

CASE STUDIES

FRANCE AT +4° C: FINANCING THE ECONOMY'S ADAPTATION TO CLIMATE CHANGE

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INSTITUT
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INTRODUCTION

The “[Action Plan for Financing the Ecological Transition](#)” published by the Institut de la Finance Durable noted that the main obstacle to the emergence of ecological transition projects was not a lack of financial resources but the low economic profitability of transition projects. The IFD is continuing its work on a sector-by-sector basis to identify the obstacles and levers for financing the transition in priority sectors. In May 2024, the IFD published its first [report on financing the decarbonisation of buildings](#), providing an assessment of the financing of carbon renovation of buildings in order to identify obstacles and make recommendations for overcoming them. In May 2025, the IFD published its second [sectoral report on financing the agricultural transition](#). Unlike many reports on the subject, the IFD takes the perspective of project leaders (households, businesses, local authorities) to understand what is hindering the implementation of projects in their financing process.

In the context of the increasingly visible consequences of climate change, the Institut de la Finance Durable has begun work on financing climate change adaptation. In response to growing demand from players in the Paris financial centre, the aim is to identify priority adaptation projects and seek financing solutions for them. In the context of France's 3rd National Climate Change Adaptation Plan (PNACC-3), this work is fully in line with measure 42 of the plan, which aims to “*mobilise financial players for the private financing of climate change adaptation*”, as well as with measures relating to the protection of populations, the resilience of territories and the evolution of the insurance system (measure 2).

To this end, the Institut de la Finance Durable conducted numerous hearings and set up a multi-stakeholder working group on adaptation (financiers, businesses, experts, public authorities, etc.) to carry out this work. This work was carried out in several stages. The first was to define specific financing cases applicable to project leaders (households, local authorities, businesses) in a climate change adaptation approach.

Adaptation refers to all the technical, economic, organisational and behavioural changes that reduce a system's vulnerability to the effects of climate change. It is a dynamic process that promotes **resilience**, i.e. the sustainable capacity of a territory, business or society to absorb shocks, adjust and continue to function despite climate disturbances.

Investments in mitigation and adaptation are therefore not mutually exclusive: they complement and reinforce each other. The former aims to reduce the scale of future disruption, while the latter limits its present and future impacts. **Taken together, these two approaches make it possible to build a development trajectory that is both low-carbon and resilient,** avoiding the transfer of climate costs to future generations.

This document brings together six case studies on climate change adaptation. Like the work on building decarbonisation and agricultural transition, **this study aims to examine concrete cases, *business cases* and financing applicable to project leaders.** The cases are studied based on the main sectors most affected by climate change: agriculture and natural resources; urban planning and territories; and finally, industry and infrastructure. This document details the case studies and complements the report analysing the obstacles and levers for financing climate change adaptation published by the IFD.

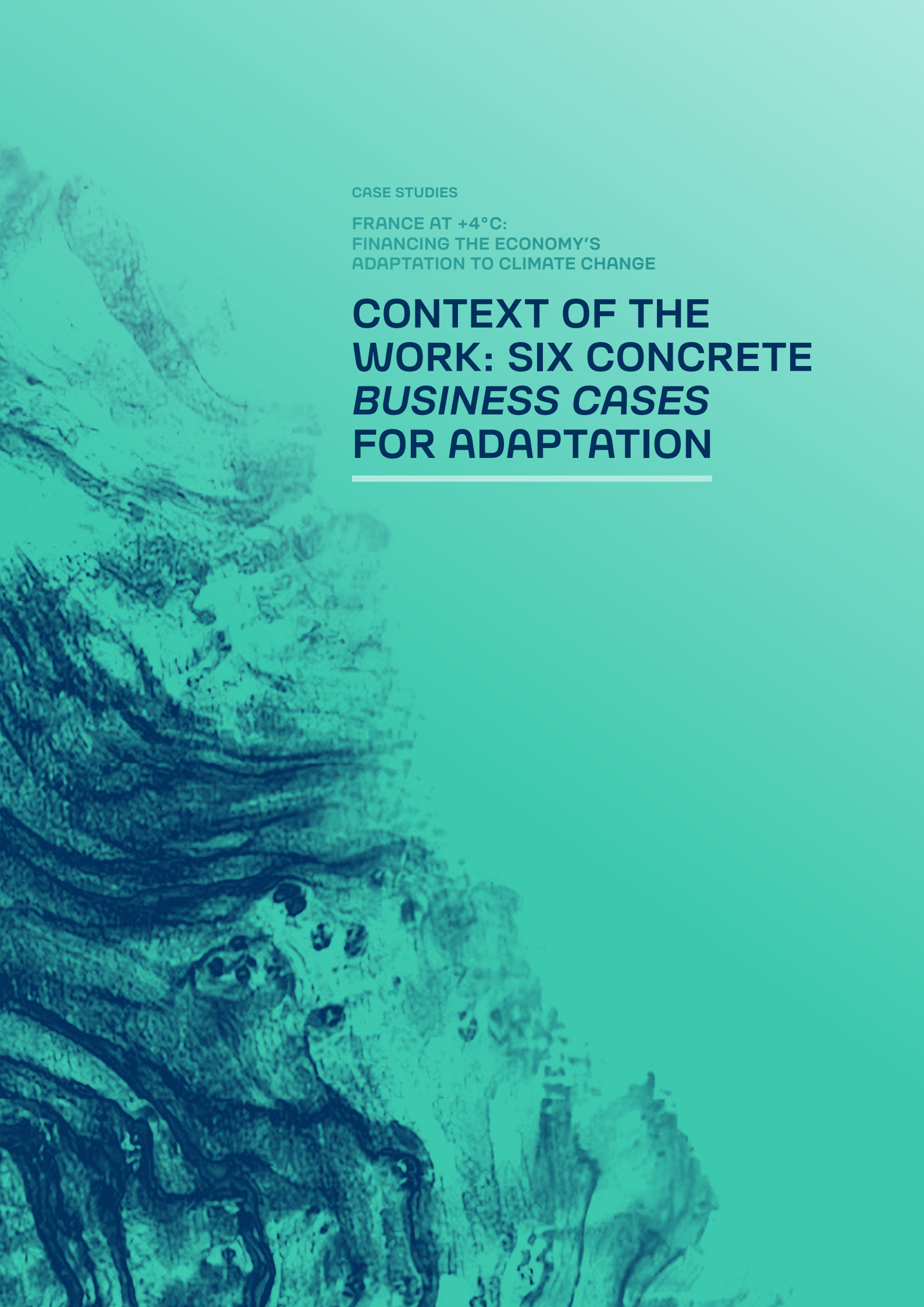
The ultimate goal of this work is to formulate the conditions for mobilising private financing tools and concrete, consensual recommendations to promote the financing of climate change adaptation. It is therefore an innovative approach that aims to contribute positively to the public debate on climate change adaptation.

KEARNEY

This report was produced with the invaluable support and assistance of the teams at the Kearney consulting firm.

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CONTEXT OF THE WORK: SIX CONCRETE *BUSINESS CASES* FOR ADAPTATION

Like the work on building decarbonisation and agricultural transition, this work aims to study specific cases, *business cases*, of financing applicable to project leaders in a climate change adaptation approach. Several cases will be studied, starting with the main sectors most affected by climate change.

The study of financing pathways is based on concrete cases

In selecting cases: Seeking a balance between stakeholders, adaptation levers, sectors, regional specificities and environmental issues, etc.

1 Agriculture & natural resources 	2 Urban planning & territories 	3 Industry & Critical Infrastructure 
Case 1.A – Regional Water Management Project Implementation of a collective consultation process on the quantitative and qualitative management of water resources within a region  Local authorities, farmers, manufacturers, associations, water agencies	Case 2.A – Adaptation plan for a metropolitan area Adoption of adaptation measures at metropolitan level (e.g. thermal insulation of buildings, greening, adaptation of infrastructure)  Local authorities, local businesses	Case 3.A – New adaptation operator Creation of a start-up offering adaptation services or products as part of the development of a sovereign economic sector.  Greentechs, start-ups, SMEs and mid-cap companies
Case 1.B – Adaptation by a forester Reforestation of a plot of spruce trees damaged by bark beetles using a mix of new, more resistant and sustainable species  Forest owners, farmers	Case 2.B – Adaptation of private property located in a vulnerable area Installation of flood barriers on private property located in a flood zone  Households	Case 3.B – Adaptation of critical infrastructure Financing of an adaptation plan for an industrial electricity production site based on local climate risks  Industrial company

Figure – Case studies of financing pathways for climate change adaptation (Source: IFD, Kearney)

Methodological remarks

Framing the work through case studies

For each case, the study answers the following questions:

- **Project pathway:** What are the main stages in each case? How complex is the pathway and how long does it take?
- **Project support elements:** What financial assistance and tools are available to bring the project to fruition (e.g. financial assistance, etc.)? Who are the actors providing this assistance (e.g. government, banks, etc.)?
- **Project obstacles:** What are the obstacles to the project?
- **Project stakeholders:** Who are the stakeholders involved in the project, particularly in terms of financing? How are they distributed? Under what conditions?
- **Project benefits and disadvantages:** What are the benefits of the project, particularly for the project leaders, and over what time frame? Who are the winners? Are there any losers? What are the savings (costs, psychological, etc.)? What are the environmental gains?

The *ultimate* goal of these case studies is to understand the financing process for project leaders in these different cases and to understand the current sources of financing (self-financing, loans, subsidies, public guarantees, etc.). **The aim is to understand where the participation of the State and financial stakeholders is necessary and needs to be strengthened in order to promote the economic profitability of these projects.**

Focus on the choice of cases

The choice of use cases should in no way be perceived as exhaustive or prescriptive. They are primarily the cases most frequently cited during the hearings conducted. It should also be noted that **an analytical approach** has been adopted here: depending on their situation and specific characteristics, the same project leader may activate several of these levers to achieve a more comprehensive transition. Furthermore, **modelling requires a simplified approach to the different cases:** in reality, the transition is much more complex and subject to the specific characteristics of each project. When it comes to adaptation, there are as many transition models as there are projects. Finally, **this work is not intended to provide financial, legal or other professional advice and should not be considered as such:** it is research aimed at promoting best practices in adaptation financing.

AGRICULTURE AND NATURAL RESOURCES¹

CASE 1.A – REGIONAL WATER MANAGEMENT PROJECT

This case illustrates the implementation of a **collective consultation process** on the **quantitative and qualitative management of water resources** at the regional level. It analyses how local stakeholders develop adaptation strategies to address water stress and arbitrate between different water uses.

Stakeholders involved: local authorities, farmers, industrialists, associations, water agencies.

CASE 1.B – ADAPTATION BY A FORESTER

This case studies the **reforestation of a plot of spruce trees damaged** by bark beetles using a **mixture of new, more resistant and sustainable species**. It illustrates the adaptation strategies of the forestry sector in the face of increasing climate risks and loss of forestry yield.

Stakeholders involved: forest owners, forest managers.

URBAN PLANNING AND TERRITORIES

CASE 2.A – ADAPTATION PLAN FOR A METROPOLITAN AREA

This case study focuses on **the financing of adaptation measures at the metropolitan level**, such as thermal insulation and investment in summer comfort in buildings, greening of urban spaces and infrastructure adaptation. It highlights the integrated approaches developed by urban areas to anticipate the effects of climate change.

Stakeholders involved: local authorities, local businesses.

CASE 2.B – ADAPTATION OF PRIVATE PROPERTY LOCATED IN A VULNERABLE AREA

This case examines the **installation of flood barriers** on private property located in an area exposed to flood risks. It analyses adaptation measures at the individual level and the levers that can be mobilised to protect households.

Stakeholders involved: households.

¹ These two use cases were chosen to complement those studied in the report on financing the agricultural transition conducted by the IFD and published in May 2025.

INDUSTRY AND INFRASTRUCTURE

CASE 3.A – NEW ADAPTATION OPERATOR

This case studies the **creation of a start-up** offering climate change **adaptation services or products**, as part of the development of a **sovereign economic sector** dedicated to resilience. It focuses on the structuring of an emerging adaptation market and its financing needs.

Stakeholders involved: green tech companies, start-ups, SMEs and mid-cap companies.

CASE 3.B – ADAPTATION OF CRITICAL INFRASTRUCTURE

This case analyses the **financing of an adaptation plan for an industrial electricity production site**, designed to address **local climate risks**. It highlights the investment needs to strengthen the resilience of strategic infrastructure in the face of physical hazards.

Stakeholders involved: industrial companies.



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THREE HEAVILY IMPACTED SECTORS: STAKEHOLDERS AND CHALLENGES

Three areas are particularly vulnerable to climate change in France: agriculture and natural resources, urban planning and territories, and industry and infrastructure. The impacts are already visible, with increasing human and economic costs; they call for planned and long-term adaptation responses. Possible solutions are presented in the full IFD report.

Key themes and challenges for adaptation	Agriculture and natural resources	Urban planning and territories	Infrastructure and industry
	Sustainable management of water resources	Physical adaptation of cities	Resilience of the energy production and transport network
	Adaptation of agricultural production systems and protection of ecosystems	Renovation, energy efficiency and energy conservation in the building stock	Adaptation of road, rail, maritime and river transport infrastructure
	Protection of the agricultural sector	Adaptation of areas vulnerable to the tourism sector	Development of new adaptation operators

Figure – Sectors facing major challenges in adapting to climate change (source: IFD, Kearney)

SECTOR NO. 1: AGRICULTURE AND NATURAL RESOURCES

SUSTAINABLE WATER RESOURCE MANAGEMENT

Agriculture is a major consumer of water: it accounts for 58% of total freshwater consumption in France (compared to 26% for drinking water and 12% for industrial cooling)². In 2020, consumption is estimated at over 4.4 billion m³, with agricultural irrigation accounting for nearly two-thirds of this (irrigation of crops for human and animal consumption, mainly concentrated in the south and west of France). However, French farmers are facing increasing water scarcity: between 1990 and 2001 and 2002 and 2018, the amount of renewable fresh water decreased by about 14% (-33 billion m³³), mainly due to lower summer rainfall and increased evapotranspiration caused by global warming³.

Droughts, which are becoming increasingly frequent and intense, directly threaten the viability of irrigated agriculture. By the time the most critical heat peaks occur, up to 20% of irrigated land could become unusable, compromising food security, the profitability of farms and, more broadly, the balance of territories (aggregated exposure data – TRACC). This risk is no longer theoretical: since May 2022, the Pyrénées-Orientales region has been experiencing a historic drought, with annual rainfall 60 to 70% below normal. Some municipalities have had to restrict the use of drinking water, and the department has been placed on high alert⁴. In the Drôme valley, projections predict a 20% drop in the river's summer flow, exacerbating the frequency of droughts and degrading water quality. Irrigation needs are therefore set to increase significantly. According to regional climate scenarios, they could grow by 20 to 40% by 2050, putting pressure on already fragile resources.

Faced with these challenges, adaptation has become essential. Farmers have already increased their irrigated areas by 23% in ten years (between 2010 and 2020)⁵ in order to limit the impacts of climate change on their activity, but this strategy alone is not enough. Irrigation remains the main response to water stress, but it increases pressure on the resource. In 2020, 6.8% of agricultural land (1.8 million hectares) was irrigated, mainly for maize (33% of irrigated land), followed by market gardening (15%). There is a need to develop more water-efficient agricultural practices, such as agroecology, soil cover and the selection of less water-intensive crops, while modernising networks to limit water losses. The restoration of wetlands and peatlands is also crucial, as these ecosystems store water, regulate flows and contribute to carbon sequestration, in line with climate policies.

2 [Sustainable Development Statistics](#)

3 [Sustainable Development Statistics](#)

4 Press article ([Le Monde.fr](#))

5 [Press article](#)

In the face of these threats, a range of adaptation solutions exist, but they require substantial, coordinated and sustainable funding. Doubling water storage capacity (from 3 to 6 billion m³ by 2050) would represent an investment of around €18 billion alone, according to an analysis by the CGET (Commissariat général de l'égalité des territoires). This estimate is based on the assumption that the cost of water storage is around €6 per cubic metre, a figure often cited in studies on climate change adaptation⁶. Other key levers include infrastructure modernisation, the shift towards agroecological farming practices and optimised water management. Some agricultural cooperatives are already moving in this direction, supported by tools such as the climate risk provision created in 2022, but their capacities remain limited given the scale of the challenges.

To coordinate these efforts, Regional Water Management Projects (PTGE) play a central role. These local consultations bring together farmers, local authorities and water managers to define strategies adapted to the regional context, reduce tensions and collectively achieve a balance between needs and available resources. In 2023, 69 PTGEs had been adopted in France in areas experiencing water shortages, and 40 were in the consultation phase. However, the development and widespread implementation of such actions require substantial funding in order to modernise infrastructure, disseminate best practices and restore ecosystems on a large scale, thereby ensuring the long-term resilience of agriculture in the face of climate change.

ADAPTATION OF AGRICULTURAL PRODUCTION SYSTEMS AND PROTECTION OF ECOSYSTEMS

France's natural resources are currently exposed to multiple converging crises. The record drought of 2022 caused 15% of 3 million hectares of deciduous forest to die, reducing the national carbon sink by 7 Mt CO₂ per year⁷. Yet the health of forests and soils is essential for preserving carbon sinks.

In terms of ecosystems, pollinator populations have declined by 20% in intensive farming areas over the past ten years, jeopardising up to 5% of fruit and vegetable crop yields⁸. The economic value of pollinators and natural pest control is estimated at around €5 billion per year. A study published by the Ministry of the Environment in 2016 estimates that the extinction of bees could cost France nearly €2.9 billion, due to the dependence of 72.2% of plant species cultivated for human consumption on the action of pollinating insects⁹.

This triple crisis – destruction of forest carbon sinks, erosion of auxiliary biodiversity and collapse of yields – threatens food security, farm resilience and the climate balance of our territories.

6 Press article ([Source](#))

7 Press article ([Le Monde](#))

8 [IPBES](#)

9 [Press article](#)

Several concrete adaptation initiatives are already being implemented in the field. Agroecology is gaining ground, with permanent plant cover improving soil organic matter (+0.3%/year) and promoting water retention, particularly through agroforestry (+25% retention)¹⁰. Varietal innovation is enabling the development of resilient seeds capable of maintaining up to 80% of yields in moderate drought conditions, compared with 50-60% for conventional seeds¹¹. Ecological networks, with hedges and copses covering at least 10% of plots, are strengthening useful biodiversity and landscape resilience. Finally, in forests, species diversification and proactive management reduce the risk of large-scale fires by up to three times¹². Hedges and copses covering $\geq 10\%$ of plots (compared to 4% today) reconnect habitats, facilitate species migration and double landscape resilience¹³. These solutions, which are often costly, require targeted funding and enhanced technical support in order to be rolled out on a large scale.

PROTECTING THE AGRICULTURAL SECTOR

The French agri-food sector (17% of national GDP), a pillar of food sovereignty and the trade balance, is on the front line of the impacts of climate change¹⁴. For several years now, extreme weather events – droughts, excessive rainfall, heatwaves, frosts – have been severely affecting crop and livestock production.

The agri-food sector, which is increasingly faced with growing variability in the quality and quantity of agricultural raw materials, is thus finding it increasingly difficult to ensure the resilience of the supply chain. In the beet sugar sector, a very wet year can severely restrict the harvesting and processing period. Manufacturers must then significantly accelerate the pace of production over a very short period, which requires a high degree of adaptability on the part of industrial facilities.

In general, industrial facilities must adapt both to the agricultural production calendar, which is becoming more unpredictable, and to the heterogeneous quality of inputs (e.g. more difficult grading, more processing losses, deformed products, etc.). This is a major challenge in terms of resilience. In addition, as agricultural production is massive and concentrated in time, with products that are often non-storable, the agri-food industry is particularly exposed to a lack of operational visibility, which complicates industrial organisation.

By 2050, without an adaptation plan, French field crops could see their yields fall by 10% to 20%, representing a shortfall of 5-10 million tonnes of lost production, while maize could lose up to 15% of its yield under extreme water stress¹⁵. The IPCC estimates that by 2071-2100, yield losses due to drought could increase by 9-12% for wheat and by more than 18% for rice compared to the period 1961-2016¹⁶.

10 INRAE, 2020, [Climate Action](#)

11 [Chamber of Agriculture](#)

12 [Chambers of Agriculture](#)

13 [Chambers of Agriculture](#)

14 [Ministry of Agriculture](#)

15 [Press source](#) and [Nature](#) article

16 [Press source](#)

Livestock farming is not spared: heatwaves cause an average loss of 2.4 to 3.5 kg of milk per cow per day, while the decline in fodder quality increases feed costs. With global warming, episodes of extreme heat will become more frequent and losses will follow the same trend¹⁷. In terms of forestry, 1 million hectares are already affected by climate-related decline, reducing wood production and carbon capture capacity¹⁸.

Beyond farms, logistics and industrial infrastructure are under strain. Grain silos, for example, see grain heat up as soon as it is harvested, requiring investment in ventilation systems and connected thermal sensors, while droughts are hampering river transport and forcing a rethink of the logistics chain. Adaptation is therefore becoming a vital necessity, not only to preserve production volumes but also to maintain export competitiveness, which is threatened by the emergence of new competitors with more favourable climates (Russia, Canada, etc.).

Furthermore, the economic consequences of inaction would be significant: the agricultural sector could suffer annual losses of up to €15 billion by 2050, representing 35 to 40% of French agricultural GDP, half of which is directly linked to climate effects¹⁹. This decline would lead to a deterioration in the trade balance, increased dependence on imports and a weakening of the rural fabric. The state would also be called upon to increase public spending to compensate for losses, manage food crises and offset inflation, not to mention the geopolitical risks associated with the loss of food sovereignty.

Finally, adapting the sector also means preserving a strategic national asset. Maintaining productive and resilient agriculture is essential for France's social, economic and diplomatic stability. This requires mobilising public and private, European and national funding through the CAP, ecological transition funds, the EIB and enhanced insurance mechanisms. Every euro invested in adaptation avoids much greater losses in the medium term. There is therefore an urgent need to define a financing plan for agricultural adaptation that is commensurate with the climate challenge.

17 [Welfarm](#)

18 [I4CE](#)

19 [Terre net](#)

SECTOR 2: URBAN PLANNING AND TERRITORIES

PHYSICAL ADAPTATION OF CITIES TO THE EFFECTS OF CLIMATE CHANGE

French cities are on **the front line when it comes to climate change**, both for their populations and their infrastructure. They are home to large concentrations of people and sensitive infrastructure, and are bearing the brunt of the acceleration in extreme weather events. **Heatwaves are occurring earlier, are more intense and last longer**. In 2019, Paris broke a historic record with a temperature of 42.6°C²⁰. In large cities, **urban heat islands** further accentuate the differences: there can be up to a 10°C difference between the city centre and the more vegetated outskirts (e.g. Paris vs the Rambouillet forest in 2003).

But heat is not the only factor. **Hydrological hazards have increased by 30% since 1950 and are becoming more intense**²¹. Two-thirds of France's 36,000 municipalities are exposed to at least one natural hazard, and 18,000 of them are vulnerable to flooding, making this the most significant risk on the national territory (Ministry of Ecology, Sustainable Development and Energy). Nearly 20 million people and 12 million homes are affected, including 18,000 municipalities threatened by the risk of flooding. The phenomenon of **clay shrinkage and swelling**, aggravated by droughts, destabilises foundations: 48% of the territory is exposed, representing 10.4 million single-family homes at risk²².

The consequences are already severe. The cost of damage caused by natural disasters in France, which amounted to €466 million per year in 2000, rose to €726 million in 2024²³. Since 2015, **heatwaves have cost between €22 and €37 billion** in deaths, medical expenses and loss of well-being²⁴. Relative to the size of the exposed population, the economic impact of heatwaves since 2015 averages between €72 per capita in 2017 and €224 per capita in 2020²⁵. In fact, a night above 20°C prevents the body from recovering, leading to an estimated 15,000 excess deaths during the 2003 heatwave, combined with heat causing an estimated 0.2% loss in GDP productivity (Garcia-Leon et al., 2021).

In response to these climate challenges, concrete solutions are emerging, often driven by **Territorial Climate-Air-Energy Plans (PCAET)**. These plans, developed by local authorities, aim to define **integrated local strategies** to mitigate greenhouse gas emissions, improve air quality and, above all, **adapt territories to the impacts of climate change**. PCAETs are behind many concrete adaptation initiatives, mobilising resources and coordinating local actors.

20 [Court of Auditors, 2024](#)

21 [Source](#)

22 [Sustainable Development Gov](#)

23 [Ecology Gov](#)

24 [Public Health France](#)

25 [Public Health France](#)

For example, to meet the objectives set out in the PCAET, **Lille** will invest **€220 million** between 2022 and 2044 to restore 600 km of waterways and improve rainwater management through the Metropolitan Waterway Restoration Plan, **thereby limiting the risk of flooding**. In Nice, a £200 million urban renewal plan has been put in place, with the installation of a geothermal heating and cooling network and energy optimisation worth £37 million, with £19 million subsidised by ADEME and PIA3. In Marseille, the application of reflective paint to buildings, which reflects the sun's heat rather than absorbing it, reduces the interior temperature by up to 10°C, also reducing energy consumption, at an estimated cost of between €2,500 and €5,000 per^{100m²} ²⁶.

Nature-based solutions are also an important avenue for adaptation. In Lyon, “rain trees” – trees planted in pits designed and sized to manage some of the runoff water, promote tree growth and biodiversity, including that of the soil – play a dual role: absorbing runoff and cooling the urban air²⁷. The city of Lyon has invested in 69 rain trees (between €4,500 and €6,200 per tree)²⁸.

These initiatives demonstrate that, thanks to the efforts of local authorities, it is possible **to take effective action to strengthen the resilience of cities** to climate change. However, these initiatives remain **too scattered and insufficiently supported**. Yet adaptation is no longer an option: it has become an absolute necessity to protect the health, economy and viability of urban areas. Yet **less than 52% of inter-municipal authorities required to adopt a PCAET have done** so. Urban planning remains largely disconnected from climate issues, and inequalities in exposure are widening in the most vulnerable neighbourhoods.

26 [Hélios Coolroof Solution](#)

27 [Cepri](#)

28 [Greater Lyon](#)

RENOVATION, ENERGY EFFICIENCY AND SOBRIETY OF THE HOUSING STOCK

Heat waves are becoming more frequent, more intense and longer lasting. In the face of these climatic extremes, **housing is becoming a public health and quality of life issue**. However, **France's old and poorly insulated housing stock is not ready**. More than 5.8 million homes are currently considered energy inefficient (labels F & G), out of 37.2 million homes in 2024, or 16%²⁹, a figure that has risen since 2007.

The situation is worsening with climate change. **Thermal discomfort is increasing**, particularly in summer: in 2023, 55% of French people reported feeling too hot in their homes³⁰. **The use of air conditioning is accelerating**, generating excessive electricity consumption: each degree above 25°C results in approximately 300 megawatts of additional consumption, equivalent to a city such as Nantes. The challenge is twofold, with a need to improve thermal efficiency in winter to limit consumption and summer comfort to cope with extreme weather conditions.

Furthermore, **regulatory pressure** is adding to the urgency. The Climate and Resilience Act provides **for a gradual ban on renting the most energy-intensive homes**: from 2025 for G-rated properties, then F-rated properties in 2028. The RE2020 environmental regulation imposes stricter requirements for new buildings, particularly in terms of summer comfort. However, the **current pace of renovation is far from meeting the targets**. Around 60,000 energy-efficient renovations are carried out each year, whereas more than 600,000 would be needed to stay on track for carbon neutrality (SPGE, 2023). The current overall renovation rate for residential properties is estimated at 1% per year, with only a minority achieving low-energy building standards.

And while needs are exploding, **conditions are becoming tougher for households**. **Renovation costs** are high – between €30,000 and €70,000 for a home (Ademe/I4CE) – and **have increased by 11% in two years**, exceeding general inflation over the same period, which was around 5.2% in 2022³¹. The **remaining costs remain prohibitive**³². At the same time, **subsidies themselves are under pressure**. The MaPrimeRénov' budget fell by 20% in 2024³³ and by 50% in 2025 compared to 2024, and simple insulation work is no longer eligible for single-family homes. In 2022, €22 billion was invested in energy renovation of buildings (including €16.4 billion in housing and €5.7 billion in the tertiary sector (I4CE). To achieve climate targets, between €20 billion and €30 billion per year will need to be added to the current level (or even €40 billion in a proactive scenario of completely phasing out energy-inefficient buildings by 2030). I4CE estimates that investment in housing needs to double, while investment in the tertiary sector needs to triple³⁴.

29 [In&Fi](#)

30 [Housing Foundation](#), 2023

31 [FFbatiment](#)

32 [Senate](#)

33 [Source](#)

34 [I4CE](#)

A few local initiatives do exist: in Nice, a **plan to renovate 400 homes is accompanied by €4.3 million in local subsidies** (ANAH, Métropole Nice Côte d’Azur, Région Sud PACA) **for owners to encourage households**³⁵. Technological solutions, such as solar control glazing and smart energy management, are delivering tangible gains. However, these responses remain too sporadic given the scale of the challenge.

ADAPTATION OF VULNERABLE AREAS

Climate change in France is manifesting itself in an **intensification of extreme weather events**: more frequent heatwaves, prolonged droughts, violent floods and devastating fires. In 2022, significant events such as the **fires in Gironde, which destroyed 22%** of the camping capacity in the Arcachon basin, and the **storms in Corsica**, revealed the vulnerability of the territory to these hazards. In addition, **rising sea levels and erosion** already threaten 20% of the French coastline, putting nearly 2,200 campsites and 1,000 residential and commercial buildings at risk by 2028³⁶.

One of the consequences of drought is **the acceleration of the phenomenon of clay shrinkage and swelling**, which affects 48% of the national territory and **54.2% of individual housing, or 10.4 million homes**³⁷. The Centre-Val-de-Loire, Occitanie, Bourgogne Franche-Comté and PACA regions are particularly exposed to this risk. The increase in drought-related claims comes at a cost: currently estimated at €700 million per year, this amount could rise to €2.1 billion in the coming years³⁸. This increase in the cost of climate-related claims raises the question of insurability and poses a risk for insurers and individuals alike, who could see their insurance premiums rise in the coming years.

Faced with the growing effects of climate change, responses are beginning to emerge to adapt the most vulnerable areas. In September 2023, France Assureurs, the CCR and the Mission Risques Naturels (Natural Risks Mission) launched the “**Initiative Sécheresse**” (Drought Initiative) to test prevention and repair solutions on 300 houses and identify the most resilient solutions.

This climate context **also has a significant impact on the tourism sector**, which accounts for around 3% of French GDP, or €75.7 billion (Ademe, 2024). With nearly **2 million direct jobs**, a large proportion of which are seasonal, this sector is particularly exposed to **disruptions linked to seasonal and geographical variations** caused by climate change. 72% of beds in collective tourist accommodation are under threat from extreme heat by 2050. Winter tourism, which generates €9 billion in revenue, is threatened by the expected 10-40% reduction in snow cover by 2050, particularly in mid-mountain resorts. To remain attractive, these resorts must **diversify their offerings and adapt to changing tourist seasons**. This transformation also affects other regions: in Provence-Alpes-Côte d’Azur, **tourist numbers are now increasing outside the summer season**, particularly in April, May, September and October. At the same time, rising sea levels and accelerated erosion are weakening coastal tourist infrastructure.

35 [Nice Côte d’Azur](#)

36 [Cerema](#)

37 [Senate](#), 2023

38 [Consequence](#) Report

Concrete solutions are being implemented to adapt the tourism sector **in line with the guidelines of the PNACC** (National Climate Change Adaptation Plan), which encourages **diversification and resilience in different regions**. For example, in the **Vercors region**, the development of “four seasons” offerings is accompanied by investments in sustainable infrastructure, such as soft transport routes and the dismantling of ski lifts. The **Fonds Avenir Montagnes** (Mountain Future Fund) is allocating €3 million to support the diversification of resorts, supplemented by a €300 million plan co-financed by the State and the regions to fund sustainable infrastructure. In addition, the **Adaptom Project for Overseas Territories** is allocating €16.7 million per year to help overseas territories adapt to climate risks. These investments, in line with the PNACC’s recommendations, are crucial to maintaining the attractiveness of tourist destinations and ensuring the sustainability of local jobs.

However, these transformations require **substantial funding**. If France wants to maintain its status as the world’s leading tourist destination, it will have to invest heavily to make its sector more resilient to climate change and guarantee the future of local jobs in vulnerable regions.

SECTION 3: INDUSTRY AND INFRASTRUCTURE

RESILIENCE OF THE ENERGY PRODUCTION AND TRANSMISSION NETWORK

The French electricity mix is **based on 70% nuclear power** and **11% hydroelectricity**, two sources that have historically been stable but are now weakened by climate change³⁹. In **2023**, nuclear power consumed **33.5 billion m³ of fresh water**, half of which was used to cool reactors, with 98% of this water subsequently being discharged⁴⁰. However, rising river temperatures and declining flow rates impose regulatory limits on thermal discharges, leading to **temporary shutdowns of power stations**. In summer, up to **10% of installed capacity** may be unavailable, representing nearly **6 GW**. At the same time, hydroelectricity production fell by **50%** in some regions during **the summer of 2022** (RTE, 2023). By **2065**, river flows could fall by **10 to 40%**, or even **70%** in some areas, jeopardising security of supply. For example, between now and 2050-2100, the average flow rate of the Rhône could fall by up to 30% in summer and fluctuate between 15 and 25% during the rest of the year, with longer periods of low water levels⁴¹.

In addition, the increased frequency of floods and rising sea levels threaten the safety of infrastructure, particularly those located on the coast or riverside⁴². However, a large part of France's energy facilities are located in coastal or riverine areas: 14 nuclear power plants on the coast and 12 on rivers. The Gravelines power plant, for example, built on low-lying coastal land, is exposed to the risk of marine submersion and could be flooded by 2050. This site is also classified as an "Area at Significant Risk of Flooding" (TRI) under European Directive 2007/60/EC on the assessment and management of flood risks⁴³.

Renewable energies are often perceived as a resilient solution, but they too are exposed to climatic hazards. The **efficiency of solar panels drops by 0.5% for every degree above 25°C⁴⁴**, representing an average loss of **15 kWh/kW installed** in a moderate global warming scenario⁴⁵. Wind power, meanwhile, is sensitive to wind variability: it must be **shut down during extreme gusts or prolonged periods of no wind**. While some innovative technologies such as floating wind turbines are proving to be more resilient – such as **Floatgen**, which withstood winds of **154 km/h** – their cost is still high, reaching up to **four times that of onshore wind turbines**.

39 [INRAE](#), RTE 2023

40 [Public Life](#) and Report Court of Auditors, 2023

41 Boudoussier, 2021

42 [Nuclear Safety and Radiation Protection Authority](#)

43 [Vulnerability report](#)

44 [Press source](#)

45 Ian Peters and Tonio Buonassisi, researchers at the *Massachusetts Institute of Technology* (MIT)

Electricity transmission infrastructure must also cope with **more frequent heat waves** and the risk of fire, causing **cables to expand** and sometimes rendering the grid unusable, reducing transformer efficiency and **decreasing the power transmitted by 1.5% per degree**⁴⁶. Increasing **floods** are weakening facilities, particularly **electrical substations**, **24%** of which will be located in flood zones by **2050**⁴⁷. Underground networks are also at risk, with **incidents increasing eightfold** in the event of high temperatures⁴⁸. During the summer of 2022, Enedis recorded 137 interruptions on the distribution network, some of which were preventive measures to avoid any risk of fire⁴⁹. RTE estimates that more than 30% of the overhead network needs to be adapted to climate change, with the rest either already adapted or not exposed⁵⁰. In some regions, this effort is particularly significant: for example, 55% of the network in Nouvelle-Aquitaine is affected.

Gas pipelines crossing flood-prone areas are also particularly vulnerable⁵¹. 32,000 km of high-pressure pipelines (GRTgaz) transport gas, and many of those crossing waterways could be affected by extreme flooding, which could damage the structures and interrupt the supply of gas⁵².

Added to this is **increasing electrification** (mobility, air conditioning) linked to consumption habits, reinforcing the need for adapted flow management and resilience of the electricity transmission network, which is also impacted by the development of solar and wind power.

46 [Court of Auditors, 2024](#)

47 [RTE](#)

48 [Court of Auditors, 2024](#)

49 [Court of Auditors, 2024](#), Enedis

50 [RTE](#)

51 [Deposit and Consignment Office](#)

52 [Caisse des Dépôts](#)

Faced with these vulnerabilities, infrastructure managers **are making massive investments to strengthen the resilience of the energy system**, both in terms of **transmission and production**. RTE plans to invest **€100 billion by 2040** to adapt its network, with a target of **100% resilience by 2060**. Enedis is **mobilising €96 billion**, including **€8.2 billion** to protect medium-voltage lines against storms. GRTgaz is **securing its pipelines** through directional drilling to bypass flood-prone areas. At the same time, measures are being taken on the production side: **EDF's adaptation programme is strengthening the physical protection of nuclear power plants**, such as Tricastin and Blayais, with the construction of dykes to cope with the risk of flooding, and the **new EPR2 reactors are designed to integrate future climate scenarios**, whether located by the sea or near fast-flowing rivers. For hydroelectricity, **EDF plans to optimise the management of summer flows in vulnerable basins**, while hybrid solutions are emerging, such as **the Floatgen floating wind turbine**, capable of producing even in extreme winds but costing 1.5 to 4 times more than fixed wind turbines, at around £198 to £329/MWh⁵³. **Efforts to reduce and reuse water**, through the modernisation of networks and the use of unconventional resources⁵⁴, complete this action plan. These transformations, although costly, have become essential to guarantee **security of supply** in a context of climate change.

ADAPTATION OF TRANSPORT INFRASTRUCTURE

French transport infrastructure is increasingly exposed to the consequences of climate change. **Extreme heat, flooding, landslides and rising sea levels** directly affect the stability and safety of the road, rail, river and maritime networks. The number of days with temperatures above 35°C is increasing, exposing rails, road surfaces and equipment to expansion, deformation and breakdowns (I4CE). At +3°C, extreme rainfall is expected to intensify, especially in northern France (HCC 2024, I4CE). In **2024 and 2025**, several railway lines were interrupted due to flooding or landslides, and there has been an increase in exposed sections, maintenance requirements and the risk of service disruption (I4CE). In the long term, **disruptions could increase eight – to elevenfold by the end of the century**, according to the Court of Auditors. The risk is not theoretical: with a **1-metre rise in sea level**, nearly **2,000 km of railway lines**, **15,500 km of municipal roads** and **355 km of national roads** would be directly threatened. However, the sector is vital to the national economy: in 2022, **338 billion tonne-kilometres of goods** were transported, **nearly 88% of which was by road**.

Extreme weather events generate significant costs for network operators. During **Storm Alex (2020)**, approximately **70 km of infrastructure was damaged**, resulting in a total of **€500 million in repairs**, including **€25 million for the SNCF alone**⁵⁵. But the economic losses do not stop there: the closure of a single railway line can cost **up to €17.5 million**, as was the case between Montpellier and Béziers in 2019⁵⁶.

53 [Source](#)

54 [Ministry of Economy and Finance](#)

55 [Court of Auditors, 2024](#), CGEDD and IGA 2021

56 [Court of Auditors, 2024](#), PNACC 3

Faced with these threats, public operators are stepping up their adaptation efforts. The **Directorate-General for Infrastructure** is leading a **national assessment of the vulnerability** of the road and rail network. The **SNCF** has put in place an **adaptation roadmap** with a **budget of €6 billion**, including **an additional €2.3 billion** on top of the annual budget of €2.84 billion to regenerate and modernise assets (PNACC 3). Concrete measures include enhanced monitoring, adjustments to operating modes, the use of weather warning tools and innovations such as **white-painted rails** to limit heat. Other countries are also experimenting with **active cooling** (Switzerland) or **physical protection against avalanches** (Austria). If we do not prepare our roads and railways for what is coming, disruptions will become the norm.

DEVELOPMENT OF NEW ADAPTATION OPERATORS

Faced with the intensifying impacts of climate change, a new type of player is emerging to support regions, businesses and citizens in their adaptation efforts. These new operators, whether public or private, provide innovative and targeted solutions to strengthen resilience to climate hazards. However, their development remains limited: of the 2,900 greentech start-ups listed in the BPI France observatory, **fewer than 60 are specialised in adaptation**, a modest figure given the scale of the needs.

The French government has put in place measures to structure support for local authorities in their adaptation efforts. The **Adaptation Mission**, launched in **November 2024**, is a single point of entry to guide local authorities towards state support, measures and operators. It mobilises key institutions such as **Cerema, ADEME, Météo-France**, the **Water Agencies, OFB, ANCT** and **Banque des Territoires**, which combine their expertise to offer operational support, from planning to financing.

At the same time, the private sector is actively pursuing innovation, driven by specialised start-ups. These start-ups are positioning themselves in targeted niches: **30%** of adaptation greentech companies focus on **heat stress**, **20%** on **water stress** and **16%** on **flooding**. Some focus on **data collection, risk assessment and monitoring (17%)**, others on **long-term surveillance and management tools (26%)**, and others on **prevention and disaster recovery (5%)**. Finally, **around 45%** offer **physical adaptation solutions**, such as resilient infrastructure, urban or agricultural equipment.

Concrete examples illustrate this diversity: **Urban Canopée**, which designs green structures to cool cities, and **Seaturns**, which develops devices to generate energy from waves, demonstrate the ability of companies to offer technical responses to local climate impacts.

These innovations require financial support to scale up. Some start-ups have received support through **France 2030, France Relance** or private funds such as **Team for the Planet**, which finances around ten companies involved in adaptation (including **Geev, Midipile, Arekon Energy, Cool Roof France, Beyond The Sea** and **Carbon Time**). This funding not only enables solutions to be tested, but also helps to structure a **green tech ecosystem for adaptation**, which is still in its infancy.

URBAN CANOPÉE – GREENING TO COOL THE CITY

Founded in 2026 by researchers from the Ecole des Ponts ParisTech, Urban Canopée designs lightweight structures made of composite materials, called “Corolles”, which enable urban greening to combat heat stress.

- **Fundraising:** €1.7 million from BTP Capital Investissement and Banque des Territoires
- More than 680 plants and 160 Corolles deployed in 63 cities, mainly in France, but also in Switzerland and Australia
- Objective: to reduce urban heat islands and improve thermal comfort in public spaces
- Place Jean Diebold in Toulouse: Three Corolles have been installed, providing 150 m² of plant cover. They have reduced perceived temperatures by **3 to 6°C**, depending on local conditions
- Montmajour Abbey in Arles: A Corolle was installed in 2023, reducing the ambient temperature by **5°C**

SEATURNS – GENERATING ENERGY FROM WAVES

Seaturns is developing wave energy technology that converts wave energy into clean, sustainable electricity

- 20% of the capital held by Team for the Planet
- Prototype tested at sea in Brest at the end of 2023, withstanding Storm Ciaran, with initial commercialisation planned for 2026 in BtoB
- Objective: To produce energy for more than 700 million households by 2050, creating more than 400,000 sustainable jobs

An aerial photograph of a forest landscape. A river flows through the lower left, with a dam visible. The forest is dense and green, with some cleared areas. The sky is blue with some clouds.

CASE STUDIES

FRANCE AT +4°C:
FINANCING THE ECONOMY'S
ADAPTATION TO CLIMATE CHANGE

AGRICULTURE & NATURAL RESOURCES

Water management - Implementation of a regional water management project (PTGE)

Supported case studies of water users

Key message: The main challenge is to include all stakeholders in a collective approach that aims above all to manage water scarcity.

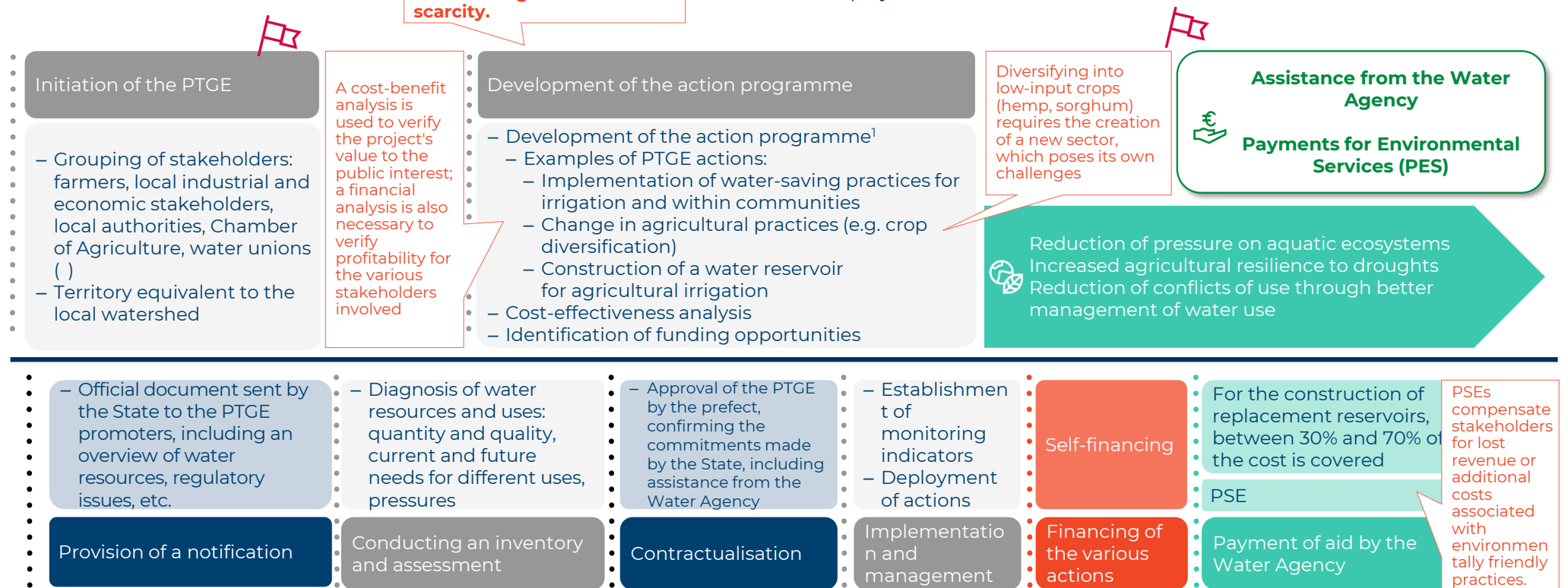
Gain

Project sponsor expenditure project

Administrative process

Operational constraints

Main obstacles



1. The action programme of a PTGE includes numerous actions, but here we have considered only a few in order to simplify the reading

PRESENTATION OF THE ADAPTATION ISSUE

The aim here is to follow the funding process for the implementation of a Regional Water Management Project (PTGE), bringing together around a hundred farmers, local industrial and economic players, as well as local authorities, water agencies, basin managers and water unions. The PTGE aims to organise, at the regional level, a concerted, quantitative and qualitative management of water resources, in a context of increasing scarcity and tension over usage linked to climate change.

While the construction of a water reservoir is sometimes a symbolic investment, it cannot be considered the main lever or the ultimate goal of a PTGE. When it is considered, as a last resort after a variety of other agroecological levers have been activated, it must meet a number of conditions to ensure its hydrological relevance and sustainability and limit its ecological impact. The creation of such infrastructure must be studied on a case-by-case basis and must necessarily be accompanied by regulation of the volumes authorised for farmers, as part of a collective and multi-stakeholder approach to water conservation.

In practice, a PTGE mobilises a much broader range of complementary actions and investments that go far beyond the issue of storage facilities alone. It may include improving water resource management, for example through the installation of meters equipped with remote transmission devices that enable real-time monitoring of the volumes withdrawn. It may also aim to reduce leaks in drinking water supply and distribution networks through the installation of sector meters and targeted network renewal programmes.

The PTGE may also encourage and promote the recirculation and reuse of process water in industrial activities, as well as the recovery of so-called unconventional water to meet agricultural needs, whether from hillside reservoirs, rainwater harvesting or the reuse of treated wastewater from treatment plants (REUT). These various investments contribute to diversifying available sources, securing certain uses and reducing direct pressure on natural environments.

Beyond infrastructure, the PTGE also relies on changes in agricultural practices to reduce water consumption at source. This involves promoting more sustainable practices, such as adapting crop rotations, choosing less water-intensive crops (such as sorghum or hemp), modernising irrigation systems, and restoring aquatic ecosystems, which are essential to the proper functioning of the water cycle. These levers help to strengthen the resilience of farms and prevent conflicts of use by engaging all stakeholders in the region in a sustainable and shared approach to resource management.

While some of these actions do not require heavy investment comparable to that of a hydraulic structure, they nevertheless generate significant additional costs and sometimes lost revenue, particularly during the start-up and transition phase. The financing of a PTGE must therefore include not only physical investments, but also the costs associated with territorial engineering, project management, technical support and economic security for the stakeholders involved in this transformation.

WHAT IS A PTGE?

Territorial Water Management Projects (PTGE) emerged in France in 2015, in a context of strengthening quantitative water management policies in response to growing pressure on resources.

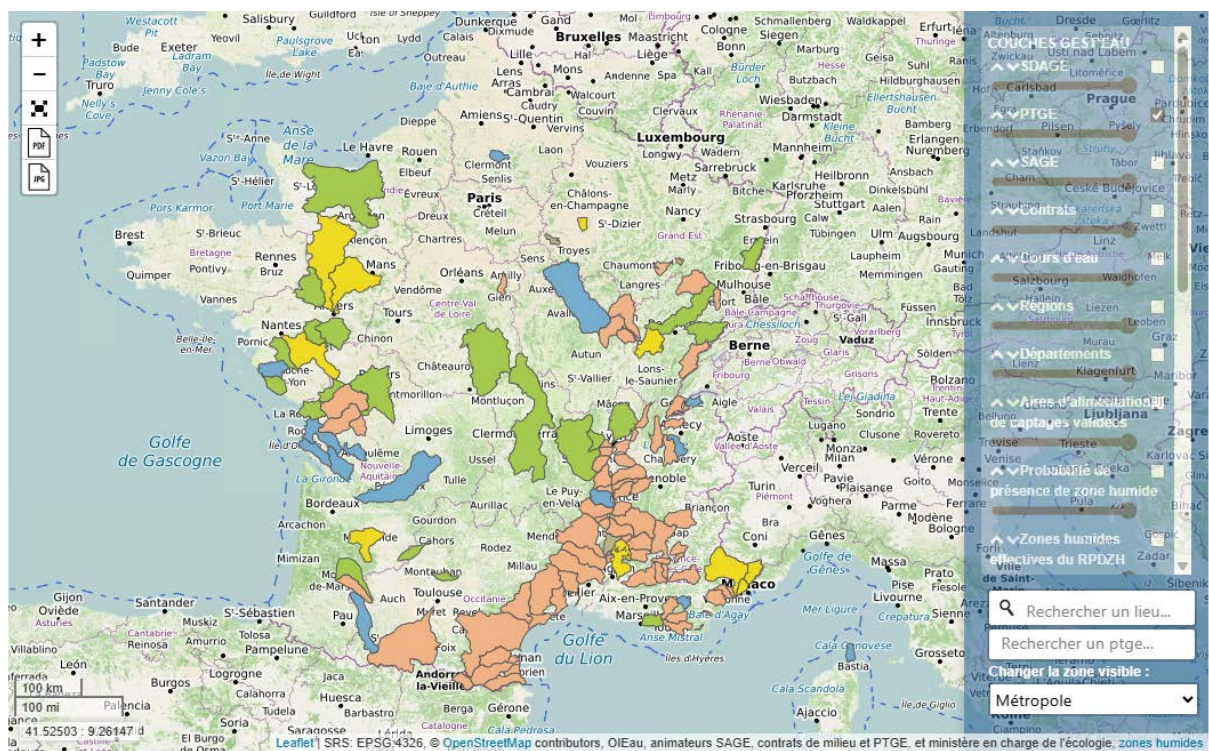
PTGEs are an approach aimed at providing a framework for regional consultation to anticipate and sustainably manage water resources within a defined regional perimeter in the context of climate change. These projects aim to co-develop locally adapted solutions based on the field knowledge of stakeholders, promoting both socio-economic benefits and positive environmental effects, in line with sustainable development principles. The initial objective of a PTGE is to build local consensus on water conservation before even targeting infrastructure construction. Hydraulic structures (dam heightening, water reservoirs) may be considered in support of the PTGE (e.g. EDF dam heightening to support low water flows). They also incorporate the need to preserve water quality by addressing sources of pollution, whether diffuse or point sources. PTGEs thus not only make it possible to anticipate tensions, reduce conflicts of use and preserve ecosystems, but also to strengthen the resilience of territories in the face of ongoing climatic and economic changes. They bring together a variety of stakeholders: local authorities, farmers, industrial players, etc.

To date, 71 PTGEs have been registered in France, at various stages of progress.

71 PTGE ou équivalent recensés
dont 20 avec des projets de
stockage d'eau intégrés au
programme d'actions



Figure – Overview of PTGEs to date (Source: Chambers of Agriculture)



LEGENDE :



Figure – Map showing the location of PTGEs (Sources: Gest'eau)

Focus on the creation of water reservoirs

The creation of water reservoirs is part of the water plan. There are three main types of water reservoirs:

- **Dams in the minor bed**, directly located in the usual bed of the watercourse
- **Hillside reservoirs**, whose water comes from rainwater runoff or sometimes agricultural drainage
- **Reservoirs disconnected from the hydrographic network and fed by pumping**: Water can be stored either from withdrawals made during periods of high water, when there is a surplus, or from the reuse of treated wastewater from urban treatment plants (REUT). These volumes can then be used during low water periods to meet demand without harming aquatic ecosystems. Depending on the situation, this type of storage can either replace summer withdrawals (known as substitution) or meet new uses, provided that the balance of water resources is preserved.

The government's position on water storage facilities primarily intended for agricultural use, as outlined in the document "*Government Policy on Water Storage Facilities Primarily Intended for Agricultural Use*", emphasises that secure access to resources, made possible by the creation of reservoirs, must serve as a lever to accelerate the agroecological transition. This security must be accompanied by concrete commitments from farmers to adopt more sustainable practices: reducing the use of chemical inputs, optimising the volume of water used per hectare, adapting crops to local conditions (choosing species or varieties that consume less water), and improving the soil's capacity to retain and infiltrate water.

The construction of a substitute water reservoir is one solution to ensure the availability of water resources for agriculture. However, this project requires significant financial resources. In particular, the construction of a water reservoir with a storage capacity of one million cubic metres requires an estimated investment of €6 million ([source](#)).

Testimonial from Garance Siestrunck, (Water Management Officer, Chamber of Agriculture)

"The controversial water reservoir projects mainly concern old projects dating back some twenty years, designed outside the PTGE framework and without the current management tools. These were mainly agricultural projects, without public consultation and without the support of a multi-stakeholder dynamic. Today, water retention projects developed within the framework of PTGE are the result of public and multi-stakeholder consultation.

The main obstacle to the implementation of PTGE identified in the 2023 follow-up report by the Chambers of Agriculture is the lack of funding. Apart from subsidies for the construction of replacement water reservoirs by the Water Agencies, there is no dedicated funding for PTGE, which often blocks projects in the implementation phase.

DESCRIPTION OF FINANCIAL MECHANISMS

PTGEs receive partial financial support from water agencies. Water agencies can provide support for investments in new infrastructure as well as changes in farmers' practices.

AID FOR AGRICULTURAL INVESTMENTS

Investments such as the construction of replacement reservoirs receive partial funding. However, the remaining amount varies depending on the project. In the case of a €6 million project, 51% of the total cost, or €3.06 million, is covered by the local water agency. The remaining €2.94 million is financed by the farmers through a bank loan, which they then repay in annual instalments.

The subsidy rate determines the economic interest of the project for farmers. Indeed, a financial analysis reveals that, from a private point of view, a subsidy of less than 51% would not be desirable for irrigating farmers, for whom the annual repayments on the bank loan would be too high in relation to the level of their profits. (See INRAE guide "*Economic and financial analysis of regional water management projects (PTGE) with an agricultural component*" Appendix 6).

Funding by water agencies is subject to specific conditions. Farmers benefiting from irrigation from reservoirs are subject to targets for reducing the volume of water used. Each water agency has specific prerequisites. For example, the creation of a replacement reservoir in Loire Bretagne can be subsidised by the local water agency up to 50% if the project meets certain conditions:

→ Zoning conditions: the reservoir project must be included in an approved PTGE (water management plan) in an area experiencing water resource imbalance, where there is a Single Collective Management Organisation (OUGC), a structure responsible for managing and distributing water volumes withdrawn for agricultural use.

- Conditions related to the structure: the water reservoir built must be collectively owned
- Conditions for beneficiaries: farmers affected by the water reservoir must implement an individual programme for transition to agroecology, with performance obligations

Furthermore, a water agency cannot award a grant for a project to build replacement reservoirs for agricultural irrigation under a PTGE when the project is located in an area with a significant quantitative imbalance in water resources. These areas, known as water distribution zones (ZRE), correspond to sectors where available resources are structurally insufficient to meet demand. In these ZREs, any withdrawal exceeding 8 m³ per hour is subject to authorisation, while others require at least a declaration. This classification leads to tighter regulatory constraints on non-domestic water use in these areas and prohibits any new withdrawals, unless they are in the public interest. New authorisations can only be considered once a sustainable balance between use and resources has been established.

PAYMENTS FOR ENVIRONMENTAL SERVICES

Payments for environmental services (PES) are an incentive-based financing mechanism designed to compensate farmers and other stakeholders in the field for services rendered to ecosystems, such as preserving water quantity and quality, biodiversity and soil carbon. PES support farmers in changing their agroecological practices.

These schemes are being implemented by a growing number of public and private actors. Water agencies are the main operators, notably through payments for the non-degradation of resources. Joint initiatives, such as the Hauts-de-France Regenerative PSE (Pour une Agriculture du Vivant, Artois-Picardie Water Agency), or purely private initiatives such as those of Vittel, McCain and LVMH, combine direct financial incentives to encourage changes in agricultural practices. However, their deployment remains limited by methodological (measuring environmental results), economic (long-term incentive payments) and collective (massification at the regional level) challenges.

Public PES, supported by the Ministry of Ecological Transition and water agencies, are part of the 2025-2030 intervention programmes at the river basin level. These schemes provide remuneration over a period of five to seven years for the management of water and landscape structures (hedges, ponds, wetlands) and production systems (plant cover, carbon and nitrogen management). For example, the Loire-Bretagne Water Agency's action plan is mobilising €2.43 billion over six years to support agricultural and ecological transition. At the same time, private PES are being developed, such as that of the Carabes & Canopée association, which directly links companies and farmers for the management and densification of hedges. These PES, which can be combined with agri-environmental measures (AEMs), offer greater territorial flexibility and remuneration proportionate to the efforts made, contributing to the emergence of a biodiversity economy rooted in the territories.

POSSIBLE IMPROVEMENTS

The success of a Territorial Water Management Project (PTGE) depends first and foremost on **broad and structured consultation**, bringing together farmers, industrialists, local authorities, environmental associations and basin managers. This multi-stakeholder approach, now explicitly recommended by the Ministry for Ecological Transition, aims to build an **ecological, economic and political consensus** around water resources.

However, feedback shows that this consultation, although necessary, **sometimes struggles to translate into concrete projects**: the absence of shared prioritisation, the lack of financial visibility and the difficulty in putting together solutions that are accepted by all hinder the operational implementation of PTGEs. Hence the need for a framework **that clearly identifies the priority needs of the territory** and translates them into appropriate projects, co-decided with local stakeholders.

To enhance the effectiveness and ambition of PTGEs, it is therefore not enough to simply discuss the issues collectively; it is also necessary to **structure a territorial programme of actions** based on robust and prioritised assessments – water savings, agroecological transition, collective management of withdrawals, modernisation of networks, ecological restoration, development of unconventional water sources, etc. It is therefore essential to put in place **financing that is tailored to specific territorial characteristics**: this secures the commitment of stakeholders, enables the emergence of solutions that balance different uses, and facilitates adherence to shared governance. Such a mechanism would consolidate local dynamics, reduce tensions over use, and make the PTGE a **genuine territorial management tool** promoting water sobriety and resilience.

The rise of PTGEs also requires better coordination **between public funding and private capital**. Today, existing budgetary mechanisms cover part of the needs, but remain insufficient to support the diversity of adaptation levers. It is therefore necessary to identify the **complementarities between public aid (water agencies, local authorities, state mechanisms, etc.) and private funding** in order to enable investment in a variety of solutions: leak reduction, measuring equipment, irrigation optimisation, agroecological innovations, water reuse infrastructure, etc. By working further upstream on this financial closure, local consultation gains credibility and increases its chances of success.

Finally, **payments for environmental services (PES)** are a key lever for making adaptation trajectories **economically viable** and mobilising private funds at the regional level. By remunerating farmers and actors in the field for the environmental benefits they produce — resource protection, carbon storage, hedge maintenance, biodiversity — PES make it possible to reconcile ecological transition and economic sustainability. **Their widespread adoption would be necessary to move from ad hoc initiatives to a genuine policy of remuneration for environmental performance in line with the regional objectives set out in the PTGEs.**

The Agricultural Water Fund, launched by the Ministry of Agriculture, may in some cases be a relevant response for financing agricultural actions included in the PTGEs. Established in 2024, this scheme aims to subsidise initiatives that secure sustainable access to water for farms, while respecting the balance of resources and adapting to climate change.

With a budget of €20 million in 2024, rising to €30 million in 2025, this fund has supported 48 projects since its inception, covering a wide range of actions related to water management in agriculture:

- 17 water retention projects, including 11 hillside water retention projects
- 11 projects to create or extend irrigation networks
- 11 projects to renovate or optimise hydraulic infrastructure
- 4 projects to raise/expand hydraulic infrastructure
- 4 projects to renovate/rehabilitate irrigation networks
- 1 project to reuse wastewater for irrigation

AN EXAMPLE OF A GOOD INITIATIVE THE PUISEAUX-VERNISSON PTGE, A SUCCESSFUL EXAMPLE OF CONSULTATION ON ADAPTING TO AGRICULTURAL WATER ISSUES

In the Centre-Val de Loire region, a group of farmers launched a collective reflection process on sustainable water management in 2010, which resulted in the development of a PTGE.

This project illustrates how regional consultation can anticipate the impact of climate change on water resources. Certified in 2020 and now supported by the EPAGE du Bassin du Loing, this project aims to achieve a balanced distribution of water between agricultural uses, aquatic environments and public safety: hydrological assessment, water conservation objectives, and selection of an action programme based on the SDAGE/SAGE of Seine-Normandie.

FUNDING BACKED BY EXPERTISE AND THE GEMAPI TAX

EPAGE was chosen to coordinate the project because it already exercised GEMAPI (aquatic environment management and flood prevention) competence in the Loing basin. This competence allows inter-municipal authorities to levy a GEMAPI tax (maximum: €40 per inhabitant) allocated to the maintenance of watercourses, flood prevention and, in this case, the PTGE coordination centre and initial hydraulic works. Thus, a portion of the GEMAPI revenue supplements subsidies from the Water Agency, the Region, the Department and European funds, while farmers provide private co-financing.

A CONCRETE AND COSTED ACTION PROGRAMME

The plan approved by the basin prefect includes several actions: the creation of seven hillside reservoirs fed by runoff and agricultural drainage water for agricultural irrigation (367,500 m³, €4-5 million), restoration of two hectares of wetlands (~€100k), widespread use of decision-making tools such as Net-Irrig, ecological continuity works and water-saving measures. Investments are staggered, monitored every six months and adjusted using volume/flow indicators.

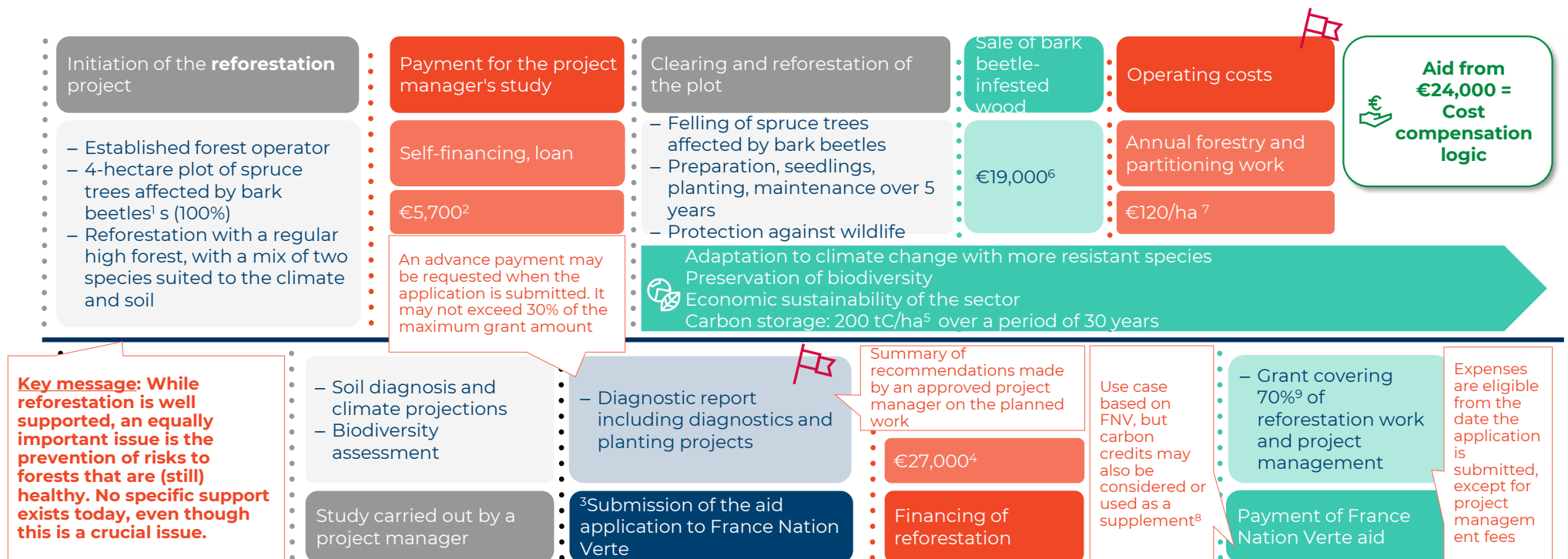
A VARIETY OF BENEFITS

The Puisieux-Vernisson PTGE generates economic and environmental benefits across the region. Securing irrigation through the creation of reserves limits yield losses during periods of drought and stabilises agricultural incomes. On a collective scale, the project helps to reduce conflicts of use, support low water flows and mitigate flood risks across the 24,000 hectares of the basin. The rehabilitation of wetlands, which is part of the action programme, strengthens the resilience of ecosystems, improves water quality, promotes biodiversity and provides natural flood control functions, thus contributing to a virtuous circle of territorial adaptation.

Forestry - Reforestation of a plot of spruce trees damaged by bark beetles with a mix of new species

Case study accompanied by a forestry operator

Gain Operator's expenditure Administrative procedures Operational constraints Main obstacles



1. Average size of private forests in mainland France in 2021: 4 ha (CNPF). Spruce accounts for 7% of the standing timber volume in private forests (IGN). Almost all spruce forests are affected by bark beetles (ONF). | 2. Project management costs covered by the France Nation Verte subsidy: €1,500 + 16% of the cost of work for farms between 4 and 10 hectares. | 3. Aid is subject to eligibility criteria: having a SIRET number; having a sustainable management document; having a felling permit issued by the CNPF; the minimum amount of public subsidy must be greater than or equal to €3,000 and less than €2,000,000; Plots with an area of between 4 and 10 hectares must be reforested with at least two species. | 4. Average reforestation cost per hectare of €4,400/ha; + the cost of wildlife protection measures of €2,280/ha (LegiFrance.fr) | 5. Hummingbirds | 6. Volume of harvestable timber at maturity of 475 m³/ha (CNPF), with a recorded price of €40/m³ (ONF) | 7. Le Revenu.fr | 8. The low-carbon label can be obtained if the subsidised amount is less than 50% | 9. France Nation Verte's minimum coverage for damaged stands is 50%, plus a 20% surcharge for the "bark beetle & crisis wood" criterion. The coverage rate can rise to 100% ("Faire filière" criterion, PEFC/FSC certification) (FNV)

PRESENTATION OF THE ADAPTATION ISSUE

This case study follows the financing process for the reforestation of a private forester's spruce plot, which was ravaged by bark beetles.

French forests are on the front line of climate change, the impacts of which are already tangible: drought and fire, water stress, proliferation of pests (e.g. bark beetles) and diseases, disruption of biological cycles, etc. Climate change is thus damaging French forests, which are vulnerable due to factors such as low diversification on many plots, which limits their natural adaptability.

Bark beetles are a major problem in France, as they are throughout Eastern Europe. Spruce forests are particularly affected, especially in the Grand Est, Jura and Massif Central regions. Following bark beetle attacks, spruce trees die and the market value of their wood plummets. Foresters often have to cut down their trees hastily to contain contamination and falling prices by trying to sell the wood while it is still green.

In this context, reforesting decimated forest plots with a variety of species aims to create forests that are better suited to their natural environment, more resilient, richer in biodiversity and more economically sustainable in the context of climate change. Reforestation of this type of forest also helps to limit the collapse of carbon storage capacity in France.

However, forest owners who wish to reforest their plots must mobilise significant resources to finance the reforestation of their plots with species adapted to soil and climatic conditions. It will take several decades before the new plants reach the necessary maturity and can be exploited, complicating the economic balance of their property.

DESCRIPTION OF FINANCIAL MECHANISMS

Public aid schemes exist to support private and public foresters, such as the forest renewal fund under France Nation Verte. This aid scheme follows on from the "France Relance" and "France 2030" programmes and has been accepting aid applications since November 2024. Designed to support forest owners whose plots are affected by climate change, this aid helps finance forest renewal (reforestation) work, subject to certain eligibility criteria.

In addition, the Low Carbon Label makes it possible to obtain private funding that acts as investment aid. The Low Carbon Label can be combined with the France Nation Verte scheme if the latter covers less than 50% of the reforestation cost.

In forestry, this label is used to financially reward climate-friendly actions, such as the afforestation of non-forest land, the restoration of degraded stands or the improvement of forest management practices. The label also includes criteria relating to adaptation and biodiversity to ensure co-benefits. Forest owners who meet the criteria of a method validated by the Ministry of Ecological Transition can obtain this certification after an assessment of their project's carbon impact. Once certified, the project can generate carbon credits corresponding to the tonnes of CO₂ sequestered by the stands.

Finally, there are other forms of assistance available, such as the Défi Forêt (Forest Challenge), European subsidies via the EAFRD, regional subsidies and tax incentives.

Here, in the context of this use case, the France Nation Verte scheme aims to offset the costs incurred by forest owners by minimising their financial outlay. Owners wishing to reforest their plots of spruce trees ravaged by bark beetles can thus benefit from support from France Nation Verte, via component 1 “Damaged stands”, which guarantees them a minimum coverage rate of 50% of the cost of reforestation work. The presence of bark beetles entitles them to a 20% increase, bringing the coverage rate to 70% of the cost of the work. This can even reach 100% through other criteria (sustainable management certification and industry bonus).

The high coverage rate prevents this scheme from being combined with the Low Carbon Label (no combination is possible if public coverage exceeds 50%).

Testimonial from Laurent De Bertier, (CEO of Fransylva)

“Several public aid schemes currently exist to support the timber industry in crisis situations, depleted or declining stands, or to promote the reforestation of abandoned agricultural land. On the other hand, day-to-day forest management, carried out by foresters, receives little support. Those who wish to anticipate the effects of climate change often have to carry out technical assessments, which are essential for guiding their management choices, but are costly and not covered by current aid schemes.

Yet such assessments would enable them to accurately assess the condition of their forest, adapt their silvicultural strategy, and select more resilient species that are better suited to future conditions.

Testimonial from Alexandre Lépée, (Business Development Manager, Hummingbirds)

“It is becoming increasingly difficult to market carbon credits at a price that covers the real costs of a forestry project. Competition is driving prices down, subsidies are still poorly aligned with the requirements of the Low Carbon Label, and while the constraints of the label are tightening, implementation costs continue to rise. This combination undermines the economic viability of many projects.”

LIMITATIONS AND POSSIBLE IMPROVEMENTS

While the rate of coverage of forest renewal costs provided for by the France Nation Verte scheme is attractive, the procedure for obtaining aid and the subsidy application process could be simplified to make it easier for as many people as possible to take advantage of it. It would also be useful to strengthen personalised support, similar to the initiative launched by Fransylva (the federation of private forestry unions in France), which offers support to its members on request. Finally, the dissemination of information about the scheme could be expanded beyond the current channels, which are local forestry unions. In addition, the link between France Nation Verte and the Low Carbon Label could be streamlined to facilitate the accumulation of funding.

Financing a project using the Low Carbon Label requires time and investment on the part of the project leader. This scheme poses a financial risk shared between the financier – exposed in the event of an overestimation of anticipated carbon credits – and the forest owner, who bears the risk if the actual credits are lower than forecast. This risk is generally mitigated by using conservative assumptions in estimating the tonnes of CO₂e sequestered.

The potential future European carbon credit framework introduces a significant financial risk: whereas in the current ex ante model, all credits for a 30-year forestry project can be issued as early as the fifth year following the verification audit, the proposed reform imposes an “ex-post” model in which the first issuance of credits would only take place after five years, following an initial verification audit, and would be limited to credits corresponding to the tonnes of CO₂e actually sequestered over the last five years. Other credits would be issued in the same way at least every five years following a new verification audit. The activity period (which corresponds to the period during which credits can be generated) is set at 30 years, with an additional 10 years of monitoring. The total monitoring period, which also corresponds to the duration of the temporary certificates, will therefore be 40 years. This model would thus spread carbon credit emissions over a 40-year cycle, instead of a single issue of all credits after five years. Such a model is likely to create significant pressure on project developers' cash flow.

Version 3 of the Low Carbon Label's afforestation and degraded forest restoration methods, to be rolled out in 2025, introduces stricter requirements that increase the pressure on the economic viability of afforestation and reforestation projects backed by the sale of carbon credits. However, a version 3bis was finally adopted, which limits the economic impact on projects. But this new methodology reduces the recognised carbon volumes for planted trees by 15 to 50%. In this context, an increase in the price of carbon credits is necessary to ensure the sustainability of projects.

Additional measures appear necessary to encourage wider adoption of the Low Carbon Label, particularly by bridging the gap between voluntary action and regulation. To date, only airlines and coal-fired power plants are required to offset 50% of emissions from domestic flights, based on a price cap of €40/t of CO₂ — a threshold that is supposed to be raised to €50, but whose application remains pending.

This obligation could be extended to other high-emission sectors in order to strengthen the sources of funding available for carbon credit-based projects, particularly forestry projects. Beyond regulatory levers, greater efforts to raise awareness among French companies of the benefits of carbon credits appear essential: the aim is to change perceptions, so that these credits are no longer seen as a simple act of patronage, but as a strategic investment in favour of ecological transition. It is also a question of increasing the number of financing mechanisms that could be considered by private financiers, such as payments for ecosystem services.

Furthermore, current schemes such as carbon credits and France Nation Verte are proving effective for afforestation and reforestation projects thanks to high levels of financial compensation, but do not sufficiently cover prevention and adaptation measures for existing stands in good health.

For forests in good health, the need to adapt to climate change mainly involves technical and human support, rather than heavy investment. In such cases, adaptation can be based on progressive silvicultural management, with species replacement over the long term, without immediate large-scale reforestation. In this context, regular expert support – for example, in the form of a free diagnostic visit every one to two years – would be an effective and inexpensive preventive measure, enabling forest owners to better assess the vulnerabilities of their forests to climate hazards and to raise awareness of the challenges of adaptation and diversification. This is one of the roles of the public institution CNPF, but its resources are too limited to really meet this need.

AN EXAMPLE OF A GOOD INITIATIVE THE LIFE FORECAST PROJECT – A STRUCTURED AND COLLABORATIVE RESPONSE

Between 2016 and 2020, a regional nature park coordinated an ambitious project with the support of the European LIFE programme: the FORECAST project. It brought together several key partners: the Centre National de la Propriété Forestière (CNPF), the Alliance Forêts Bois cooperative, and local authorities. Together, they developed a comprehensive programme with a clear objective: to help forest managers anticipate and adapt their forests to the effects of climate change.

Several measures have been put in place across the region:

- 25 experimental sites to test different adapted silvicultural management methods (thinning, enrichment, natural regeneration)
- 3 arboretums to experiment with tree species that are more resilient to the future climate
- 100 soil pits to better understand soil water retention
- 112 diagnostics of tree decline to establish priorities for intervention

These actions have helped build a shared base of technical knowledge that is useful to all managers, whether they are private owners, cooperatives or local authorities.

MIXED FUNDING FOR CONCRETE RESULTS

The LIFE FORECCASt project had a total budget of €1,314,300 over 45 months (from July 2016 to April 2020) to implement a comprehensive programme for adapting forests to climate change. The project was delivered on time, with a minimal budget overrun (103% of the initial budget) and a slight extension to finalise the digital deliverables.

Funding was shared among seven contributors:

Funder	Contribution (%)	Estimated amount (€)
LIFE Programme (EU)	60%	~ € 788,580
CNPF (National Forest Ownership Centre)	11.8%	~ € 155,086
Occitanie Region	10.8%	~ € 142,944
Haut-Languedoc Regional Nature Park (lead partner)	6.5%	~ € 85,429
Hérault Department	5.4%	~ € 70,972
Tarn Department	5.4%	~ € 70,972
Alliance Forêts Bois	0.25%	~ € 3,286

This multi-level budget structure (European, regional, departmental, local, professional) is an example of good territorial coordination. It has made it possible to spread the financial risks, involve stakeholders in the field from the design phase onwards, and secure funding for various items (employees, equipment, R&D, training, digital tools, communication).

FORECCASt has directed its funding towards directly operational actions, with concrete deliverables for forest managers:

- **Experimental forestry sites:** soil preparation, planting of species, scientific monitoring
- **Development of digital tools:** mobile application co-developed with professionals (FORECCASt by BioClimSol)
- **Acquisition of soil and climate data:** creation of regional databases that will be useful beyond the project
- **Training and awareness-raising:** organisation of conferences, technical publications, support for elected officials and managers
- **Skills transfer:** integration of the application into the national infrastructure of the CNPF

Zoom: the FORECCAsT by BioClimSol application, a tool for managers

One of the project's most significant deliverables is the FORECCAsT by BioClimSol application, a decision-making tool designed to support forest management choices by taking climate change into account. This application combines:

- Georeferenced data (precipitation, temperatures, water balances, terrain characteristics),
- User-entered data (stand composition, health status, management history),
- An in-depth soil analysis, facilitated by data collected in the field during the project.

The tool provides a **climate vigilance diagnosis** and offers **tailored recommendations** to improve the resilience of stands, whether for existing forests or reforestation projects.

Since 2023, the application has been available through paid training. The revenue generated contributes to its maintenance, improvement and nationwide deployment.

CONCRETE IMPACTS FOR FORESTERS, MOMENTUM GAINED

The project has reached more than 30,000 people, the majority of whom are stakeholders in the forestry sector, particularly public and private foresters directly involved in adapting their forests. It has helped to establish a foundation of new practices based on detailed field observations, experience sharing and available climate data.

Among the results:

- **70% of the foresters involved** believe that the project will lead them to change their management practices.
- **New silvicultural itineraries** have been tested in the field, with more than 30,000 trees planted and 32 species tested.
- **An action plan in the event of a climate crisis** has been distributed to more than 3,000 elected officials and managers, facilitating rapid decision-making in the face of uncertainty.
- The adaptation levers mobilised respond to specific concerns:
- **Optimisation of water management** through targeted thinning and the choice of species less sensitive to drought.
- **Reduction of economic risks** through better anticipation of losses and diversification of outlets for local timber.

WHAT NEXT? AN APPROACH THAT CAN BE REPLICATED IN OTHER FOREST AREAS

The tools developed with and for managers are now being used in other forest areas. Several local authorities have expressed their willingness to draw inspiration from them. The data, methods and digital application are now hosted by the CNPF, ensuring their long-term maintenance, updating and dissemination.

This continuity enables foresters to gradually take ownership of the tools, train their teams and integrate climate adaptation into their management plans, regardless of the size of their forest.

Discussions are underway to integrate these approaches into other funding mechanisms, such as the CAP, regional adaptation funds, or through partnerships with ADEME or public banks.

LESSONS LEARNED FROM THIS EXPERIMENT:

- **Mobilising dedicated adaptation funding:** the LIFE programme has been instrumental, as it is specifically dedicated to the environment and climate. This is a lever that is still under-used by many forest areas.
- **Build strong local partnerships:** the involvement of local authorities (region, departments, regional nature park) facilitated the ownership of the project on the ground.
- **Involving professionals from the outset:** the contribution of the CNPF and Alliance Forêts Bois to the technical design of the actions ensured their relevance for managers.
- **Considering sustainability from the outset:** a realistic economic model and transferable tools are among the guarantees of continuity for foresters after the end of the project.
- **Integrate co-benefits:** by linking adaptation, water management, biodiversity and the timber industry, the project appealed to a wide range of stakeholders, which facilitated its funding and dissemination.

An aerial photograph of a coastal landscape. A winding river flows through a green, hilly area towards a small town with a cluster of buildings. The town is situated near a body of water, which is visible in the upper right corner. The overall scene is captured from a high angle, showing the natural contours of the land and the layout of the settlement.

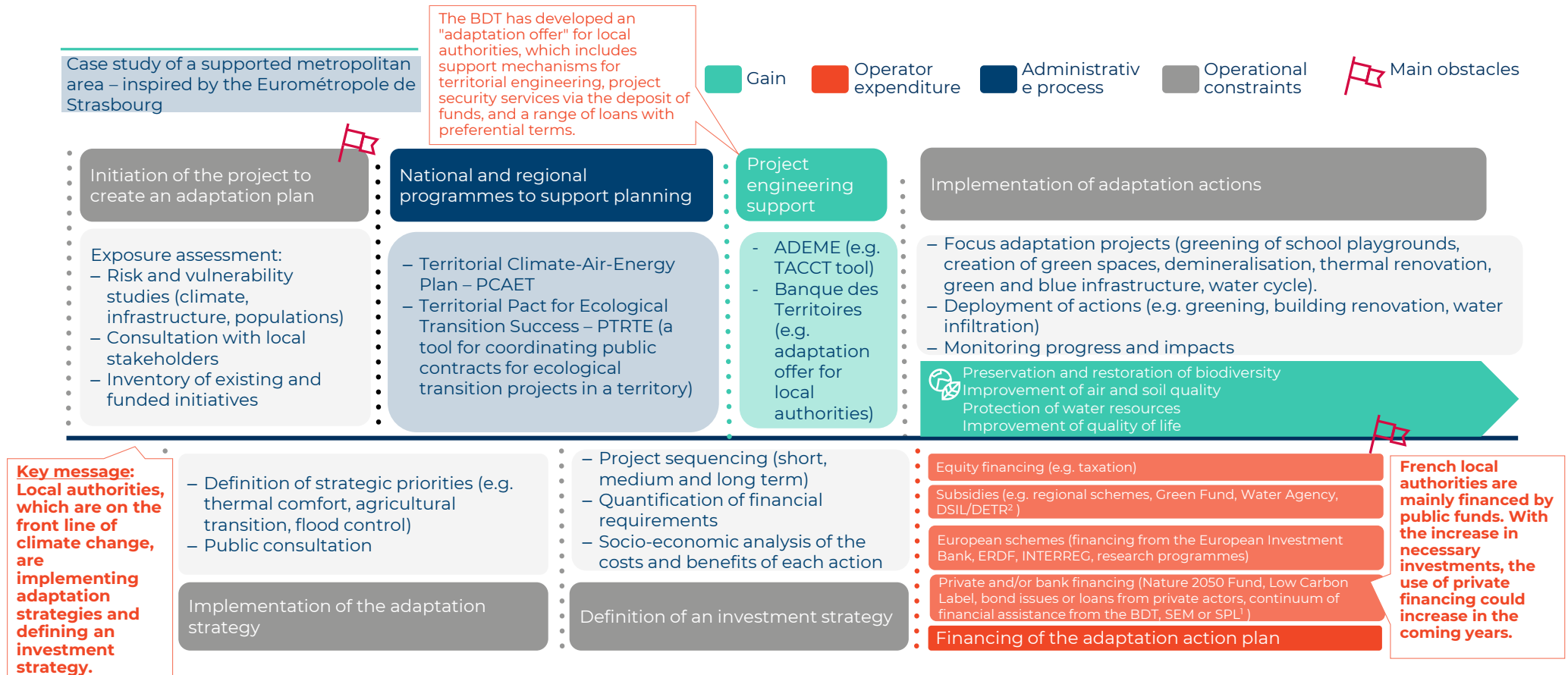
CASE STUDIES

FRANCE AT +4°C:
FINANCING THE ECONOMY'S
ADAPTATION TO CLIMATE CHANGE

URBAN PLANNING AND TERRITORIES

CASE STUDY 2.A: ADAPTATION PLAN FOR A METROPOLITAN AREA

Urban Planning and Land Use - Adaptation Plan for a Metropolitan Area



1. Local authorities or their groupings may create local semi-public companies (SEM) or local public companies (SPL) whose purpose is to incorporate a public project into an entrepreneurial approach that sometimes requires expertise specific to the private sector | 2. DSIL = Local Investment Support Grant and DETR = Rural Areas Equipment Grant.

PRESENTATION OF THE ADAPTATION ISSUE

Local authorities, which are on the front line when it comes to climate change, can implement adaptation strategies to make their territories more resilient to climate change. The attractiveness of territories remains a key issue in the context of climate change.

The implementation of these objectives depends on the assessment of exposure to climate hazards and is carried out in consultation with the various local stakeholders, in particular through national and regional planning support programmes and engineering support provided by various public tools (ADEME, Banque des Territoires, etc.). Strategic priorities may differ from one region to another and are justified according to exposure to risks (e.g. thermal comfort, agricultural transition, flood control, greening and renaturation of cities, creation of green spaces, demineralisation, better water cycle management, etc.). Through their climate change mitigation objectives, several local authorities are already financing projects with a co-benefit of “adaptation” that should be identified and better promoted (e.g. decarbonisation of buildings, nature-based solutions) in order to deploy an adaptation strategy.

French local authorities are mainly financed by public funds. With the increase in necessary investments, the use of private financing could increase in the coming years. The use of private financing can sometimes be perceived as risky. Indeed, the trauma of variable rates applied to local authorities in the past may have led to mistrust of private financing tools, which tends to explain why their use remains residual at this stage. Furthermore, the challenges of adapting territories respond to public good issues, for the benefit of the community, which may also explain why the use of private financing is still residual at this stage. However, public financing mechanisms tend to be insufficient in a context of public expenditure straits. Thus, increasing local taxation is a lever that may have its limits. **It is therefore appropriate for the private financial sector to develop tools tailored to the needs of local authorities according to the nature of the projects.**

DESCRIPTION OF FINANCIAL MECHANISMS

→ **The main lever used by local authorities remains self-financing or “equity” financing.** As such, **increasing tax revenues (through local taxes and duties)** is one of the various means available to local authorities to invest in and finance certain adaptation objectives. **The reallocation of existing budgetary resources**, even if this may be to the detriment of other political priorities, can also be used.

→ **Borrowing:** this allows local authorities to spread their investment efforts over time. For example, cities wishing to finance their climate change adaptation plans can take out **targeted bank loans that promote adaptation and territorial resilience**. Banks are developing a range of financing mechanisms for local authorities. Bond issues or loans from banks can finance certain ecological transition or adaptation measures in local areas. For example, Banque des Territoires offers dedicated loans such as [the Aqua Prêt](#) for financing water management infrastructure, the [Action Cœur de Ville](#) loan, which encourages landlords to integrate biodiversity and adaptation into their urban projects, and the Adaptation loan. It also offers a specific “intracting” tool⁵⁷.

More broadly, the Banque des Territoires recently launched an “[adaptation offer](#)” for local authorities, which includes support mechanisms for territorial engineering, project security services through the deposit of funds, and financing in the form of dedicated loans. This comprehensive support offer is tailored to different types of territories: mountainous, coastal, overseas, and urban, in order to meet their specific needs⁵⁸. **The European Investment Bank (EIB) also offers financing to help cities and businesses implement their climate change adaptation plans.** The EIB invested €12.6 billion in France in 2024, two-thirds of which was earmarked for climate investments⁵⁹. The EIB directly finances projects led by local authorities through long-term loans at favourable rates. It supports investments related to adaptation, such as energy renovation, flood and heatwave-resistant infrastructure, and water management.

→ **The use of grants and public aid schemes** is an important source of funding. The Green Fund, the Barnier Fund, the financial schemes deployed by the Water Agencies, ADEME and regional schemes are all levers that can be used to finance certain adaptation measures by local authorities. **European schemes are also attractive sources of funding for French local authorities.** For example, the ERDF fund and the INTERREG programme also help to strengthen economic and social cohesion in European territories and can meet financing needs related to ecological transition financing objectives. More broadly, the European research programmes LIFE and Horizons also contribute to the debate on the efficiency of adaptation financing in Europe.

→ **Other more innovative levers**, such as the issuance of carbon credits for the development of sustainable forestry projects or projects related to agricultural transition via the Low Carbon Label scheme, can also be activated. “Sponsorship” funding deployed in partnership with local businesses can also be explored.

57 For the specific case of energy renovation work on public buildings, the Banque des Territoires offers “[intracting](#)”. This tool makes it possible to “circumvent” municipal budgetary principles, with the investment budget on one side and the operating budget on the other, without any communication between the two. This financial tool makes it possible to repay an investment through savings made on the operating budget.

58 See the full offer here: <https://www.banquedesterritoires.fr/offres/adaptation-changement-climatique-littoral>

59 <https://www.eib.org/fr/press/all/2025-088-le-groupe-bei-a-investi-126-milliards-d-euros-en-france-en-2024-en-faveur-de-la-croissance-de-la-transition-verte-et-de-l-innovation>

→ In a context of significant financing needs to address climate issues, **public-private partnerships can also be attractive for French regions.** For example, local authorities or their groupings can also create local semi-public companies (SEMs) or local public companies (SPLs) whose purpose is to incorporate a public project into an entrepreneurial approach, sometimes drawing on private sector expertise. These groupings make it possible to outsource the steps to be taken in the region. Another example: Guadeloupe is trialling a local adaptation fund composed of a multi-stakeholder financing committee, which can be accessed by farmers, tourism operators, public institutions and businesses in the region to finance adaptation projects in the region⁶⁰.

Focus on the Territorial Climate-Air-Energy Plan (PCAET)

A PCAET is a mandatory planning tool for inter-municipal communities with more than 20,000 inhabitants (including metropolitan areas). It aims to integrate ecological transition into local policies by covering three areas: mitigation (reducing greenhouse gas emissions and improving energy efficiency), adaptation to climate change (risk prevention, water resource management, reduction of heat islands, protection of vulnerable populations) and improvement of air quality. In concrete terms, the PCAET is used to draw up a territorial diagnosis, define a long-term strategy and implement a programme of concrete actions. It is therefore a reference document that guides choices in urban planning, mobility, housing and resource management at the territorial level, while coordinating public, private and associative actors around common objectives.

In 2025, the aid dedicated to inter-municipal authorities for the development of their Territorial Climate-Air-Energy Plans (PCAET) was doubled: the share of the Green Fund devoted to these plans increased from €100 million to €200 million, without increasing the overall amount of the Green Fund (€1.15 billion).

60 <https://agirpourlatransition.ademe.fr/entreprises/aides-financieres/catalogue/aap/experimentation-dun-fonds-local-dadaptation-en-guadeloupe>

LIMITATIONS AND POSSIBLE IMPROVEMENTS

While the range of financial mechanisms available for adaptation is relatively broad, their actual allocation remains uncertain and sometimes complex for local authorities to mobilise. Familiarisation with these various mechanisms and engineering requirements are essential in order to properly address adaptation issues in the regions. Supporting local authorities in their efforts would enable them to roll out their adaptation strategies more quickly.

Furthermore, in a context of constrained public spending, strengthening the commitment of the private sector appears to be essential. For example, there are currently very few offers specifically dedicated to local authority adaptation in the banking sector⁶¹. More broadly, some municipalities are encountering problems with the insurability of their territories due to their growing exposure to climate risks.

However, some pioneering local authorities are experimenting with innovative solutions, such as the issuance of green bonds – as was the case with the City of Paris in 2017, enabling it to finance its Climate Plan. However, these initiatives remain few and far between, even though they could be rolled out more widely to structure a genuine market for local climate finance. The benchmark for green bonds is the International Capital Market Association (ICMA) Green Bond Principles (GBP), which explicitly include **climate change adaptation** as one of the eligible categories for the use of funds.

A range of “public-private” tools can be developed depending on the nature of the projects to be financed. For example, support for improving the resilience of certain commercial activities in the regions can be provided through co-financing.

AN EXAMPLE OF A GOOD INITIATIVE: THE ADAPTATION STRATEGY OF THE EUROMÉTROPOLE DE STRASBOURG

The Eurométropole de Strasbourg has defined a Climate 2030 action plan to strengthen the resilience of the region in the context of accelerating climate change. This plan comprises several components, with measures to reduce greenhouse gases, protect biodiversity, and also a component on adaptation issues.

This section is organised into five areas:

- Improving and disseminating knowledge about climate change and associated risks;
- Adaptation to rainfall events through sustainable water management;
- Adaptation to heat and strengthening the role of vegetation and water;
- Protection and preservation of water resources;
- Preservation and restoration of biodiversity.

61 With the exception of the Banque des Territoires, which is beginning to develop a range of specific tools, such as for [coastal adaptation](#).

Three areas in particular have been addressed:

- **Promoting rainwater infiltration:** The Eurométropole de Strasbourg has adopted a strategy aimed at **managing rainwater at the plot level** to limit discharges into the public network. All new construction must incorporate infiltration systems (basins, trenches), including in public spaces. This approach, funded by the metropolis and the Rhine-Meuse Water Agency, aims to **reduce the risk of flooding** and **recharge the water table**.
- **Adapting to heat through greening:** To combat **urban heat islands**, the metropolitan area is increasing the **greening of public and private spaces** (pavements, buildings, car parks, courtyards, roofs). This nature-based, low-cost solution **cools the area** through shade and evapotranspiration. The scheme is funded by the city with support from the Rhine-Meuse Water Agency.
- **Reducing leaks in the drinking water network:** The metropolitan area has launched a **real-time monitoring** programme **for the water network**, which is divided into 12 sectors equipped with flow sensors. This monitoring system enables **leaks to be detected quickly** and improves the performance of the network, contributing to **more sustainable resource management**. The operation is co-financed by the metropolitan area and the Rhine-Meuse Water Agency.

The Eurométropole de Strasbourg has adopted a multi-year investment plan (PPI) to support the 2020-2026 mandate, which aims in particular to strengthen the city's ecological transition and resilience to climate change. This PPI was developed with the aim of increasing the metropolitan area's investments by 20% compared to the 2014-2019 term of office, in order to incorporate new projects, particularly actions relating to climate change adaptation. Additional operational investments materialised in 2021, reaching €193 million, after €176 million in 2019 and €127 million in 2020. This trajectory continued until 2024, when operational investment expenditure reached €276 million.

The Eurométropole de Strasbourg mainly used debt to finance its Climate Action Plan. Outstanding debt rose from €579 million at the end of 2020 to €631 million at the end of 2021, an increase of 9%. At the end of 2024, outstanding debt reached €776 million, up 34% compared to 2020. Other sources of funding were used by the local authority, such as **tax increases** (through an increase in property tax). Funding was also sought from **the European Investment Bank**. In addition, certain subsidies were used, such as the "Territorial Water and Climate Contracts" financed by the Water Agency. Additional funding has also been sought with the launch of a new initiative called **Guichet Carbone**, based on a voluntary carbon contribution mechanism. This approach makes it possible to finance carbon sequestration projects using carbon indicators as the main measurement tool. Strasbourg's carbon budget supports various projects, including tree planting, the restoration of hay meadows and the creation of new parks. Thanks to this mechanism, local and external companies can purchase carbon credits and directly finance regional projects. These actions have a dual objective: to reduce carbon emissions and strengthen adaptation to climate change. This model guarantees private funding for concrete environmental initiatives, while offering tangible benefits for the local community. It thus promotes the sustainable participation of businesses in the region's ecological transition. This project is still in its infancy, with less than €50,000 raised to date. A scale-up is needed.

More broadly, the Eurométropole de Strasbourg region is piloting the European research project Horizon ClimateFIT, *launched in 2023, which aims to accelerate the financing of adaptation strategies for European local authorities across various test territories (Eurométropole de Strasbourg, the city of Brescia in Italy, Alba Iulia in Romania and the Flanders Region in Belgium). The Eurometropolis of Strasbourg has identified two projects to be funded on its territory as part of this research project:*

- The creation of a hub around the Port Autonome de Strasbourg to reduce imperviousness and increase vegetation in the southern terminal of the river port.
- The renovation of the Strasbourg Eurometropolis Administrative Centre.

Focus on the methodology developed within ClimateFIT⁶² to support European territories in defining their adaptation strategy and associated investment plan

Led by the World Climate Foundation and funded by the EU's Horizon Europe research programme, this project develops strategies, plans and investment concepts for European territories. Adaptation investment planning is at the heart of the project: it helps public authorities match their adaptation needs to potential projects, with cost-benefit analyses to obtain financial support from the private and public sectors.

The CLIMATEFIT investment planning process involves a five-step approach, in which **territories work to define objectives, assess risks and prioritise options over time, evaluate the cost of adaptation measures, establish the economic and financial case, and build a portfolio of projects**. The approach also emphasises the conditions conducive to effective mobilisation of finance. **Each step is supported by a regional governance mechanism called a 'local resilience working group', which brings together relevant entities from the public sector, the private sector, and financial and investment entities.**

The process is designed to remove the various barriers to adaptation financing and help distribute responsibilities between the public and private sectors based on the economic, fiscal and financial costs and benefits of adaptation. It also relies on guidance and capacity-building activities on financing before and after the investment planning process, with an emphasis on developing adaptation strategies at an early stage, as well as at the project level.

Taylor, R., England, K., and Lea Eggert, A.. (2025) Developing an Adaptation Investment Plan [Link].

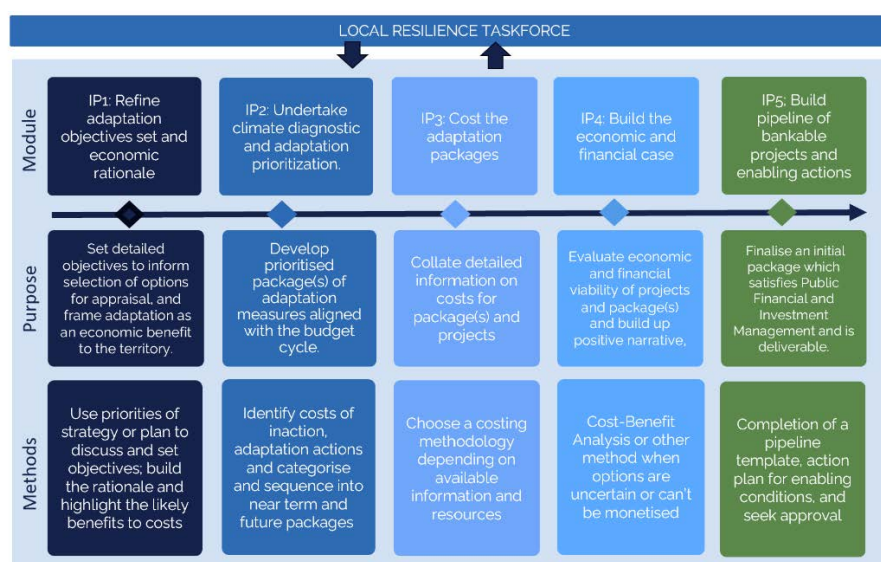
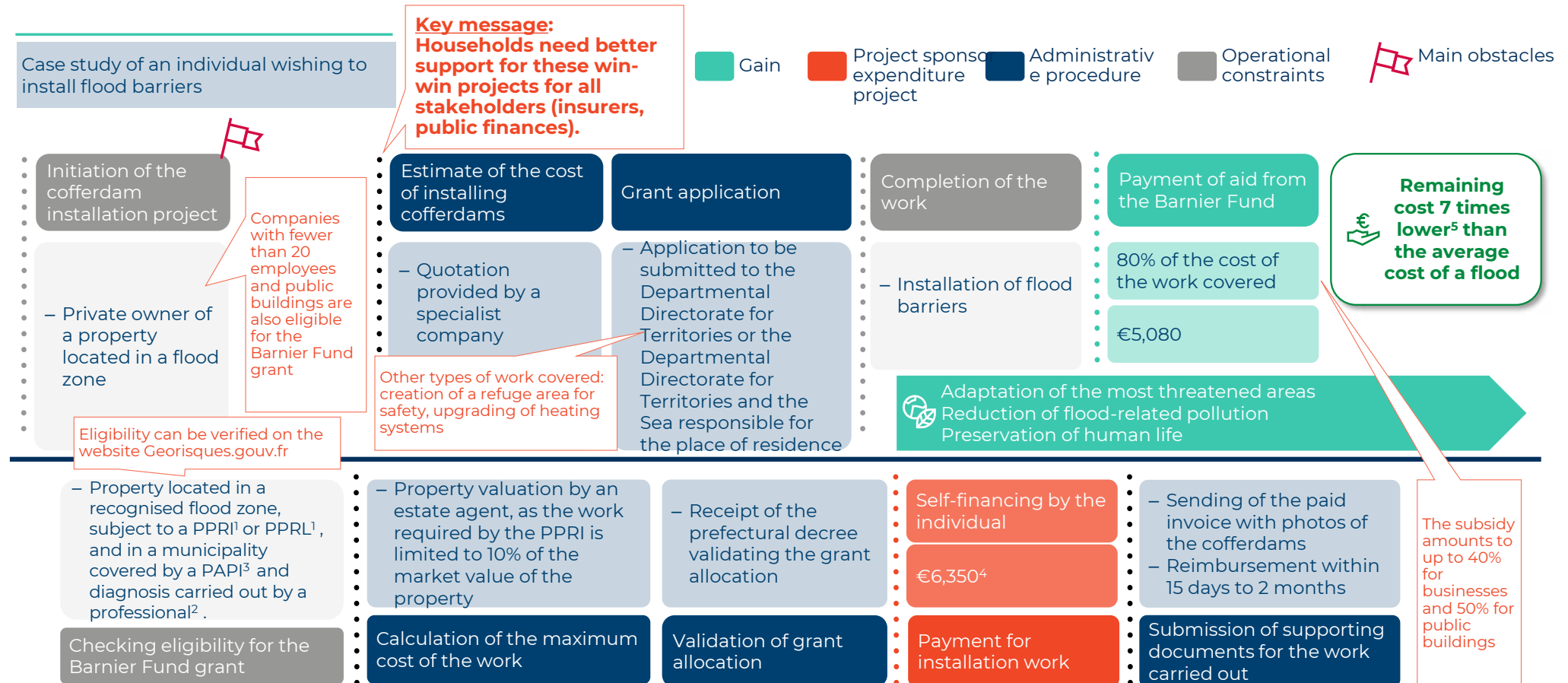


Figure – The CLIMATEFIT Investment Planning process. (Source: Taylor, England and Lea Eggert, 2025)

62 For more information: <https://climatefit-heu.eu/>

Urban Planning & Land Use - Installation of flood barriers



1. Natural flood risk prevention plan / Natural coastal risk prevention plan | 2. This assessment is required in order to access Barrier fund assistance: it provides a detailed assessment of the property's vulnerabilities. It can be quite costly (around £500 to £800). Some local authorities may offer it free of charge to their residents | 3. Flood prevention action programme | 4. Cost excluding installation. €450 for a 1 m long and 0.8 m high aluminium slide cofferdam, door or window type, and €1,200 for a 3 m long and 1 m high aluminium cofferdam, garage door type. €600 for a 1 m long and 0.8 m high aluminium self-locking cofferdam, door or window type, and €1,000 for a 2 m long and 1 m high aluminium cofferdam, garage door type. (EPI Seine). For a detached house, which generally has a garage, two doors and two windows per façade, the average budget for purchasing and installing flood barriers is therefore €6,350. The average cost of flooding is between €9,000 and €10,000 (France Assureurs).

PRESENTATION OF THE ADAPTATION ISSUE

This case study follows the financing process for the installation of flood barriers by a private individual who owns a detached house located in an area at high risk of flooding.

Extreme weather events such as floods are becoming more frequent in France, revealing the vulnerability and exposure of several metropolitan areas. Flooding is the number one natural hazard in France. 124 areas have been identified by the government as territories at significant risk of flooding due to sea submersion and/or river overflow. These 124 TRI areas encompass 2,560 municipalities and 11.9 million people. In addition to these large risk areas, there are also areas at risk of flooding in the event of exceptional climatic incidents, which affect most municipalities. In total, 18.5 million French people are exposed to flood risk, representing around 27% of the total population ([source](#)).

However, flooding can be very costly for individuals: the average cost of such damage is between €9,000 and €10,000 ([source](#)). The damage caused by such an event involves repairing/rebuilding the structure, replacing furniture and equipment (appliances, heating, etc.), and decontaminating and cleaning the home. Given these significant costs and the acceleration of the phenomenon, preventive measures such as the installation of flood barriers appear crucial.

There are several types of flood barriers: slide-in barriers, which require prior installation of slides to secure the panels, and self-locking barriers, which are made of a single piece and do not require slides.

The cost of the cofferdam (excluding labour for installation) varies:

- Sliding cofferdam: between approximately £400 for a door or window type cofferdam and £1,000 for a garage door type cofferdam
- Self-locking cofferdam: between approximately £500 for a door or window type cofferdam and £850 for a garage door type cofferdam

For a detached house, which generally has a garage, two doors and two windows per façade and gable, the budget for the purchase and installation of flood barriers (excluding labour costs) in this case would be:

- €5,700 if sliding cofferdams are chosen
- €7,000 if self-locking cofferdams are chosen

Preventive work therefore seems all the more relevant given that the cost of installation is lower than the average cost of a single incident.

DESCRIPTION OF FINANCIAL MECHANISMS

Individuals wishing to carry out work to protect their homes from the risk of flooding can benefit from support from the Major Natural Risk Prevention Fund (FPRNM), also known as the Barnier Fund. This financial support takes the form of grants.

All prevention and adaptation work defined by a vulnerability assessment is eligible for subsidies: flood barriers or cofferdams, flood-adapted equipment (evacuation, drains, pumps), development work, creation of a refuge area, etc.

This grant is available to private owners of detached houses, businesses with fewer than 20 employees and public buildings, subject to the following eligibility criteria:

→ **Be located in an area with a Flood Risk Prevention Plan (PPRI) or Coastal Risk Prevention Plan (PPRL) with a Flood Risk Action Plan (PAPI) in progress.**

Risk prevention plans (PPR) are national documents that provide a legal and regulatory framework by delimiting risk areas (e.g. flooding) in a given territory and defining the urban planning rules that apply there. They aim to prevent the risk from worsening by regulating land use planning. The PAPI is a tool for financing and implementing works. It enables local authorities to carry out concrete actions (e.g. installation of cofferdams, construction of dykes, etc.). Coverage of a territory by a PAPI makes it possible to release funding via the Barnier fund.

→ The works required by a PPR are limited to 10% of the market value of residential or mixed-use properties.

→ Individuals are eligible for 80% of the cost of the works, up to a limit of €36,000 per property, 40% for businesses and 50% for public buildings.

Based on an estimated cost of €6,350 for anti-flood barrier equipment, with a subsidy covering 80% of the cost of the work, the remaining cost is €1,270, which is around seven times less than the average cost of flooding for an individual. However, this amount remains significant for the most vulnerable households.

LIMITATIONS AND POSSIBLE IMPROVEMENTS

Whilst the Barnier Fund subsidy scheme offers attractive coverage for individuals, with the remaining costs excluding labour for individuals seven times lower than the average cost of flooding, it remains too little known, thus hindering its widespread use and the adaptation of properties located in areas vulnerable to climate risks. However, using the Barnier Fund is a major opportunity to accelerate adaptation. By providing individuals and local stakeholders with more information about this subsidy scheme, it would be possible to make better use of this lever for resilience. According to the Caisse Centrale de Réassurance, the Barnier Fund is a strategic prevention tool that could save up to €8 in damages for every euro invested. Increased use of this fund would benefit both households, by securing their assets, and insurers, by reducing long-term compensation costs.

Furthermore, the remaining costs not covered by the Barnier Fund may continue to be an obstacle to households carrying out these projects. Additional support solutions for households must be devised to enable all households concerned to make these necessary investments. In general, comprehensive support for the work (whether from the insurer or a public agency such as France Renov' in the case of energy renovation) is a significant advantage, as one of the barriers to carrying out the work is the technical aspect (finding a trustworthy contractor, the time required to complete the work, the technical nature of the issues involved, etc.).

Insurers, who are on the front line when it comes to the consequences of climate change, have begun to consider ways of strengthening preventive measures and promoting adaptation to new risks. The AEMA group, as part of the discussions following the third National Climate Change Adaptation Plan (PNACC), has made several recommendations to this effect, aimed at preserving living conditions in France in the coming decades. Among the proposals put forward are:

→ **Strengthening the Barnier Fund**, identified as a strategic tool at the national level, with:

- An increase in its endowment to **€450 million**, corresponding to the sums actually collected from insurers (compared to €300 million currently),
- **Simplification of administrative procedures** and greater visibility of the scheme,
- **Broadening the eligibility criteria** to cover more situations,
- **The explicit inclusion of the phenomenon of clay shrinkage and swelling (RGA)** within its scope.

→ **The creation of a zero-interest loan** dedicated to risk prevention work, in order to support the most exposed households, particularly those that are most financially vulnerable.

→ **Better coordination between risk prevention and energy renovation policies**, with a view to ensuring the overall effectiveness of building interventions.

The rapid increase in the number of claims related to climate hazards (floods, droughts, clay shrinkage-swelling, submersion, forest fires, etc.) is putting pressure on the French natural disaster compensation system. In this context, measure 2 of the PNACC-3 aims to maintain the possibility for every French citizen, everywhere in France, to insure themselves against natural risks by modernising our insurance system around three main axes:

- Creating a natural disaster insurance observatory led by the Caisse Centrale de Réassurance
- Preserving the broad mutualisation of climate risks
- Strengthen prevention and awareness through insurance stakeholders

AN EXAMPLE OF A GOOD INITIATIVE

Inond'action, supported by the Entente Oise-Aisne and 80% funded by the Entente and the Barnier Fund, is a programme of individual flood protection for buildings located in flood-prone areas (housing, very small businesses with fewer than 20 employees and sensitive public establishments), with or without a PPRI (flood risk prevention plan).

The scheme comprises two phases:

1. **Home assessment** (€900 financed by Entente Oise-Aisne, €100 payable by the individual, reimbursed if the work is carried out; for non-individuals, the contribution is 20% of the cost of the assessment):
 - The technician takes altimetric measurements of openings (doors, windows, etc.) and vulnerable elements (boilers, electrical panels, tanks, etc.), as well as potential points of water entry (grates, cracks, pipes).
 - This data is compared to the reference flood level, and a report is then produced detailing the recommended work.
2. **Carrying out the work**, 80% of which is subsidised by the Entente Oise-Aisne or the Barnier fund, with the aim of preventing water from entering or limiting material damage:
 - Installation of flood barriers (cofferdams) to seal openings.
 - Installation of non-return valves, sealing of ventilation grilles.
 - Raising of sensitive components (boilers, meters, electrical equipment), secure fixing of tanks, etc.



CASE STUDIES

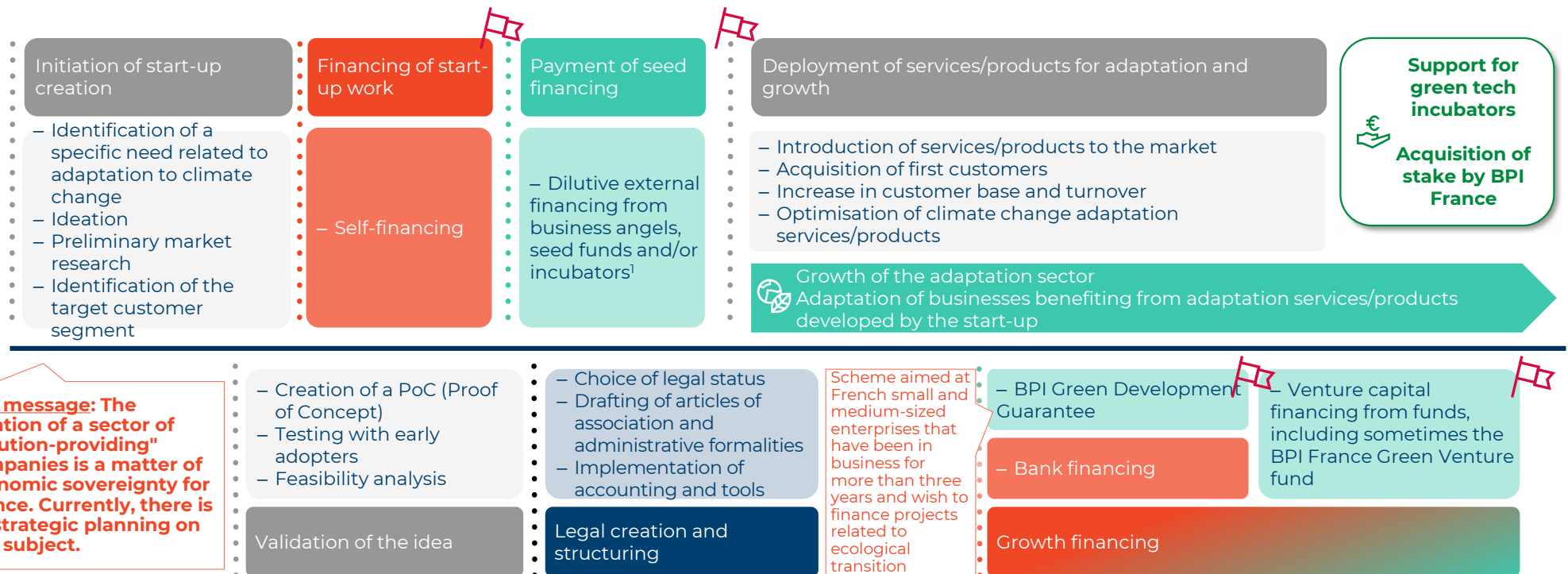
FRANCE AT +4°C:
FINANCING THE ECONOMY'S
ADAPTATION TO CLIMATE CHANGE

INFRASTRUCTURE AND INDUSTRY

Critical industry and infrastructure – Financing an adaptation operator

Case study accompanied by the creation of a start-up specialising in adaptation

■ Gain
 ■ Project sponsored expenditure
 ■ Administrative process
 ■ Operational constraints
 🚩 Main obstacles



1. Greentech Innovation type (government initiative)

PRESENTATION OF THE ADAPTATION ISSUE

The aim here is to follow the potential financing path of a young start-up company offering services/products for adaptation to climate change.

The acceleration of climate change and its impact on the French economy has led to the rise of green tech companies offering adaptation-focused solutions. Despite the scale of the challenges posed by climate change, these companies remain few in number: Bpifrance has only identified around 60 to date.

Adaptation greentechs specialise in the following solutions:

- 49% of these greentech companies collect data, assess and monitor risks
- 51% carry out risk prevention and post-disaster restoration, mainly using physical solutions to combat heat stress, water stress and flooding

LES GREENTECH CENTRÉES SUR L'ADAPTATION RESTENT PEU NOMBREUSES ET PROPOSENT MAJORITAIREMENT DES SOLUTIONS NUMÉRIQUES



Figure – Overview of adaptation green techs (Source: BPI France)

DESCRIPTION OF FINANCIAL MECHANISMS

An adaptation operator can raise funds from BPI France, which has invested €8.5 billion in venture capital between 2020 and 2023 to finance green tech companies offering innovative solutions to combat climate change. This funding is not specifically dedicated to climate change adaptation, but also includes mitigation solutions. Bpifrance Développement notably offers the Green Development Guarantee.

In addition, the Ministry for Ecological Transition has launched the Greentech Innovation initiative, which aims to identify and promote innovative start-ups and SMEs committed to ecological and energy transition. Certified companies benefit from:

- Visibility among investors, local authorities and large groups
- Privileged access to public funding such as Bpifrance
- Support via a network of public and private partners.

This label covers both mitigation (reduction of GHG emissions) and adaptation to climate change (water management, risk prevention, resilient agriculture, biodiversity). In terms of adaptation, it gives credibility to young companies, reduces barriers to access to financing and facilitates integration into innovation ecosystems. It also aims to direct public procurement towards these experiments. This initiative is supported by a national network of Greentech Incubators, comprising around thirty members. The network is open to incubators wishing to join the initiative.

An adaptation operator can also mobilise private venture capital funds to finance its development. Venture capital is an essential source of financing for start-ups and innovative young companies: it not only provides significant financial resources during critical growth phases, but also offers strategic support (mentoring, sector expertise, access to networks of industrial or institutional partners). In the field of climate change adaptation, the support of these funds can translate into backing for projects such as the development of technological solutions for water management, digital tools for anticipating climate risks, more resilient agricultural systems, or even infrastructure and population protection measures.

Focus on the Green Development Guarantee

The Green Development Guarantee is a scheme aimed at French small and medium-sized enterprises that have been in business for more than three years and wish to finance their ecological transition projects. It is neither a loan nor a grant, but a guarantee provided by Bpifrance: it covers up to 80% of the bank loan taken out by the company, which makes it easier for the bank to approve the financing and allows it to be obtained on more advantageous terms (reduced rates, simplified procedures). The scheme is based on a certificate system (Company in Transition/Solution Provider).

In addition, Bpifrance now includes adaptation, water and biodiversity among the strategic priorities of its 2026-2030 Climate Plan. Furthermore, the assessment of the impact of Diag Adaptation and the integration of physical risks into CSRD reporting confirm the public bank's shift towards greater support for adaptation solutions. These factors validate the relevance of the recommendations made here.

LIMITATIONS AND POSSIBLE IMPROVEMENTS

Despite the existence of tools such as the Green Development Guarantee and the Bpifrance Observatory's listing of more than 60 start-ups active in the field of climate change adaptation, **there is currently no mechanism specifically dedicated to supporting the creation of businesses focused exclusively on this area.** The greentechs supported by Bpifrance's venture capital programmes — around 2,750 between 2020 and 2023 — remain mainly focused on climate change mitigation rather than adaptation. Furthermore, these 60 start-ups mainly offer digital solutions and are not industrial companies, which further slows down the emergence of an industrial fabric in this field.

Targeted public support would enable the planning of an industrial sector that meets the growing need for adaptation solutions in many sectors (urban planning, agriculture, water management, health, etc.). Entrepreneurial innovation in these areas is progressing slowly: the emergence of new solutions is essential to anticipate and address the effects of climate change. The establishment of a specific public mechanism would therefore be a major opportunity to structure and accelerate the growth of the adaptation sector. **The development of an economic adaptation sector is an opportunity for French industry to invest in a rapidly growing sector. Many large companies and mid-sized companies have the assets to position themselves as international leaders.**

At the same time, **strengthening the focus of private funding, particularly seed funds and venture capital funds,** appears to be an additional strategic lever. By stimulating the emergence of innovative solutions and consolidating a genuine value chain around adaptation, this capital would help to build a robust economic sector and strengthen collective resilience to climate hazards.

AN EXAMPLE OF GOOD INITIATIVES

STARQUEST AND CCR JOIN FORCES TO LAUNCH AN INVESTMENT FUND DEDICATED TO INNOVATION FOR NATURAL DISASTER PREVENTION

Since autumn 2024, Caisse Centrale de Réassurance (CCR) has been involved in an innovative initiative with Starquest, a greentech private equity player, launching the Climate Change Resilience Fund (CCR-F). This fund, with a target of €100 million, aims to support around 15 unlisted companies — from start-up to more advanced stages — capable of offering concrete and measurable solutions to prevent natural disasters and strengthen adaptation to climate change.

The investment scope covers a broad spectrum, ranging from emerging technologies such as artificial intelligence for risk prevention to more traditional approaches such as geotechnical techniques to combat drought or individual flood protection measures.

The fund is managed by Starquest, whose 15 years of experience in investing in ecological transition guarantee its ability to identify relevant opportunities and structure a genuine industrial sector for climate resilience.

This initiative is fully in line with CCR's long-term strategy, which relies on responsible investment as a lever to preserve the insurability of territories while limiting the exposure of its own liabilities to the increase in climate-related claims.

DESCARTES UNDERWRITING, DEVELOPING A PARAMETRIC INSURANCE MODEL TO TACKLE CLIMATE RISKS

Descartes Underwriting is a climate change adaptation operator listed in Bpifrance's Greentech Observatory. The company has developed a parametric insurance model: compensation is triggered automatically as soon as a measurable threshold (rain, wind, drought, etc.) is exceeded, without the need for on-site assessment, thanks to the use of satellite data, proprietary climate models and artificial intelligence. This model enables companies and governments to adapt more effectively to the effects of climate change by receiving rapid compensation (5 to 15 days) in the event of extreme events.

Its clients include large multinationals (Amazon, Sanofi, Club Med), governments of emerging countries, and insurers who use its advanced modelling capabilities.

Descartes has experienced rapid growth supported by several rounds of fund-raising: approximately €2 million in seed funding in 2019 from venture capital fund BlackFin Tech, €15.7 million in Series A funding in 2020 from investment funds Serena, Cathay Innovation and BlackFin, then €100 million in Series B funding in 2022 led by Highland Europe and Eurazeo, and finally the entry in 2025 of the American fund Battery Ventures to support its growth capital strategy.

Critical industry and infrastructure – Adaptation of an industrial electricity production site

Case study involving a company with electricity generation infrastructure

Key message: Maintenance work (repairs) must be distinguished from work to prevent future risks and better planned over time.

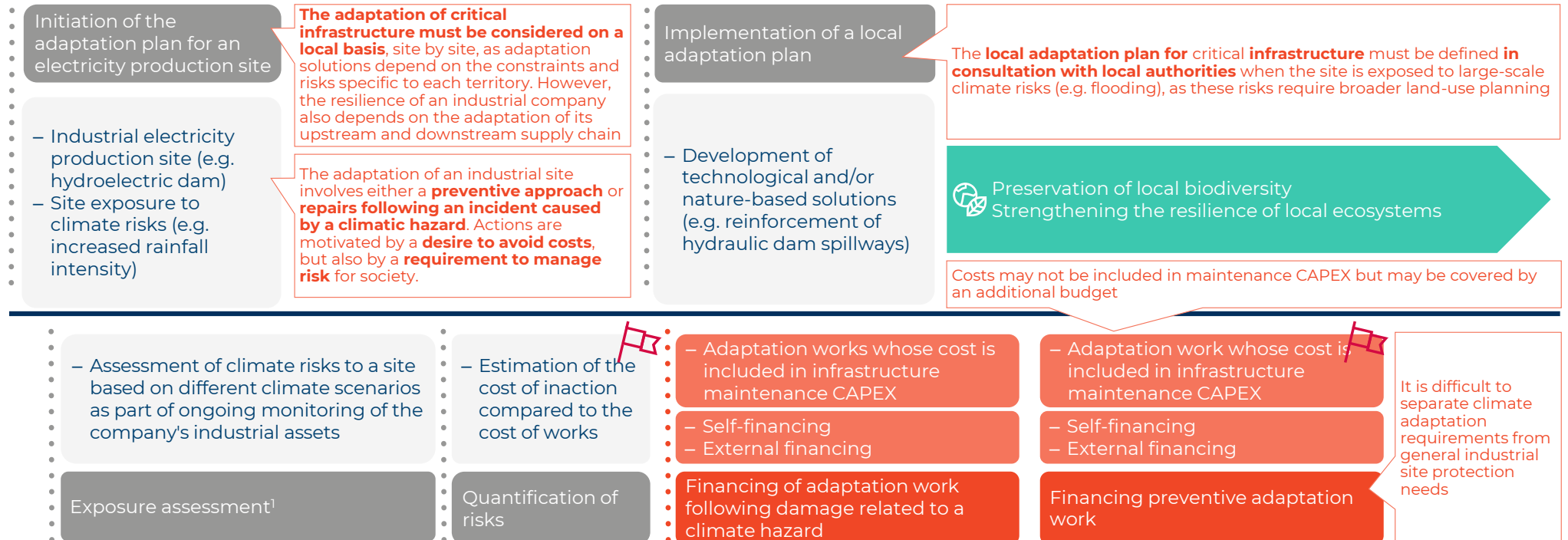
Gain

Project sponsor expenditure project

Administrative process

Operational constraints

Main obstacles



1. Hearing conducted with Engie, report by the Court of Auditors "Adapting nuclear and hydroelectric power plants to climate change"

PRESENTATION OF THE ADAPTATION ISSUE

The aim here is to follow the potential financing path of a company wishing to adapt one of its industrial sites – in this case, an electricity production site – to climate change.

A key challenge in adapting electricity production sites is to strengthen the resilience of infrastructure in the face of increasingly frequent extreme weather events, such as flash floods, floods, prolonged droughts and landslides. These hazards, exacerbated by climate change, directly threaten the continuity of production, the integrity of equipment and the safety of people. Water resources represent a major risk, given their strategic importance in French electricity production. Water is directly or indirectly involved in the electricity production cycle through nuclear power plants and hydraulic structures, which account for 67.1% and 13.9% of electricity production in France, respectively (2024, [source](#)).

To address these climate challenges, energy companies are implementing a series of targeted improvements. For example, hydraulic dams are undergoing structural reinforcements such as the reinforcement of spillway areas with engineering systems such as spillways, closed systems and fuse plugs, enabling better management of exceptional flows. In terms of thermal and nuclear power generation, cooling systems are being adapted to continue operating efficiently even in the event of high temperatures or critical drops in river levels. This may include diversifying cooling sources or creating buffer basins. Nuclear power plants exposed to flood risk can also be protected by building dykes (e.g. Gravelines nuclear power plant). At sites exposed to landslides, soil stabilisation, slope reinforcement and drainage improvement works are undertaken to secure the foundations of the equipment. These measures extend the life of the facilities, reduce the risk of production interruptions or outages, and ensure greater security of energy systems in an increasingly uncertain climate.

The adaptation of an industrial site must be approached on a localised basis, site by site, rather than globally, as adaptation solutions depend on constraints and risks specific to each territory. However, a site's vulnerability is closely linked to its ecosystem and its place in the value chain: a supplier's failure to adapt can have direct consequences for an industrial player (e.g. flooding at a Porsche aluminium supplier).

Furthermore, adaptation measures can take the form of either repairs following an incident caused by a climate hazard or a preventive approach. The costs associated with repair are rising overall due to the increase in climate hazards and the damage they cause, but the costs associated with preventive adaptation are also rising due to the strengthening of industrial responses to future hazards.

DESCRIPTION OF FINANCIAL MECHANISMS

Industrial companies operating critical infrastructure generally use their own financial resources to fund the adaptation of their assets. This funding is often included in the CAPEX budget⁶³ s for maintenance decided upon in the company's own budget cycles. It is difficult to separate the climate adaptation requirements of industrial sites from the general needs of asset protection and improvement. **However, adapting assets can become a considerable investment for manufacturers, particularly in a context where climate variability is becoming increasingly extreme, making it necessary to resort to specific financing programmes.**

Other industrial companies (e.g. Michelin) are adopting a more comprehensive approach to adaptation, with investments that far exceed their maintenance CAPEX and are part of a major cross-functional industrial project, with decision-making at the highest level of the organisation, at executive committee level.

The allocation of funds to make industrial sites more resilient is motivated in particular by a desire to avoid costs: fewer production interruptions due to floods, heat waves, droughts or storms, lower emergency repair costs and insured/uninsured claims, etc. Investments are also part of a broader approach to risk management at the societal level. (e.g. adaptation of nuclear power plants). For industrial players, particularly in the energy sector, risk management is an integral part of their core business. **However, adapting to climate change requires a change of perspective.** Given the uncertainty of climate trajectories and the limitations of models based on historical data, it is essential to adopt a forward-looking approach that goes beyond the vision of the past, in order to integrate plausible futures in terms of climate events and behavioural changes into decision-making, in line with the TRACC (reference warming trajectory for climate change adaptation).

LIMITATIONS AND POSSIBLE IMPROVEMENTS

Today, adaptation is sometimes addressed on a site-by-site basis and financed within maintenance CAPEX, which limits the possibility of having a consolidated vision at the company level. The implementation of a global adaptation plan, based on a local approach consistent with the specific characteristics of each site, would make it possible to aggregate these expenses outside the traditional maintenance framework. Such clarification could promote better traceability of investments dedicated to adaptation and facilitate external financing, particularly from investors committed to these issues.

To meet the costs of adapting their various industrial sites, companies can resort to borrowing. Other financing tools can be used, such as green bonds. While it is currently difficult to identify specifically what constitutes adaptation expenditure as opposed to site safety expenditure, and therefore **to issue bonds to finance adaptation**, better identification of the scope of these actions would simplify the issuance of these financial instruments and thus the financing of adaptation.

63 A company's capitalised investment expenditure on its balance sheet.

As the costs of adapting critical infrastructure for industrial companies can be significant, they must be weighed against the minimum level of service desired and guaranteed by the industrial company. In some situations, agreeing to implement occasional production interruptions may be more cost-effective than massive investments. The same logic applies to companies operating transport infrastructure. In the case of the SNCF, it is sometimes more economical to cancel a journey than to make the investments necessary to cover all risks and ensure all journeys. However, these decisions cannot be made in isolation. They need to be clarified **with the authorities in the area concerned** in order to collectively define the **minimum level of service** that the area considers essential. Certain infrastructure – such as the continuous power supply to hospital areas, which is essential for the computerised processing of patient records or the operation of critical equipment – cannot be interrupted in any way. Determining these regional priorities makes it possible to guide investment, define acceptable interruption margins and calibrate adaptation costs to ensure the continuity of essential services.

Funding for adaptation could be stimulated by including specific criteria in public tenders. Currently, the majority of tenders (for renewables, for example) do not include any adaptation clauses. Including criteria of this type would therefore align requirements and stimulate the implementation of climate change adaptation measures in projects.

AN EXAMPLE OF GOOD INITIATIVES

ENGIE: IMPLEMENTING SITE-BY-SITE ADAPTATION PLANS

The insurability of industrial sites is a growing challenge for Engie, a major player in electricity production with a large portfolio of infrastructure. Although climate change adaptation plans are not yet formally required by insurers, the company is already anticipating a possible tightening of criteria by integrating a structured adaptation approach across its sites.

These plans, which are documented and based on a prevention approach, aim to strengthen the physical resilience of facilities in the face of climatic hazards (heat waves, floods, droughts), while ensuring continuity of operation. This proactive strategy not only secures assets in the short term, but also preserves their insurability in the medium and long term, in a context where insurers' requirements could change rapidly as climate risks intensify.

EDF: A PROJECT TO ADAPT NUCLEAR POWER PLANTS TO CLIMATE CHANGE

Launched in 2021, EDF's ADAPT project aims to anticipate the impacts of climate change on nuclear power plants and guarantee their electricity production capacity by 2050. In particular, it focuses on securing access to water and essential infrastructure. This project mobilises dedicated resources, draws on scientific advice and benefits from the expertise of the group's climate and R&D departments. Its approach is based on an individualised analysis for each site, combining climate, hydrological and thermal projections built on different climate change scenarios. The adaptation measures identified in this context () are integrated into the Grand Carénage, the industrial programme launched in 2014 by EDF to extend the life of its nuclear fleet.

Under the ADAPT plan, certain expenses have been estimated — €150,000 in 2021, €270,000 in 2022, and €550,000 in 2023 — but EDF does not systematically isolate the amounts specifically devoted to climate change adaptation. The company highlights the difficulty of distinguishing what strictly constitutes adaptation from other safety investments. However, it recognises the need to better qualify these expenses and plans to work on this, in particular by drawing on the adaptation plans that each major entity within the group will be required to establish as part of its corporate social responsibility (CSR) policy.

SNCF: AN ASSESSMENT OF INVESTMENT COSTS IN ORDER OF MERIT

The example of SNCF, which manages such a critical infrastructure network, is also instructive. SNCF has implemented a method for prioritising possible adaptation actions, acting and investing in order of merit. Actions are classified into three categories:

“No regrets” actions from an adaptation perspective: these include the renovation and modernisation of the network. These are actions with a considerable cost, but with a low additional cost specifically related to climate change adaptation.

Actions requiring “case-by-case analysis” (e.g. hydraulic structures), the results of which vary according to risk exposure (increasing over time), commercial potential, costs and the expected regeneration horizon.

Costly actions (e.g. retrofitting operations).

This method aims to prioritise low-cost actions before implementing more costly adaptation projects. It also seeks to optimise normal renovation cycles to strengthen the resilience of facilities.

Testimonial from Louise Fournon (Climate Project Manager, Engie)

“For several years now, we have implemented an Enterprise Risk Management (ERM) system which, for each site, maps environmental and societal risks, assesses their materiality and then consolidates these analyses at group level. On this basis, local teams develop and deploy their adaptation plans. The percentage of sites covered by the ERM process is monitored and managed on an ongoing basis.

Adaptation costs are pooled in maintenance CAPEX because, in practice, it is rarely possible to distinguish line by line between investments strictly dedicated to adaptation and those related to safety or routine maintenance.”

Testimonial from Alexandre Marty (Head of Climate and Natural Resources, EDF)

"Today, the vast majority of our assets are low-carbon electricity generation facilities, which are already eligible for the Green Bond Framework. For these infrastructures, the actions taken in response to climate change often have a dual objective: mitigating emissions and adapting to climate impacts. This dual purpose makes it difficult to identify precisely and separately the expenditure strictly related to adaptation, which hinders its inclusion in specific financing mechanisms.

Although there will always be an element of subjectivity in assessing what constitutes climate change adaptation, the conclusion is clear: it already represents a significant burden for us. In 2024, we recorded approximately €800 million in CAPEX related to adaptation, out of a total budget of €23 billion. This is an additional cost on top of our investments, and one that is set to increase inflationarily in the coming years, raising questions about the limits of our investment capacity."

Testimonial from Francis Renault (Head of Adaptation, Michelin)

The idea that "adaptation is local" is only true to a certain extent. In reality, a site's resilience is closely linked to its ecosystem. Our value chains are highly intertwined, so a failure to adapt in Asia or flooding on the other side of the world can have direct consequences for the group. While we are focusing our efforts primarily on our own industrial sites, where we have direct leverage, we are also trying to work on our upstream and downstream supply chains with an approach based more on influence. We are therefore seeking to strengthen our relationships with our suppliers and think tanks, and to encourage action by public authorities."

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INFORMATION ABOUT THE REPORT

Director of publication

Yves Perrier, President of the IFD

Editors

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FOR MORE INFORMATION

contact@ifd-paris.com.

