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# THE 2024 ANNUAL PUBLIC REPORT

## Public action to adapt to climate change

Summary report

March 2024

# The overall situation of the public finances (at the end of February 2024)

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Strong inflationary pressures and high energy prices marked 2022 and 2023, which weakened the economic recovery from the health crisis and pushed back the end of the "whatever it costs" approach. As a result, France started 2024 with one of the worst public finances in the eurozone. The financial provisions for the year were based on an over-optimistic growth forecast of 1.4 %, which the government decided to lower to 1.0 % in February, and which is still high in relation to the forecasts of national and international bodies (0.7 % is the consensus of economists). This downward revision is accompanied by savings measures designed to maintain the deficit forecast and the multi-year trajectory set out in the public finance programming bill. At a time when the debt burden is rising rapidly, the multi-year trajectory of bringing the deficit back below 3 % by 2027 will require major efforts to control spending, which must be identified and reinforced quickly.

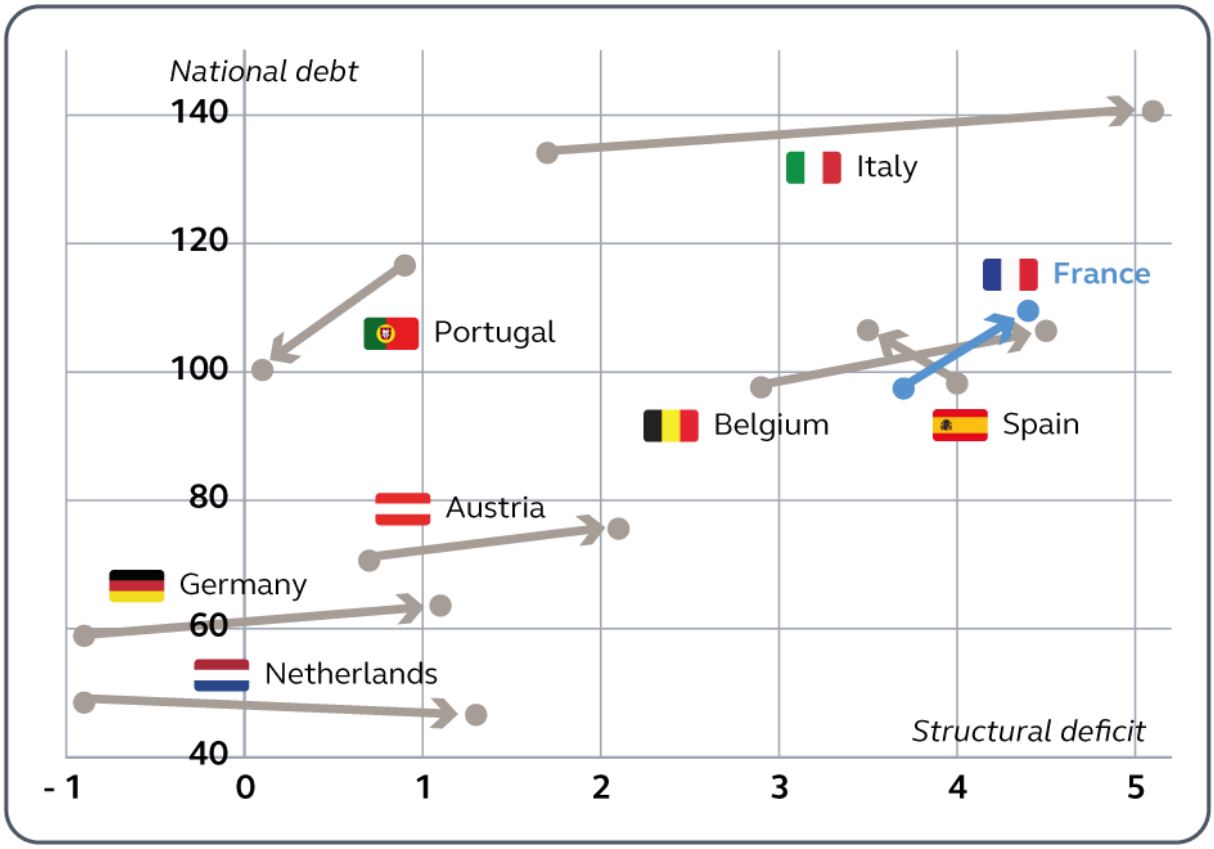
## A deficit that will remain high in 2024, despite the scheduled end of inflation-related support measures

Against a backdrop of a marked slowdown in economic activity, with real growth of 1 %, there was no change in 2023 in terms of the reduction in the public deficit, which is expected to reach 4.9 % of gross domestic product (GDP), compared with 4.8 % in 2022. Prices, particularly energy prices, remained high and the exceptional support and stimulus measures were only slightly reduced, while tax revenue, unlike in the previous two years, was lacklustre.

For 2024, the government is forecasting a reduction of 0.5 points of GDP in the public deficit, to 4.4 % of GDP, as a result of phasing out exceptional measures.

No new structural savings were planned in the Budget Act for 2024, with only the pension and unemployment insurance reforms, already underway, to curb spending. The government must now urgently make savings estimated at €10bn to offset the fall in revenue due to lower growth and maintain this target balance. Even in this scenario, national debt would reach almost 110 points of GDP at the end of the year, or €3,200bn, up by more than €800bn compared with 2019. Between 2023 and 2024, the debt burden is expected to increase by €10bn, to €57bn. As a result, France's public finances remain among the worst in the eurozone.

**National debt and structural deficit trends in the main European countries between 2019 and 2023 (as a % of GDP)**



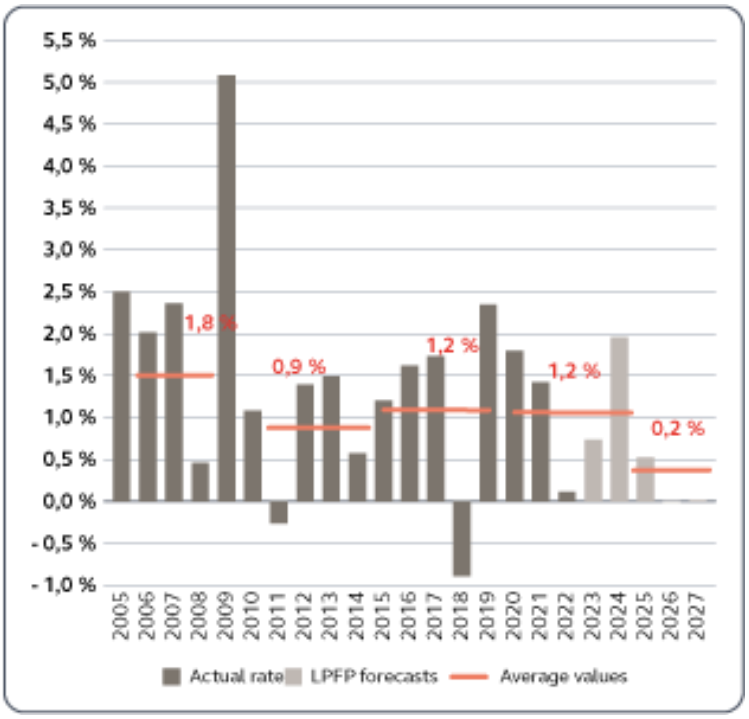

*Source: november 2023 European Commission forecast*

Significantly reducing the deficit, putting national debt on a downward trajectory and preserving growth potential are the three objectives set for the 2023-2027 multi-year trajectory. Complying with these three objectives is all the more necessary given that the public finance situations of eurozone countries, and France in particular, have veered off course with the crisis, creating increased risks of instability.

## A credible path for bringing the deficit back below 3 % in 2027

The multi-year trajectory for 2023-2027 set out in the Public Finance Programming Bill (LPFP) enacted on 18 December 2023 appears problematic in the light of France's European commitments. The public deficit is not expected to fall below 3 points of GDP until 2027, and debt as a proportion of GDP would only fall very slightly at the very end of the period. This trajectory is not very ambitious, even though it is underpinned by favourable macroeconomic assumptions up to 2027 and forecasts a marked slowdown in public spending (excluding interest expenditure) compared with historical trends.

**Growth rate of public spending, excluding interest expenditure and exceptional measures, in real terms* (in %)**




*Source: Insee and the Public Finance Programming Bill*
** Volumes have been calculated using the consumer price index excluding tobacco.*

Government's spending trajectory assumes not only that the target balance for 2024 will be maintained, but also that around €50bn of new savings will be made between 2025 and 2027 compared with the pre-crisis trend. However, these savings measures are essentially unsubstantiated at this stage, as the effects of the pension and unemployment insurance reforms have already been taken into account. Such an effort will be all the more difficult to implement as many sectoral programming laws (Defence, Justice, Home Affairs, Research) are already increasing spending for several ministries, and the ecological transition is expected to prompt a growing amount of private and public funding.

Moreover, this trajectory confirms a growing social security deficit, since the balance of the mandatory basic schemes and the Old Age Solidarity Fund (FSV) is set to deteriorate, rising from €8.7bn in 2023 to €17.2bn in 2027, meaning that the burden of today's social benefits will be passed on to future generations.

The margins of safety around the LPFP trajectory therefore appear to be extremely small. Any unpleasant macroeconomic surprises between now and 2027, or any budgetary performance that falls short of the stated ambitions, would run the risk of increasing the public debt ratio over the programming period.

It is essential to demonstrate selectiveness in spending and to offset any additional expenditure or tax cuts with savings or increases in revenue. It will also be crucial to undertake ambitious reforms in certain key sectors to bring about a lasting change in the pace of spending, and to make improvements in the quality of spending a top priority.

# General summary

Article L.143-8 of the French Financial Courts Code stipulates that the Court of Account's annual public report (APR) "shall include findings and recommendations resulting from audits or evaluations relating to a major public action issue to which [it] wishes to draw the attention of the public authorities and help inform citizens". In accordance with these provisions, the Court has decided to devote its 2024 APR to public action to adapt to climate change.

The effects of climate change are considered to have two main types of impact, involving both general repercussions on economic activity and specific consequences for certain business sectors:

- the impact on major infrastructure, facilities, towns and cities and, more generally, housing (which has been built);
- the impact on the physical and biological environment (coastline, forests, crops, etc.) and on individuals (during heatwaves, increased fire or flood risk, etc.).

16 themes were examined, which, with the exception of three that were more cross-sectoral, fall into these two main categories.

For several years now, in its regular publications on the state of public finances, the Court has been stressing the need for public administrations to prepare for funding the cost of the ecological transition. The issue of a precise valuation of the amount and the distribution between public and private stakeholders of the burden of the "wall of investments" to be made in order, in particular, to adapt the economy and society to the effects of climate change, is actually of crucial importance. However, the issue of adapting to climate change cannot be approached solely from an economic and financial perspective. First and foremost, it requires political choices to be made in all areas of public action. It is from this perspective that the audits carried out by the Court and the *Regional And Territorial Chambers Of Account* in 2023 to support this report were conducted.

The financial courts have endeavoured to identify the main lessons to be learned from this body of work in the light of the major questions that French people are posing when, as is increasingly the case, the issue of adapting their living environment, their surroundings and their activities comes to the fore, particularly at the time of climate-related disasters, the frequency, intensity, location or scale of which were hitherto unknown in mainland France or the overseas territories (heatwaves, forest fires, cyclones, etc.).

The first question is what to expect in specific terms, and when: the French people want to understand and prepare for the consequences of climate change on their daily lives.

They also wonder how the efforts required to adapt should be identified, decided on and shared between all the stakeholders involved (public authorities, businesses, households, non-profit organisations, researchers, etc.): adaptation should not be seen solely from a technical angle, it is also a democratic issue for the French people.

The complexity of adaptation and the scale of the expenditure involved, at a time when the state of public finances remains worrying, are finally leading the population to ask themselves how we can design, finance and implement solutions that are both appropriate and sustainable: what can we do that is effective at the lowest cost?

Echoing these questions, the work of the financial courts underlines the need for public action adapting to climate change to be transparent, coherent and efficient.

## The need for transparency

The urgency of adaptation is now well recognised, as is the need to link it with the fight against global warming, which must not be neglected. These two priorities should be reconciled, not set against each other. The new urgency of adaptation stems from the fact that the fight against global warming is taking so long to have an effect: it is not in any way the abandonment of mitigation.

However, there are many uncertainties surrounding this priority. They are linked to the diversity of responses required at various regional levels and over different timelines. They also result from the need to deal with a number of different risks in many areas. The intensification and acceleration of the effects of climate change are also a source of uncertainty when it comes to categorising and sequencing the measures to be taken to deal with it. Climate change is therefore overtaking the natural adaptation of forests, thus requiring the implementation of measures that had not been anticipated until now. Similarly, the accelerating effects of climate change in mountain areas are liable to compromise the economic viability of a large number of winter sports resorts sooner than previously thought.

The implementation of public action requires us to reduce as far as possible these many kinds of uncertainties. The aim is to gather the data needed to make accurate and reliable projections, and to adapt the applicable standards to take account of changing risks. In all three areas – data, projections and standards – the work of the financial courts highlights the extent of the progress that needs to be made.

In this context, informing the public is a major issue to ensure public support for the process. It must address the risks and the choices to be made in response, but also the opportunities offered by adaptation to climate change. The increased use of the *MaPrimeRénov'* scheme as a means of funding comprehensive retrofit projects as part of the housing policy should both improve the comfort of residents' homes and encourage building firms to recruit professionals with the skills to carry out this type of work.

There will always be a degree of uncertainty, which should not be paralysing: given the urgency of adaptation in many areas, public authorities must accept this and act, by setting objectives that are consistent with the state of knowledge, determining a trajectory for achieving them and demonstrating agility if changes in projections require objectives to be modified or the trajectory to be adapted.

## The need for coherence

Coherence means reconciling the objectives of adaptation to climate change with those of other public policies with which it is in line or opposition.

In many areas, adaptation objectives need to be coordinated with those of economic development. The measures to be taken to adapt the coastline to the risks of coastal erosion and flooding may be constrained by the desire of the populations and elected representatives concerned to ensure the continued existence of activities, particularly tourism, threatened by the retreat of the coastline. The objectives of adaptation may also need to be combined with those of urban planning policy. In order to take effective action against forest fires, urban planning documents drawn up by municipalities or groups of municipalities must restrict building in forested areas or sectors posing particular risks.

Adapting to climate change also means protecting ecosystems, landscapes, spaces and natural resources. This is particularly true of water resources, on which, for example, nuclear power plants and hydroelectric facilities are both dependent for the operation and safety of their installations, which means that delicate trade-offs have to be made.

Coherent public action also requires appropriate planning, but also trade-offs and the coordination of stakeholders at an appropriate scale, national, regional or local depending on the topic.

Audits show that there are often gaps in planning. The third National Climate Change Adaptation Plan (PNACC), which was being finalised when this report was published, will have to fill these gaps. However, the implementation of appropriate planning is a necessary but not sufficient condition to ensure the coherence of public action to adapt to climate change. Although there are many stakeholders involved, there also needs to be a leader to make decisions and coordinate. From this angle too, the report reveals a mixed picture. It shows, for example, that government is not yet fully assuming its role as the operational leader of adaptation with regard to its property policy, which it has so far focused on reducing greenhouse gas emissions from buildings. It also emerges that the issue of coordinating the actions of entities of 'municipal groupings' is a major challenge of coherence for public action to adapt urban centres, the coastline or mountain resorts, which must be designed and implemented on an intermunicipal rather than a municipal scale.

The government, for its part, must set targets and define a trajectory for achieving them. For example, it is responsible for determining the expected level of availability of the rail network according to the severity of the hazards encountered.

## The need for efficiency

The context of urgency or of understanding the effects of climate change over time, which characterises, for example, the policy of preventing climate-related natural disasters overseas, carries with it the risk of maladaptation, i.e. measures designed to reduce the vulnerability of a natural or human system that actually lead to increasing it. A typical example is the systematic or overzealous use of snowmaking equipment by some mountain resorts. Another is the over-reliance on air conditioning in response to the increasing number and intensity of heatwaves.

The stakeholders involved are sometimes at a loss to choose the most effective solutions and determine the timetable for implementing them. Research has a major role to play in providing them with solutions that are constantly adapted to risks that are themselves evolving. The work of the financial courts shows that, on the ground, support for it is mixed. The adaptation of cereal farming benefits from the contributions by a comprehensive and effective public and private research and innovation system. However, research is struggling to provide operators and businesses in the forestry and timber sector with practical solutions for adapting to the effects of climate change. Similarly, in the housing sector, the lack of technical knowledge means that it is not yet possible to devise practical and sustainable solutions in response to the risks of flooding and the shrinkage and swelling of clay soils.

In all cases, deciding between the available options must be preceded by an accurate assessment of the current and future costs of adaptation, which is still too often incomplete or even non-existent, due to a lack of sufficient data and sometimes also a lack of clear objectives. This is typically the case in the housing sector, where these two shortcomings currently make it impossible to put an overall figure on the cost of adapting the housing stock. However, 'true pricing' is an essential decision-making element in defining and implementing financially sustainable solutions. These assessments are also essential for measuring, more accurately than hitherto, the overall impact that adapting to climate change will have on public finances.

However, adapting to climate change requires more than just new operating expenditure and investment. Other levers for public action need to be activated to empower stakeholders and encourage them to adapt. The aim is to encourage businesses, households and non-profit organisations to act or to change their behaviour through regulation, by influencing the prices of goods and services or by introducing financial solidarity mechanisms.

The financial sector thus offers an example of the benefits of encouraging adaptation through regulation and pricing. In this field, the primary criterion for allocating finance remains financial profitability, not environmental impact. It is only by changing the economic and financing conditions for businesses, in order to shift the profitability sliders, that a greater proportion of capital will be channelled into financing the ecological transition in general and adaptation to climate change in particular.

The introduction of financial solidarity mechanisms is also a way of bringing together, on a relevant geographical basis, all the stakeholders involved in adaptation. The report thus mentions the prospect of creating a fund to assist the redevelopment of the coastline, which local authorities and groups of municipalities located on the seafront could use to finance actions jointly funded by government, subject to a spending target that they would have to meet from their other resources.

Lastly, the effective rollout of adaptation actions presupposes that decision-makers are encouraged to use the data, tools and solutions made available to them. Adapting forests to climate change and taking preventive action against forest fires means developing engineering and the project management capability of local stakeholders as close to the forest as possible. The same applies to adapting to the changing coastline, which involves coastal areas in highly complex actions and projects, requiring rare skills.

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The issue of adapting to climate change concerns all areas of public action. It primarily concerns public administrations – government departments, local and regional authorities, national and local public agencies, public companies – but it must also involve all stakeholders in society: households, businesses, the education community, non-profit organisations, the research community, etc.

However, the public is at the heart of this. Nothing can be done without them, let alone against them: the yellow vests crisis has shown that the French want to be involved in the decisions that directly affect their daily lives.

Nevertheless, many of the measures that are likely to be implemented in response to the effects of global warming will affect their lives in the most essential areas: food, housing, transport, leisure activities and so on.

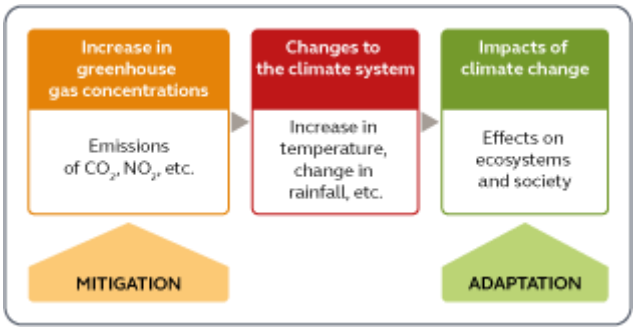
They therefore need to be convinced of the need for clear, coherent and effective action at the lowest possible cost, but also of the opportunities offered by adaptation to improve their quality of life, develop solidarity between generations and regions, and encourage job creation and economic growth.

That is the aim of this report.

# Introductory chapter

The latest reports from the Intergovernmental Panel on Climate Change (IPCC) emphasise that, despite measures to mitigate climate change, which primarily involve reducing greenhouse gas emissions, climate change is inevitable over the course of this century. In addition to the urgency of mitigation, there is now a more widespread awareness of the need for adaptation.

**Climate change mitigation and adaptation**




*Source: ministry of energy transition / National Observatory for the Effects of Global Warming (ONERC)*

Has France fully grasped these challenges? Have Government and local authorities made enough changes to existing public policies or developed new ones to deal with the situation? It is illusory to hope for definitive answers to these questions. As climate change itself is gradual, France and each of its territories will also have to adapt to it gradually.

Nevertheless, it is possible to examine, sector by sector, whether or not adaptation in our country has begun to be considered, and to assess its initial impact.

This exercise is all the more useful given that public adaptation policies, which impact businesses and households, will begin to weigh on national and local public finances, and that not adapting, or adapting badly, could ultimately prove much more costly.

## Increasingly significant climate change

While temperatures have been rising since the beginning of the last century, the IPCC's reports shed light on how the climate could evolve. To date, international efforts to try to mitigate climate change have been insufficient.

*Effects already measurable, but dependent on trends in greenhouse gas emissions*

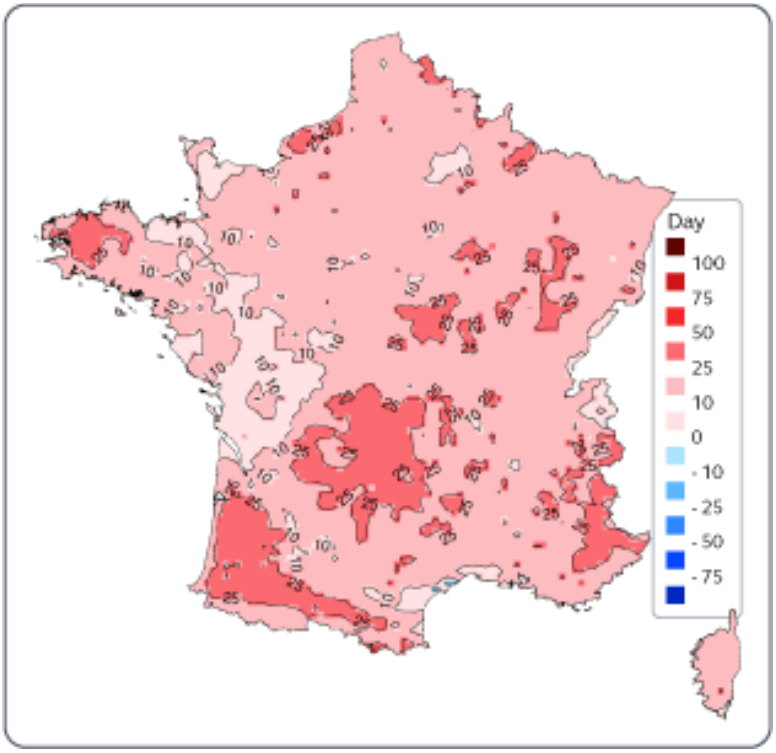
With the advent of the industrial era, the world gradually entered a period of anthropogenic climate change, i.e. change caused by human activities.

The rise in average global surface temperatures, observed since the beginning of the 20th century, has been greater since 1980.

The IPCC estimates that the average temperature rise over the last decade (2011-2020) has already reached 1.1°C compared with the period 1850-1900. Its sixth report presents five scenarios for climate change between now and 2100 based on greenhouse gas emissions. It shows that, in the most favourable scenario, the rise in average temperatures would be close to 1.5°C in both 2050 and 2100, and that the intermediate scenario, the closest to current greenhouse gas emission trajectories, would lead to a rise of 2°C by the middle of the century and close to 3°C by 2100.

This report also highlights the correlation between the rise in average temperatures and the increase in extreme weather events (rainfall intensity, temperature extremes, severity of droughts, etc.).

**Change in the number of days with dry ground from now until the end of the century**




*Source: Météo France, DRIAS 2020 projections*
*For further reading:*
*Difference in the number of days with dry ground (SWI < 0.4): difference between the period concerned and the reference period;*
*For RCP4.5: Scenario with moderate emissions.*
*Distant future (2071-2100) – Current average.*
*Multi-model result: median of the entire SIM2 hydrological model forced by the DRIAS-2020 set of climate simulations.*

Finally, it points out that as average temperatures rise, they will vary from region to region. In mainland France, temperatures are changing and will continue to change more strongly than the global average. According to *Météo France*, since 2010, the average annual temperature has been consistently 1.5 to over 2°C higher than during the 1961-1990 period.

In this context, the IPCC's intermediate scenario would result in a rise in temperatures of around 3.8°C for mainland France by the end of the century. The warming is expected to be greater in mountainous areas than in low-lying areas, and there is likely to be an increasingly marked gap between south-east and north-west over time. The situation in each overseas territory will also be specific.

*International mobilisation with limited impact*

The international community has gradually come together to try and mitigate climate change. To date, this mobilisation has proved insufficient. From the outset, the European Union has been a driving force in international mobilisation. Following the Paris Agreement, it has set itself the goal of achieving net zero by 2050, starting with a reduction in greenhouse gas emissions of at least 55 % by 2030.

Since the 1997 Kyoto Protocol, emissions from developed countries, including France, have fallen; those from intermediate countries have risen sharply, as have those from the world as a whole. At this stage, the sum of all the commitments made does not make it possible to

meet the goals of the Paris Agreement. To assess what we will have to adapt to throughout the 21st century, we therefore need to pay attention to the IPCC scenarios, which are more pessimistic than the one corresponding to compliance with the Paris Agreement.

## Adaptation policies gradually being developed, to be rolled out across the regions

Adaptation policies are more progressive than mitigation policies and are necessarily regional. In France, as elsewhere, they have only been developed relatively recently.

*Adapting to the effects of climate change is complex and multi-faceted*

Policies to adapt to climate change take place on different timescales depending on its effects. They also presuppose adapting to three types of phenomena: higher global temperatures; the resulting long-term structural and physical changes, such as rising sea levels, melting glaciers and thawing permafrost; and one-off extreme weather events: heatwaves, droughts, extreme rainfall and storms.

In view of these varied phenomena, adaptation policies need to be territory-based: each country, each region, each territory must adapt to changes in its own environment. However, *Météo France* stresses that the levels of uncertainty in terms of the magnitude of each of these effects are significantly higher than those relating to temperature changes under the IPCC scenarios. Adaptation policies will face this difficulty in the long term.

Insofar as climatic hazards are set to increase, the strengthening of policies to reduce vulnerability will not dispense with the need to strengthen crisis management systems, or to debate the definition of the targeted level of safety in the light of the risks identified.

*Adaptation: a well-identified need, with implementation frameworks gradually being developed*

In France, there have been several stages in the development of adaptation policies over the last twenty years.

The first national adaptation strategy (adopted in November 2006) was presented as a report for decision-makers, stressing the need to draw up a genuine national adaptation plan.

The law of 3 August 2009 provided for the preparation of a national climate change adaptation plan (PNACC). The first PNACC, adopted in July 2011 for the period 2011-2015, identified 20 areas broken down into 242 measures. The cost of their implementation to the state budget was estimated at around €170m.

The PNACC 2, adopted in December 2018 for a new five-year period, aims to adapt from the middle of the 21st century to a regional climate in mainland France and the overseas territories consistent with a global temperature rise of 2°C compared with the pre-industrial era. It is refocused on six main areas, grouping together 29 themes. However, PNACC 2 no longer covers topics such as energy, industry, transport infrastructure or mountains, which figured prominently in the first plan.

The Government's cumulative budgetary expenditure under this plan was estimated at €2.9bn at the end of 2022, for that relating to the national territory, i.e. an annual average of €600m. This amount does not include development aid, adaptation expenditure by public companies, expenditure committed at national level within a framework other than the PNACC 2, such as the recovery plan or the Green Fund, or expenditure by local authorities.

The preparation of PNACC 3, which should be finalised in 2024, is taking place within a radically new framework in terms of climate scenarios. The proposal is to prepare for global warming of 2°C in 2030, 2.7°C in 2050 and 4°C in 2100 in mainland France.

As with previous plans, all the adaptation policies implemented in France will not be limited to the PNACC 3. At national level, these are supplemented by sectoral strategies. At a local level, regional plans for planning, sustainable development and regional equality

(SRADDET), local climate-air-energy plans (PCAET) and other planning documents will have an important role to play in their development and implementation.

If a warming trajectory leading to 4° C by 2100 were to be adopted, the content of PNACC 3 would have to be significantly different from that of the two previous plans, as would the budgetary effort required. In this respect, the absence of comprehensive and coherent figures for all public stakeholders is particularly noteworthy at this stage.

The effects of climate change are generally considered to have two main types of impact:

• the impact on major infrastructure, facilities, towns and cities and, more generally, housing (which has been built);

• the impact on the physical and biological environment (coastline, forests, crops, etc.) and on individuals (during heatwaves, increased fire or flood risk, etc.).

The Court examined 16 topics that fall mainly into these two broad categories. Naturally, these 16 chapters are not intended to be comprehensive. However, the variety of areas examined gives a specific picture of the challenges that France is having to and will have to face, the way in which it is preparing for them – or not – to date, and the initial results of the national adaptation policy.

# Part One:

# Cross-sectoral public actions

1. The place and role of public research in adapting to climate change
2. Helping the economy adapt to climate change: the role of financial institutions and banks
3. Development aid and adaptation to climate change: the contribution of the French Development Agency [*Agence française de développement*] (AFD)

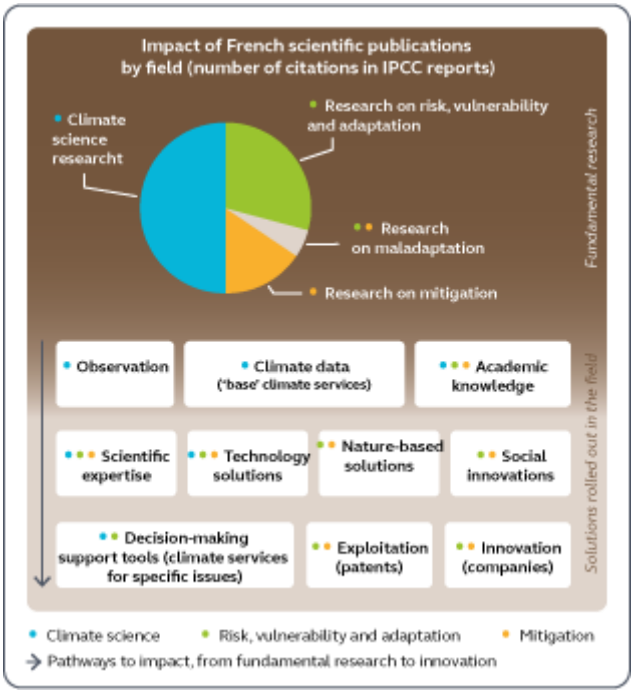
# The place and role of public research in adapting to climate change

Research plays a key role in adapting to climate change, particularly through the support provided by the French climate science community to the climate projections of the Intergovernmental Panel on Climate Change (IPCC). Its role is part of a *continuum*, with research for adaptation including research on adaptation and all the infrastructure, data and knowledge that form its basis, as well as research at the intersection of climate change adaptation and mitigation, which is crucial for limiting maladaptation. To support its analysis, the Court relied in particular on more than 40,000 citations of publications mentioned in the IPCC reports.

## France is a world leader in climate science, with a more modest position in adaptation and mitigation

French research stands out in the climate sciences and, to a lesser extent, in the fields of adaptation and mitigation (see diagram below).

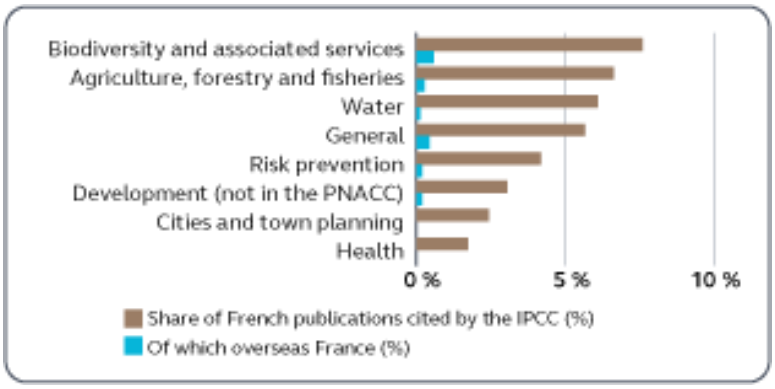
**Place and role of research in adaptation**




*Source: Court of Accounts*

Research into risk, vulnerability and adaptation has a variable impact depending on the sector and territory. As the graph below shows, French research ranks at the highest international level in the fields of biodiversity and ecosystem services, Mediterranean areas and coastal and island areas. France is also well positioned in agricultural, forestry and water-related issues. However, it is not sufficiently positioned in the areas of health, urban planning, cities and development. The graph below also shows that overseas territories are poorly represented overall. Climate projections for overseas France must be implemented rapidly.

**Impact of French research on adaptation by sector (% of citations worldwide)**




*Source: Court of Accounts analyses based on citations from the IPCC (6th cycle) cross-referenced with Hal*

In terms of IPCC citations, at least 7 % of French laboratories have contributed to work on adaptation and at least 3 % more directly on adaptation issues. However, the level of involvement in adaptation remains variable, with a handful of laboratories accounting for these citations. Humanities and social sciences are underrepresented. Scientific ecosystems remain compartmentalised. This weakness, which is not specific to France, increases the risk of maladaptation. With a few exceptions, the main French operators all specialise in climate science.

## Resources to be strengthened in the long term

France's performance in research for adaptation and, to a lesser extent, research on adaptation, can be explained by the resources rolled out (see summary table below).

**Resources for research for adaptation (in €m)**

| *Type of resources* | **Estimated amounts in €m per year** |
|---|---|
| *Research projects (1/3 European Union, 1/3 National Research Agency (ANR) and 1/3 future investments)* | 81 |
| *Human resources (excluding research bodies)* | 129 |
| *Research infrastructures (operating)* | 149 |
| *Total research for adaptation (low estimate)* | 359 |
| *Total public research expenditure across all sectors (source: MESR, for 2020)* | 18,100 |
| *Proportion of research for adaptation (%)* | At least 2 % |

*Source: Court of Accounts summary and estimates. The amounts for multi-year projects have been standardised by the number of years concerned in order to obtain an annual average. Data relating to the staff of research bodies cannot be produced due to shortcomings in the information systems.*

The European Union and the French National Research Agency (ANR) are the two main funders of the French research cited by the IPCC.

The ANR funds the production of new knowledge, in line with the second National Climate Change Adaptation Plan (PNACC). Over the period 2012-2022, funding allocated to research for adaptation increased. The second PNACC has had no additional effect compared with the first. Specific funding for adaptation even decreased between the two plans.

The ANR also manages the research funding earmarked for future investment programmes (PIA), which finances more applied research. Most of the PIA funding for adaptation was focused on the period of the first PNACC. The new Priority Research Programmes and Equipment (PEPR) should increase the funding devoted to research for adaptation.

Permanent staff are essential for carrying out project-based research, organising facilities to produce new knowledge and solutions and, ultimately, offering high-quality expertise. These staff are also needed to mentor young talent. However, staff numbers are stagnating in both climate science and research into risk, vulnerability and adaptation. The momentum observed for theses within these fields has come to a standstill since 2017-2018. Given the growing need for expertise in the field of adaptation, the scientific pool remains undersized.

Research for adaptation requires the involvement of major research facilities to provide the basic data necessary. The operating cost of these facilities for adaptation is estimated at at least €137m per year. Many facilities are facing issues related to their age, with no funding identified for their modernisation.

## Scientific support for society suffering from a lack of national coordination

The resources rolled out for research for adaptation has made it possible to build up a pool of scientists who provide essential expertise. This is done primarily through contributions to the IPCC, whose work informs climate policy. Over the last ten years or so, regional groups of climate experts (GREC) have been set up to inform decision-making as closely as possible to local issues. There are no such groups in five regions of mainland France or in the overseas territories, with the exception of Guadeloupe. These groups have different statuses, variable reach, little structure and are not always based on the state of the art. Their status should be harmonised.

French research is innovating and proposing numerous solutions for adaptation. In order to meet operational needs, the climate projections developed by the climate sciences need to be combined with studies applied to specific sectors and regions (such as, for example, the analysis of the consequences of the massive use of urban air conditioning in relation to alternative adaptation strategies) and with the use of ‘à la carte’ expertise or targeted climate services.

Among the technological solutions, climate services are expanding rapidly, making it possible to provide information in a format suitable for decision-making support. Overall, French public research plays a significant role in 39 services. Since 2018, the number of climate services rolled out has risen sharply. Despite this progress, their sectoral influence appears limited, except in the field of tourism. The rollout of these services therefore needs to be accelerated. The Adaptation Resource Centre, set up as part of the second PNACC, could play a more central role.

The second PNACC requires the ministry for ecological transition to co-lead the ‘knowledge and information’ aspect of this plan with the ministry for higher education and research (MESR), in conjunction with the other ministries and implementing partners. The ANR and the ministry for ecological transition do carry out joint work, but only to track the funding devoted to research on adaptation afterwards. The latter, which is more difficult to develop, needs to be steered and directed in a specific way. The development by the MESR of a national research strategy on adaptation issues, in support of the more general PNACC led by the ministry for ecological transition, would give impetus to this field of research.

# Recommendations

The Court makes the following recommendations:

1. develop a national strategy for adaptation research to support the National Climate Change Adaptation Plan (m*inistry of higher education and research*);
2. rebalance resources in favour of research on adaptation, with particular emphasis on health, cities, overseas territories and areas where adaptation and mitigation are shared (m*inistry of higher education and research, ministry for ecological transition and territorial cohesion*);
3. create a label for regional climate expert groups and include them in a network coordinated by the ministry for ecological transition (m*inistry of higher education and research, ministry for ecological transition and territorial cohesion, High Council on Climate*);
4. set up research dashboards and a map of the expertise available to all stakeholders on adaptation to climate change and other scientific issues relating to climate and biodiversity (m*inistry of higher education and research, ministry for ecological transition and territorial cohesion*);
5. prioritise climate services, tools that offer decision-making support based on climate projections, according to their use and user feedback (*ministry for ecological transition and territorial cohesion*).

# Helping the economy adapt to climate change: the role of financial institutions and banks

## An evolving framework for action, and recent attention to adaptation issues

In 2015, the Paris Agreement recognised both the key role of the financial sector in the transition to a more sustainable economy and the priority of adapting to climate change.

To implement this direction, the European Union (EU) and France have progressively strengthened the obligations of financial and non-financial companies to be transparent about their climate commitments. Environmentally friendly economic activities are defined by the Taxonomy Regulation adopted by the EU in June 2020[1]. The European Sustainable Finance Disclosures Regulation (SFDR), in force since March 2021, defines the transparency requirements for financial products. Lastly, the Corporate Sustainability Reporting Directive (CSRD) standardises and broadens the scope of extra-financial data to be provided by companies in order to obtain reliable and comparable information.

This framework, which has not yet been fully consolidated, has its limits. The definition of environmentally friendly activities in the taxonomy is very restrictive at this stage, which could prove to be a disincentive even for the most committed stakeholders. The absence of a link between the texts is detrimental to the framework's overall coherence insofar as investments in activities that are not aligned with the European taxonomy can nevertheless be considered sustainable under the SFDR regulation. Lastly, some of its concepts, such as the notion of 'sustainable investment', lack precision, leaving stakeholders with a margin for interpretation that increases the risk of greenwashing and therefore requires clarification.

At the same time, at the request of the European Central Bank (ECB), national supervisory bodies of markets and financial players, the risk management framework of banks and insurance entities is evolving to include climate risk in the assessment of the risk profile of client companies. The ECB carried out resilience tests in 2021, which showed that climate risk was not yet sufficiently integrated and asked financial companies to take corrective measures by the end of 2024.

The same applies to public entities such as *Banque Postale* and *Bpifrance*, which are also subject to ECB tests. The integration of climate risk is not yet complete, even though significant efforts have been made, such as *La Banque Postale* using climate indicators to support decision-making and *Bpifrance*'s climate risk management teams participating in investment committees. At this stage, these advances have not yet had an impact on lending decisions. The *Caisse des Dépôts et Consignations* also conducted a test but based on different assumptions and a different scope from the ECB's exercise. There is still room for improvement to ensure that the actions and results of all public entities are comparable.

## Funding still limited for the transition, and embryonic for adaptation

The Pisani Ferry - Mahfouz report of May 2023 estimated the investment needed for the transition at an additional €66bn by 2030, or 2.3 points of GDP, without distinguishing between the share to be borne by public and private stakeholders. Assessing the financing needs for adaptation to climate change is still at an exploratory stage, even though this financing is often inseparable from that for mitigation.

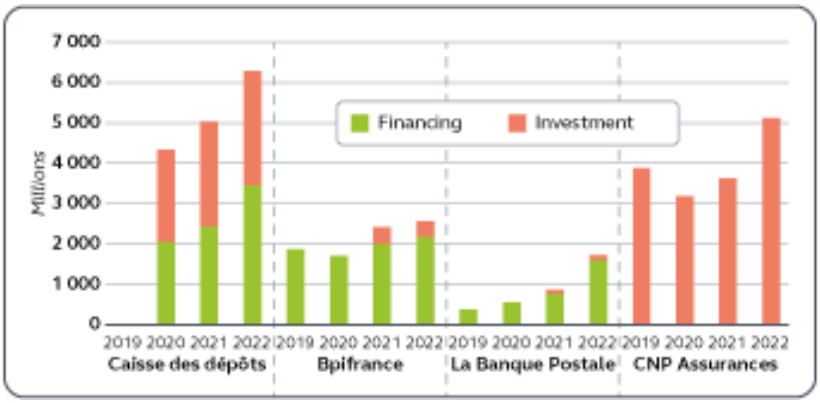
The new framework for action decided on following the Paris Agreements is currently being adopted by the stakeholders involved. Not all the implementing conditions have yet been defined, and the risks of 'greenwashing' remain high. The result is a profusion of voluntary commitments and financial products that are too heterogeneous to be rigorously assessed and

[1] The European taxonomy classifies economic activities that have a positive impact on the environment. Its aim is to steer investment towards 'green' activities.

compared over the recent period. There are two public labels for 'sustainable' investment: *Greenfin*, created in 2015 by the ministry for ecological transition, and *Investissement Socialement Responsable* (SRI) [Socially Responsible Investment], created in 2016 by the ministry of the economy. Both are currently being overhauled to incorporate the climate objectives of European regulations.

The available data shows that the (re)allocation of financial flows to the transition of the economy is limited in scope. The outstanding €200bn for European green funds represents just 1.3 % of the total outstanding amounts under asset management in the EU, and the outstanding €100bn for French green and sustainable loans remains modest in relation to needs.

**Annual financing and investment flows in green projects by public finance entity (€bn)**




*Sources and definitions:*
Caisse des Dépôts*: loans granted by the* Banque des Territoires *(BDT) (excluding the €6.8bn for energy-efficient construction not initially provided for in the Climate Plan); equity investments (BDT and Asset Management) provided for in the Climate Plan.* Bpifrance*: green loans, methanation, energy savings, energy environment provided for in the Climate Plan, loans and aid for innovation included in the financing;* Bpifrance*'s own direct investments in partner funds. LBP: green loans and leases; investment in private infrastructure debt by LBPAM. CNP Assurances: listed and unlisted green investments (private equity, property, forestry, infrastructure, debt), excluding subsidiaries.*

Adaptation is not covered by specific provisions or earmarked funding from private finance companies. In the public finance sector, only the *Caisse des Dépôts et Consignations* has a plan to better direct funding towards actions to adapt to climate change: €1.2bn is expected to be deployed between 2023 and 2027. It intends to adapt its plan as the impact of climate risk is identified and measured.

Ultimately, the current situation is not conducive to the clear direction of financial flows towards transition or adaptation projects, and it does not make it possible to connect the actions of the various stakeholders in a convincing manner.

## Levers to increase financing for the transition and adaptation

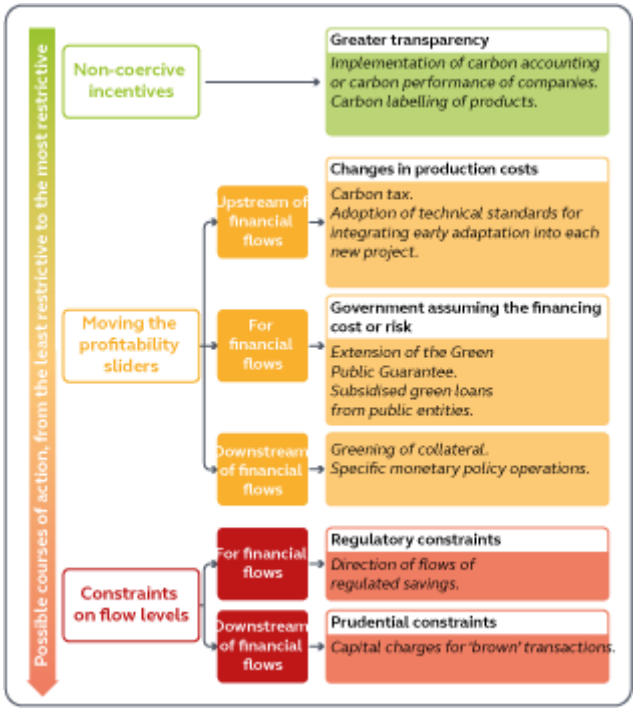
Preventing greenwashing is a key public concern: 76 % of people consider that sustainable finance is a communication argument with no practical implications for the use of their savings[2]. The development of controls on green financial products requires a harmonised legal framework to be defined, the technical difficulties of measuring their environmental impact to be resolved and the fragmentation of the stakeholders involved to be remedied.

The Government and central banks can strengthen incentives through the reputational effect of greater transparency and act more directly on profitability indicators for adaptation projects, as the small number of profitable green projects largely explains the limited level of

[2] FIR-IFOP study on Socially Responsible Investment, 2022 (5th edition).

financing. Other levers can be used, such as specifying the constraints on the use of regulated savings or adjusting the cost of capital to take account of climate risk.

**Possible levers**




*Source: Court of Accounts*

Governance and dialogue between the stakeholders involved in the transition, whether public or private, would benefit from being better structured and taking better account of adaptation issues. No public policy on adaptation encompasses the action of public and private financial players, which hinders the implementation of a coordinated intervention strategy. The National Climate Change Adaptation Plan (PNACC) for 2018 to 2022 included only three actions targeting the financial sector, out of 58, and these were neither followed up nor implemented.

Drawing up a national reference strategy for adaptation, as recommended by the High Council on Climate from 2021, will give financial players a clear view of the changes to come. On 12 July 2023, the Ecological Transition Financing Committee (CFTE) brought together financial and industrial stakeholders, supervisory authorities and the ministry of the economy for the first time to discuss the financing of the transition. However, there is still a great deal of work to be done to assess the public and private financial needs in terms of adaptation, and to break them down by sector by promoting coordination between public and private entities.

# Recommendations

The essential aspects of the framework for action by financial institutions to finance adaptation is defined at European level. However, there are levers available at national level, in respect of which the Court of Accounts makes the following recommendations:

1. make regulations more consistent and easier to understand:

   a. by supporting the revision of the SFDR regulation to include minimum sustainability requirements and align it with the taxonomy;

   b. by establishing a table of correspondence between European and national regulations, which will need to be harmonised when the CSRD directive is transposed *(ministry of the economy, finance and industrial and digital sovereignty*);

2. include in the National Climate Change Adaptation Plan (PNACC 3) estimates of the funding requirements for the proposed adaptation measures *(ministry for ecological transition and territorial cohesion, ministry of the economy, finance and industrial and digital sovereignty, general secretariat for ecological planning*).

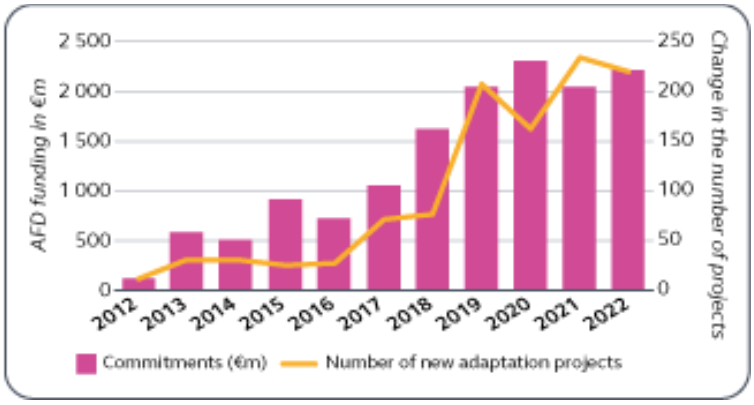
# Development aid and adaptation to climate change: the contribution of the French Development Agency (AFD)

Countries facing development challenges also have high levels of vulnerability to climate change. Funding for developing countries has therefore become both a central development issue and an integral part of international action to adapt to climate change, particularly since the 2015 Paris Agreement. The main donors are increasing their funding in this area and shifting the balance in favour of adaptation policies.

## Adapting to climate change, a mobilisation issue for AFD

To implement its international commitments, France has mainly used its bilateral aid, in particular via the French Development Agency (AFD), which is its main operator. Since 2014, the French government has increased its funding targets in respect of the climate. Its projects funding adaptation have thus risen from €146m in commitments in 2012 to €2.2bn in 2022.

**Change in the number of projects (right-hand scale) and AFD funding (left-hand scale, €m) devoted to adaptation (annual financial flow)**



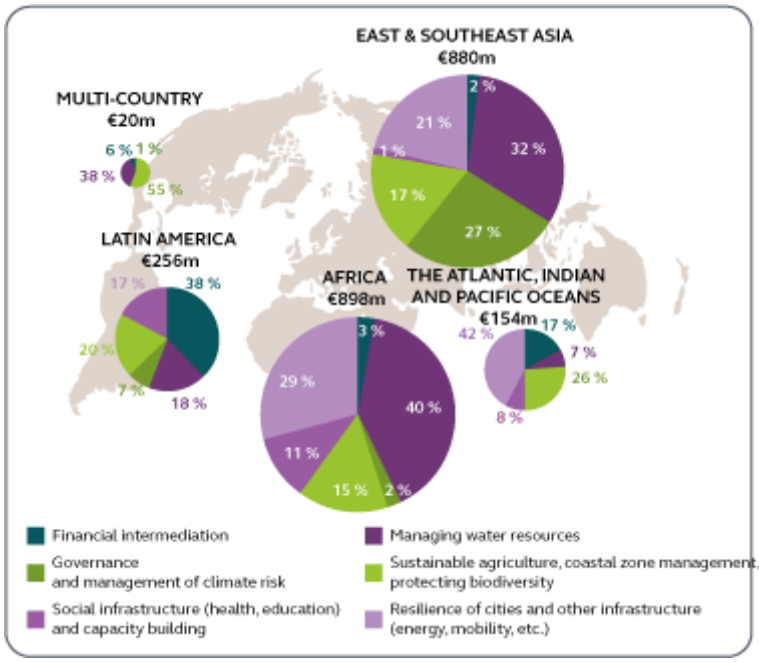

*Source: AFD*

Today, France stands out for its strong relative commitment to climate issues[3]. AFD is contributing to this by helping to structure 'climate finance'[4] at global level through networks of development banks, thereby helping to raise the level of international commitments in this area.

[3] In 2021, it accounted for 18.1 % of climate finance under Official Development Assistance (ODA), and 8.3 % of overall French ODA.

[4] 'Climate finance' represents all the resources mobilised for projects that have an impact on mitigating or adapting to climate change. 'Adaptation finance' only includes resources that contribute to adaptation.

**Thematic and geographic breakdown of AFD's adaptation projects in 2022**




*Financial intermediation means supporting the financial sector, which in turn supports development projects.*
*Source: AFD*

## Proven achievements and limitations to be taken into account in project management

A review of adaptation projects carried out in Morocco and Senegal shows that they have helped to define solutions that reduce people's dependence on external financial, technical or scientific resources. In the Atlas mountains of Morocco, this has led to restoring traditional farming practices, while in Senegal it has involved local people in finding solutions and co-financing the improvements needed to prevent flooding. AFD's action also helps to transform its institutional and economic partners and strengthen their capacity for action.

However, there are certain limitations. Firstly, an adaptation project is always specific to an area. Secondly, unlike mitigation projects, adaptation results are more difficult to measure. Lastly, the partners' demands are still often aimed at short-term economic development rather than sustainable adaptation to climate change, and some deep-seated vulnerabilities cannot be fully addressed by adaptation projects.

## Approaches to be developed and shared

AFD has undertaken several transformations to take adaptation issues into account in all its activities, with the aim of making them all compatible with the Paris Agreement.

The Group is making progress in incorporating adaptation issues into its sectoral and regional strategies, but the progress remains uneven. The tools rolled out since 2014 to integrate the consideration of adaptation issues into project management (‘sustainable development opinion’ and ‘climate screening’) make it possible to build robust advice for most of the projects funded. However, a significant proportion of funding (6 % in 2022) is not yet subject to these measures.

**Rating grid for the ‘resilience’ aspect of the sustainable development opinion**


*Source: Court of Accounts based on AFD data*

AFD is also developing analyses that will enable it to better identify climate-related financial risks for its own activities. They should now be better exploited, as the agency's exposure to climate risk is likely to increase, particularly as a result of the government's recent decision to concentrate its action in the most vulnerable countries.

Finally, AFD should share its expertise on biodiversity and adaptation issues more widely, not only internationally, but also with national stakeholders facing similar issues.

# Recommendations

The Court makes three recommendations:

1. as part of the commitment to increase the funding allocated to ‘adaptation’, increase the funds allocated to grants funding studies prior to adaptation projects (vulnerability studies and feasibility studies), in order to guarantee their quality *(ministry for Europe and foreign affairs, french development agency*);
2. systematically analyse the impact of each financing action in terms of adaptation to climate change, using methods adapted to its specific features *(french development agency*);
3. share experiences more widely both with partners abroad and with French stakeholders faced with comparable adaptation issues, in particular local authorities *(french development agency*).

# Part Two:

# Living environment and infrastructure

1. Adapting housing to climate change
2. Adapting cities to climate change
3. Adapting nuclear and hydroelectric plants to climate change
4. Adapting electricity transmission and distribution networks to climate change
5. Adapting the national rail network to climate change
6. Taking account of adaptation to climate change in the government's property policy
7. The ministry of the armed Forces and the challenges of climate change

# Adapting housing to climate change

Adapting housing to climate change aims to limit the effects of risks linked to the increased frequency and intensity of heat spikes and flooding, and to the acceleration of the phenomenon of shrinkage and swelling of clay soils, which weakens foundations. Recent standards apply to new buildings. Government and local authorities now need to address all of these risks concerning the existing stock, for which priority is currently being given to energy retrofit.

## Energy retrofit is not primarily aimed at adapting homes to climate change

France is strongly committed to a policy of retrofitting its housing stock, with the aim of combatting global warming by reducing energy consumption and greenhouse gas emissions from housing. With €3.1bn in subsidies paid out in 2022, the *MaPrimeRénov'* scheme is the main tool, ahead of the application of the reduced VAT rate of 5.5 %, the reduction in the cost of work through energy saving certificates and the zero-rate eco-loan.

**Change in financial resources allocated to energy-efficient home retrofit, by scheme[5]**

| *In current €bn* | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|
| *EEC (1)* | 0.25 | 0.6 | 0.97 | 1.2 | 2.05 | 3.15 | 3.4 | 1.8 |
| *CIDD / CITE (2)* | 0.87 | 1.7 | 1.7 | 1.95 | 1.13 | 1.08 | 0.31 | 0.10 (p) |
| *Eco-PTZ (3)* | 0.1 | 0.08 | 0.06 | 0.05 | 0.04 | 0.03 | 0.03 | 0.04 (p) |
| *5.5% VAT* | 1.08 | 1.18 | 1.07 | 1.15 | 1.24 | 1.31 | 1.76 | 1.91 |
| *Live better* | 0.52 | 0.42 | 0.5 | 0.53 | 0.76 | 0.6 | - | - |
| *MaPrimeRenov'* | - | - | - | - | - | 0.57 | 2.06 | 3.1 (4) |
| *Local authority aid* | | | | | | 0.02-0.1 | 0.02-0.1 | 0.02-0.1 |
| *TOTAL* | 2.82 | 3.98 | 4.3 | 4.88 | 5.22 | 6.74 | 7.56 | 6.95 |

*Notes: (1) Amounts estimated on the basis of the volumes of EEC (energy efficiency certificates) issued each year and the exchange prices on the secondary market, for the residential and tertiary sectors only, excluding EEC validated for financing programmes, in particular support programmes. (2) The data taken into account is that of the budgetary impact, i.e., in principle, that following the completion of the works. (3) Year of budgetary impact. (4)* MaPrimeRenov' *aid estimated at €2.8bn for 2023. (p) provisional data. Sources:* DGFiP, DHUP, Anah *(key figures for 2017 to 2022), EEC register (Emmy), budget documents, survey of local authorities, Court calculations and estimates*

*MaPrimeRénov'* has met its quantitative targets, which were increased to 700,000 homes a year in 2021, for simple work targeting mainly low-income and very low-income owners of detached houses.

In line with its objective of mitigating climate change, this scheme only partially addresses the risk of heat spikes, which, until 2023, was not taken into account except in the French overseas territories. Ventilation and insulation works, which help improve comfort during the summer months, account for only a quarter of *MaPrimeRénov'* applications, with the remaining three quarters involving changes to heating systems. Comprehensive retrofits, which make a greater contribution to adapting homes than isolated works, account for only 3 % of the surface areas renovated.

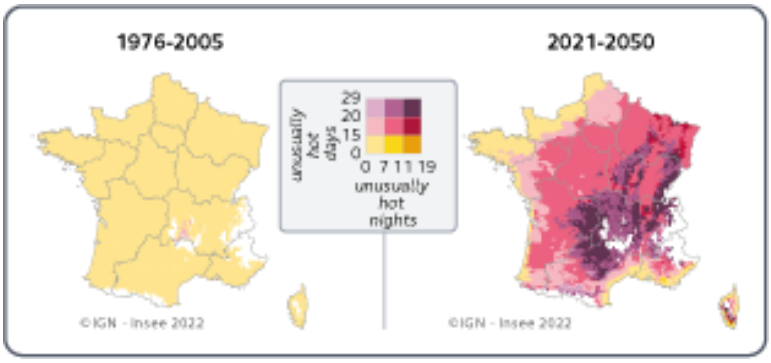
A number of changes have been announced: the government wants to increase the number of comprehensive retrofits to 200,000 in 2024, i.e. a threefold increase compared with 2022, and *MaPrimeRénov'* could include work to help improve comfort during the summer

[5] Court of Accounts, *La rénovation énergétique des bâtiments (Energy retrofit of buildings*), observations to the Prime Minister on 28 July 2022; data updated in 2023 for 2022.

months from 2024. The question of whether flood risk prevention should be included in the scheme remains unresolved.

However, the frequency and intensity of heat spikes, flooding, and the shrinkage and swelling of clay soils are set to increase, affecting a growing proportion of the country. 80 % of the population lives in an area that will be exposed, on average, to more than 16 unusually hot days over the next 30 years[6]. The elderly, children and people in precarious situations will be particularly vulnerable. If homes are not adapted, air conditioning could be used on a massive scale. However, this solution presents all the risks of maladaptation: higher energy bills, increased greenhouse gas emissions and worsening effects of urban heat islands.

**Frequency of unusually hot days and nights for the periods 1976-2005 and 2021-2050**




*Note: grid squares with an average altitude of over 1,000 metres are not considered.*
*Source: Insee, no. 1918, August 2022, Météo France data, Drias 2020*

Shrinkage and swelling of clay soils, which can cause major structural damage, now affects the whole of mainland France, with more than half of all detached houses located in areas at moderate or high risk. The increased risk of flooding particularly affects the western seaboard of mainland France. Recent insurance studies predict a significant increase in losses associated with these two risks over the next thirty years.

## Adapting housing requires a comprehensive approach to the existing stock, involving government and local authorities

New regulations cover the adaptation of new homes at the design and construction stage. The RE 2020 environmental regulation, which has applied to new housing stock since 2022, includes improving comfort during the summer months by reinforcing the requirement expressed in hours of perceived thermal discomfort per year. Preventing the risk of clay soil shrinkage and swelling is covered by rules that have applied to builders since 2020. Lastly, flood risk must be taken into account in town planning documents, which lay down requirements for buildings located in areas at risk of rapid flooding. Recent examples of development projects incorporating the issue of adapting housing also provide information on existing solutions and their consequences, particularly economic.

In the absence of a specific policy, the adaptation of existing housing stock to climate change receives irregular budgetary appropriations. Besides MaPrimeRénov" subsidy for insulation and ventilation work (€1.3bn over the period 2020-2022), the fund for preventing major natural risks was provided with €205m in 2023. However, with €205m available in 2023, this fund is mainly dedicated to the State-region planning contracts and, in the case of housing, to the purchase of properties at immediate risk with a view to their demolition.

The prospective cost of adapting existing homes is not currently quantifiable, due to a lack of technical data and defined objectives. The overall cost of improving comfort during the summer months through the *MaPrimeRénov'* scheme is unknown, in the absence of precise

[6] Insee, no. 1918, August 2022, *Météo France* data, Drias 2020.

knowledge of the need and the parameters selected. Furthermore, the assessment of the funding needed to prevent flooding or the shrinkage and swelling of clay soils is hampered by a lack of technical knowledge, in a context where preventive work could prove more costly than post-disaster intervention. For none of these risks is the general adaptation of all housing to climate change the only or even the most appropriate solution. The range of possible measures extends from low-cost awareness-raising campaigns to change habits in terms of summer comfort, to the radical transformation of the housing stock through new urban planning policies.

Investment in research needs to be stepped up to identify less costly solutions to prevent damage and develop '*solutions with multiple benefits*', which combine the objectives of current retrofit work. Data quality must be improved, and the data shared with stakeholders, particularly local stakeholders, so that they can back up their decisions and adapt solutions to the geographic realities of their areas.

Local authorities have a key role to play through their town planning policies. Adapting housing involves both retrofitting the building and improving the surrounding environment, such as creating cool areas for summer comfort. This requirement will be taken into account all the more quickly if the principles and techniques of adaptation are integrated into the construction, major retrofit and urban renewal operations also carried out by local authorities. To that end, national programmes such as the 'new national urban renewal programme' or '*Action Coeur de Ville*' could be put to better use.

# Recommendations

The Court makes the following recommendations:

4. confirm the inclusion of solar protection processes in the scope of work eligible for support schemes for the energy retrofit of housing *(ministry for ecological transition and territorial cohesion, ministry for the economy, finance and industrial and digital sovereignty*);
5. support and accelerate research and development projects and trials relating to the prevention of flood risk and the risk of shrinkage and swelling of clay soils *(ministry for ecological transition and territorial cohesion*);
6. regularly raise public awareness of the risks to housing posed by heat spikes, flooding and the phenomenon of shrinkage and swelling of clay soils *(ministry for ecological transition and territorial cohesion, Cohesion, Anah, Ademe*).

# Adapting cities to climate change

Climate change is having a major impact on the living conditions of urban populations. In particular, it is leading to an increase in maximum summer temperatures and more frequent heatwaves. Due to their geographic location and the characteristics of their development, some cities are more prone to these changes than others. Paris, which saw a record heatwave of 42.6° C on 25 July 2019, is the European capital most at risk in the event of a heatwave.

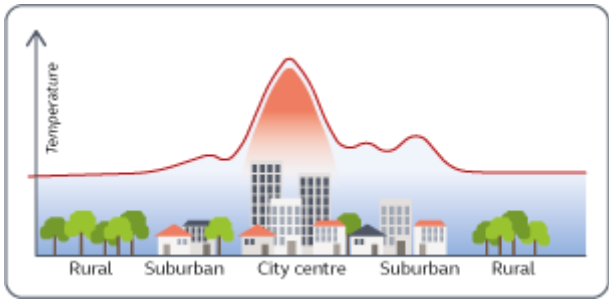
Rising temperatures are not the only consequence of climate change. It is also causing new difficulties in the supply of drinking water and an increased risk of flooding. However, this chapter focuses mainly on the issue of adapting cities to rising temperatures. This phenomenon is the part of climate change that is most visible to the population, and as such plays a key role in the adaptation strategies that are being put in place, particularly through revegetation.

Cities are obliged to adopt an adaptation strategy as part of their local climate-air-energy plans (PCAET), and to take this into account when drawing up their urban planning and development documents. The Court and seven *Regional and Territorial Chambers of Accounts* reviewed the action taken to implement these framework documents. Their review was based on audits of the central administrations of the relevant ministries and 19 cities and groups of municipalities with more than 50,000 inhabitants.

## Adaptation strategies that only partially meet the challenges of climate change

The vulnerability studies on which risk assessments are based are generally inadequate. In particular, exposure to the urban heat island phenomenon has not yet been precisely identified. The guidelines adopted to deal with these issues do not set out any trajectories detailing the various stages required for their implementation and the interactions between the measures they provide for. These trajectories, recommended by the European Commission, would help to facilitate their assessment. Furthermore, despite the fact that they have been mandatory for the last ten years or so, urban inter-municipalities have only belatedly adopted adaptation strategies, and their rollout has not yet been completed throughout the country.

**Structure of urban heat islands**




*Source: Cerema*

There is considerable room for improvement in the way that local plans are coordinated with other planning documents relating to adaptation to climate change. Although they make a major contribution to the implementation of the national plan to adapt to climate change, they are not sufficiently taken into account in the monitoring of its implementation. Their relationship with urban planning and development documents is also problematic. Work on simplifying the relationship between these documents is incomplete and should be continued.

## The continued limited impact on organisations and an incomplete evaluation of the costs

The political and administrative organisation of urban authorities is evolving to take account of climate change and apply the adaptation strategies adopted. The participation of municipalities in their preparation is necessary in view of the powers they exercise, and some cities are voluntarily adopting ‘climate’ plans to supplement them. Failing a rationalisation of local powers, the involvement of municipalities in local planning for adaptation to climate change should be better supervised and generalised. The government's decentralised services and its implementing partners support these initiatives within the framework of the missions assigned to them. However, the increasing number of contracting processes in parallel with the rollout of local climate-air-energy plans does not facilitate the coordination of stakeholders, which if improved would help to strengthen the local cohesion of public action as a whole.

The precise identification of the cost of adaptation is hampered by the lack of evaluation by local authorities of the costs associated with adaptation strategies. However, the available data shows that the amount of expenditure incurred to date remains limited. In addition, the budgetary resources available to support the necessary investments, in particular through the water agencies and the Green Fund, have been insufficiently used up to 2022. Approaches to preparing local ‘green budgets’ are still experimental and do not make it possible to identify the costs of adaptation. The financial issues associated with adapting to climate change also relate to preventing expenditure whose effects are poorly anticipated and would contribute to increasing vulnerability to climate change. To that end, tools such as preliminary climate impact analysis grids are available to identify the risk of ‘maladaptation’, which needs to be prevented by taking into account future climate trends and the availability of water resources now and in the future.

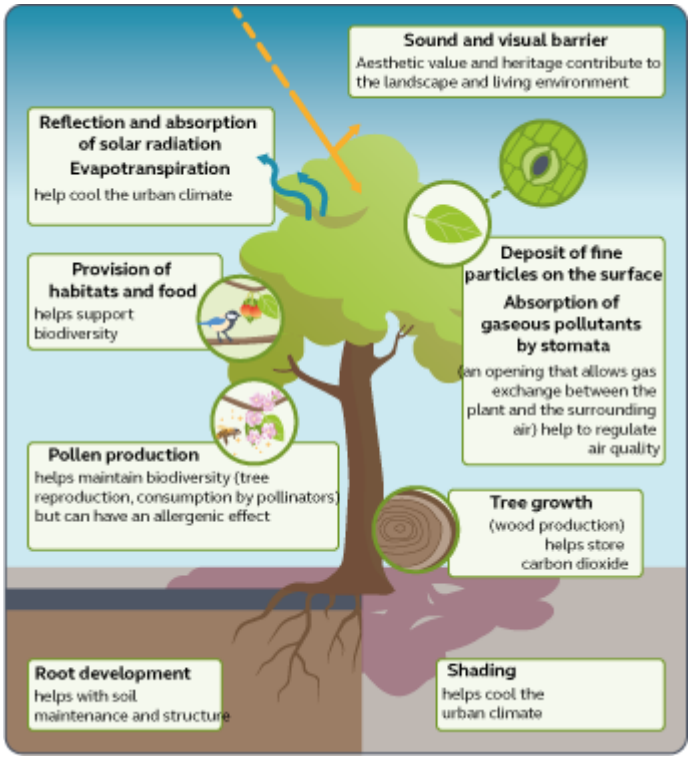
## Revegetation, an emerging solution that needs to be part of a wider trajectory

To limit the effects of heatwaves, urban authorities are adopting greening measures to take advantage of evapotranspiration and the shade created by trees. A review of these measures provides an illustration of the more general findings on adaptation planning.

These ‘no-regrets’ measures are favoured by urban authorities. They may be effective in the long term, but they do not address all the issues associated with heatwaves. They should also be combined with more effective short-term measures.

Effective implementation of greening measures requires the coordination of a large number of stakeholders, including municipalities, who have different objectives. Consideration also needs to be given to the technical and regulatory constraints inherent in the complexity of a dense urban environment. Furthermore, the effectiveness of revegetation to cool cities depends on changes in services and practices in the management of green spaces and nature. These measures are part of a legal framework that is still under development, and their cost is limited. By way of illustration, a 10 % increase in the amount of tree cover in towns and cities by 2050 would represent an investment effort of €360m per year between 2025 and 2035. Such an objective seems sustainable given current spending by municipal groupings in this area and the Green Fund allocation, subject to the joint use of private land.

## The benefits provided by trees in the city




*Source: Cerema, City of Metz Métropole as part of the Ecosystem Services provided by Trees, Modulated according to Essence (SESAME) project*

# Recommendations

The Court makes the following recommendations:

1. streamline the planning documents addressing adaptation to climate change, in particular by improving the link between the national climate change adaptation plan and the adaptation section of local climate-air-energy plans *(ministry for ecological transition and territorial cohesion*);
2. involve municipalities in local planning for adaptation to climate change, by providing for the development of joint strategies at the intermunicipal level *(ministry for ecological transition and territorial cohesion*);
3. effectively implement the obligation for financial programming and monitoring the implementation of expenditure for adaptation to climate change *(public agencies for intermunicipal cooperation subject to the obligation to adopt a PCAET*);
4. include in the common set of local adaptation strategies a plan providing for measures to protect the natural heritage and targets for increasing the surface area of green spaces and tree cover *(ministry for ecological transition and territorial cohesion*).

# Adapting nuclear and hydroelectric plants to climate change

In France, nuclear and hydroelectric plants accounted for up to 89 % of total electricity production from 2014 to 2022[7]. The question of how to adapt them to climate change is therefore a crucial one.

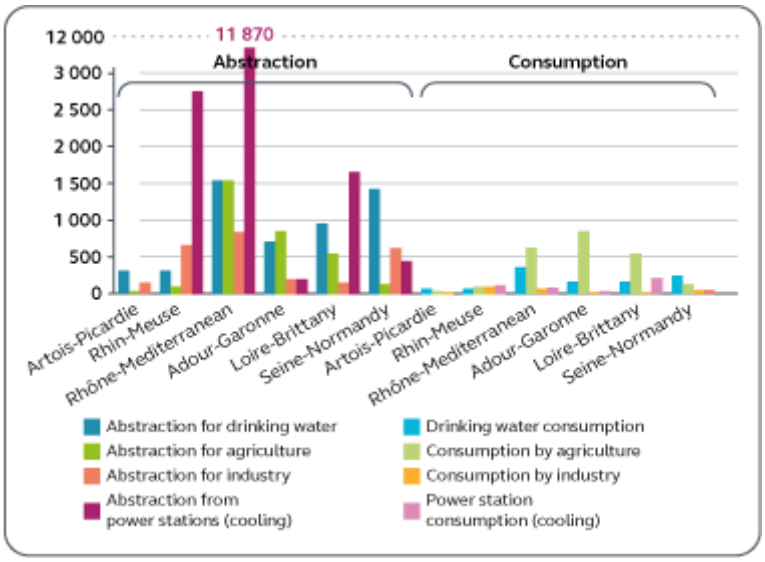
## Climate change puts nuclear and hydroelectric power plants at greater risk

Operators rely on climate modelling from the IPCC or *Météo France* to measure the impact of climate change, particularly on water resources, and to prepare for changes.

Nuclear and hydroelectric power plants are dependent for their operation and safety on water resources, the availability of which is being affected by global warming.

Water consumption by nuclear power plants is the third largest volume of water consumed in France, after agriculture and drinking water, accounting for 12 % of total consumption. Nuclear power plants are subject to site-specific environmental standards for water abstraction and discharge, designed to limit the impact on the aquatic environment downstream and allow water resources to be shared for other uses. These standards, combined with increasingly frequent heatwaves and droughts, can reduce the availability and production of the plant, particularly for heat-sensitive sites by rivers.

**Freshwater abstraction and consumption in mainland France by use and river basin, in millions of m3 average 2012-2018**




*Source: https://www.statistiques.developpement-durable.gouv.fr/leau-en-france-ressource-et-utilisation-synthese-des-connaissances-en-2021*
*Note: in March 2023, the General Commission for Sustainable Development (CGDD/SDES) updated the data on water consumption with the following explanation: "The dataset on estimated freshwater consumption was revised downwards in March 2023 following the availability of detailed water consumption data per nuclear power station. These estimates for consumption by the power stations, transmitted by EDF, showed that the coefficients previously used to estimate power station consumption led to an overestimate of that consumption. This revision modifies the total consumption value and the breakdown of uses accordingly." This graph therefore replaces the one that appeared in the Court's report submitted to the Senate in February 2023.*

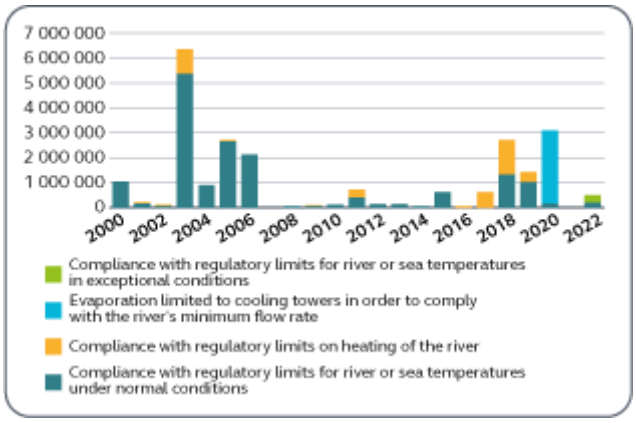
[7] Source: RTE, *Electricity generation in France - Access to RTE data* (rte-france.com). Between 2014 and 2022, hydroelectric generation contributed between 10% and 13 % of total annual electricity production, with nuclear generation accounting for 62 % to 77 %.

Hydroelectric activity is also subject to numerous constraints that affect the operation and production of the plant: environmental provisions, controlled flows, low-water replenishment in order to protect the many other uses of water in various sectors of activity. In the case of cross-border rivers, minimum flows at border crossings can restrict the operation of power stations and hydroelectric facilities and affect electricity production. These constraints are exacerbated by climate change.

*The impact of heatwaves on electricity generation is limited in the short and medium term, but is set to increase*

Annual production losses resulting from climatic changes, particularly heatwaves, remain limited for the nuclear power plants. Until now, with the exception of 2003, they have always been less than 1 % of annual production. However, they are concentrated over a few sites and over short periods, usually during the summer, and can therefore be critical from time to time, increasing the risk of pressure on the network.

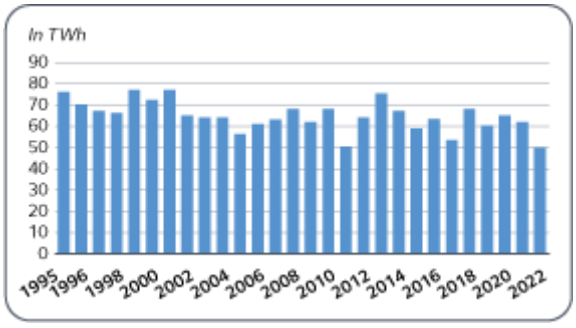
**Production losses (MWh) per year attributed to high temperatures (heatwaves) and low flows (low water)**




*Source: EDF*

Average hydroelectric generating capacity has so far remained fairly stable over the short and medium term. In addition to significant annual variations in production, EDF takes into account multi-year averages over periods of 10 to 20 years to estimate the average production capacity of its facilities: climate change is estimated to have reduced it by an average of 1 TWh between 2012 and 2022. EDF expects this reduction to continue at the same rate over the next twenty years.

**Change in hydroelectric generation since 1995**




*Source: RTE, 2022 electrical power budget*

*Safety guidelines and standards incorporate adaptation to climate change*

The initial designs of the current nuclear power plants and hydroelectric facilities predate the emergence of the concept of climate change. However, the large margins used for their design and resistance to extreme events have made it possible to incorporate climate change.

As far as nuclear power plants are concerned, climatic hazards and climate change have been recognised as key safety factors and incorporated into the requirements imposed by the safety authority.

By determining the respective responsibilities of owners, operators and licensees, the Water Act of 30 December 2006 was the starting point for harmonised and strengthened safety standards and requirements for hydroelectric facilities. These rules take into account assumptions that increase the effects of phenomena, in particular to withstand floods, with safety coefficients for the sizing of structures and their equipment.

## Operators have taken climate change into account, but still need to step up their adaptation action

*The organisation of the adaptation process is gradually being rolled out, but the cost of adaptation is still insufficiently measured*

For several years now, EDF has been stepping up its climate research and, as of 2014, set up a climate department recognised by the scientific community. The Group's main entities, in particular those responsible for nuclear and hydroelectric generation, have adopted climate change adaptation plans. The management of both nuclear and hydroelectric power plants is coordinated and optimised.

Identifying the investment and operating expenditure specifically attributed to measures to adapt to climate change remains difficult for both *Compagnie Nationale du Rhône* (CNR) and EDF. For nuclear power plants, the implementation of the adaptation plan in 2021 has made it possible to assess certain expenditure. The estimated cost in terms of investment is €1bn for the period 2006-2021 and around €600m for the next fifteen years. However, these estimates need to be supplemented and refined.

*The intensification of climatic constraints means that both government and operators need a better understanding of water constraints*

In particular, it is necessary to know how river flows will change in a few years' time, something that current climate forecasts can only predict in the long term. For nuclear power plants, it is also a question of consolidating and updating the scientific bases justifying the regulatory limits on thermal discharges, setting the values of which will be all the more sensitive as the number of hot spells increases.

EDF will also have to develop research into and the implementation of water-efficient cooling systems to limit the consumption of nuclear power plants and biocidal treatment systems that reduce the amount of chemical reagents discharged into the natural environment.

*Adaptation to climate change is a determining factor for nuclear power development projects and their location, and may justify certain hydroelectric development projects*

The new reactors, which will operate until 2100 or even beyond, will be confronted with climatic hazards on a different scale to those of the next twenty to thirty years. These developments justify the operator exploring, from the design stage onwards, new ways of ensuring the safety of infrastructures and their operation while optimising production in terms of water management, and planning the location of new reactors according to, among other criteria, climate-related constraints.

Climate issues are one of the factors determining the installation of new EPR. EDF has assessed the possibility of installing the first three pairs of EPR2 reactors on existing nuclear sites. The choice of location for the planned four additional reactor pairs will have to be carefully considered during the pre-feasibility studies.

The flexibility of hydroelectric generation is an asset that encourages the search for ways to develop it. EDF's aim is to improve the performance of hydroelectricity through preventive maintenance and optimising its facilities. Projects to raise dams and develop pumped-storage

power stations are also envisaged. However, they are now at a standstill, in particular because of the difficulties encountered in extending the duration of the concessions concerned by these investments.

# Recommendations

As a result of its recent work, the Court has already had occasion to make four recommendations[8]. The elements presented above lead it to add four more:

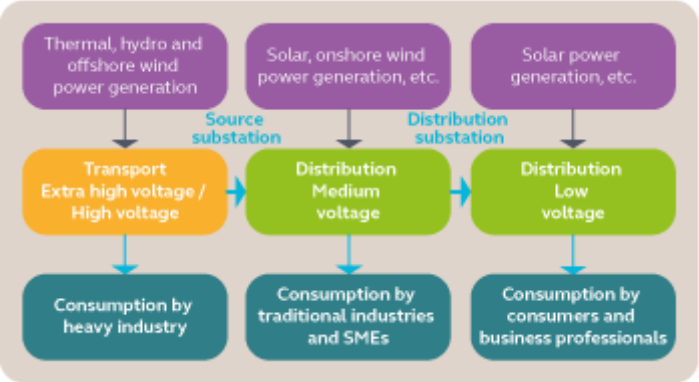
1. improve the reliability of measurements of water abstraction and consumption by nuclear power plants *(ministry of the economy, finance and industrial and digital sovereignty, ministry for ecological transition and territorial cohesion, Nuclear Safety Authority, EDF, 2024*);
2. identify and calculate the costs of adapting nuclear and hydroelectric generation to climate change, both in terms of operation and investment *(EDF, CNR, 2024*);
3. measure and publish the impact of water stress on nuclear power plants located by rivers or estuaries and, if necessary, adapt their storage capacities before discharging liquid effluents *(ministry of the economy, finance and industrial and digital sovereignty, ministry for ecological transition and territorial cohesion, Nuclear Safety Authority, EDF, 2024*);
4. formalise a common approach to adapting to climate change for new nuclear power, integrated and broken down by site *(ministry of the economy, finance and industrial and digital sovereignty, Nuclear Safety Authority, Institute for Radiation Protection and Nuclear Safety, EDF, 2024*).

[8] In observations dated 2 December 2022 on the renewal of hydroelectric concessions, and in its March 2023 communication to the Senate Finance Committee on adapting nuclear reactors to climate change.

# Adapting electricity transmission and distribution networks to climate change

Electricity transmission and distribution are two of the four main activities of the electricity industry, alongside upstream generation and downstream sales to end consumers.

**Simplified presentation of the electricity system**




*Source: Court of Accounts*

The electricity transmission network comprises almost 106,000 km of extra-high-voltage (225 and 400 kV) and high-voltage (63 kV, 90 kV and 150 kV) lines used to transmit electricity over long distances. The distribution network is much more extensive: over 1.4 million kilometres. It is made up of medium-voltage (10 to 30 kV) and low-voltage (230 or 400 volts) lines.

*Réseau de transport d'électricité* (RTE) is the sole operator of the transmission network, while there are 114 distribution network operators. There are six operators in France serving more than 100,000 customers, of which Enedis is the main one, serving 95 % of the country.

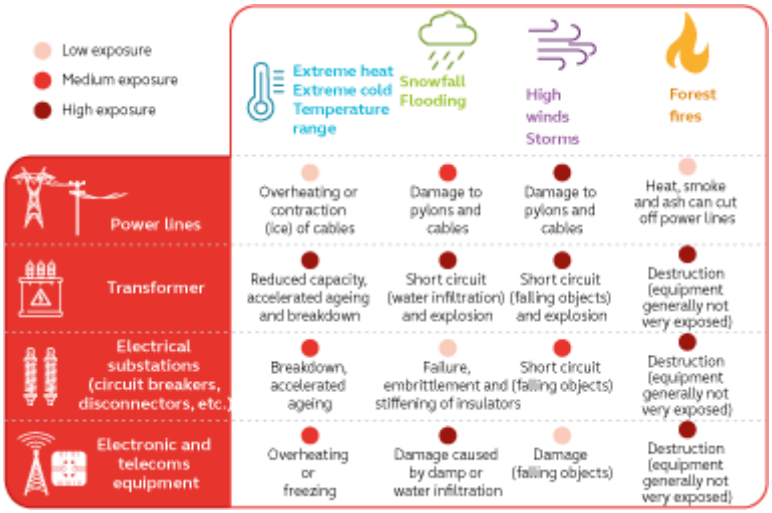
## Increased risks and identified vulnerabilities

*Climate change is exposing the electricity grid to greater risks, which vary depending on the nature of the structures involved*

The electricity grid, which is made up of a large number of lines spread throughout the country, is simultaneously exposed to various climatic hazards and highly resilient. Nevertheless, climate change is leading to changes in the intensity and frequency of extreme events.

The electricity grid is traditionally exposed to storms and strong winds, which cause pylons to fall, either directly or as a result of falling trees. An excess of ice and sticking snow can also weigh down lines to the point of breaking them.

**Exposure of various electricity network facilities to climatic risks**




*Source: Carbone 4*

The climate models do not show any significant foreseeable changes in storms in France. With regard to frost and sticking snow, they predict a reduction in the number of days of exposure to this type of extreme event. On the other hand, episodes of extreme heat and flooding, which are more frequent in the context of climate change, are liable to affect the electricity grid. The former can damage cables, including underground cables, but above all reduce electricity transmission capacity. Flooding, particularly as a result of torrential rain, can damage underground substations and lead to power cuts extending beyond the flooded areas.

*The storms of 1999 revealed the vulnerability of the grid and led to the first adaptation measures*

The storms of 1999 revealed not only structural faults in the electricity grid, but also the limits of operators' capability to restore power. The development of monitoring tools, such as communicating sensors, has enabled operators to gain a better understanding of their networks and identify their vulnerability to climatic hazards.

The network operators then took the first adaptation steps, which focused on resilience in the face of storms and strong winds. RTE has set up a safety programme to reinforce the foundations of pylons and prevent cascading falls. Distribution network operators have concentrated their efforts on the overhead network and the eradication of technologies identified as the cause of most faults, such as bare wires.

Adaptation measures have gradually been extended to other risks. For example, the heatwave in 2003 highlighted the failure of certain underground cables, leading operators to implement programmes to replace entire sections.

## Adaptation measures to be strengthened

*Adaptation plans have been put in place in response to climatic events*

The Enedis ‘climate hazards’ plan, implemented from 2006 onwards, focuses in particular on strengthening the resilience of the overhead medium-voltage network. RTE, for its part, initially focused its efforts on reinforcing structures to cope with the risks associated with storms, before a recent programme (2019) focused on the increased frequency of heatwaves and preventing flood risk.

Installing lines underground was the main action taken by network operators to improve infrastructure resilience. It is substantially more expensive in terms of investment. In the network development plan (SDDR) published in 2019, RTE estimated that 40 % of the additional cost would be incurred by systematically undergrounding new 63 to 225 kV lines,

i.e. between €750m and €1.5bn, depending on the scenario, between 2021 and 2035. Enedis, for its part, estimates that completely undergrounding its networks would cost €170bn in investment, 60 % of which would be for the low-voltage network.

Distribution network operators have gradually phased out the most accident-prone technologies, such as lines with bare copper conductors, known as ‘bare wires’, or the insulation system used for certain underground cables, in particular those insulated with impregnated paper, which were laid in urban areas until the late 1970s. Similarly, following the flooding of the Seine in 2016, RTE and Enedis jointly drew up a map of electricity networks in flood-prone areas of the *Île-de-France region*.

*These plans must be accompanied by greater coordination between the stakeholders involved and a formalisation of government’s objectives with regard to operators*

The growing interdependence of networks (electricity, gas, transport, water, telecommunications, etc.) makes it essential to coordinate the various operators. In the case of the electricity transmission network, this coordination also comes under European level. As far as the distribution network is concerned, the challenges of adaptation are essentially national, if not local. Cooperation between the various stakeholders and Enedis' role as a facilitator are essential if climate scenarios are to be applied at local level and a shared vision of network infrastructure defined for the medium and long term.

Government must play a more active role in this context, particularly through the public service contracts signed with operators. The contract signed with RTE currently focuses on the issues of the energy transition and makes too little mention of climate adaptation issues. The situation with Enedis is more unsatisfactory, since despite the Court's repeated recommendations, no public service contract has yet been signed, even though this is a legal obligation.

*The financial consequences of measures to adapt to climate change need to be better identified and incorporated into network operators' investment programmes*

Expenditure on measures to adapt to climate change is difficult for network operators to identify. Most of this expenditure serves several purposes, making it difficult to allocate. According to the information available, the cost of future adaptation expenditure is currently estimated at around €1.5bn for RTE (between 2020 and 2050) and €15.5bn for Enedis (between now and 2040). Operators will have to work harder to identify and more accurately calculate all of this expenditure, both operating and investment.

Network operators are anticipating a sharp increase in their investment, particularly due to the development of renewable energies, which is transforming the traditional architecture of networks and leading to significant connection costs. In addition, there is the cost of renewing equipment as a result of ageing networks. Network operators must take advantage of these future investments to increase their resilience and incorporate climate issues.

The timeframes used by the two main network operators in their prospective studies do not go beyond 2050.

Enedis' investment plans are even limited to 2040. However, electricity grid equipment has an average lifespan of 50 years, with some structures having a lifespan of more than 70 years. Adaptation measures will therefore need to be supplemented with longer-term analyses that take into account the impact of the future climate.

# Recommendations

In the light of these findings, the Court makes the following recommendations:

1. amend the Order of 17 May 2001 determining the technical conditions to be met by electricity distributors in order to take account of the changing risks associated with climate change *(ministry of the economy, finance and industrial and digital sovereignty*);
2. include climate change adaptation objectives in the public service contracts signed between government and network operators (already in place for RTE, to be drawn up for Enedis) *(ministry of the economy, finance and industrial and digital sovereignty, RTE and Enedis, 2024*);
3. immediately publish the implementing decree provided for in Article L.322-11 of the French Energy Code to enable the distribution network operators concerned to draw up network development plans (PDR) in consultation with stakeholders *(ministry of the economy, finance and industrial and digital sovereignty*);
4. identify and calculate the costs of adapting electricity transmission and distribution networks to climate change, in terms of operation and investment *(RTE, Enedis 2024*).

# Adapting the national rail network to climate change

The national rail network, made up of some 27,000 km of lines and 3,000 passenger stations, is structurally vulnerable to severe weather events. The trends emerging from climate forecasting models point to an increase in the frequency and intensity of these events. Under these conditions, defining a relevant adaptation strategy requires a better understanding of the operational and financial consequences of climate change. It also requires the implementation of a structured approach, overseen by government.

## The operational and financial consequences are still poorly understood

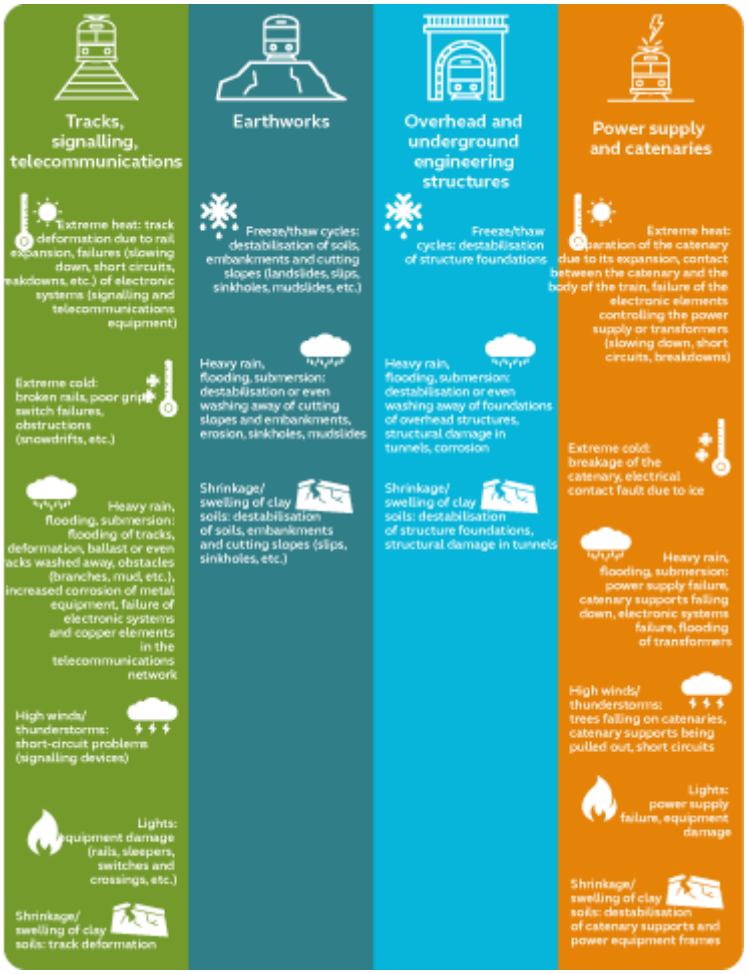
Railway infrastructure is made up of many components, from tracks to catenaries, earthworks, engineering structures and passenger stations. These different elements each present specific vulnerabilities to extreme weather events.

With the exception of the high-speed lines, the network has age-related weaknesses such as less demanding building standards than today, more lines particularly exposed to the risk of flooding and outdated technology. In addition, the dilapidated state of some of its components, such as the tracks and the copper telecommunications network, increases their vulnerability to weather-related hazards.

The two SNCF entities concerned, *SNCF Réseau* and *SNCF Gares et connexions*, have undertaken studies to assess changes in these vulnerabilities with regard to both climate change scenarios set out in the IPCC's 5th report for the timeframes 2030-2050 and 2080-2100[9]. They show an increase in the proportion of the network exposed to high levels of risk, in particular that linked to extreme heat, shrink-swell of clay soils and flooding. Both companies now need to develop tools that will enable them to base their maintenance and investment decisions on predictive analyses that take climate change effects into account.

[9] RCP 4.5 and RCP 8.5 scenarios (see introductory chapter).

**Network's physical vulnerability to climatic hazards encountered**




*Source: Court of Accounts, based on* SNCF Réseau *data*

In operational and financial terms, climate change will lead to a deterioration in network reliability, loss of revenue and higher operating and investment costs. These consequences are still poorly understood, even though analysing them is a prerequisite for defining an adaptation strategy.

Weather-related hazards are already causing thousands of incidents, ranging from delays of just a few minutes to track closures for repairs. In 2022, they accounted for 19 % of the minutes of delay attributable to *SNCF Réseau*. These disruptions could be multiplied by at least 2.2 or even 2.4 by 2050 and by 8 or even 11 by 2100 according to both scenarios mentioned above.

Only exceptional events give rise to specific monitoring of the additional costs incurred. Between 2009 and 2021, they amounted to €38m for *SNCF Réseau*. Added to this is the loss of revenue for transport operators and the valuation of time lost by end users.

## The need for a structured strategic approach to adaptation, overseen by government

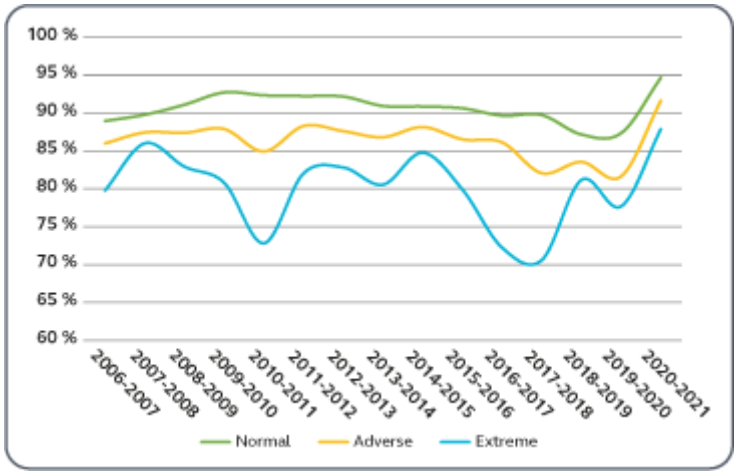
In the absence of general directives from Government, the day-to-day management of the rail network in the face of weather-related hazards relies solely on the initiative of network operators. It is guided primarily by safety requirements, but also by the need to protect the infrastructure and rolling stock. It is based on constant technical adjustments made on the basis of feedback. This ongoing adaptation will improve the resilience of the network, but it does not take into account the anticipated effects of climate change.

The same applies to decisions to modernise or renew infrastructure components. Replacing the most obsolete elements will certainly help to make the system more resilient to climatic hazards, but the volume of work involved needs to be measured against climate change forecasts. However, the standards applicable to network components, whether internal to the operators or derived from European standards, do not take account of the future climate. Even when they can be considered robust, their resilience has not been examined to date. Nor is there any analysis framework defined by the public authorities specifying the degree of resilience to climate change that new infrastructure projects should achieve. This assessment therefore remains at the discretion of the project owner.

The development of a target vision for adapting the rail network to climate change, shared by the various stakeholders (authorities organising transport, infrastructure operators, users), would appear to be necessary in order to set the adaptation process in motion and focus investment on priority actions. In particular, the expected level of network availability needs to be determined on the basis of the intensity and frequency of the hazards encountered, in line with the modal shift targets set by the public authorities.

The performance of the network could thus be assessed by means of an indicator differentiated according to the degree of severity of the meteorological phenomena, like the one developed by Network Rail in the United Kingdom.

**Performance level of the rail network in the United Kingdom according to the intensity of the climatic hazards encountered**




*Source: Network Rail*
*Note: the green curve corresponds to normal weather conditions, the orange curve to unfavourable weather conditions and the blue curve to extreme conditions.*

On an operational level, several structural obstacles to the rollout of an adaptation policy can be identified within *SNCF Réseau* and *SNCF Gares et Connexions*. These include their dependence on the expertise of consultancy firms to carry out vulnerability studies, the limited awareness among operational players of climate change issues and, above all, the lack of a specific organisation responsible for formalising the adaptation strategy and translating it into action plans.

These action plans would be incorporated into the performance contracts signed by these operators with government and subject to regular review, which should provide an opportunity to look more closely at the risks that are currently poorly understood at the level of a single operator, such as those arising from interdependencies between networks. Linking the infrastructure adaptation plans to the performance contracts would also ensure that the cost of adaptation investment is taken into account in the allocated financial envelopes.

In addition, network operators need to identify adaptation measures that can be rapidly incorporated into current renewal programmes. For example, the question of raising the rail

destressing temperature, which is set at 25° C as standard throughout the rail network, could be asked during all track renewal operations in the regions most exposed to extreme heat.

# Recommendations

The Court therefore makes the following recommendations:

1. identify and calculate the costs of adapting the rail network and stations to climate change, in terms of operation and investment *(*SNCF Réseau*,* SNCF Gares et connexions*, 2026*);
2. incorporate the latest climate change forecasts into national standards and guidelines for the design of rail network components and stations and regularly adjust design margins accordingly *(*SNCF Réseau*,* SNCF Gares et connexions*, ministry for ecological transition and territorial cohesion, 2024*);
3. for transport infrastructure development projects, supplement the reference framework for socio-economic analyses with an analysis of resilience to climate change *(, ministry for ecological transition and territorial cohesion, 2025*);
4. define a climate change adaptation plan included in the targets and performance contract, based on an impact study, budgeting and organised monitoring *(*SNCF Réseau*,* SNCF Gares et connexions*, ministry for ecological transition and territorial cohesion, 2025*).

# Taking into account adaptation to climate change in the government's property policy

Adapting the State's property portfolio to climate change is a critical issue for the government, given its size and the inadequate knowledge of its characteristics. The fact is that, until now, this issue has not been taken into account in governmental investments, whether made or planned.

## The State's extensive property portfolio is largely ill-adapted to climate risks

The State owns a very extensive property portfolio, comprising 192,000 buildings with a total surface area of 94.4 million m². It is highly diversified including office space, housing, universities, museums, prisons, law courts, etc.

**The State's property portfolio by function**

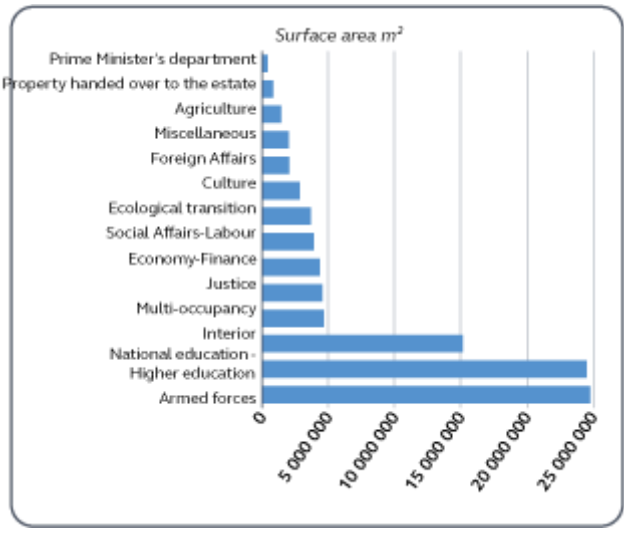
| ***Type of building*** | **Number of buildings** | **Surface area ($m^2$)** |
|---|---|---|
| *Office space* | 20,521 | 22,862,303 |
| *Education or sports buildings* | 10,290 | 20,139,079 |
| *Technical buildings* | 45,536 | 19,335,774 |
| *Housing* | 48,660 | 18,157,011 |
| *Health and social care buildings* | 7,269 | 9,195,318 |
| *Cultural buildings* | 1,462 | 3,279,356 |
| *Agricultural or livestock buildings* | 1,924 | 629,974 |
| *Engineering structures, road networks* | 15,459 | 470,699 |
| *Places of worship* | 320 | 375,823 |
| *Monuments and memorials* | 1,040 | 360,817 |
| *Other* | 40,197 | 291,859 |
| ***Total*** | **192,278** | **95,098,014** |

*Source: Infocentre France Domaine – Property inventory – Retrieved on 28/04/2023*

These premises and their users are exposed to a wide range of climatic risks, including extreme temperatures, storms, flooding, rising sea levels and geological disturbances. They differ according to their location, with a high prevalence in the southern and overseas areas, accounting for almost a third of premises.

The state of maintenance of these buildings and the characteristics of each of them are still insufficiently documented. The specific tools implemented by the Government's Property Department need to be supplemented and enhanced with vulnerability data associated with the climatic risks incurred. This information is indispensable if adaptation to climate change is to be taken into account in the ministries multi-year property strategy plans (SPSI) and regional property master plans (SDIR).

**The State's property portfolio by ministry**




*Source: Infocentre France Domaine – Property inventory – Retrieved on 28/04/2023*

## Adapting to climate change, a blind spot in the government's property policy

Until now, the Government's property policies and associated funding (notably the "major investment plan" and "recovery plan"") have given priority to mitigating global warming by reducing greenhouse gas emissions and energy costs. Taking account of the construction and public works needed to adapt to climate change consequences, remains a blind spot in the government's property policy. The PNACC 3 plan currently being prepared should correct this, in the context of the new climate scenario to be opted for by government.

The same is true of the PNACC 2 (2018-2022), which included only two measures, out of 471, contributing to adaptation. One of them concerned the implementation of the RE 2020 environmental regulation, which aims to guarantee comfort in hot weather but only applies to new buildings, i.e. an average of 2-3 % per year of the State's total property portfolio.

The same is also true of the forecasted costs of property investment needs, estimated by a working group of the general secretariat for ecological planning at the end of 2022 at between €142.2bn and €146bn from now to 2051, which do not include climate change adaptation costs.

## The urgent need to incorporate adaptation into the government's property strategy

Given the recurrence of extreme climatic events, it is becoming urgent to incorporate global warming adaptation measures into the objectives for transforming the State's property portfolio. This aspect should be included into the guidelines set out in the future French strategy on energy and climate and its various components (the national low-carbon strategy, the national climate change adaptation plan and the multi-year energy programme). It should also be operationalized in national and decentralised ministerial strategies. The priorities, timetable and financial trajectory will have to be specified.

In order to achieve this, rapid work is required to ensure that the repositories and technical information on State buildings are complete and reliable in terms of their vulnerability to climate change.

State buildings must also comply with the various climate change regulations, including the 2018 European Directive on the energy performance of buildings, the so called 'tertiary' decree of 23 July 2019 and the RE 2020 environmental regulation, as well as the Law of 22

August 2021[10], known as the ‘Climate and Resilience’ law, which requires all landlords, including the State, to provide their tenants with decent properties that meet minimum energy performance criteria. These regulatory obligations, which focus on mitigation, will have to be supplemented to take specific account of adaptation to climate change, in line with the recommendations of the international benchmarking report on climate change adaptation policies published by the Inspectorate General for the Environment and Sustainable Development in December 2022.

The adaptation dimension will also have to be integrated into the financial trajectories for property investment, taking into account the budgetary sustainability of the Government's property strategy.

Lastly, the adaptation strategy requires a partnership and participatory approach with local authorities, which own large property portfolios, and those who utilize State buildings, whether they are users or employees.

[10] Law no. 2021-1104 of 22 August 2021 on combatting climate change and building resilience to its effects.

# Recommendations

Following these findings, the Court makes the following recommendations:

1. incorporate the adaptation objective into the government's property policy, specifying priorities, a timetable and a financial trajectory including the necessary additional funding *(ministry of the economy, finance and industrial and digital sovereignty, general secretariat for ecological planning*);
2. complete the reliability of the technical reference framework for State property and supplement this information with data on building components *(ministry of the economy, finance and industrial and digital sovereignty*).

# The ministry of the armed forces and the challenges of climate change

The ministry of the armed forces holds a special position within the State in terms of its ability to help combat global warming or adapt to it. Operational activity, which is at the heart of the armed forces' mission, is inextricably linked to the use of a considerable fleet of land vehicles, most of which are highly motorised. The primacy of these operational requirements means that the armed forces benefit from exemptions, both at national level and at European and international level, regarding their participation in the general policy to combat global warming.

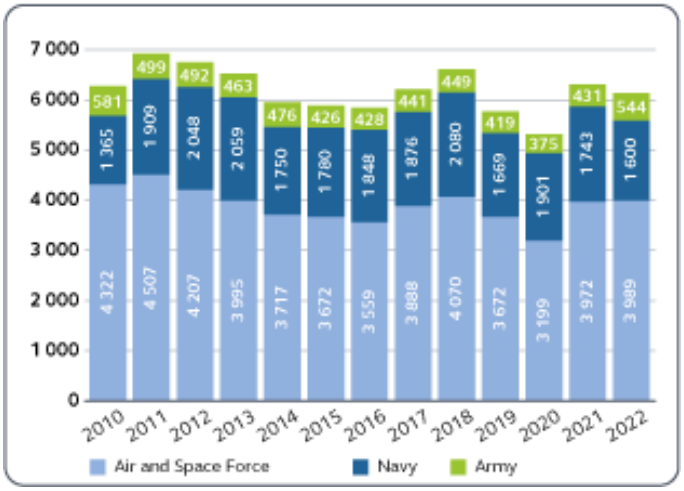
## Due to its operational constraints, the ministry of the armed forces will experience slow change in the motorisation of military equipment and a limited reduction in its greenhouse gas emissions

The energy consumption of the ministry of the armed forces is particularly high, due to the size of its fleet of military equipment (armoured and non-armoured land vehicles, aircraft and ships), its building infrastructure (which accounts for a quarter of the total useful floor area occupied by the State) and its workforce.

The mobility of the armed forces is an essential factor in their operational effectiveness. It requires power levels that alternative motors cannot and will not be able to offer in the medium term as a replacement for combustion engines. However, since energy autonomy is a condition for the operational performance of the armed forces, they take care to optimise fuel consumption right from the design stage of their equipment (vehicles, aircraft and ships).

As a result, the armed forces have not considered it necessary to take further steps to reduce their consumption of fossil fuels, which has not decreased over the last ten years. Given the key role played by defence in the overall energy consumption of the ministry of the armed forces, it is likely that the decarbonisation trajectory of the defence sector will continue to lag behind that of the civilian sector for some time to come.

**Energy consumption by the armed forces 2012-2022 (GWh)**

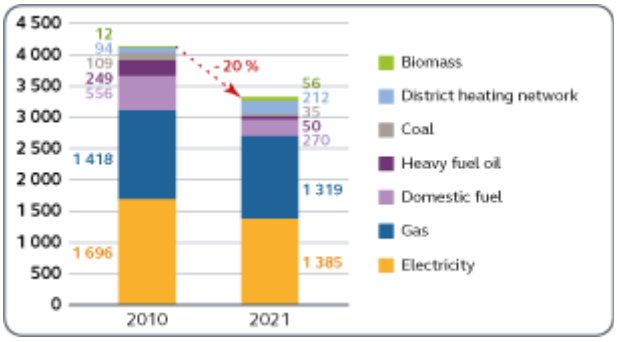



*Source: Court of Accounts, based on data from the ministry of the armed forces*
*Note: consumption billed by the Operational Energy Service (SEO).*

The only notable change is that, as in the civil aviation sector, the armed forces will be incorporating biofuel into aviation fuel, albeit to a limited extent (5 % by 2030). Since, under the ‘single fuel’ policy, most land army vehicles run on aviation fuel, their energy consumption will essentially follow the same decarbonisation trajectory as the aviation sector.

The ministry of the armed forces has made progress in reducing the consumption of fossil fuels in the operation of its buildings. However, this is mainly due to the reduction in the size of the armed forces rather than to the reduction in the nominal consumption of buildings. Future progress can therefore only be achieved through efforts requiring more specific measures.

**Change in energy consumption (GWh) for the ministry's infrastructure between 2010 and 2021**




*Source: Court of Accounts, based on data from the ministry of the armed forces*

## Identification of the necessary adaptations to climate change has barely begun

As part of its 'Climate & Defence' strategy, adopted in 2022, the ministry of the armed forces has begun work to identify the necessary adaptations to climate change, focusing on three themes:

- changes in the nature of conflict and the use of force as a result of climate change: conflicts over access to resources, the dynamics of migratory movements, the geostrategic impact of opening up new shipping lanes in the Arctic as a result of melting ice, etc.;

- capability and innovation: the aim is to identify, by environment (land, sea, air), all the effects and risks associated with climate change on weapon systems (in terms of use, support, etc.);

- infrastructure resilience, with the aim of proposing a plan to adapt to the effects of climate change by 2030 (rising sea levels, storms, torrential flooding, rising temperatures, water stress, etc.).

In addition, two specific topics are covered by other initiatives. Firstly, there is the issue of securing the onshore facilities required by nuclear-powered ships (aircraft carriers and submarines). Adaptations are underway following the Fukushima accident, which led the ministry of the armed forces to modify its safety standards by updating the climatic data to be taken into account. The second is the contribution of the armed forces to protecting the national territory and strengthening the protection of the overseas territories, which involves, in particular, the continuous adaptation of their response missions in the event of natural, health or climatic disasters, but also improving their links with the internal security forces, which should be encouraged by setting up regional reserves.

The slow pace of the decarbonisation of the armed forces' operational activities is liable to have two consequences. Firstly, the retention of combustion engines will lead to a divergence between the technologies used for defence and those used in the civilian sector. This is expected to result in an increase in the cost of equipment, since it will more often be specific to the armed forces. There is also a risk that this trajectory will make the armed forces appear less than 'virtuous' when it comes to climate issues. This possible deterioration in their image, on a subject to which young people are currently very sensitive, could be detrimental to the attractiveness of the defence sector and make recruitment more difficult in all the fields concerned. The identification of both these risks should prompt the ministry of the armed forces to consider the adaptation measures that could be taken to counter their potentially damaging effects.

# Recommendations

In view of the above, the Court makes the following recommendations:

1. quantify the contribution of each action in the ministerial energy performance strategy to achieving the target objectives and update the forecast trajectories annually *(ministry of the armed forces*);
2. establish the 'carbon footprint' of all services of the Ministry of the Armed Forces, including carbon sequestration, and update it as often as is required by law *(ministry of the armed forces*);
3. advance the work on optimising energy consumption for operational mobility, in particular by making better use of available data and improving the collection of relevant data *(ministry of the armed forces*);
4. speed up the process of identifying adaptations to climate change that the armed forces will have to implement *(ministry of the armed forces*).

# Part Three:

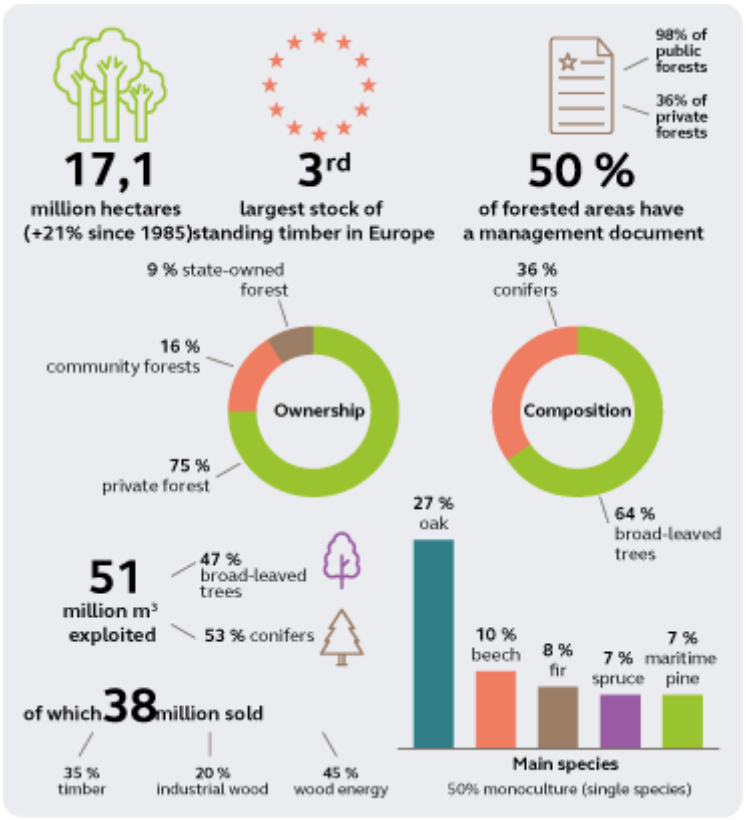
# The natural environment, people and activities

1. Sustainable management of mainland France’s forests: adapting to climate change
2. Coastline management in times of climate change
3. Preventing climate-related natural disasters in overseas France
4. Protecting the health of vulnerable people during heatwaves
5. Adapting cereal crops to climate change
6. Mountain resorts and climate change

# Sustainable management of mainland France's forests: adapting to climate change

Following uninterrupted growth in forest cover since the 19th century, the forest has been suffering the consequences of climate change for some years now, in particular the excess mortality of certain species. This destruction has consequences both for the environment by weakening the forest's role in carbon sequestration, threatening biodiversity and transforming landscapes, and for the sector's economy. These changes are having a major impact on society as a whole, with tens of thousands of hectares destroyed by fire or dieback.

**A snapshot of mainland France's forests**




Source: Court of Accounts, based on data from the National Forest Inventory (IFN), IGN 2022

## The intensification and acceleration of the effects of climate change on all mountain ranges

The consequences of climate change on forest stands have been observed for several years. However, all stakeholders involved have been surprised by the intensification and acceleration of these effects over the last five years, with the succession of heatwaves and droughts. Many forest species are increasingly unsuited to their environment, as the speed of climate change means that they can no longer adapt naturally as they did in the past. A range of species across the country will be affected, irreversibly transforming forest landscapes. Moreover, the mountain ranges are increasingly vulnerable to forest fires.

Faced with this situation, those involved in forestry are confronted with uncertainties about the measures to be implemented to adapt their forests. With resources which are still inadequate, forestry research is struggling to overcome these uncertainties due to the lack of effective communication of knowledge in the field.

Some owners, particularly in eastern mountain ranges, are also financially vulnerable. Forest communities in particular, which account for almost 20 % of wood sales in France, saw their forestry revenues fall sharply before recording further increases in 2021 and 2022. However, this reflects a deterioration in the profitability of their forestry assets (large volumes of decayed wood sold at low prices) as well as a marked reduction in their forest estate, pointing to a significant loss of revenue in the future. These difficulties have a direct impact on the implementation of adaptation measures, with municipalities reducing their level of investment in forestry. Many of them are financially unable to rebuild their destroyed plots.

### Recent adaptation measures face implementation difficulties

As a matter of urgency, the government reacted by announcing measures to adapt to the situation, in terms of forest renewal and strengthening forest firefighting resources. However, the implementation of these measures, which stem from the ministerial 'roadmap' (2020), the forest and wood conference (2022) and the Law of 10 July 2023 aimed at strengthening the prevention and combatting the intensification and spread of fire risk, is coming up against structural difficulties.

The adaptation measures financed by the recovery plan mainly concern aid for forest renewal, the level of which (€210m for 2021-2022 and then €145m for 2023-2024) remains limited in view of the destruction caused by dieback or fire. Furthermore, these measures have been insufficiently focused on adaptation. The future national scheme announced by government to "*plant a billion trees in 10 years*" should therefore focus funding more strongly on this issue.

The 'forest renewal' aspect of the recovery plan is hampered by the inability of forestry contractors to meet the demand for plantations. This sector is suffering from structural problems (attractiveness of professions, training provision, organisation of mainly individual companies) which will need to be addressed in order to meet the requirements of massive forest renewal. This situation is exacerbated by the reduced capacity of the National Forest Office to carry out forestry work.

At the same time, forest firefighting resources, which mainly rely on the local action of the departmental fire and rescue services (SDIS) and the intervention of national civil protection resources (to the tune of €340m per year), are set to be strengthened. In the face of increasing risk, however, the increase in resources comes up against major organisational limitations: availability of trained personnel (weather forecasters, civil protection flight crews), difficulties faced by the fire and rescue services (SDIS) overwhelmed by personal rescue missions, and industrial constraints that make the equipment renewal schedule uncertain.

Finally, the extreme fragmentation of property ownership also hinders the implementation of these adaptation measures. For fire protection, the specific model of the *ASA de DFCI* (authorised property owner associations for defence against forest fires), present in *Nouvelle-Aquitaine*, needs to be strengthened and developed in other regions. In the field of forest management, groupings should be encouraged in order to enlarge the area of sustainably managed forest. At present, there are too few links between private and public forests in the field.

## Changes in management and preventive methods, a prerequisite for successful forest adaptation

Financial measures alone are not enough: the performance of public action to adapt forests also requires changes in management and preventive methods.

Firstly, development and planning tools need to be reviewed: forest management documents are no longer adapted to the changing situation of forest stands. Their programmes, which were determined on a long-term basis, are no longer monitored and all too rarely include adaptation issues. Operators' resources must be redeployed to include

regular monitoring of forest stands and their vulnerability, supported by the new tools available. Expertise in the field and support for stakeholders are more essential than ever.

Urban planning documents do not take sufficient account of fire risk. The obligation to devote more and more effort to the defence of dispersed hot spots partly absorbs the additional resources deployed. The definition of ‘danger zones’, created by the Law of 10 July 2023, will make it possible to integrate the necessary instructions and restrictions to combat forest fires, provided that the services in charge of urban planning are sufficiently aware of them.

In addition, pressure from large game, which is increasingly strong and widespread in certain mountain ranges, is hampering forest renewal. The measures taken to date have not improved a situation that is, on the contrary, steadily deteriorating. The large number of deer also has an impact on public finances, since the protection of seedlings could account for between €225m and €375m in subsidies under the future ten-year national forest renewal plan.

The current system for regulating large game does not guarantee the protection and renewal of forests and cannot be left to the discretion of hunters alone. The intervention of public agencies to organise and direct regulation operations in the most unbalanced sectors is therefore becoming necessary.

Finally, in the context of increased risk, firefighting requires more than just relief measures.

# Recommendations

The Court makes the following recommendations:

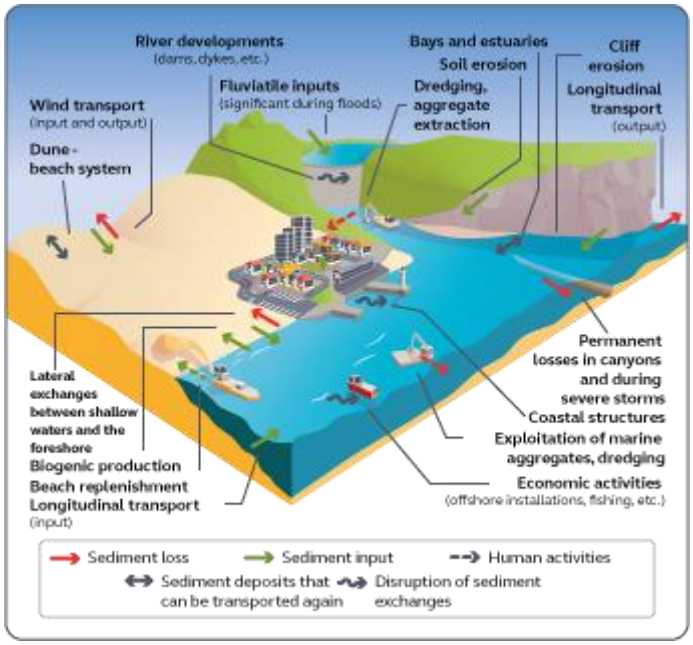
1. encourage forest communities with regular forestry products to improve the financial management of their activity and their forestry investments by encouraging the establishment of specific budgets *(ministry of the interior and overseas territories, ministry of the economy, finance and industrial and digital sovereignty*);
2. make it easier to group municipal forests together by supporting the creation of intermunicipal forest management structures and using forest charters to involve private forests *(ministry of the interior and overseas territories, ministry of agriculture and food sovereignty*);
3. integrate the adaptation issue into forest management documents based on regular monitoring of the condition of stands and allocate human resources to operators to support this process in the field *(ministry of agriculture and food sovereignty, national forest office, national centre for forest property*);
4. entrust national public agencies with managing and organising the regulation of deer populations in areas where there is a significant imbalance *(ministry for ecological transition and territorial cohesion, national forest office, national centre for forest property, french biodiversity office*);
5. in departments which are newly at risk, make up the delay in rolling out existing legal and organisational measures to prevent and combat forest fires *(ministry of the interior and overseas territories*).

# Coastline management in times of climate change

The coastal fringe is exposed to natural phenomena, whether marine or continental in origin, and is subject to human development interventions, which cause the coastline, the boundary between land and sea, to advance or retreat. These changes are now being accelerated by the consequences of climate change, in particular the rise in sea level and the increase in extreme weather events.

With 10 % of the population of mainland France concentrated along the coastline, and even two to six times more in summer, and 20% of the coastline in retreat, a national survey was carried out into the response of the public authorities in terms of knowledge of the phenomena and adaptation to their effects, covering both current actions and those planned for the decades to come.

**Sediment losses and inputs along the coastline**




*Source: Cerema*

## The retreat of the coastline: a phenomenon exacerbated by climate change with consequences that are insufficiently anticipated

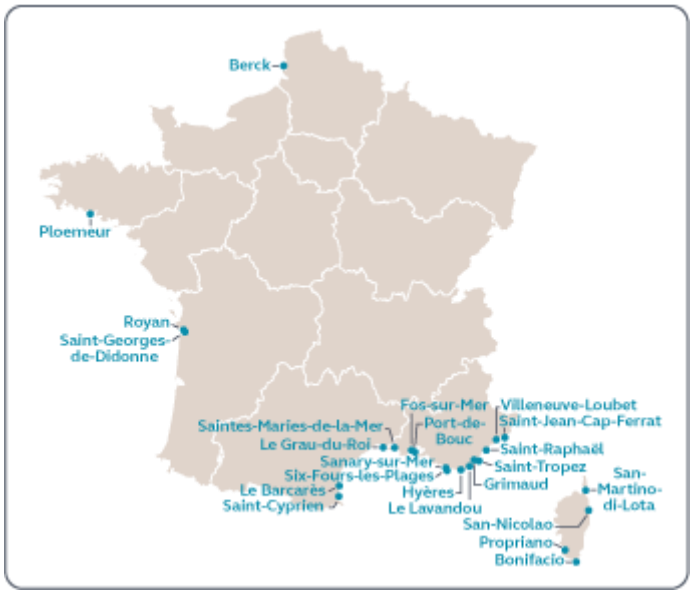
Coastline movement, which has been going on for a long time and is generally gradual, is being accelerated by climate change. Its consequences, particularly when it takes the form of erosion, threaten people, property and activities located on the seafront. The threat can be exacerbated when erosion is combined with coastal flooding, two natural risks that interact but whose dominant characteristics justify, to a certain extent, separate legal and financial treatment.

Knowledge of coastal erosion is still imperfect, but it is already a cause for concern. Improving this situation is complicated by the fact that several operators are involved in this area, but they are not always coordinated. The identification of the assets and activities affected by the retreat of the coastline and their economic estimates for 2050 are still very patchy and need to be improved. The corresponding stakes are in the tens of billions of euros.

At present, risk projections are not sufficiently integrated into urban planning and development policies. Many areas heavily affected by coastal erosion are still not covered by a coastal risk prevention plan (PPRL), meaning that urban development can continue in areas at risk. In addition, the PPRLs covering such areas do not take account of the foreseeable rise

in sea level and could therefore underestimate the risk. The ‘Climate and Resilience’ Law of 22 August 2021 created a new mechanism to encourage the integration of this risk into local authorities' planning policies, but it now needs to be ramped up with the full support of these local authorities. In this respect, the list published by the decrees of 29 April 2022 and 31 July 2023 only includes 253 municipalities, whereas 298 have been identified by government as being the most at risk.

**Municipalities in mainland France most at risk from coastal erosion, not covered by a PPRL and not on the list of the ‘Climate and Resilience’ Law**




*Source: Court of Accounts, based on Cerema data (April 2021)*

## Incomplete national and local preparation and adaptation strategies

Faced with this growing phenomenon, action strategies were formalised, first at national level from 2012, then at local level. These documents promote the reduction of vulnerability and sustainable adaptation to the retreat of the coastline, but their implementation is incomplete. The national strategy, which is currently being revised, cannot be evaluated. Few regions have implemented it, with a few rare exceptions, such as *Normandy*, *Occitanie* and *Nouvelle-Aquitaine*, the latter being notable for its broad, uniform coverage of local action plans.

The main reason for this lack of local structuring lies in the major difficulties of governance at local level, despite the fact that a large number of stakeholders, both private and public, are legally competent. As coastline management is not a mandatory part of the intermunicipal ‘management of aquatic environments and flood prevention’ (GeMAPI) remit, it is not always dealt with in a coherent manner in terms of its scale and in relation to the risk of coastal flooding. However, the intermunicipal level is the most appropriate.

## Adapting rather than combatting: still a rare choice

In addition to these difficulties, there are legal and financial obstacles to the relocation of property at risk, as it is the case in other countries. The ‘Climate and Resilience’ Law has removed some of the obstacles, by facilitating future spatial reconfiguration projects in coastal areas, but the low level of local acceptance and the cost of these projects are holding them back. It is hardly surprising, then, that the historic method of intervention - sea defence by means of structures - is still favoured, to the detriment of a genuine effort to adapt, despite being encouraged through experimentation. In particular, there are five partnership development projects between government and local authorities in *Normandy*, *Nouvelle- Aquitaine* and *Occitanie*.

In order to reduce the current uncertainties, and in addition to stronger local support for the tools of the ‘Climate and Resilience’ law and clear governance, it is important to create the conditions for long-term funding to manage the retreat of the coastline.

Expenditure on this policy, which is largely co-funded and still moderate, is sustainable today, but this will be different in the future, although it is not possible to quantify it exactly given the monitoring tools available. The financial needs to be covered by 2100 should be identified, particularly in terms of spatial reconfiguration, which only a few theoretical studies have calculated – over 20 years, between €22m for the relocation of a neighbourhood of 30 houses and €835m for the reconfiguration of a 3km seafront. The Court calls for a system of public funding for coastline management based on solidarity across coastal areas and on each local authority's own resources, consistent with the financial responsibility of private owners to protect their property from the sea.

# Recommendations

The Court makes the following recommendations:

1. require all areas at high risk of coastline retreat to be risk assessed which is enforceable on town planning authorisations and takes account of the foreseeable rise in sea level attributable to climate change *(ministry for ecological transition and territorial cohesion, municipalities and EPCIs [intermunicipal authority for cooperation between local authorities]*);
2. include objectives and indicators in the next national strategy for managing the coastline so that its implementation can be monitored and evaluated *(ministry for ecological transition and territorial cohesion*);
3. make coastline management a compulsory GeMAPI mission carried out by municipal groupings *(ministry for ecological transition and territorial cohesion, ministry of the interior and overseas territories*);
4. rigorously and uniformly monitor the current costs and funding of coastline management in order to identify future needs *(ministry for ecological transition and territorial cohesion, ministry of the interior and overseas territories, ministry for the economy, finance and industrial and digital sovereignty, municipalities and EPCIs*);
5. set up a system for funding public management of the coastline, establishing financial solidarity between coastal areas and including a contribution to be made by each coastal local authority or grouping from its own resources *(ministry for ecological transition and territorial cohesion, ministry of the interior and overseas territories, ministry for the economy, finance and industrial and digital sovereignty, municipalities and EPCIs*).

# Preventing climate-related natural disasters in overseas France

Climate change will lead to an increase in extreme weather events in the French overseas territories, which are exposed to almost all natural hazards and have significant geographic, economic and social vulnerabilities. How climate change is taken into account in the prevention of natural disasters in the French overseas territories, the organisation adopted, the resources deployed, the methods used and their limitations, are becoming crucial issues, even if we exclude from their scope the degradation of marine environments and coral reefs or the rise in sea level and seismic or volcanic events.

## Developing and disseminating knowledge about climate change

Preventing natural disasters requires building a solid knowledge base on climate change. Recent work by *Météo France*, in conjunction with other research organisations and laboratories, has made it possible to refine the geographic accuracy of climate projections and to identify in detail the amplification of natural hazards linked to climate change in different regions.

However, the quality and accuracy of this information remains generally inferior to that available in mainland France. To close this gap, *Météo France* plans to provide high-resolution simulations (2.5 km) by the end of 2025 for the French West Indies, French Guiana, Réunion, Mayotte, New Caledonia, Wallis and Futuna and the most populated islands of French Polynesia.

For this scientific knowledge to go beyond the strict circle of experts and extend to those involved in prevention and the civil society, three difficulties need to be overcome: firstly, the highly technical nature of the subject and the sheer volume of data available, which means that appropriate and regularly updated information media need to be designed; secondly, the lack of systematic analysis of vulnerabilities and risks in each territory based on hazards, which puts the effectiveness of public authorities' action into perspective; and thirdly, the lack, within local authorities, of the tools and skills needed to use this knowledge and translate it into public policies.

## Promoting a new culture of risk awareness

The increase in the number of disasters linked in particular to climate change is accentuating the need to develop a culture of risk awareness within the population, as an essential vehicle of prevention.

The culture of risk awareness is already present in the overseas territories, with memories of cyclonic phenomena and with the population's knowledge of alert levels and behaviour to adopt. It is maintained by a large number of risk reference documents, both at departmental and local level, and by awareness-raising campaigns.

However, this traditional culture is tending to fade, especially among the younger generations, due to the relatively low frequency of extreme weather events.

At the same time, individual behaviours are less appropriate and less supportive of prevention efforts, particularly among the populations most at risk. This is particularly true of relocation projects and the tightening of building standards.

It is essential to restore a culture of risk awareness, adapted to the new issues, targeting young people in particular, and using communication methods tailored to them.

## Adapting the pre-operational organisation

The many planning documents provided for in the regulations fall into two categories:

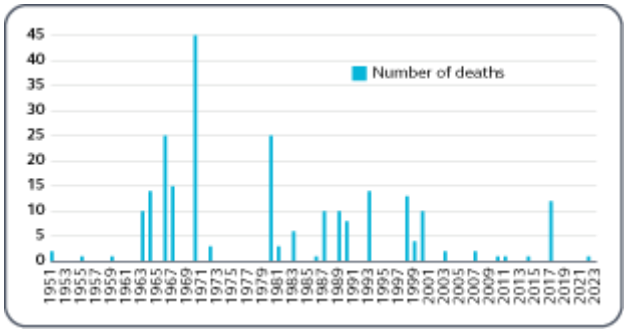
- those aimed at operational preparedness for disaster: departmental risk analysis and coverage plan (SDACRE), civil protection response organisation plan (ORSEC), local emergency plans (PCS);

- planning documents that focus on prevention by developing organisational responses that can be applied over time: natural risk prevention plans (PPRN), local urban development plans (PLU), flood risk management plans (PGRI).

The adoption and application of these plans vary from one territory to another. Furthermore, most of these documents, which are not revised regularly enough, do not take sufficient account of climate change as a risk amplifier. Government departments have begun to list the latter with a view to bringing them up to date with the latest scientific data. However, this exercise is complicated by the number of documents, their complexity and their technical nature.

Despite population growth in the areas at risk and an increase in the intensity of meteorological phenomena, the number of deaths due to climatic phenomena in the French overseas territories has been falling steadily for over fifty years, while the overall level of destruction has remained stable or even increased, demonstrating the usefulness of the prevention strategies rolled out.

**Change in the number of deaths between 1951 and 2023**




*Source: Court of Accounts*

However, some territories are more vulnerable than others, in particular because of shortcomings in the pre-operational measures rolled out. The national resources pre-positioned in the various territories should be adjusted according to the effects of climate change, the types of hazards and their occurrence.

The scenarios used in overseas exercises do not take sufficient account of the increasing likelihood of hazards overlapping, which increases the risks of additional impact, a totally devastating, replicating or successive phenomenon (cyclone, earthquake, tsunami, etc.) that exceeds the disaster response capability of a given territory. Only *Météo France's* inter-regional office for the Indian Ocean is working with Réunion's government departments to characterise an extreme cyclonic event.

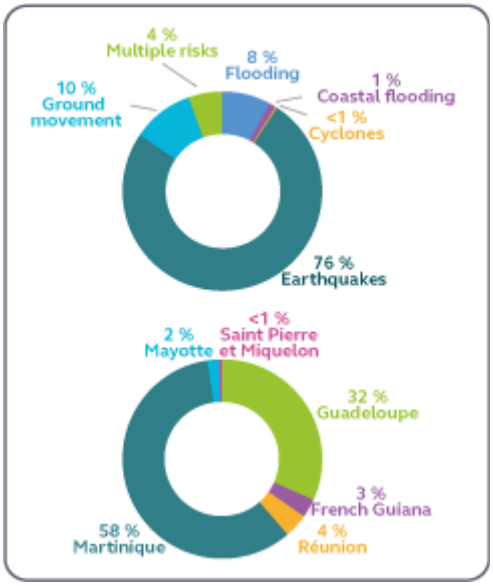
Finally, the feedback that follows the exercises focuses almost exclusively on the collective point of view (preparation of elected representatives and public officials, response forces). It does not take sufficient account of the individual point of view of residents (perception of risks, memory of disasters, knowledge of preventive measures).

## Ensure that consideration of climate change in the prevention of natural disasters is one of the priorities of public policies in the French overseas territories

There are many ways in which prevention policy can be funded. However, local authorities in the French overseas territories struggle to effectively use the financial resources made available to them because of the specific skills, particularly in terms of engineering, required to design projects, which are unevenly available in the overseas territories.

The Barnier Fund, which in 2023 had total resources of around €200m, including €42m for the overseas territories, is the main national funding tool for the policy of preventing major natural risks. However, most of the money is used to fund seismic reinforcement measures for buildings, as part of the French West Indies earthquake plan, and cannot be used by local authorities in the Pacific, as the French Environment Code does not expressly provide for this possibility.

**Breakdown of net funds to prevent major natural risks (FPRNM) 2009-2018**




*Source:* Caisse centrale de réassurance

The demographic, economic and social situations in overseas France can lead to difficult trade-offs between development policies and policies to prevent and combat exposure to risk. Similarly, the structural fragility of the overseas territories, combined with a lack of awareness among residents and elected representatives of the new risks posed by climate change, means that priority is given to investments with shorter-term benefits. More generally, in territories which are periodically tested by social, economic and health crises, in addition to climatic hazards, the logic of administrative and financial management of these crises' consequences tends to take precedence over preventive policies, which need to be developed beforehand and over time.

The development of knowledge, the growing awareness of the effects of climate change, the adaptation of planning and resources, and the search for innovative solutions which aim to more effectively reconcile sometimes contradictory objectives, would help to make the prevention of natural disasters a public policy priority.

# Recommendations

In this context, the Court makes the following recommendations:

1. promote climate expertise for all the overseas territories on a sufficiently detailed territorial scale to enable public action to organise better prevention of natural disasters *(*Météo France*, New Caledonia local authority - 2025*);
2. draw up and update all planning, prevention organisation and public information documents relating to natural hazards for local authorities in overseas departments and territories and in New Caledonia *(ministry of the interior and overseas territories, ministry for ecological transition and territorial cohesion, New Caledonia and French Polynesia authorities - 2025*);
3. assert, at national and regional levels, a strategic steering function responsible for accumulating and disseminating knowledge relating to climate change and developing preventive measures, in particular by adapting planning documents *(ministry of the interior and overseas territories, ministry for ecological transition and territorial cohesion, New Caledonia and French Polynesia authorities - 2024*);
4. define for New Caledonia and French Polynesia, and on their initiative, the conditions for setting up and funding a natural risk prevention fund *(ministry of the interior and overseas territories, New Caledonian and French Polynesian authorities - 2024*).

# Protecting the health of vulnerable people during heatwaves

In 2003, a heatwave caused almost 15,000 excess deaths in France[11], mainly among elderly people living alone at home and in social and medico-social facilities.

The Court of Accounts looked at the impact of heatwaves on health, particularly for the most vulnerable: the elderly living at home or in institutions, pregnant women, young children, people suffering from chronic diseases, people with disabilities and the homeless. It did not take into account the situation of people impacted because of their professional or physical activity, or the situation of prisoners.

Among the measures adopted since 2003 are the introduction of heatwave plans, the triggering of specific weather alerts, the obligation for municipalities to keep lists of elderly and isolated people, and the installation of cool rooms in residential homes for dependent elderly people (*Ehpad*). However, the number of deaths recorded during heatwaves, particularly in 2020 and 2022 (an excess of almost 2,000 and 2,800 deaths respectively), shows that the health risk is still insufficiently controlled. Furthermore, the health impact of heatwaves is too often measured using mortality data alone, and rarely in terms of their long-term consequences on health.

## Heatwaves and their impact on health still poorly measured

A health watch is organised every year between 1st June and 15 September by *Santé publique France*, which shows that the increase in mortality linked to heatwaves in France between 2014 and 2022 is 33,000 deaths.

In terms of prevention, an *ORSEC*-health management plan for heatwaves defines four warning levels (green-yellow-orange-red) which alert the population when 'biometeorological' indicators are exceeded.

Not all departments are exposed to the same level of risk: the south of France is already experiencing higher heat-related mortality than the rest of France.

Climate projections for the next 20 years point to a widespread expansion of heatwaves, with only the Channel coastline spared. In addition, urban heat islands can increase temperatures by up to 8° C, making Paris the city with the highest mortality risk among 854 European cities.

Compared with the large number of publications on mortality, there are far fewer studies on the effects of heatwaves on morbidity and healthcare use. The Court therefore focused on the morbidity caused by heatwaves by matching data from *Météo France* with data from the national health data system for each department in mainland France.

When heatwaves last for more than three days, there is a 5-10 % increase in use of emergency care, across all age groups. When they last for more than seven days, there is a 15 % increase in use of emergency care for children under the age of two. There have also been cases of diuretic intoxication, with a time lag. Among the sharply rising number of callouts of the Paris fire brigade (BSPP), those relating to the death of people aged over 85 rose by 28 % between the fourth and sixth day, and by 53 % after seven days.

During heatwaves, hospital admissions are slightly down, due to fewer accidents as a result of reduced physical activity. On the other hand, in both emergency and inpatient departments, the use of care is particularly marked in the field of renal health (acute kidney

[11] Between 4 and 18 August 2003, the number of deaths rose by more than 75% compared with the national average for the same period from 2000 to 2002.

failure, pyelonephritis) and, to a lesser extent, in urology (renal colic, urinary retention) and pneumology (pneumopathy).

The number of GP consultations remains stable, but the proportion of elderly people consulting their GPs increases at the beginning of heatwaves, as do the proportion of young children after seven days. In addition, the number of psychologist sessions reimbursed by mutual health insurance companies is increasing.

From 2018 to 2022, heatwaves caused a 4% increase in deaths in *Ehpad* rising by 18 % when they lasted more than 7 days. In home nursing services, a heatwave lasting more than four days increases deaths by 2 %.

Little is known about the health situation of homeless people living in France, 50 % of whom are in Paris. The non-profit organisation '*Le Collectif des morts de la rue'* recorded 611 deaths in 2022, but no link was established with the heatwaves. During heatwaves, callouts of the Paris fire brigade to these people increases by 18% over the first three days and by 24 % after seven days.

## A public response that needs to be scaled up

The latest data and the outlook for mortality and morbidity in the event of heatwaves mean that public action needs to be stepped up.

The first step is to build up a body of scientific knowledge on the effects of heatwaves. In addition to existing epidemiological studies, it is necessary to develop clinical research based on the examination of patient files, as well as health insurance expertise to measure the effects of heatwaves on health expenditure.

The capacity of all hospital, social and medico-social buildings to guarantee summer resilience should be rapidly assessed.

When it comes to prevention, communicating with the public is essential. Among the measures available, use of 'FR-Alert' to send individual alerts[12], which was not used during the heatwaves of 2022 and 2023, could be helpful.

The list of medicines requiring special precautions during heatwaves, drawn up by *ANSM* (the French National Agency for Medicines and Health Products Safety), must be consulted on with learned societies, hospital federations and the non-profit organisations for users, and must be widely disseminated among health professionals.

The municipal register of elderly and isolated people, which records less than 10 % of the people concerned, could be improved by replacing the requirement for consent to be included with systematic inclusion and the possibility of objecting.

In the context of a systemic crisis with several simultaneous failings[13], the effectiveness of the operational response depends on the preparation beforehand, particularly by the prefects, who steer the crisis response at local level. In support of the prefect's action, and in particular to avoid overcrowding in emergency departments, the regional health agency must ensure that 'white plans' (emergency response plans) are rapidly put in place in the primary care sector and that 'blue plans' (risk management plans) are prepared for medical and social care facilities and services. It is also responsible for supporting independent action by health professionals to help vulnerable people at home (non-prescription care by independent nurses, prescription renewals by pharmacists).

[12] FR-Alert is a population alert and information system that has been rolled out nationwide since June 2022. The system sends a written message in real time to anyone with a mobile phone once it is switched on, informing them of their presence in a danger zone and what they should do to protect themselves (chemical, nuclear, meteorological risks, etc.).

13 Red alert (extreme heatwave), power supply or rail network failure, telecommunications breakdown, fire requiring evacuation, difficulties accessing drinking water, etc.

The various outreach initiatives for the most disadvantaged groups during periods of extreme heat, which supplement permanent measures (outreach workers, basic health care service, etc.), are still not enough to protect the health of homeless people. Clearing camps and shanty towns exposes the people concerned to health risks, especially dehydration. If no alternative accommodation is available, such clearance could be suspended during the orange and red alert periods, with increased attention given to ensuring access to water.

# Recommendations

The Court makes the following recommendations:

1. carry out the work needed to improve knowledge of the consequences of heatwaves on the health of vulnerable people, adapt this work to the specific characteristics of overseas France and improve monitoring and warning indicators *(ministry of labour, health and solidarity, ministry for ecological transition and territorial cohesion, CNAM*);
2. acquire the means to improve knowledge of the health situation of homeless people, by developing a health database linked to the information system of the integrated reception and orientation service (SI-SIAO), in cooperation with the organisations managing accommodation and care facilities *(ministry of labour, health and solidarity, ministry for ecological transition and territorial cohesion*);
3. involve learned societies and non-profit organisations for users in the *ANSM*'s preparation of the list of medicines of interest in the event of a heatwave, and systematically disseminate it to health professionals *(doctors, pharmacists, nurses) (ministry of labour, health and solidarity*);
4. broaden the criteria for including the most vulnerable people on the municipal register and replace prior annual consent with a permanent right to object *(ministry of the interior and overseas territories, ministry of labour, health and solidarity*);
5. prepare a list of health, social and medico-social facilities to assess their adaptation to heatwaves *(ministry of labour, health and solidarity, ministry for ecological transition and territorial cohesion*).

# Adapting cereal crops to climate change

France is the European Union's leading cereals producer. In 2021, it accounted for 27 % of common wheat production, 21 % of grain maize production and 22 % of barley production. In 2020, cereals covered 8.9 million hectares (Mha). Silage maize (harvested green, whole plant) occupied 1.4 Mha, followed by other cereals in a very small minority: triticale[14], durum wheat, sorghum and oats. In total, cereal crops cover 36 % of the utilised agricultural area (UAA) and are found throughout France, with the exception of mountainous areas, the Mediterranean rim and the French overseas territories. More than half the cereals consumed in France are used to feed livestock. The French industry also exports around half its production, generating the second-largest agricultural surplus (€6.8bn in 2021) behind alcoholic beverages.

This key sector for French agriculture has to reconcile various issues: food sovereignty, production for export, the agro-ecological transition and the sharing of water resources.

Its activities and performance must now be considered in the light of the climate, because agriculture, which emits greenhouse gases while also generating a carbon sink, is particularly sensitive to climate change.

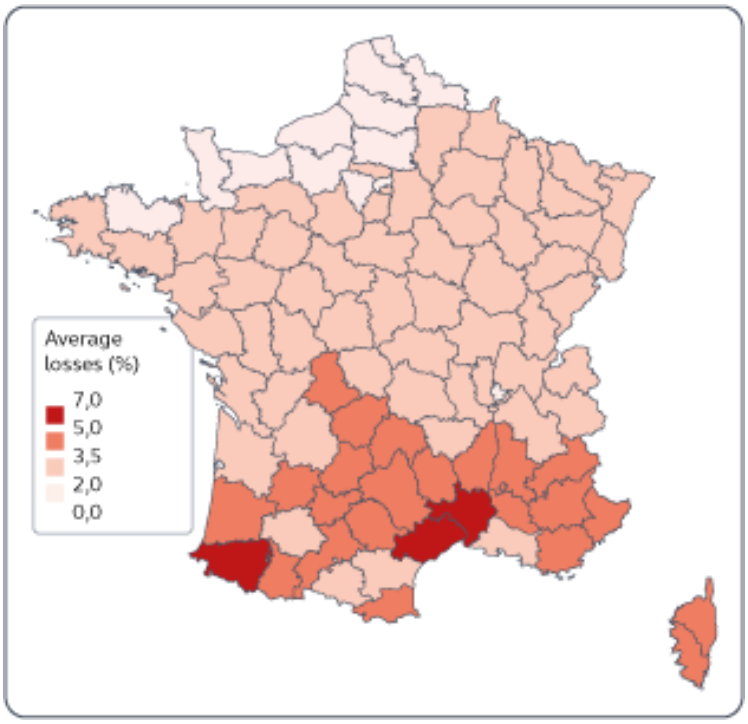
## The consequences of climate change over the last 20 years

The effects of climate change have been felt in cereal yields, which have been stagnating since the beginning of the century, whereas they had been increasing for 50 years thanks to genetic progress. The deterioration in soil quality caused by the simplification of rotations and intensive use partly explains this trend. Added to this phenomenon is the increase in the frequency and intensity of extreme events – droughts or excessive rainfall – which pose a threat to crops and are combined with the difficulty of anticipating these events.

According to the simulations, average yields should not be much affected in the future in France, except in the south of the country, where the most marked changes will be concentrated, mainly due to lower rainfall. This is particularly true of maize, which starts growing in July. Depending on the region and on development conditions for the industry, maize could be replaced by sorghum, which is more resistant to drought. Beyond these average trends, inter-annual variations linked to climatic hazards are expected to increase, intensifying losses in the case of a ten-year event.

[14] A hybrid between wheat (durum or common) and rye, grown mainly as a fodder crop.

**Simulation of average annual common wheat crop losses in a 2050 climate (as part of the RCP 8.5 scenario of the 5th IPCC report)**




*Source: data from the thesis of Dorothée Kapsambelis, winner of the Court of Accounts 2023 thesis prize. Simulations by the* Caisse Centrale de Réassurance *(CCR) in partnership with the* Institut Agro Rennes-Angers *and* Météo France

## A gradual and inevitable adaptation

Before 2020, it was difficult to identify public policies specifically designed to promote adaptation. Adaptation measures did exist, but few were labelled as such, apart from the measures set out in the national climate change adaptation programme (*PNACC*). However, the ministry of agriculture does not have the data to identify and replenish the amounts invested specifically in adaptation or to better document the environmental effort made, particularly in the green budget.

The "*Varenne agricole de l'eau et de l'adaptation au changement climatique*" of 2021 marked a turning point, with adaptation becoming a priority for public action. The consultation launched by government in 2023 on the reference warming trajectory for adaptation to climate change (*TRACC*) will lead to the definition of a specific adaptation plan for agriculture. The ministry of agriculture will have to develop the capacity to monitor actions to promote adaptation, their funding and their results, including to enable them to be properly evaluated.

## Active research into adapting cereal crops to climate change

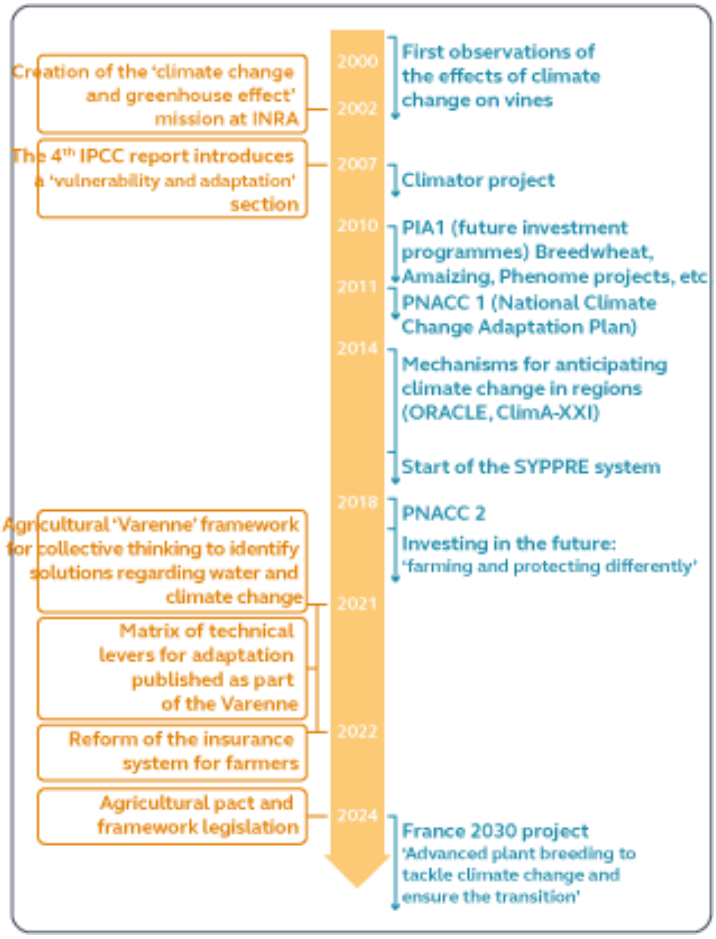
France has a comprehensive cereals research and innovation system. It includes both private and public stakeholders (seed producers, the Arvalis technical institute, the French National Research Institute for Agriculture, Food and the Environment (*INRAE*), the French agricultural research and international cooperation organisation (*CIRAD*) and their academic partners), which have developed a range of technical levers for adaptation. It is up to farmers to make the most of this system, depending on the soil, climate and material conditions of their business.

Since the end of the 1990s, researchers have been studying the expected impacts of climate change on agriculture, and the work has led to progress on adaptation solutions for various sectors at local level. Genetic innovation, of which France's leadership is important,

has contributed to this. The plant variety certificate, which replaces the patent in Europe, allows cereal varieties to be developed in an open way, using government-approved specifications.

Research and innovation, both public and private, are thus one of the driving forces behind adaptation. They have made it possible to identify and develop techniques likely to reduce climate-related risks including varietal selection, crop diversification, soil moisture retention, controlled and precision irrigation, agro-ecological practices, agro-forestry, etc. Individually or in combination, these techniques must be designed and implemented in a way that is consistent with the objectives of mitigating climate change and maintaining biodiversity. They must also be planned as part of a long-term strategy to secure this essential component of French agriculture for the future.

**Summary of the adaptation of cereal crops to climate change 2000-2023**




*Source: Court of Accounts*

## Various technical levers to be rolled out, structural transformations to be anticipated

Among the various technical levers available, some improve existing practices, such as bringing forward sowing dates or planting earlier varieties. Others require systemic changes, such as crop diversification, soil conservation and agroforestry. To enable these developments, the initial and continuing training system plays a major role, with farmers called upon to develop engineering skills to combine all the parameters as effectively as possible.

However, habits, norms and overlapping interests are holding back the necessary systemic transformations. The latter are also riskier for farmers, who need to be reassured by successful experiments or rely on 'system references' that can be reproduced or adapted locally. It is therefore important to strengthen experimental or pilot farms that can demonstrate the success of some of these systemic transformations.

Similarly, the reform of the insurance system at the beginning of 2023, which should encourage farmers to invest in equipping their farms and thus protect themselves in the short term against climatic hazards, is not accompanied by an incentive to undertake the systemic transformations needed to adapt to climate change. Future changes to the CAP, by far the most powerful tool for supporting agriculture, could encourage pioneering farmers who are undertaking these transformations.

# Recommendations

In the light of all these findings, the Court makes the following recommendations:

1. design and update a dashboard to specifically monitor actions and funding linked to the adaptation of agriculture to climate change *(ministry of agriculture and food sovereignty - 2025*);
2. provide financial support and accreditation for experiments in structural transformation aimed at adapting crops to climate change *(ministry of agriculture and food sovereignty - 2025)*.

# Mountain resorts and climate change

France is a major destination for winter tourism with 53.9 million skier-days, ranking it second in the world. Whereas in other countries, ski areas are run by the private sector, in France they are a public service, organised mainly by the municipalities. The ski lift industry generates annual sales of €1.6bn, and overnight stays in the mountains account for 22.4 % of all overnight stays in France.

The purpose of the audit carried out by the financial courts was to identify the impact of climate change on winter tourism in mountain areas and examine how resorts have adapted to it. It was based on monitoring 42 resorts, spread across the *Alps*, the *Pyrenees*, the *Massif Central* and the *Jura*, to illustrate the diversity of areas and situations.

## The French ski business model is running out of steam

At the end of the 20th century, ski resorts were able to rely on growth in ski tourism, which in turn led to growth in property infrastructure and ski lifts. Since the beginning of the 21st century, however, the business model for ski resorts has been permanently affected by climate change. From the end of the 2000s, the decline in skiing activity and the increasing unsuitability of the resorts' infrastructure undermined the financial equilibrium of ski area operations and the local economy that partly depends on them.

This trend is exacerbated by climate change, which is having a greater impact in the mountains than in low-lying areas. According to scientific forecasts, this phenomenon is set to intensify in the medium term, with more marked consequences for snow conditions and risks originating in glacial and periglacial environments. This applies to both snowfall and artificial snow.

The vulnerability of resorts varies depending on their exposure to climate risk, the scale of their economic activity and the financial strength of the local authority on which they depend. Nonetheless, they will all be affected to a greater or lesser extent by 2050, and some resorts could hope to continue operating beyond that date. However, the resorts to the south of the Alps will be affected more quickly than the others.

More and more resorts are already unable to break even. The local authorities concerned will therefore have to bear an increasingly heavy financial burden. As a result, they need to be extremely cautious when it comes to investment.

## Adaptation policies are not up to the challenge

Snow production makes it possible to ensure reliable snow cover in the short term. However, it provides only relative and temporary protection against the effects of climate change. Its cost is high, and its effectiveness tends to diminish as temperatures rise. Furthermore, the impact of this production on water resources appears to be underestimated. Water withdrawal authorisations for snow production should take greater account of climate forecasts.

Diversification initiatives are rarely backed up by a comprehensive plan. There is little coordination between the initiatives of the local authorities, leading to a risk of competition between areas.

The government’s ecological planning initiatives, which are of little use to the mountain tourism sector, do not provide any real impetus for change. The same is true of the regions, which do not seek to influence local decision-making, despite their powers in terms of tourism planning. However, they in fact focus their subsidies on boosting snow production, without taking into account the prospects of climate change, particularly in the *Alps*.

In order to structure the actions of local authorities more effectively, real climate change adaptation plans need to be put in place, which can be enforced against public funding bodies.

## Governance to be reviewed and funding to be rethought

With governance centred at municipal level and insufficient consolidation of authorities, the current structure does not allow mountain stakeholders to adapt to the realities of climate change at the level of a specific region.

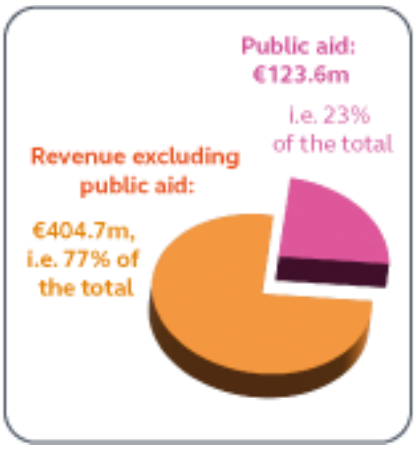
Like other major ski countries, it would be in France's interest to promote a structure that brings together all the players concerned around regional projects and broader governance, to preserve resources and enhance the value of natural areas. This is all the more necessary as industrial wastelands are appearing in France's mountainous regions: almost 200 unused facilities, which have not been dismantled, have been identified nationwide, but the law does not provide a sufficient framework for their future.

In financial terms, the Court estimated that ski lift operators with annual revenues of less than €15m receive public funding of €123.6m a year.

Unless there is a fundamental rethink of the resorts' business model, the level of public subsidy can only increase given the climate projections, depriving them of the leeway they need to develop four-season tourism[15].

The financial stakes are all the higher given that the cost of the initial measures to adapt to climate change in the resorts is currently estimated at €91.70m per year.

**Weight of public spending in the revenue of resorts generating less than €15m in annual revenue (in €m)**




*Source: Court of Accounts*

[15] In the mountains, the most commercially exploitable seasons are winter and summer, as well as the so-called 'shoulder seasons' of spring and autumn. For the sake of convenience, the Court refers to this type of tourism as four-season tourism.

# Recommendations

In order to support adaptation to climate change while taking into account the very significant disparities between resorts, the Court makes the following recommendations:

1. Set up a national observatory bringing together all the data on vulnerability in mountain areas, accessible to all local stakeholders (*ministry for ecological transition and territorial cohesion*);
2. Adapt the regulatory framework so that water withdrawal authorisations for snow production take account of climate forecasts (*ministry for ecological transition and territorial cohesion*);
3. Formalise plans for adapting to climate change, based on the plans for the mountain ranges provided for in the Climate and Resilience Law (*organising authorities, ministry for ecological transition and territorial cohesion*);
4. Make all public support for investment in ski resorts conditional on the content of climate change adaptation plans (*ministry for ecological transition and territorial cohesion,* regions*,* departments);
5. Implement a system of governance for resorts that is no longer the sole responsibility of local authorities (*ministry of the interior and overseas territories, local authorities*);
6. Set up a climate change adaptation fund to finance diversification measures and the dismantling of obsolete installations, financed by the proceeds from the tax on ski lifts (*ministry for ecological transition and territorial cohesion, ministry of the economy, finance and industrial and digital sovereignty*).