 2020.</p>



Implementation period	Type of measure
<b>Medium-term actions (beyond 2020)</b>	<p><b>Exclusive purchase of zero-emission buses from 2025-2030 and exclusive purchase of zero-emission vehicles for public fleets by 2030</b>            The Region has already planned to replace 20% of its buses by 2020, substituting, in particular all Euro 0 and E1 with low-impact vehicles and developing the LNG (liquefied natural gas) technology for local public transport in certain cities, and providing for the construction of three LNG and biomethane filling stations. New power line projects will be developed, partly thanks to residual ERDF ROP funds (European Regional Development Fund - Regional Operational Programme, 2014-2020) in various cities in the Region with a 7 million-euro pilot project for electric public mobility. At the end of the pilot project, the Region will increasingly incentivize transport companies to exclusively purchase electric buses in urban areas.</p>
	<p><b>Promotion of the implementation of the EV charging infrastructure,</b> in particular in all public buildings</p>
	<p><b>Support for EV battery charger installation in the workplace</b></p>
	<p><b>Improvement of the railway electrification system</b>            The new 2019-2034 service contract provides for a complete renewal of the railway fleet, with the replacement of most of the regional rolling stock. The first and most sizeable introduction of new stock will take place starting in June 2019 and will end in 2020 with 86 new trains, entailing an investment of around 600 million euros.</p>
	<p><b>Improvement of regional rolling stock</b>            The new 2019-2034 service contract provides for a complete renewal of the railway fleet, with the replacement of most of the regional rolling stock. The first and most sizeable introduction of new stock will take place starting in June 2019 and will end in 2020 with 86 new trains, entailing an investment of around 600 million euros.</p>

The strategic guidelines identified to manage the risks associated with climate change promote the optimisation of existing networks with respect to the construction of new and large-scale works, providing for a weighted assessment of infrastructure efficiency standards and their vulnerability to climate change in relation to their functionality.

A crucial role is played by **promotion of analysis of the vulnerabilities of the transport system**, with reference to the three aspects of sensitivity (infrastructure, services and demand), including preparation of vulnerability maps based on experience. When identifying adaptation measures, particular attention is also paid to biodiversity and natural ecosystems, as well as to their evolution under climatic variables. This type of activity requires coordinated methodologies defined at national level, with regard to the type of phenomena that can be expected, the methods of diagnosing of land and infra-

structure vulnerabilities, and finally to the definition of new technical standards and optimal solutions to refer to.

**Adaptation of the infrastructure and transport system must also be implemented through local mobility planning tools**, according to the respective powers of local authorities.

In order to allow the implementation of complementary and support measures, it is advantageous **to implement awareness-raising actions**, public debate and regional coordination, involving all stakeholders, in particular the infrastructure and services managers.





## 4.2 Land (landslides, floods and soil degradation)

A very large proportion of regional residential areas, infrastructure, real estate and production business is subject **to potential critical issues due to hydrogeological instability.**

About 12% of the Region is potentially exposed to **landslides** that affect large areas of the mountainous/hilly area; 45% of the region is subject to hydraulic hazards, very often in relation to the secondary reclamation network in the lowlands. Furthermore, the region's land has an average sensitivity to **desertification** in lowland and foothill areas and a low sensitivity in hilly and mountainous areas. Following agri-environment measures and regional soil protection policies, soil loss due to water erosion (5.64 t/ha/year) is however slightly lower than the Italian average (7.7t/ha/year), although considerably higher than the EU average.

Climate change scenarios, envisaging an **increase in extreme events**, will lead to greater hydrological instability in relation to the easier triggering or recurrence of landslides and to more frequent river floods, especially in the small foothill basins connected to the urban fabric. The expected long dry periods, reduced precipitation and positive temperature anomalies will lead to more arid conditions which, combined with unsustainable management, especially in agriculture, may accentuate soil degradation and trigger desertification processes.

Various measures, acting on different fronts, are planned to contain the increasing hydrogeological risk:

- ♣ Improvement of knowledge of phenomena and of the area, data sharing
- ♣ Policies and regulations regarding land management and use of water resources
- ♣ Planning and implementation of structural defence interventions, widespread maintenance of the area and works
- ♣ Promotion of activities and practices focused on sustainability and the prevention and mitigation of soil degradation
- ♣ Integration between functional coordination and planning levels

- ♣ Improvement of systems for forecasting, early warning and monitoring of phenomena, information to the population and dissemination of risk culture and the Alert Web portal

The **intervention priorities** relate to the construction of hydraulic works for waterways, especially in sections near towns and industrial sites. These are accompanied by: ordinary and extraordinary maintenance for hydraulic safety and slope security; beach nourishment of coastal areas; interventions for the defence of drainage canals, as well as irrigation works to combat water scarcity, especially in the agricultural sector. In order to guarantee necessary prevention and to reduce the vulnerability of areas, businesses and citizens, efforts will be intensified in the coming years to improve early warning systems and to provide adequate knowledge of the tool for ever greater efficiency.

**The guidelines identified by the regional strategy** to manage the risks associated with climate change must aim to: improve geo-technical and structural knowledge of river bank defence systems and their control during an event; systematize maintenance, security and vulnerability reduction plans for structures and infrastructure (such as roads and distribution networks) of strategic importance, including for the safety of the area and its inhabitants; relocate areas exposed to greater risk.

The key objectives are:

- ♣ maintenance of correct and fast emergency management to deal with the unpredictability of extreme events
- ♣ application of innovative tools and methods for monitoring phenomena and collecting and sharing data, information and predictive and hydrometeorological modelling systems
- ♣ constant study of the alterations of the most significant hydrological regimes and phenomena (e.g. flash floods) due to climate change and its effects on soil degradation, development of technologies for the control and widespread surveillance of banks through research

The table gives a detailed description of the adaptation actions to be implemented in the short and medium term and of the allocated resources.

Implementation period	Type of adaptation measure
<b>Short-term actions (by 2020)</b>	<p><b>Improvement of land adaptation interventions</b>            A package of 29 interventions with a total value of 84.7 million euros, including:</p> <ul style="list-style-type: none"> <li>• Baganza river overflow basin</li> <li>• Lavino stream overflow basin</li> <li>• Hydrogeological risk and landslide prevention</li> <li>• Senio stream overflow basin</li> </ul>
	<p><b>Doubling of ordinary and extraordinary maintenance activities</b>            A three-year 2018-2020 programme is planned, for a continuous and structural action of prevention and safety for the area, with a value of about 19 million euros. The first actions constitute a package of 160 adaptation interventions for a total of 12.19 million euro and will concern, for example:</p> <ul style="list-style-type: none"> <li>• Increased hydraulic safety</li> <li>• Slope maintenance</li> <li>• Beach nourishment and redevelopment of coastal areas</li> <li>• Analysis and design of structural prevention measures</li> </ul>
	<p><b>Measures for land adaptation by the Regional Agency for Territorial Risk Prevention and Civil Protection and by the Interregional Agency for the Po River (AIPO)</b>            A large-scale programme of new measures to make the areas affected by the Secchia and Panaro basin less vulnerable, involving total expenditure of 56.37 million euros, including:</p> <ul style="list-style-type: none"> <li>• Reinforcement of the banks of the Secchia and Panaro rivers</li> <li>• Expansion of the Secchia river's overflow basin</li> <li>• Improvement of the network of minor waterways without banks.</li> </ul>
	<p><b>Extraordinary maintenance works for the land reclamation consortia</b>            In particular, this concerns works and interventions for the defence of drainage canals and irrigation works, to counteract problems related to water scarcity for the agricultural sector. Interventions involving 7 regional land reclamation consortia.</p>
<b>Medium-term actions (beyond 2020)</b>	<p><b>Maintenance and improvement of the warning system</b>            The "Allerta meteo Emilia-Romagna" web portal, a multimedia platform available to both mayors and to all those involved in the civil protection system, from the prefectures to regional services, is already one of the most advanced regional platforms in Italy.</p>
	<p><b>Creation of a 'risk culture' that is as broad as possible at all institutional, economic and social levels.</b>            In order to guarantee necessary prevention and to reduce the vulnerability of areas, businesses and citizens, efforts will be intensified in the coming years to provide adequate knowledge of the tool for ever greater efficiency.</p>





### 4.3 Water resources

Climate change has direct effects on the water system, impacting hydrological and hydrogeological needs and processes and resource availability. In particular, the risks have been grouped into three main categories:

♣ **Critical issues for meeting water needs.**

In the face of climate change, an increase in the critical issues connected to meeting supply requests is to be expected, particularly in torrential watercourses that already experience very low water levels in the summer and considerable exploitation.

♣ **Critical issues for the quality of water and aquatic ecosystems.** A reduction in the recharge of aquifers can lead to an imbalance between recharge and withdrawals, resulting in gradual lowering of aquifer levels, which results in reduced groundwater bodies.

♣ **Saltwater wedge intrusion / increase in subsidence phenomena.**

For the Apennine watercourses, the most critical issues are primarily attributable to the irrigation sector and to the upper Emilian plain area (Tebbia, Nure, Taro, Parma, Enza, Secchia and Panaro): the need to respect the minimum vital flow (MVF) downstream of the consortia diversions in the foothills involves frequent critical issues due to the inadequate available irrigation resource. In the Romagna area, the land that can only be irrigated with Apennine waters is less extensive, however in these areas, since supplies are often autonomous, it becomes problematic to guarantee operational management of withdrawals that respects the MVF.

For the Po river, the current critical issues are essentially connected to local infrastructure conditions and to rising saltwater wedge phenomena in the end section of the river, which begin to occur with flow rates lower than 600 m<sup>3</sup>/s and, for flow rates between 250 and 300 m<sup>3</sup>/s, can impact an area of about 30,000 ha. A reduction in irrigation volumes that can be taken from the Po, as envisaged in the Water Balance Plan for the Po river basin, could impact the entire Emilian lowlands and all the area of Bologna and Romagna served by the Emiliano Romagnolo Canal.

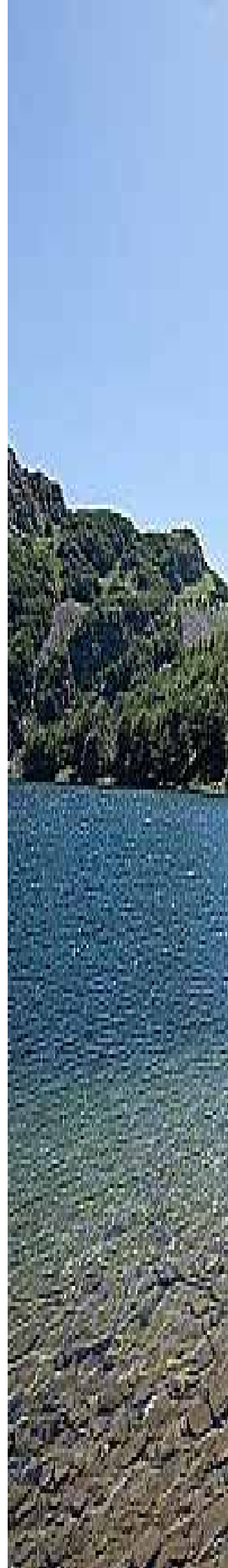
There are also natural areas of high environmental value whose existence is conditioned by the presence of water and which are threatened by a hydrological cycle that is becoming increasingly “dry” as a result of climate change: this is the case of wetlands, of springs with significant travertine deposits and of the rare resurgence that still exists in the Emilian lowlands.

**Water planning** is currently being revised: the Management Plans (PDGs) produced by the Basin Authorities that set targets and related key measures have been approved.

The issue of the scarcity and quality of water resources in Emilia-Romagna as a consequence of climate change is particularly complex and urgent.

The actions identified in the strategy, shown in the table, have a multisectoral, managerial and infrastructural value, as well as an impact in terms of both short and medium to long-term effectiveness.

Implementation period	Type of measure
<p><b>Medium-term actions (beyond 2020)</b></p>	<ul style="list-style-type: none"> <li>• Adaptation of drainage systems and networks and urban rainwater treatment</li> <li>• Refinement of treatment systems on urban wastewater purifiers for reuse of wastewater;</li> <li>• Reduction of losses from distribution networks;</li> <li>• Provision of resource storage basins (large and/or small);</li> <li>• Promotion of projects and feasibility studies to encourage artificial aquifer recharge;</li> <li>• Financial instruments (incentives, subsidized loans for interventions, co-financing, etc.) for implementing adaptation interventions/measures (irrigation reuse, cultivation choices and practices, civil and industrial reuse)</li> <li>• Requirement/incentivization for water efficiency/saving standards in civil and similar constructions (regulations, certifications and co-financing)</li> <li>• Improvement of predictive and scenario-based modelling systems for surface water and ground water, as well as of management and decision support tools;</li> <li>• Development of solutions for reducing evapotranspiration through shading measures, particularly in irrigation distribution channels, in line with their environmental and hydraulic objectives.</li> <li>• Development of water retention solutions in urban areas.</li> <li>• Development of knowledge on environmental aspects for the management of reservoirs and storage basins.</li> <li>• Promotion of agricultural production that requires less water;</li> </ul>





#### 4.4 Coastal areas

The **Emilia-Romagna coast** consists of low, sandy coast and, to the north, of a delta lagoon system at the mouth of the Po river. In the northern part, the area behind the coast lies at lower altitudes than sea level and contains wetlands with a very significant natural environment. The southernmost part of the coast is instead characterized by almost continuous urbanization. The coast is a dynamic environment whose balance depends on the interaction between natural factors, such as sea level variation, weather and sea conditions, river sediment supply, subsidence and human factors.

Climate change will contribute to altering these complex mechanisms, worsening environmental quality and decreasing the safety of the area and its suitability for human activities. In particular, coastal areas are subject to numerous pressures resulting from human activity (aquaculture, fishing, tourism, urbanization and pollutant loads from the hinterland), which make them particularly vulnerable to sea warming and rising and to the variability of freshwater supplies from river basins. The main impacts of climate change on the coast can be summarized as follows:

- ♣ increase in coastal erosion caused by the increase in frequency and intensity of coastal storms;
- ♣ increased risk of marine ingressions inland due to a rise in the average sea level and lowering of the soil surface due to subsidence;
- ♣ reduced effectiveness of defences against marine ingressions and erosion;
- ♣ worsening of the quality of coastal and transitional waters;
- ♣ ingressions of the saltwater wedge along river mouths and in underground aquifers;
- ♣ deterioration of the quality of marine and transitional waters;
- ♣ increased anoxia in marine and transitional waters;
- ♣ flora and fauna alteration of marine and transitional ecosystems: loss of biodiversity, increase in algal and microalgal blooms.

These changes will have serious repercussions on human activities and will cause increasingly frequent damage to exposed structures and infrastructure.

The Flood Risk Management Plan (PGRA) and Regional Government Decision no. 417 of 2017, both derived from the Floods Directive (2007/60/EC), and the Guidelines for Integrated Coastal Zone Management - ICZM (Regional Council Decision no. 645 of 20 January 2005), contain actions for coastal areas that can be attributed to the **categories of climate change mitigation and adaptation on the coast**.

The actions involve multiple aspects of intervention:

- ♣ adoption of early warning systems based on forecasting models and the "Allerta meteo Emilia-Romagna" web portal
- ♣ deepening of knowledge
- ♣ reimplementation of river sediment transport
- ♣ containment of subsoil drainage
- ♣ artificial sediment supply of the coastal system with beach nourishment and management of coastal and harbour sediment
- ♣ control and reduction of pollutant loads in river basins
- ♣ maintenance and enhancement of the remaining natural coastal areas
- ♣ adaptation of existing defence and port works

An **integrated plan for the defence and adaptation of coastal areas to climate change** is the main action of the next long-term planning to secure funding for the implementation of integrated and ongoing measures to defend the coast. The plan will be able to integrate the various sector plans through coordination of river basin and coastal area planning with particular reference to sediment management. This plan will strengthen the policies to regenerate the coastal physical system through nature-focused interventions, including raising coastal land and beach nourishment.

The table gives a detailed description of the actions to be implemented in the *medium term*.

Implementation period	Type of measure
<p><b>Medium-term actions (beyond 2020)</b></p>	<p><b>Implementation of the Integrated Coastal Areas Management Plan</b>, whose general objective is to ensure an adequate level of safety in relation to coastal areas, inhabitants, economic activities and environmental, historical and cultural heritage.</p> <p>The plan, which is unique in Italy, will pursue this goal through the systemization of the most up-to-date knowledge, strategies and best management and intervention practices, as well as of existing coastal regulations (e.g. PGRA measures, basin plans, urban planning legislation, regional landscape plan, sector plans, etc.).</p> <p>The plan should contain:</p> <ul style="list-style-type: none"> <li>• a periodically updated profile of the state of the coast and defence works and of the current or anticipated coastal critical issues and risks, including in relation to recognized climate scenarios;</li> <li>• an analysis and summary of the regulations governing the coastal area, in order to define the intersection between existing regulations and safeguards for the area and its assets and inhabitants;</li> <li>• strategic management and intervention guidelines for the different types of critical issues and for the specific critical areas identified, also based on what is already outlined in the Flood Risk Management Plan regarding the coast (Regional Government Decision no. 1300 of 2016) and the guidelines for the Integrated Coastal Zone Management (Regional Council Decision no. 645 of 2005)</li> <li>• a general plan of the interventions considered necessary to ensure or increase the level of safety and resilience of the coastal areas as a whole, particularly of the most critical areas;</li> <li>• guidelines on how to update and involve local areas, participation, in the preparation and revision of the plan.</li> </ul>
	<p><b>Improvement of the early warning system and monitoring of data useful for the alert system</b></p> <p>The current EWS (<i>Early Warning System</i>) for coastal storms and the related tools and databases for monitoring certain physical parameters, which are already very advanced compared to other regions of Italy and Europe, will be further improved in order to guarantee a more adequate system of prevention and defence against the impacts of extreme and increasingly frequent events caused by climate change.</p>
	<p><b>Coastal defence redevelopment</b></p> <p>Small beach nourishment measures and coastal defence works to control the erosion and subsidence of the coastline.</p>

At the same time, the planning will strengthen urban policies to reduce the vulnerability and hardening of the coast, with a long-term vision that also includes prohibition of permanent buildings and adaptation of buildings, as well as the possibility to relocate certain structures, partly in order to reduce the costs of securing them. The plan will be supported by the expansion and improvement of coastal and weather/sea monitoring systems, which are fundamental for under-

standing natural processes and changes induced by human activity and by climate change, supporting intervention strategies. To optimise these measures, public-private agreements will be promoted, such as for the implementation of multi-purpose coastal interventions and, at national level, insurance requirements will have to be established for damage from extreme events, including through tax breaks or other economic instruments.



## 4.5 Settlements and urban areas

**Urban areas and settlements have always been the areas that most contribute to the increase of greenhouse gas emissions,** through urban traffic and residential, industrial and tertiary heating and cooling, yet they are also significantly affected by the effects of climate change due to their nature and due to the fact that these effects impact the areas with the greatest concentration of people and activities. Rising temperatures, heat waves, decreasing precipitation and its increased intensity and concentration over time, flooding, drought and water supply crises, increased levels of air pollution and aggressive pathogens are among the main effects of climate change at the urban level. Considering it fundamentally important to have a regulatory system which can guarantee and support urban planning that is adequate not only for the new demands of living from an economic and social perspective, but also and above all from an environmental

perspective, the Emilia-Romagna Region, in continuity with previous legislation, approved **the new regional urban planning law no. 24 of 21 December 2017 on the protection and use of land.** The law's key points include the goals of limiting land consumption, of regeneration and of urban quality, returning to the theme of 'urban and ecological-environmental quality standards' and its relative characteristics, analysing this theme, developing its essential components and, above all, placing it at the centre of the 'Strategy for urban environmental and ecological quality'.

Its implementation is also a priority for managing risks associated with climate change. In the *short term*, priority is given to safeguard and enhance the area.

Implementation period	Type of measure
<b>Short-term actions (by 2020)</b>	<b>Safeguard and enhance the area</b> All the municipal administrations will have to renew their urban planning instruments, nullifying expansion forecasts and focusing the new strategy on urban regeneration that significantly increases the resilience of cities and the local area. The new settlement margin reserved for the enlargement of the economic and productive base is indicated in 3% of the current urbanized area, estimated at 70 square kilometres for the whole region.

The new approach and prerequisite of urban planning therefore becomes that of resilience, namely of the ability of the urban organism to adapt to environmental and social challenges; of the study of urban metabolism aimed at creating or strengthening virtuous circuits in the use of resources and in the growth of well-being with a vision – as holistic as possible – of quality of life and sustainable choices. With law 24/2017 and the relative guidelines and coordination for implementation, the Region attributes a partly new role to the municipal General Urban Plan (PUG), which

not only deals with regulation of the physical component of the settlement system, but also necessarily involves the social, economic, production and cultural components, giving the complex theme of climate change a central and essential role in the cities of today and tomorrow. The assumption is that settlement and environmental quality can be defined by the complex (and constantly evolving) synthesis of a performance system; the plan strategy defines and pursues this synthesis, operating according to various lines of action and by various means:

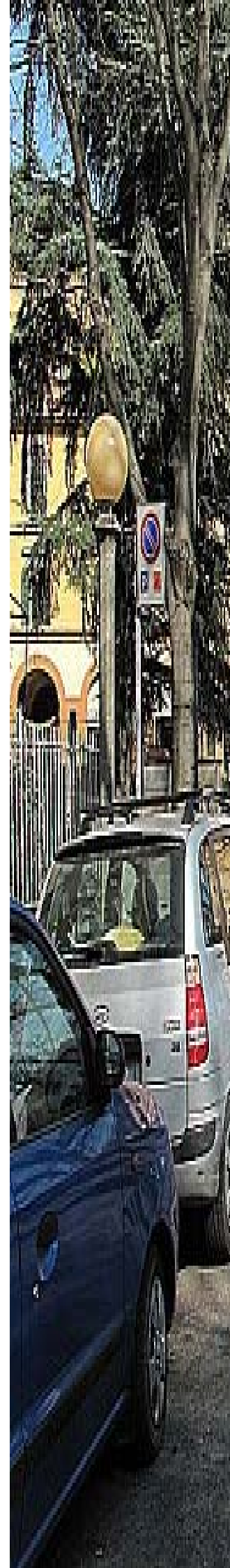


- ♣ growth and enhancement of services and technological networks,
- ♣ increase in the quantity and quality of public spaces,
- ♣ enhancement of unique cultural and landscape heritage,
- ♣ improvement of components and environmental well-being,
- ♣ development of sustainable mobility,
- ♣ increase in the resilience of the housing system with respect to climate change and seismic events,
- ♣ improvement of urban metabolism.

The PUG is assigned the task of assessing the state of affairs, establishing critical issues and priorities and, through the strategy, identifying the actions to be implemented and the environmental ecological facilities necessary to reduce CO<sub>2</sub> emissions and to increase absorption sources, to increase the degree of settlements' hydraulic safety, to mitigate the heat island, to reduce health impact due to thermal stress and, finally, to improve the qualitative and quantitative management of the urban water cycle.

The measures may be on a supra-municipal scale, or on an urban scale, involving the PUG's implementation tools or, finally, on a building scale, involving the plan's regulatory component. Strategies that will be divided into:

- ♣ structural or directional actions, designed to avoid or reduce exposure to climate risks (such as construction standards, eco-friendly roofs for protection from overheating in summer and water lamination in winter, construction of flood defences, creation of eco-friendly infrastructure, etc.);
- ♣ actions resulting from the use of IT technologies, which are useful for increasing the ability to find, analyse and disseminate information regarding the relationship between land and climate change.





## 4.6 Energy system

The **energy sector is an economic sector that is particularly vulnerable to climate change**, as an effect, on the one hand, of the high sensitivity of energy production and consumption in relation to the increase in temperatures and the intensity and frequency of extreme phenomena and, on the other hand, of the strict requirements to which energy services must respond, in quantitative and qualitative terms, particularly with regard to their continuity.

With the increase in global average temperature, less energy will be required for space heating and more energy will instead be required for space cooling: this increase in electricity consumption in the summer, due to the increasing use of air conditioning systems, will result in an increased risk of blackouts.

**Production and supply of energy will also be influenced by the likely reduction in the availability of water resources for hydroelectric production or for cooling of thermal power stations.** Other possible impacts may occur as a result of the variation in energy demand, availability of natural resources (water, wind, etc.) and land vulnerability (instability, etc.); these will have direct repercussions on the location of plants and energy infrastructure.

On 1 March 2017, the region approved the **Regional Energy Plan (PER), which defines Emilia-Romagna's strategies and goals for climate and energy until 2030**, in terms of strengthening the green economy, energy saving and efficiency, renewable energy development and measures relating to transport, research, innovation and education. In particular, the PER adopts the European goals for 2020, 2030 and 2050, regarding climate and energy as development drivers for the regional economy.

Indeed, transport, electricity and heating, which impact the entire regional fabric, are the three sectors that will be the focus of the measures to achieve the goals set by the European Union and adopted by the PER.

To create the new energy strategies put in place by the Region, the **PER was joined by the 2017-2019 Three-Year Plan funded with resources totalling 248.7 million euros**: 104.4 million euros from the ERDF ROP (European Regional Development Fund - Regional Operational Programme), 27.4 million euros from the EAFRD RDP (European Agricultural Fund for Rural Development - Rural Development Programme) and 116.9 million euros from the region's additional resources.

The table outlines the actions to be implemented in the short and medium term.

Implementation period	Type of measure
<b>Short-term actions (by 2020)</b>	<p>The region's main ongoing actions for adaptation and mitigation and for safeguarding the energy system relate to:</p> <ul style="list-style-type: none"> <li>• energy saving and efficiency measures</li> <li>• promotion of renewable energy sources</li> <li>• the development of smart and resilient energy management systems, both on point scale and on an urban scale (smart grid)</li> <li>• promotion of information and education about combating climate change in the energy sector, including thanks to the spread and improvement of data, information and knowledge</li> </ul>
<b>Medium-term actions (beyond 2020)</b>	<p>The intervention priorities identified for the regional energy system relate to:</p> <ul style="list-style-type: none"> <li>• increased energy consumption for cooling and air-conditioning environments</li> <li>• interventions aimed at reducing the expected increased vulnerability of the water system due to the reduced availability and quality of water resources following long periods of drought</li> </ul>

Therefore, among the future guidelines for climate change adaptation and mitigation in the energy sector, priority will be given to measures aimed at optimising the management of energy demands for heating and cooling (energy saving, "climate proof" building criteria, financial and credit instruments), for optimising the transmission and distribu-

tion of electricity (microgrids, demand-side management, storage systems), for increasing the resilience of the energy system (renewable sources, energy saving, storage systems), for electricity production (consumption planning) and renewable production (with particular regard to measures to facilitate water storage).

## 4.7 Production system

With regard to the production sector as a passive subject, which suffers the consequences of climate change, the risks to be considered vary greatly depending on the type of activity carried out, the type of structure that hosts the activity and obviously the company's location. Essentially, the risks fall into three categories:

- ♣ **structural damage** to a company's production facilities and structures, usually related to extreme events such as heavy rain (and consequent flooding and land instability), strong winds, tornadoes, fires, lightning, etc.;
- ♣ **interruption of service production or delivery**, due for example to problems regarding the supply of raw materials (for the agro-industrial sector, for example), energy (black-out risk) or water (in the

case of prolonged periods of drought or high temperatures);

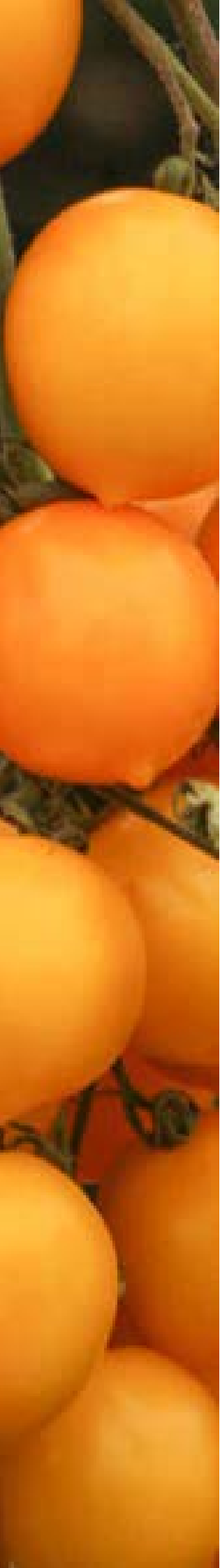
- ♣ **problems for the health or safety of workers** due to the deterioration of the working environment (for example, due to prolonged periods of high temperatures which adversely affect the working conditions of the workers at the plants).

The **intervention priorities** in the production sector, which emerged from analyses carried out in drafting the Climate Change Adaptation and Mitigation Regional Strategy, aim to make the local area and businesses secure, especially in relation to hydrogeological instability (landslides, floods, etc.) that could damage physical structures and production activities, particularly in lowland and coastal areas.

The table outlines the actions to be implemented in the *short* and *medium term*.

Implementation period	Type of measure
<b>Short-term actions (by 2020)</b>	<p>The regional actions in place to counter the effects of climate change in the production sector include:</p> <ul style="list-style-type: none"> <li>• general actions for the safety of the area (to counter landslides, floods, etc.)</li> <li>• measures to promote energy saving and self-consumption of energy (in particular from renewable sources)</li> <li>• measures for the safety of buildings and industrial plants</li> <li>• measures to improve the logistics and transport of the production system measures for the reduction of water consumption and the production of waste</li> </ul>
<b>Medium-term actions (beyond 2020)</b>	<p>The actions to implement in the medium term will be:</p> <ul style="list-style-type: none"> <li>• promoting energy saving and self-consumption of energy from renewable sources</li> <li>• planning of new production sites in areas that are not sensitive to climate change (erosions, landslides, floods, etc.)</li> <li>• protection of existing industrial sites, both through land management (hydraulic regulation, dams, barriers, etc.) and production facilities</li> </ul>





## 4.8 Agriculture

The region's agriculture is among the most advanced in Italy. The operators' good level of technical and scientific knowledge and the innovative propensity of the entire regional system enable the high diffusion of very innovative production techniques designed to reduce environmental impact. Furthermore, an integrated and organic production system has been active in the region for many years, enabling reduction of the use of plant protection products (-20÷-35%), abandonment of highly toxic products, reduction of distributed fertilizers by 35% and rational use of water for irrigation (-35% of volumes) (RDP data 2007-2013).

However, climate change has complex direct and indirect effects on regional agriculture. These effects include: increased concentrations of pollutants in groundwater and surface water; leaks of pollutants following extreme events; an increase in the level of CO<sub>2</sub> emissions due to the increase in temperature; a possible decrease in soil organic matter; the spread of invasive alien species and of new adversities for plants and animals (RDP 2014-2020).

Although there is a good spread of high-efficiency irrigation systems, the availability of water resources is low compared to the other Po Valley-Veneto regions, a situation that is partly exacerbated by high losses in the distribution system and increased summer water deficits. Crops with a spring-summer production cycle will therefore be more exposed to impact, with significant decreases in yields, already experienced during the 2003 and 2012 drought events, and they will be associated with greater business risk due to increased costs of irrigation, which is also used to reduce the temperature. Climate change will also make rainfall interaction more problematic. In the livestock sector, direct negative impacts on housing conditions are expected, due to the worse thermal conditions: greater risk of heat stress during the summer with a negative impact on appetite, food intake, reproductive performance, milk and meat quality and consequently on the quality of the typical products of the supply chain, dairy and delicatessen products. Increased ground-

water with respect to the ingression of the saltwater wedge, which may increase, leading to processes of soil degradation and desertification in the coastal areas.

The agricultural system's response can therefore only be to increase its support for companies through the introduction and maintenance of integrated biological and conservative agriculture and of other agri-environmental management techniques with a lower emission impact, including support for the spread of precision agriculture, which also aims to optimise water resources.

The table outlines the climate change mitigation and adaptation interventions in agricultural planning in the *short term*.

The guidelines for future planning and programming of EU funds also provide for:

- ♣ an increase in the practice of planned irrigation based on actual irrigation needs estimated by specific technical assistance services
- ♣ the launch of water-saving measures in agro-industrial transformation processes
- ♣ improvement of irrigation infrastructure and optimisation of irrigation planning at a consortium level, including through new technologies for interpreting regional needs.

It will also be fundamental to finance and enhance the development of new agronomic techniques according to specific environmental conditions and research for the development of genetic improvement and the selection of crop varieties in relation to local climate change projections.

Implementation period	Type of measure
<b>Short-term actions (by 2020)</b>	<p><b>Priority 5 - RDP 2014-2020 “Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors”</b> has four focus areas aimed at mitigating change climate.</p> <p>Overall, priority P5 is assigned 6% of total resources, including around 53% for investments, 33% for interventions in the forest sector and 1.6% to sustain the land. The strategy is completed with 8.8% of initiatives aimed at developing climate change innovations and 4% for training and information initiatives.</p>
	<p><b>Priority 4 - RDP 2014-2020 “Restoring, preserving and enhancing ecosystems related to agriculture and forestry”</b> is focused on the reduction of greenhouse gas emissions and carbon storage, while also initiating innovation investment measures that lead to the reduction of energy consumption and atmospheric emissions.</p>
	<p>Support of farmers' active role in <b>land management and conservation of natural resources</b></p>
	<p><b>Actions designed to safeguard water quality (F16)</b> by promoting production techniques that reduce pressure on the environment, counteracting erosion in hilly and mountainous areas and improving the physical quality of the soil by preserving the organic matter in soils (F17) and the promotion of sensible use of water resources (F18).</p>
	<p><b>Improvement of information and education measures (F01, F02, F03), together with support of sustainable management of ecosystems and preservation of biodiversity, species and habitats (F13, F15)</b>, with particular reference to the characteristics of the Natura 2000 areas, including through implementation of specific allowances for areas subject to regulatory and natural constraints (F13), to preserve biodiversity of agricultural interest, protecting endangered species and breeds (F14).</p>





## 4.9 Cross-cutting actions

By its very nature, the issue of climate change is a cross-cutting theme that must be addressed in a systematic manner by many if not by all of the sectoral areas of public policy. Aside from clear specific actions for each sector, others have been identified, which we could define as 'general and cross-cutting' and which should be considered a reference point for every regional plan/programme, with the aim of developing a culture of combating climate change and building resilience that is as widespread as possible. In particular, the most important general and cross-cutting actions/guidelines are identified below:

- 1. SCIENTIFIC KNOWLEDGE** – Increasing awareness of how scientific knowledge is a fundamental prerequisite for supporting planning and organizational decisions to address climate change;
- 2. EIA AND SEAS** – Introduction to the theme of climate change in the preparation of Strategic Environmental Assessments (SEAs) of plans and programmes and in Environmental Impact Assessments (EIAs) of plants and infrastructure;
- 3. CLIMATE CHANGE SCENARIOS** – Integration of climate change scenarios throughout sectoral planning and organization; in other words, the strategy document should be taken as a reference (together and as part of a more general regional sustainable development strategy) for all assessments, as defined by Legislative Decree 152/2006;
- 4. COORDINATION** – Improvement of the coordination of the subjects involved in planning and organizational activities with both a cross-cutting approach (dialogue and comparison between different sectors) and a vertical approach (greater dialogue between regional administration and local authorities in both top-down and bottom-up directions);
- 5. MONITORING** – Introduction of assessments on the effectiveness of mitigation and adaptation actions measured through effectiveness indicators including selection and decision-making methods and criteria for future planning.

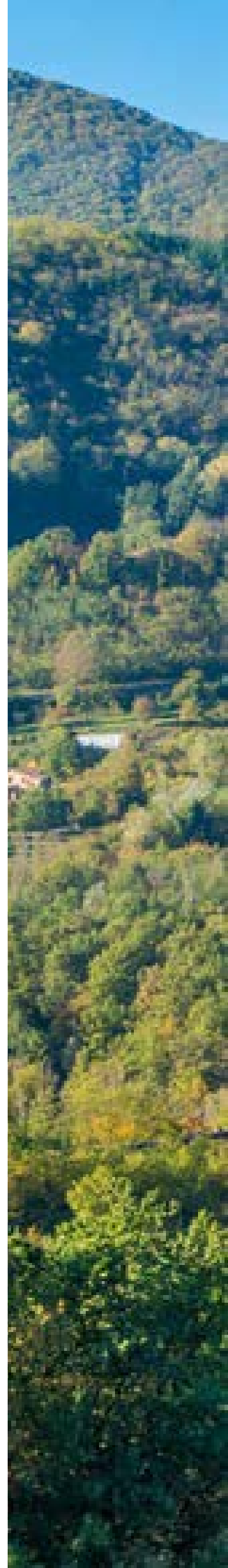
The Climate change mitigation and adaptation strategy for the Emilia-Romagna Region is framed in the context of European and Italian policies and of international relations and agreements that the Region endorses in order to **make its own contribution** to the management of a problem that involves everyone. This problem has and will have a significant impact on the Region and it must be prevented and managed to guarantee the regional system an adequate ability to adapt to changes that will inevitably occur.

On the one hand, it is important to **observe** climate change that is already underway, as well as to predict and prevent possible impact related to phenomena that in the short or long term will produce changes to the area and to climate conditions and meteorological phenomena. On the other hand, it is necessary to be able to **construct and monitor the greenhouse gas emissions** that are produced by the region, the activities that produce them and possible emission reductions that can be achieved through appropriate actions.

Knowledge of the phenomenon and an adequate information and environmental accounting system make it possible to **plan measures for the prevention and management of climate change**. Through its planning and use of available financial resources (for example, those from the European Structural Funds), the Region has for some time already implemented a very extensive framework of measures that have the effect of reducing greenhouse gas emissions (e.g. by reducing energy consumption and improving transport and mobility). For every sector (both for each physical-biological sector and for each technical-economic sector) it is possible to gather measures already in place and to define possible measures to be implemented in the medium and long term. It is also possible to compose a framework of issues that can be considered as priorities for regional action intended to mitigate and manage climate change, taking into consideration the environmental vulnerability of the various regional areas or actions already in progress or planned.

Through all these tools and content, the strategy is presented as a joint **reference tool** for describing regional action on the subject of climate change, interpreting the relevant sectoral and local plans and supporting the planning and implementation of concrete measures.

In order for the strategy to function accordingly and to effectively support the **implementation of regional prevention and adaptation policies**, the Region has prepared a number of organizational and technical structures (governance structures) and has set up some important initiatives focused on communication and involvement of citizens, businesses and local public administrations (*Regional forum on climate change*).



## 5. Managing: processes and tools for adaptation, mitigation and sustainable development

### 5.1 Governance structures

First of all, the “Climate Change Organization Office” (POCC) was established, which helps to promote and coordinate all the regional departments and services affected by the measures covered by the strategy. The POCC is managed by the Impact Assessment and Promotion of Sustainable Development Service through an organization that involves various regional structures (ART-ER and ARPAE Emilia-Romagna) and, in particular, serves to:

- ♣ Guarantee maximum synergy and coherence between planning tools, their monitoring and the joint vision and guidelines identified in the strategy;
- ♣ Monitor and evaluate the effectiveness of regional policies on climate change mitigation and adaptation in the various areas of regional legislation and planning;
- ♣ Support adaptation measures in different sectors and the alignment of sector policies with medium and long-term strategies;
- ♣ Analyse the economic impact of current and predicted climate change on the various civil, service and production sectors and on the region’s urban and natural environments;
- ♣ Update and adapt the strategy in the long term in relation to ongoing climate change;
- ♣ Support the activities envisaged in the 2014-2020 Joint Regional Assessment Plan for Emilia-Romagna;
- ♣ Assess the progress of the implementation of adaptation and mitigation actions and their integration into local plans and/or other existing plans;
- ♣ Assess the effectiveness of the adaptation and mitigation actions implemen-

ted in the various intervention areas by monitoring them through appropriate indicators;

- ♣ Offer technical support in defining and implementing tools and promote, together with the permanent Forum, a continuous dialogue and the exchange of good practices between the different areas and different levels;
- ♣ Collaborate in coordination activities both at regional and local level with local administrations in defining SEAPs (Sustainable Energy Action Plans) and especially SECAPs (Sustainable Energy and Climate Action Plans), including through climate change scenarios and their impacts, provided at local level by the observatory on climate change scenarios and their impacts (ARPAE);
- ♣ Promote the spread of information about funding tools and sources for the implementation of adaptation policies;
- ♣ Coordinate the activities of the Regional forum on climate change and to periodically
- ♣ report on the activities of the Regional Council.

For these purposes, the POCC is supported by the **observatory on climate change scenarios and their impacts**, established at ARPAAE Emilia-Romagna, which is tasked with recognizing and documenting ongoing climate change, developing future climate scenarios and their impacts, as well as analysing scenarios for specific intervention options for integrated regional sector plans. The ultimate goal of the activity carried out by the observatory is availability of basic information on climate change scenarios and their impact on the area and on regional sectors.

### 5.2 Regional forum on climate change

In order to engage stakeholders in an active discussion to gather the contributions and participation of citizens, businesses and local public administrations, the Region is launching a **Regional forum on climate change**. The Forum will have the dual objective of:

- ♣ establishing a place for permanent dialogue with local authorities and productive sectors for comparison and coordination



of mitigation and adaptation policies at local level;

- ♣ informing citizens about adaptation and mitigation issues, as well as training them so that they can improve their ability to understand and assess the actions proposed in the joint mitigation and adaptation strategy and in the sector's plans and programmes.

The regional Forum will mainly operate with the following tools:

- ♣ a web platform;
- ♣ actions to support the development of a communication campaign;
- ♣ involvement of the main regional stakeholders through awareness-raising and training activities.

To carry out its activities, the regional Forum will also have to establish and maintain a permanent dialogue with the main regional and/or national scientific research bodies in order to guarantee the transmission of knowledge and services on the constantly evolving issue of climate change that are always up-to-date and innovative.



Emilia-Romagna  
**we contribute**  
**to sustainability.**