REDUCING HOUSING INEQUALITIES

National report on the regulatory system of environmental and energy policies: France

An extract from Deliverable 3.2, *'National reports on the regulatory system of environmental and energy policies'*, of the ReHousIn project

August 2025

FOREWORD

This report is an extract from Deliverable 3.2, National report on the regulatory system of environmental and energy policies', of the ReHousIn project, which examines the economic mechanisms, norms, and institutional and contextual factors that shape the Environmental and Energy Policies (EEPs) in nine European countries.

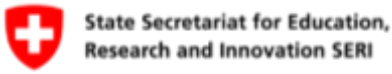
The full version of the deliverable is available here.

Title	**National report on the regulatory system of environmental and energy policies: France**
Author(s)	Federica Rotondo, Antoine Guironnet, Marco Cremaschi (SciencePo)
Cite as	Rotondo, F.; Guironnet, A.; Cremaschi M. (2025). *National report on the regulatory system of environmental and energy policies: France. Deliverable 3.2, "National reports on the regulatory system of environmental and energy policies"*. ReHousIn: Contextualized pathways to Reduce Housing Inequalities in the green and digital transition https://rehousin.eu/sites/default/files/media/documents/National%20report%20on%20the%20regulatory%20system%20of%20environmental%20and%20energy%20policies_France.pdf
Contributors	Jacqueline Grace Vera
Dissemination level	Public
Submission date	August 2025
Work package	WP3 [Changing environmental & energy policies (EEPs)]
Project title	ReHousIn: Contextualized pathways to Reduce Housing Inequalities in the green and digital transition.
Grant Agreement No.	101132540
Coordinator	Metropolitan Research Institute (MRI)

This document has been prepared in the framework of the European project ReHousIn – "Contextualized pathways to reduce housing inequalities in the green and digital transition".

The ReHousIn project aims to spark innovative policy solutions towards inclusionary and quality housing. To achieve this, it investigates the complex relationship between green transition initiatives and housing inequalities in European urban and rural contexts, and develops innovative policy recommendations for better and context-sensitive integration between environmentally sustainable interventions and socially inclusive housing.

This project is co-funded by the European Union. The UCL's work on this project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee. The ETH work on this project is funded by the Swiss State Secretariat for Education, Research and Innovation (SERI) under the Swiss government's Horizon Europe funding guarantee.



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NATIONAL REPORT ON THE REGULATORY SYSTEM OF EEPs in FRANCE

1. Executive summary

The main objective of this report is to provide insights on the national regulatory and institutional system of Energy and Environmental Policies (EEPs) in France. The analysis specifically focuses on housing retrofitting (section 4), nature-based solutions (section 5), and densification policies (section 6), framed within the broader context of national climate change mitigation and adaptation policies (introductory section). The concluding section revolves around main changes in EEPs in France and outlines hypotheses on the relations and trade-offs between these policies and the housing inequalities that are further discussed in another report on the housing system from a multi-level perspective in France (D4.2).

Since the late 1990s, France has progressively strengthened its commitment to climate mitigation and adaptation through national strategies (SNBC) and plans (PNACC). Parallel to this, national legislation has progressively translated these strategic orientations into specific objectives and introduced regulatory and financial tools. However, challenges emerge, and recent obligations face political backlash, leading to setbacks and implementation delays.

Housing retrofitting policies in France include specific targets for the social housing stock, particular attention to energy poverty issues, and a focus on renovating the most energy-inefficient buildings. In recent years, there has been a shift of focus from fiscal incentives to direct subsidies, with recent particular focus on owner-occupiers and low-income groups. Despite growing involvement of local authorities and horizontal coordination, the national level continues to play a central role in setting objectives, regulatory frameworks, and implementation tools. No specific tools, such as rent control after renovation, are currently in place to address affordability challenges, which raises the risk of renovictions, while the regulatory framework remains undifferentiated across urban contexts and regions, potentially potentially exacerbating spatial inequalities.

Densification policies have evolved from a focus on the reuse of urban areas near public transport to the integration of zero land take objectives as part of a broader land sobriety scope. Several fiscal and regulation tools have been introduced to support the reuse of industrial sites or vacant buildings, with varying outcomes depending on the degree of urbanization of the targeted areas (metropolitan, peri-urban, rural, etc.). While densification regulations affect local planning tools, their implementation remains optional and uneven, also depending on the willingness of local authorities. Zero land take objectives face national-local tensions and political resistance especially in smaller urban contexts and rural areas and may lead to uneven territorial impacts.

The institutionalisation of NBSs is a recent process, driven by European and international frameworks. There are no regulatory or financial tools explicitly dedicated to NBSs, and

implementation mainly relies on incentivising instruments such as project promotion, information dissemination, and guidelines. The absence of shared definitions, regulations, and targeted funding makes the implementation of NBS particularly complex. More recently, the *Plan Nature en Ville*, part of the national biodiversity strategy, has reinforced the focus on the integration of nature into urban areas. Overall, the landscape remains fragmented, shaped largely by local political will.

2. Introduction and methodology

The main objective of this report is to provide a national assessment of the regulatory systems of Energy and Environmental Policies (EEPs) in France. It specifically focuses on housing retrofitting, nature-based solutions, and densification policies which are framed within the context of national climate change mitigation and adaptation policies.

2.1 Introduction

Since the late 1990s, France has progressively strengthened its commitment to climate change mitigation and adaptation, developing national plans, regulatory framework aligned with, and evolving in parallel to, international and EU targets. As stated by Halpern (2017), the origins of EEPs in France, a country with a unique position as a nuclear state within its context, can be traced back to the ecological and anti-nuclear movements that emerged in the late 1960s and subsequently in the 1970s. As stated by Poupeau (2013) there is a strong path dependence in energy and environmental policies: "*The state's choices are still heavily influenced by the paradigm of nuclear energy, considered a cheap source of energy that contributes (or would contribute) to national energy independence, and is moreover highlighted for its contribution to the fight against climate change*". Recently, the "*Affaire du Siècle*" campaign represents an emblematic example of the growing wave of criticism directed at the French government by environmental organizations, who engaged in legal litigation for inaction against climate change (Redon et al., 2020). This criticism focuses on the deregulation in climate policies and the government's failure to take meaningful action to meet its commitments under international agreements (e.g. the Paris Agreement).

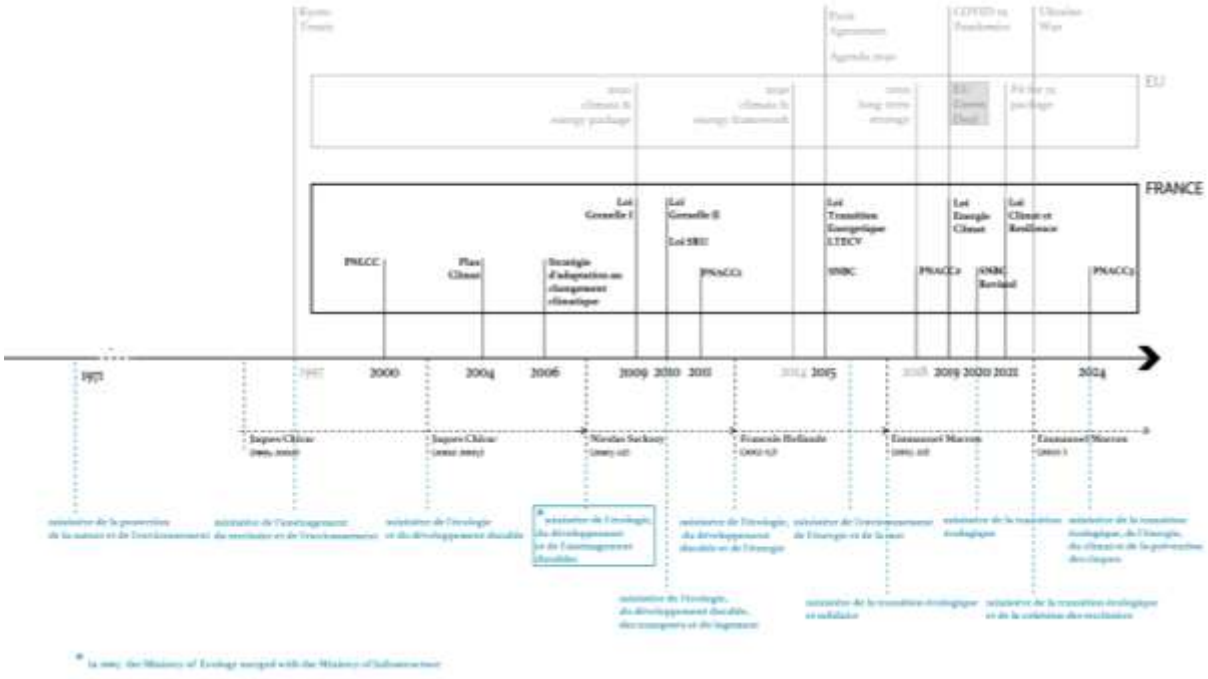

Figure FR1. timeline illustrating key EEPs in France over time within the European and global contexts. In light blue the evolution of french ministries in charge of EEPs.

In line with the Kyoto Protocol objectives, France's commitment to addressing climate change emerges between the late 1990s and the early 2000s, particularly with the adopted *Programme National de Lutte Contre le Changement Climatique* (PNLCCC) and the *Plan Climat*. In 2007 an important milestone was represented by the merger of the Ministry of the Ecology, the Ministry of Infrastructure and part of the Ministry of Industry as part of the administrative reorganisation under the Sarkozy presidency (Bonnaud and Martinais, 2014)[1]. Shortly afterwards, the environmental laws *Grenelle I*[2] and *Grenelle II*[3] were adopted, defining the national regulatory framework that prioritised environmental issues across different domains, such as transportation, energy and agriculture. The *Loi de Transition Énergétique pour la Croissance Verte* (LTECV) of 2015[4], coincided and alligned with the adoption of the Paris Agreement and the elaboration of the Agenda 2030.

More recently, the *Loi Energie Climat* in 2019 sets national targets in line with European goals, committing to achieve carbon neutrality by 2050. Later in the same year, also in response to the Yellow Vest movmenet and in name of “climate justice”, the Macron presidency launched the *Convention citoyenne pour le climat* (CCC), as citizens consultation aimed at supporting the elaboration of measures to redeuce GHG emissions.

[1] It led to the creation of the DGALN (*Direction Générale de l’Aménagement, du Logement et de la Nature*), which brings together competences for urban planning, landscape planning, housing, and nature

[2] *Loi n° 2009-967 relative à la mise en œuvre du Grenelle de l’environnement*. Available at the link https://www.legifrance.gouv.fr/loda/id/JORFTEXT000020949548

[3] *Loi n° 2010-788 portant engagement national pour l’environnement,* Available at the following link: https://www.legifrance.gouv.fr/loda/id/JORFTEXT000022470434/

[4] *Loi n° 2015-992 relative à la transition énergétique pour la croissance verte.* Available at https://www.legifrance.gouv.fr/loda/id/JORFTEXT000031044385. From now on referred to as the *Loi Transition Énergétique*

As highlighted by Réseau Action Climat (2021) the French government supports the EU's overall target, contributing significantly to the push for higher climate ambition (see Annexe 2). However, France did not support the European Parliament or countries such as Denmark and Sweden in advocating for even more ambitious goals, such as 60% or 65% GHG reductions by 2030. Overall, France commits to the EU's long-term strategy of becoming the first climate-neutral continent by 2050, primarily based on two pillars: the *Stratégie Nationale Bas-Carbone* (SNBC), for implementing climate change mitigation policies, and the *Plan National d'Adaptation au Changement Climatique* (PNACC), specifically dedicated to France's adaptation strategy.

The ***Stratégie Nationale Bas-****Carbone* (SNBC) was introduced in 2015 by the *Loi LTECV*, with the aim of establishing a framework to guide the implementation of national energy and climate objectives (Poupeau, 2023). The latest adopted version (SNBC2), revised in 2018-2019, aims for a 100% reduction, making France a net-zero emissions country by 2050 and defining an intermediary objective of 40% reduction in GHG emissions by 2030 compared to 1990 levels[5]. While overall objectives over the long term are set in national plans and programs (e.g., the SNBC), the actual resources to meet these goals are allocated through annual budget processes, which may result in year-to-year adjustments of operational targets. The elaboration of SNBC3 started in 2023 at includes the aim of raising the 2030 target from 40 to 50% reduction in GHG emissions by 2030. It remains an ongoing process also affected by political instability.

In addition, since the early 2000s, France has also developed a ***Plan National d'Adaptation au Changement Climatique*** **(PNACC)**, starting with the *Stratégie d'adaptation au changement climatique* (2006) and the with PNACC1 (in 2011) and PNACC2 (in 2018). At the end of 2023, a public consultation phase was launched to inform the drafting of the third version of plan[6]. The goal is to protect the population and build societal resilience, taking into account the projected +4°C temperature rise in France by 2100 compared to pre-industrial levels, considering that this rise will manifest differently across the entire national territory (Réseau Action Climat, 2024). The new PNACC includes 51 measures organized around 5 main pillars[7]. According to the document presenting the PNACC 3 "*The measures have been designed with an approach that takes into account the differences in situation between territories and actors, with the goal of not increasing or creating inequalities, both social and territorial, by identifying the populations and territories least able to cope and therefore most in need of support*"[8].

[5] The SNBC sets emission thresholds not to be exceeded from 2019 to 2033 (the carbon budgets). The SNBC2 sets carbon budgets for 2033 and, among the strategic orientations for specific sectors, prioritizes the building and public works sectors in achieving France's ambitious climate targets. It is available at the following link: https://www.ecologie.gouv.fr/sites/default/files/documents/2020-03-25_MTES_SNBC2.pdf. A summary in English is available here: https://unfccc.int/sites/default/files/resource/en_SNBC-2_summary_compl.pdf

[6] https://consultation-pnacc.ecologie.gouv.fr/sites/default/files/2024-10/Document_de_presentation_du_PNACC_3.pdf

[7] Namely: protecting the population, particularly the most vulnerable groups; ensuring the resilience of territories, infrastructures, and ecosystems; adapting human activities; protecting natural and cultural heritage; and mobilizing society

[8] See footnote 56

2.2 Methodology

Following this introduction, the report is organized into three sections, each focusing on a single type of EEP, namely: housing retrofitting, nature-based solutions, and densification policies in France. Key transversal issues are addressed in subsections for each selected EEP, including the emergence of the issue and related policy decisions, the implementation process, the size and role of the market, the multilevel governance framework, achievements, assessments, and challenges. The final section provides a summary and discusses the changes in energy, environmental, and retrofitting policies, along with their impacts on multilevel governance across the EU, national, and local levels. The report draws on a mixed-methods approach, including document analysis, policy lab and semi-structured interviews.

Document analysis include both grey and scientific literature. Grey literature mainly consists of policy briefs, technical reports, regulations, and legislative acts collected from institutional websites and available in open access. Scientific literature is collected and organized into thematic clusters according to whether it refers to housing retrofitting, Nature-Based Solutions or densifications policies.

A *policy lab*, in the form of a focus group, was held in Paris in March 2025 involving policy makers, national agencies, social housing representatives, experts and advocacy groups on housing needs. The main aim was to gather worldviews from a plurality of stakeholders on key issues. The main topics under discussion included 1) the synergies and trade-offs between environmental and social goals and 2) cooperation and frictions in multilevel horizontal and vertical governance, and territorial variations (Cremaschi et al., 2025[9]). The policy lab helped in gathering information for this report and collecting contacts for the interview phase.

Semi-structured interviews were conducted between May 2025 and July 2025 and contributed to enriching the present report, as well as integrating additional references and documents. Different institutions were engaged, including national ministries, governmental and para-public agencies, interests and advocacy groups and experts (see Annex 1 for the list of interviewees). The purpose of interviews is twofold: to fill the research gaps identified in a draft version of the present report, and to delve deeper into first hypotheses on the relations and trade-offs between EEPs and the housing issues.

3. General governance system

In France, multi-level governance is organized around the State, regions, departments, intercommunalities, and municipalities. While decentralisation reforms since the 1980s have transferred significant responsibilities to local authorities, particularly to intercommunalities for urban planning, the State retains a central role in setting overall objectives and regulatory frameworks, especially in housing and energy renovation policies.

[9] unpublished document reporting on the first Policy Lab held in March 2025 at SciencesPo, Paris. It offers insights into current policy debates on the social consequences and trade-offs of green policies, as perceived by key stakeholders in France.

In France, housing policy remains very much centralized despite four decades of devolution of various sectors of urban policy to local authorities. The central state assumes a key role in defining the main policy orientations and instruments for the production and financing of housing. The *Housing and Construction Code* sets rules at the national level, which cannot be adjusted; while 80% of all state aid depends on schemes set at the national level (Driant 2024)[10]. Likewise, key housing policies are conducted by the central state, such as tax incentives to support individual investment into private rental housing, or through national agencies (such as ANRU for urban regeneration or ANAH for housing retrofitting). This centralization is due to a combination of political-economic factors: keeping control of a key industry (in terms of economic growth, employment, tax revenues), ensuring an equal treatment of local situations across the country, and a mistrust of local interests (Ibid.). Indeed, housing was not included in the first devolution laws of the 1980s, or only indirectly as the 36,000+ municipalities had become responsible for zoning plans through which they could control construction. For policymakers, further devolution has been conditioned on reaching a form of institutional integration above the municipalities through the creation of intercommunal institutions (1999), which then became responsible for setting local targets and implementation measures through elaborating local housing programs (*Programme local de l'habitat*, PLH), either as a condition of exercising the distribution of construction subsidies on behalf of the central state (2004), or mandatory (2009). However, such distribution of construction subsidies (*aides à la pierre*) for the social and private housing remains optional, while their volumes are still set by the central state and remain limited overall (Driant 2014)[11]. Since then, the role of intercommunal institutions in housing has been reinforced by subsequent reforms, which have transferred them the responsibility of zoning plans (*Plan local de l'urbanisme intercommunal*, PLUi) from municipalities (2014), as well as in social housing allocation. Additional transfers have been opened to some as leading organisations on housing (*autorité organisatrice de l'habitat*) since 2022, but only three of them have opted out for this status.

It should be noted that the Paris region is specific in that regard. First, the governance of housing remains particularly fragmented given multiple actors, and the fact that intercommunal institutions are more recent (Le Hervet 2012). In particular, the regional council has attempted to endorse a key role in the coordination of local housing policies through the target set by its regional plan (*Schéma directeur régional de la région Île-de-France*, SDRIF)[12]. Second, additional, specific rules apply. On the one hand, the City of Paris is also a district (*département*), which means that it combines attributions, technical and financial resources that would otherwise be separate across different tiers of government. Additionally, the metropolitan authority (*Métropole du Grand Paris*) created in 2016 should adopt a plan on housing and emergency shelter (*Plan métropolitain de l'habitat et l'hébergement*)[13]. On the

[10] The remainder of state aid financed by local authorities is mostly made up of brick-and-mortar subsidies contributing to the financing of social housing construction and renovation.
[11] By that time, the most developed form of devolution was the transfer of social support schemes (*Fonds de solidarité pour le logement*, FSL) to districts (*départements*).
[12] In addition to its implication in the financing of social housing production. However, the regional council had to revise its plan to adjust its housing targets with those set by the central state (from 60,000 to 70,000). Moreover, the commitment of the regional council towards housing has slowed since its shift to the right: recently, subsidies for social housing were stopped (source: Interview with housing policy expert, April 22, 2025).
[13] Although it did not in practice, due to political disagreement over the geography of social housing production. See D4.2 for more details.

other hand, the central state retains control over key elements: housing construction targets (set at 70,000 per year since the Grand Paris law of 2010) and their spatialisation (*territorialisation des objectifs de logement*) through negotiations between state representatives (Prefect) and local authorities, as well as the co-chairing (with the head of the regional council) of the regional committee on housing and shelter (*comité régional de l'habitat et de l'hébergement*, CRHH) that has to elaborate a regional plan (SRHH). This plan is instrumental in spatialising the housing construction targets, and is based on many elements prepared by the central state administration[14].

In 2008 the DGALN (*Direction Générale de l'Aménagement, du Logement et de la Nature*) was created to merge responsibilities for urban planning, housing, nature, and biodiversity under a single directorate. The organisation of competences and cross-sector coordination within the DGALN is strongly influenced by the broader ministerial structure, which has evolved over time with varying degrees of stability[15]. Within DGALN, Nature-Based Solutions are mainly integrated by the DEB (*Direction de l'Eau et de la Biodiversité*), but also by the *sous-direction de l'aménagement durable* within DHUP (*Direction de l'Habitat, de l'Urbanisme et des Paysages*). Densification issues fall primarily under the *sous-direction de l'urbanisme réglementaire et des paysages*, which, together with the *sous-direction de l'aménagement durable*, are the two main sub-departements working on urban planning. Finally, energy renovation is addressed both by the *sous-direction du financement et de l'aménagement* and by the interministerial body CIPREB, currently responsible for coordinating the national energy renovation plan for buildings (*Plan de Rénovation Énergétique des Bâtiments*).

[14] Interview with housing policy expert, April 22, 2025.
[15] Today, the DGALN operates under the Ministère de la Transition écologique, de la Biodiversité, de la Forêt, de la Mer et de la Pêche, but also interacts with other ministries, such as the Ministère de l'Aménagement du Territoire et de la Décentralisation

Figure FR2. Schematic representation of the distribution of competences among the directorates and sub-directorates of the DGALN. Red, green, and blue circles refer respectively to housing retrofitting, Nature-Based Solutions, and densification. The solid black circle refers to urban planning, while the dashed black circle refers to housing

Parallel to the horizontal distribution of competences within the ministry, governance also unfolds vertically, involving multiple levels of government from the national to the local scale, each with its own responsibilities.

The governance of housing retrofitting operates through a multi-tiered structure from the nation to the intermunicipal level.

- Although local authorities are playing an increasingly active role in supporting the implementation and coordination over **building renovation** and energy poverty matters, the national level plays a central role in terms of defining main energy and climate objectives, setting regulations and designing implementation mechanisms.
- Regarding **densification** policies, the State plays a primary role by defining long-term objectives for combating land take (*Zero Artificialisation Nette* by 2050) and setting medium-term objectives and conditions for local authorities (a 50% reduction of land consumption by 2030). The implementation of these policies is entrusted to planning instruments at the regional level (SRADDET) and at the inter-municipal level (SCoT) and municipal level (PLU).

	Housing	Housing retrofitting	NBSs	Densification
National level	Definition of national targets (*and for Greater Paris: local targets*) Setting of regulatory, financial and support tools	Definition of energy and climate objectives as part of national regulations	Definition of biodiversity and water management objectives	Definition of long term and medium-term objectives for combating land take

	Financing of housing policy (80% of all public aids), including through national agencies (Anah)	Setting of regulatory, financial and support tools		Setting of regulatory and planning tools
Regional level	Elaboration of regional planning frameworks integrating energy and climate issues (SRADDET) and housing construction targets			
	Distribution of additional subsidies for social housing construction, remediation against poor housing conditions, etc. In the case of the Ile-de-France region: co-chairing the regional committee on housing (CRHH)	Holding the competence over building renovation and decentralized renewable energy production Elaboration of energy efficiency strategies		In the case of the Ile-de-France region: co-chairing the regional committee on housing (CRHH)
Departmental level	Elaboration of departmental plans to coordinate housing policy between intercommunal level (PLH) and the rest Distribution of additional subsidies for social housing construction Management of Housing solidarity fund (Fonds de solidarité logement, FSL)	Holding the competence over energy poverty Coordination of intermunicipalities, local actors and organisations		
Intermunicipal level	Elaboration of intermunicipal housing programs (PLH) that sets housing construction targets Elaboration of intermunicipal zoning plans (PLUi) that regulates land-use Distribution of additional for social housing subsidies In the case of the Paris region: elaboration of a housing plan (PMHH) by the metropolitan authority	Integration of climate-related issues into intermunicipal planning frameworks (SCoT for one or more EPCI combined with single municipalities, PLUi for each EPCI)		
		Elaboration of a program to improve energy efficiency and reduce GHG emissions (PCAET by EPCI). PCAET includes quantitative climate and energy objectives		Local implementation depends on contextual conditions and remains non-binding
Municipal level	Implementation through delivery of construction permits (if not transferred to intermunicipal institution), eminent domain purchase powers, etc. Distribution of additional subsidies for social housing construction	Supporting households and coordinating locally renovation programs	Local experimentation dependent on political will, resources and interpretation of concept	

Table FR1. competence of ecological transition and housing policies across governance levels

4. Housing retrofitting

The late 1990s saw a growing debate on climate issues, and from the beginning of the millennium, a series of political initiatives aimed at translating general objectives and sectoral initiatives followed. Over the last two decades, and primarily through its technical agencies, the central government carried out this exercise of policy promotion and support for an increasingly sophisticated debate. France's initiatives accompanied and sometimes influenced EU directives on building energy regulations since 2000, although it has taken a cautious stance on some measures such as ETS extension for fear of social impacts.

4.1 The policy cycle: emergence of the issue and policy decisions

Over time, France supported the increasingly ambitious objectives proposed by the European Commission and developed a number of national policies and regulations affecting housing retrofitting (Figure FR3). Recently, France has contributed to the European debate by bringing forward some of the provisions set out in the *Loi Climat et Résilience*, such as the gradual ban on renting energy-inefficient housing (*passoires thermiques*). However, France adopted a more cautious approach to extending the EU Emission Trading Systems (ETS) to building heating and road transport, due to the potential social and economic impacts on vulnerable households with no access to low-emission alternatives. As Réseau Action Climat (2021) stated about the extension of ETS2: "*The government fears a new social crisis, similar to the one it experienced with the Gilets Jaunes protests, this time on a European scale".*

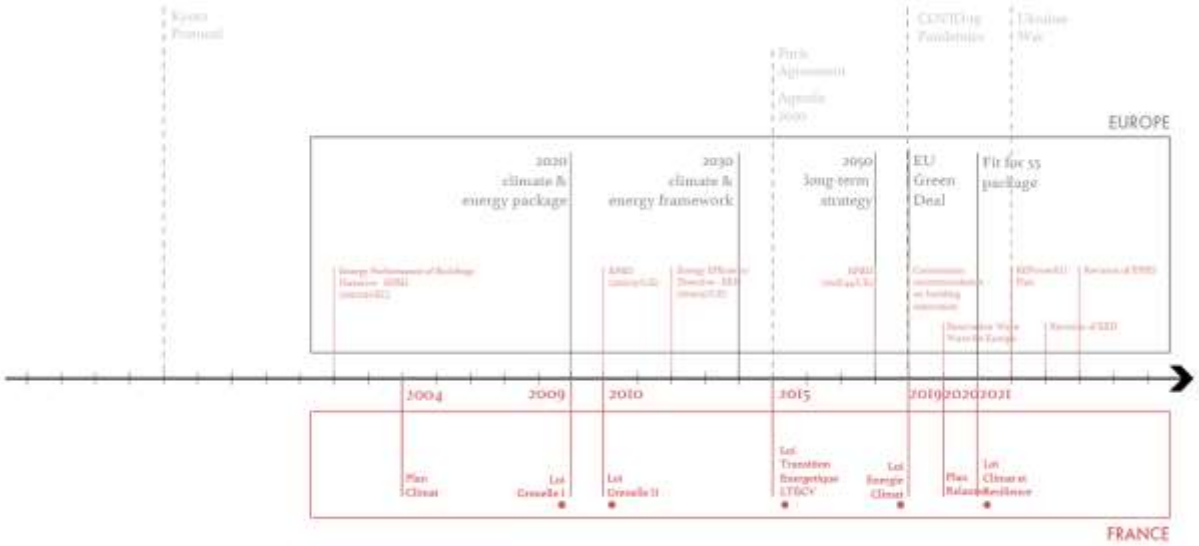

Figure FR3. timeline illustrating key policies and regulations in France and EU affecting housing retrofitting. Binding documents are marked with filled red dots.

In 2004 the ***Plan Climat***[16] outlined several guidelines for combating climate change, focusing on improving the energy performance of existing buildings. It highlighted key tool to obligate

[16] https://unfccc.int/resource/country/plan_climat_fr.pdf

energy producers to finance energy-saving projects in construction and industry and to propose tax credits to incentivize property owners to invest in energy efficiency improvements[17]. In 2006, France transposed the European Directive on the Energy Performance of Buildings (EPBD) and introduced the Diagnostic de Performance Energetique (DPE). In this context, The *Plan Climat* also provided local authorities the option to exempt property owners from property tax (*taxe foncière*) if they carried out works improving their energy label.

After that, the ***Loi Grenelle I*** (2009) set a target to reduce energy consumption in the existing building stock by at least 38% by 2020. It also aimed to renovate 400,000 housing units annually starting from 2013, with a target of 80,000 social housing units renovated before 2020. To achieve these goals, the ***Loi Grenelle II***, introduced in 2010, implemented measures to support the objectives of Grenelle I by essentially "greening" the Urban Planning Code (*Code de l'Urbanisme*-CU) and the Building and Housing Code (*Code de la Construction et de l'Habitation* - CCH). Key elements of the *Grenelle II*, related to the renovation of existing buildings, include: reinforcing the obligation for the energy performance diagnosis (DPE); reforming tax credits for energy transition; expanding the CEE system for owners of large properties (such as real estate companies); and providing subsidies for energy-saving works for social housing providers (*bailleurs sociaux*).

In 2015, the ***Loi Transition Énergétique*** aimed to set key objectives and measures in line with the Paris Agreement on climate change. The law devoted special attention to the building sector and the urgent need to accelerate the energy retrofitting of homes and combat energy poverty. The main objectives included the renovation of 500,000 homes per year from 2017, of which at least half would be occupied by low-income households[18]. In addition, the law aimed to renovate all housing with a DPE rating of F and G (i.e., with a theoretical consumption greater than 330 kWh/m²/year) before 2025, and to achieve a building stock with BBC (Low-Energy Building) standards by 2050 (with energy consumption lower than 80 kWh/m²/year, depending on the climate zone). The ***Plan de rénovation énergétique des bâtiments***[19], presented in 2018 by the Ministry of *transition écologique et solidaire* and the Ministry of *de la cohesion des territoires*, aligns with the objectives of the *Loi Transition Énergétique* (Pellegrino, 2019). The plan proposed to translate national objectives into 13 actions organized around four key areas: making energy renovation of buildings a national priority, scaling up the renovation of housing and fighting energy poverty, accelerating the renovation and energy savings of tertiary buildings, and strengthening skills and innovation.

The ***Loi Energie Climat***, presented to the Council of Ministers in 2019 by the Ministry of *transition écologique et solidaire*, aimed to enshrine the objective of carbon neutrality by 2050 into law by revising the goals of the *Loi Transition Énergétique* upwards. The ambition was to promote widespread, high-performance energy renovations, with the two factors – massification and high performance – being presented as inseparable by the law. In this context, *MaPrimeRénov' (MPR)* was conceived as a program to improve homes' energy

[17] Respectively, the so-called *Certificats d'Economie d'Énergie* (CEE) and the *Crédit d'impôt pour la transition énergétique* (CITE), formally introduced with the 2005 finance law.
[18] Of which 100,000 thermal sieves of social housing and 150,000 thermal sieves occupied by homeowners
[19] https://www.ecologie.gouv.fr/sites/default/files/documents/Plan%20de%20r%C3%A9novation%20%C3%A9nerg%C3%A9tique_0.pdf

efficiency, aiming to accelerate the energy transition and reduce GHG emissions through a revamping of the funding system.

The following year, the National **Plan de relance (2020)** allocated €30 billion to the first pillar, ecology and energy transition, of which more than €6 billion is earmarked for energy renovation. Specifically, the €6 billion was distributed to buildings distributed across four primary areas of intervention: energy renovation of private buildings, with an additional €2 billion allocated to the *MaPrimeRenov'* (see section 4.2.1) mechanism for 2021-2022; deep renovation of social housing with €500 million allocated for 2021-2022, of which €40 million is reserved for a project call aimed at strengthening industrial solutions for the mass renovation of the social housing stock (*MassiRéno*); thermal renovation of public buildings with €2 billion for 2021-2022; and energy renovation of small and medium enterprises. According to the government website monitoring the *Plan Relance*[20], the targets of 40,000 social housing to be renovated by 2022 were achieved, and the targets for 700,000 valid applications by 2022 under the *MaPrimeRenov'* program were met. In continuity with the *Plan de Relance*, the *Fond National des Aides à la Pierre* (FNAP) established a budget of €200 millions for retrofitting more than 35,000 social housing in 2023.

Loi Climat et Résilience initially prohibited renting homes classified in energy classes G by 2025, F 2028, and homes classified in energy class E by 2034 even though these restrictions have been relaxed more recently. The law also included a rent freeze for energy-inefficient housing starting in 2022, along with the implementation of state support for the renovation process. As Apur (2022) reported, "*This new regulation represents a major challenge for the evolution of the rental supply in the City of Paris, as well as in many large cities with a predominantly old housing stock*". The INSEE observed that, in 2018, more than half (54%) of the principal residences in the city of Paris had an energy performance diagnosis (EPD) rated E, F, or G[21]. This percentage was higher than the one defined for the same year at the national level (41%).

A transversal issue that emerged at the international level during the oil crisis of the 1970s is the increasing prioritisation of **energy poverty** in the policy agenda. The issue remains complex, involving multiple factors, such as controlling energy prices in the medium term, reducing poverty among the most vulnerable, and accelerating building renovations (Guyet, 2024). The Energy Poverty Advisory Hub provides several indicators, including arrears on energy bills and the inability to keep homes adequately warm, highlighting the worsening situation in Europe due to the energy crisis and the resulting increase in energy prices.-Member states are implementing various actions, ranging from palliative measures, such as income support, to preventive measures, such as energy renovation programs targeting the most vulnerable populations (Guyet, 2024).

Since the 2000s, energy poverty has become increasingly evident in France, partly due to rising energy prices (Meillerand and Nicolas, 2022). In response to this issue, the state implemented measures to improve of housing thermal quality, provide income support to heating and regulate energy pricing. he *chèque énergie*, introduced in 2018 as a replacement for the *tarifs sociaux de l'énergie*, provides a voucher to low-income households to help them

[20] https://www.economie.gouv.fr/plan-de-relance/tableau-de-bord#
[21] https://www.insee.fr/fr/statistiques/6458354#graphique-figure2

pay their energy bills. In addition, France has launched several energy renovation programs targeting the most vulnerable families, such as those run by the National Agency for habitat (*Agence Nationale de l'Habitat*, ANAH)[22] (see section 4.2.1). The eligibility criteria for ANAH renovation aid are set at the national level; however, implementation varies locally depending on available resources and actor networks (Guyet, 2024).

4.2 The implementation process

Various tools coexist to support housing retrofitting in France ranging from financial to regulatory and support tools. From the early 2000s, public action relied on incentive-based tools such as tax deductions, subsidies[23], or subsidised loans (Fack and Giraudet, 2024). Over time, advisory and informational tools, such as national and local platforms, were introduced to facilitate retrofitting policy implementation. Since the 2020s, there has been a shift from a focus on tax deductions — which required upfront payments and offered reimbursements over time — towards a stronger emphasis on direct subsidies for private renters and homeowners, with particular attention given to the latter. In contrast, social housing tenants can access only some of these instruments (such as the energy obligation schemes), and public support for the renovation of the social housing stock remains limited. However, certain funding envelopes are made available by public bodies or other institutions (such as ANRU or Action Logement[24]), as well as by other actors, including local authorities. More recently, with increasingly ambitious European and national targets, more coercive measures have been discussed, such as restrictions on renting or selling energy-inefficient buildings (*passoires thermiques*).

4.2.1 Financial tools

Sereralkey financial tools support housing retrofitting in the French context (Figure FR4 and Table FR2). To date, the primary financial mechanism is *MaPrimeRenov' (MPR)*, which can be combined with other tools introduced in the early 2000s, such as *Eco-PTZ*, or the *Certificats d'Économies d'Énergie (CEE)*, and, where applicable, local subsidies. According to ONRE (2024) the number of homes receiving support by different schemes increased between 56% from 2016 to 2021. Giraudet et al. (2020) assess some of these measures' medium- and long-term impact, evaluating energy improvement trajectories relative to state-set targets in the residential sector.

[22] Created in 1971 with the aim of supporting the renovation of private housing, it gradually expanded its scope including energy renovation. Over time, it also redefined its targets, shifting from a focus on private landlord to owners occupiers. On the one hand, the agency supports households, both owners-occupiers and private landlords, in carrying out renovation works; on the other hand, it collaborates with local authorities in designing area-based renovation schemes.

[23] mainly managed by l'*ANAH*

[24] A French association, jointly managed by representatives of employers and employees, financing housing initiatives, especially for employees, mainly through the PEEC (*Participation des Employeurs à l'Effort de Construction*).

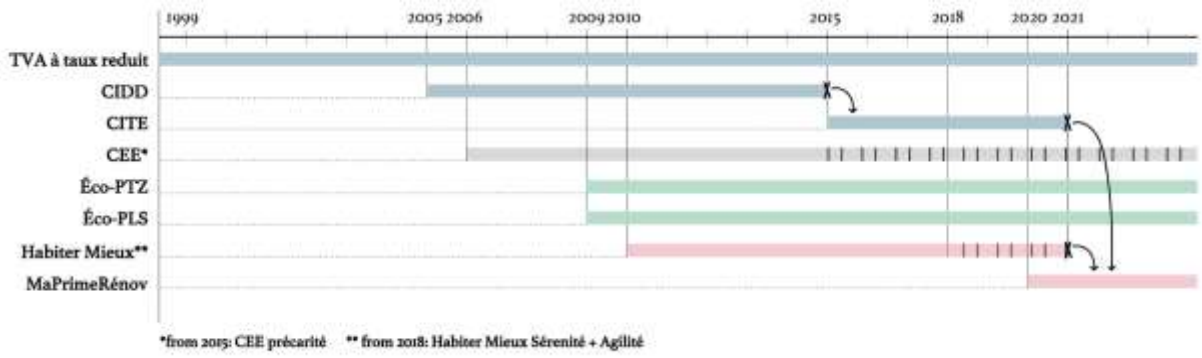

Figure FR4. diagram representing key financial tools for housing retrofitting in France, specifying their duration and evolution over time. A distinction is made between fiscal incentives (in blue), subsidized loans (in green), direct subsidies (in red) and obligation scheme (in grey)

The ***TVA à taux réduit***, since 1999, involves improving, transforming, renovating, and maintaining residential buildings older than two years. This measure was introduced in France, following the European Directive 1999/85/EC[25], initially for a three-year period. It was first extended in 2003, and then permanently implemented since 2005. Over time, the government expanded the scope of this measure to include energy efficiency works (such as solar panel installations, thermal insulation, etc.) from 2005 and materials (such as windows, boilers, etc.) from 2014-2015, benefiting from a VAT rate of 5,5%. Access to the reduced *TVA à taux reduit* is not conditioned on meeting a specific energy performance target.

To replace the ***Crédit d'Impôt Développement Durable*** **(CIDD)**, established in 2005, the ***Crédit d'Impôt pour la Transition Énergétique*** **(CITE)** was launched in 2015 as part of the *Loi Transition Énergétique*. This incentive promotes energy efficiency works in primary residences in exchange for reduced income taxes. The taxpayer was required to pay the full amount for the works upfront and then receive a refund in the form of a tax credit (typically spread over 5 years). In practice, this scheme proved less encouraging for the most vulnerable households and excluded certain types of work and materials (such as heat pumps). This is also one of the main reasons why the *CITE* was later replaced in 2020 by the *MaPrimeRénov'* program.

In 2009, the ***Éco-PTZ (Éco-Prêt à Taux Zéro)*** was introduced to finance energy retrofit investment investments for houses used or intended to be used as primary residences[26]. As reported by the annex to the draft finance bill for 2024[27], the number of *Eco-PTZs* quadrupled from 2018 to 2022 due to simplifications and the strengthening of the program, but also due to the context of rising interest rates. It can be combined with other subsidies, such as the *CEE* and *MaPrimeRenov'* (MPR), provided by *ANAH*. In addition, for social housing only, the ***Éco-***

[25] Directive 1999/85/EC of 22 October 1999 amending Directive 77/388/EEC regards the possibility of applying on an experiment basis a reduced VAT rate on labour-intensive services. The directive is available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31999L0085

[26] This measure provides an interest-free loan for different energy works (from individual items to complete renovations). The bank loan can be up to 30,000 euros for single-item renovations and 50,000 euros for global renovations, with a repayment period of up to 20 years.

[27] Available at: https://www2.assemblee-nationale.fr/static/16/pdf/Annexes_PLF/Effort_financier_%C3%89tat_r%C3%A9novation_r%C3%A9nerg%C3%A9tique_b%C3%A2timents.pdf

Prêt Logement Social (Éco-PLS) is a measure stemming from the work of the Grenelle de l'Environnement, aimed at encouraging the energy renovation of the most energy-consuming buildings. The Éco-PLS distributed by the *Caisse des Dépôts et Consignations (CDC) through its Banque des Territoires (BdT).*

The national agency ANAH provides some state aid for energy renovation of private housing. In 2020, ***MaPrimeRenov'(MPR)*** replaced the former schemes (CITE, ***Habiter Mieux Agilité*****, and *Habiter Mieux Sérenité)***. Unlike the CITE system, which consists of a tax credit, *MPR* offers households direct financial support ("invoice discount"). Initially, *MPR* was reserved exclusively for low-income families. Still, since 2022, it has been extended to all income groups (intermediate and higher incomes) as well as individual landlords (i.e. not corporate), although with varying subsidy thresholds based on income[28]. For collective housing, *MaPrimeRenov' Copropriétés* (previously *Habiter Mieux Copropriétés*) is now available to all unions of co-owners (*syndicats de copropriétaires*), increasingly questioned about energy renovation works (Brisepierre, 2020)[29]. In this context, low-income households often face multiple challenges, including complex administrative procedures and the need for upfront financing (Defay and Driant, 2023). According to Apur's (2022) report on the city of Paris, for owner-occupier households with a monthly income of less than €2,150, the average cost of external thermal insulation represents nearly a full year of income (11.8 months). As a result, this system benefits households with savings or access to credit to the detriment of economically vulnerable ones.

		Beneficiaries				**Targeted tenure**		
		owners' occupants	owners' landlords		co-owners (syndacats de coproprieté)	OO	PR	SR
			Individuals	*Collective entities*				
Loans	Éco-PTZ	✓	✓		✓	✓	✓	
	Eco-PLS			✓				✓
Subsidies	MPR par geste	✓	✓			✓	✓	
	MPR d'ampleur	✓	✓			✓	✓	
	MPR copropriétés				✓	✓	✓	✓
Fiscal incentives	TVA taux réduit	✓	✓	✓	✓	✓	✓	✓
energy obligation schemes	CEE	✓	✓	✓	* for shared spaces only	✓	✓	✓

[28] The aid amount depends on the type of renovation and the household's income, with different criteria for Île-de-France and the rest of France#. The user receives a discount on the renovation invoice through a combination of MPR and CEE aids, with the remaining cost potentially covered by an Eco-PTZ or additional local aids if available. The company that carries out the energy renovation work applies a discount on the invoice based on the subsidy the household will be able to benefit from. After the work is completed, the subsidy is directly paid by the administration to the company.

[29] This subsidy is conditional on achieving at least a 35% energy gain and applies to co-ownerships with at least 75% primary residences

Table FR2. main financial tools for energy renovation in relation to corresponding beneficiaries and impacted tenures. This table is not exhaustive; it includes the main state aid and long-term support mechanisms currently in use in 2025.

National financial tools can be complemented with local ones. The study conducted by ONRE (2024) analyzes geographical disparities in provision of aid, finding that aid levels can vary greatly by department. About 60% of local authorities provide some kind of local aid, most of which can be combined with state aid (Vailles and Ousaci, 2024). However, certain departments provide more than others, and metropoles such as Lyon, Grenoble, Bordeaux, and Paris provide substantial local subsidies (sometimes exceeding €10,000 per household).

4.2.2 Regulatory tools

Le ***Diagnostic de Performance Énergétique*** **(DPE)**[30] was introduced in 2006 to provide households with information about the energy and environmental performance of homes. Initially created as an informational tool to enable more informed decisions, the DPE has acquired a regulatory character over time. Some changes occurred in years that followed, particularly between the late 2010s and early 2020s. On the one hand, the *DPE* methodology was broadened to include not only energy consumption, but also the amount of GHG emissions. On the other hand, it became mandatory to include the *DPE* in real estate sales and rental listings. The DPE methodology has evolved over time, affecting the categorisation of the housing stock into most and least consuming categories and the implementation of related policies (see, for instance, below the rental ban the so-called *passoires thermiques*) (Fack and Giraudet, 2024).

The *Loi Climat et Resilience* (2021) initially included a gradual **ban on renting of homes classified in energy classes E, F and G by** 2034. The original provisions of the law stated that, starting in 2025, if a rented property fails to meet the minimum energy performance standards, tenants have the right to act against their landlords[31]. According to a 2022 INSEE study focused on the Île-de-France region, social housing on average has a higher proportion of energy-efficient homes (rated A to D), likely due to the newer construction of its housing stock. In contrast, 55% of privately rented main residences in the region are considered energy-intensive (Chaput et al., 2022). More recently, the rules on banning the rent of energy sieves have been re-discussed and, partially, lifted or relaxed[32]. At present, relaxations are being proposed specifically for co-owners' condominiums, as decision-making takes longer than in situations with a limited number of property owners.

[30] https://rt-re-batiment.developpement-durable.gouv.fr/presentation-generale-du-dpe-a783.html

[31] Suppose a judge determines the property does not meet the required energy performance standards. In that case, they may order the landlord to make the necessary repairs, impose a rent reduction for the tenant, and even require the landlord to compensate the tenant.

[32] In 2024, the government issued an order that, by changing the mode of calculus for small size apartments (under 40 sq. m.), lifted the rental ban on 140,000 units initially labeled as F. This was reported by the press as being the result of a lobbying by representatives of the real estate industry (cf. *Mediapart*, 14/02/25, *https://www.mediapart.fr/journal/ecologie/140224/passoires-thermiques-la-calculette-du-ministre-au-service-des-proprietaires*). In 2025, a draft bill was introduced in the Senate, containing provisions that would lift the ban in specific conditions (e.g. when works for energy upgrading are impossible to implement because of technical, architectural or heritage reasons, or disproportionate costs; or in case of recent negative vote by co-owners).

4.2.3 Support and information tools

Several tools are available and promoted at the national and local levels to support local authorities and individuals in implementing housing retrofitting policies.
Among these, France Rénov' is the national platform coordinating and centralising energy renovation policies. In addition, the *Agences Locales de l'Énergie et du Climat* (ALEC), established by the *Loi Transition Énergétique* in 2015, focus on promoting the energy transition and combating climate change locally. These agencies operate as public services, offering information and awareness-raising activities and providing advice and support to public bodies in their energy transition efforts.
Furthermore, local authorities introduce complementary financial support and tools to those implemented nationally. For instance, the City of Paris launched the *Éco-Rénovons Paris* program to encourage housing retrofitting in 2016, primarily for co-owners (*copropriété*). In addition, the City of Paris provides additional grants for renovation works[33].

4.3 Size and role of the market

The energy market liberalisation phased out public monopolies and tariffs in the last 30 years, introducing supplier competition. However, rising energy prices forced the government to introduce a 'tariff shield' and incentivise energy-saving measures for low-income households. As the complexity of public market regulation increases, innovation and challenges become intertwined, making it difficult to evaluate the resulting policy mix.

4.3.1 Energy price setting

For a long time, the French state maintained a monopoly on electricity and natural gas through two national companies (*Électricité de France - EDF* and *Gaz de France GDF*), which distributed energy at government-regulated prices. This situation changed with the liberalization process of the energy market initiated at the European level between the late 1990s and early 2000s and the subsequent opening of national markets to competition (Poupeau, 2013). From 2019, the *Tarifs Réglementés de Vente* (TRV) for gas were gradually removed, while regulated tariffs for electricity partly remain in effect. However, they were expected to be adjusted or phased out gradually. Indeed, following the market opening, users can choose from different suppliers offering fixed tariffs (where the energy price remains unchanged for the duration of the contract), indexed tariffs (where the price follows market trends), or tariffs exclusively linked to renewable sources, depending on the case.
From 2021 onwards, partly in response to inflation dynamics and rising energy prices, , and likely also due to concerns about massive social unrest similar to the Yellow Vests movement sparked by proposed additional taxes on oil, the French state introduced several support measures for households to help with energy bills (electricity and gas), including the *bouclier*

[33] In 2022, for instance, the combined support from ANAH and the City of Paris helped 3,314 housing units. Of these, 2,302 benefited from the Habiter Mieux/MaPrimeRénov' program, thanks to energy savings of over 35% (Apur, 2022). The total amount of subsidized works reached €61.8 millions, with €28 millions in grants from ANAH and €8.2 millions from the City of Paris, bringing the total financial support for renovation projects to €36.3 millions (approximately 58% of the overall amount).

tarifaire (tariff shield). The study by INSEE (2022)[34] assesses the impact of this tool, stating that "*gas TRVs would have gradually increased by 66.5% including taxes between October 2021 and February 2022 in the absence of the tariff shield. As for electricity TRVs, they would have increased by 35.4% including taxes on February 1st, 2022. Furthermore, since market offers are partly indexed to regulated tariffs, the prices of these offers would likely have been more dynamic without the 'shield'*".

4.3.2 Energy obligation schemes

One of the most common tools in energy obligation schemes in France is the *Certificats d'Économies d'Énergie* (CEE). The program drives private sector investment in energy-saving measures and acts as a key incentive for housing retrofitting. The *CEE*, introduced in 2006 by the *Loi POPE*[35], set obligations for energy companies to promote and finance projects that reduce energy consumption. *CEE*, which can be sold or traded on the market between energy suppliers, certifies the amount of energy saved through the implemented projects. Since 2015, a portion of these energy savings obligations must be achieved for low-income and very low-income households facing energy poverty. The share of CEE allocated to energy poverty compared to the traditional *CEE* has evolved over time: starting in 2022, in line with the goals of the *Loi Climat et Résilience*, the targets to be met have increased by 25%, setting more ambitious levels for CEE aimed at those in energy distress (Figure FR5). This system can be combined with other subsidies, such as *MaPrimeRénov'* (see section 4.2.1).

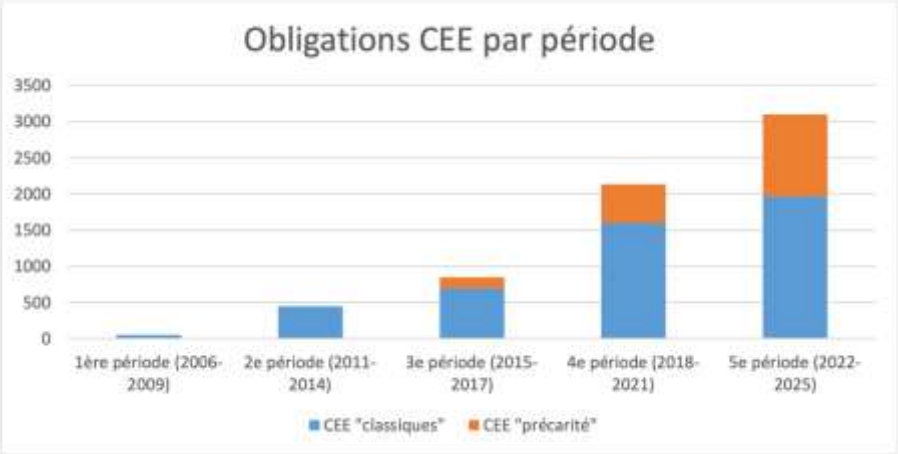

Figure FR5. evolution of CEE obligations objectives (in terms of TWhc) over time (source: CEE annual report, 2023[36])

4.3.3 Bank loans

Banks also finance housing retrofitting through credit instruments linked to financial markets (Gimat et al., 2022). One example is the Prêts verts (Green Loans) offered by Banque Postale

[34] https://www.insee.fr/fr/statistiques/6215309?sommaire=6215395
[35] https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000813253/
[36] https://www.ecologie.gouv.fr/sites/default/files/documents/Bilan%20annuel%20CEE%20P5%20-%202023-%20VPubli.pdf

to social housing providers for the renovation of social housing stock. These loans are financed through green bonds issued by the *Caisse Française de Financement Local* (CAFFIL). For instance, since 2021, Néolia (an *Entreprise Sociale pour l'Habitat* – ESH, see WP4 4.1) has benefited from these loans to renovate its housing stock, mainly to address technical constraints that limited access to éco-prêts issued by the CDC and to take advantage of the competitive interest rates offered by Banque Postale[37].
Additionally, in 2024, the Minister of Housing commissioned a report from two senators on the creation of a public bank to finance energy retrofit. Its purpose would be to help households to finance the outstanding cost of investment that is left once subsidies and other public support schemes are deducted[38].

4.4 The multi-level governance process

Local authorities managed energy networks before nationalisation in the early 20th century. Following the energy crises of the 1970s, they sought to improve the energy efficiency of their building assets and later address energy poverty issues. Since the 1990s, new regulatory frameworks have assigned regions, departments, and inter-municipal authorities additional responsibilities related to housing energy renovation, energy poverty and, more generally, climate action plans. Historically, local authorities have been the organizing bodies for public energy distribution networks. As noted by Poupeau et Bouteaud (2021), the involvement of local authorities in energy-related issues is part of a long-standing process. Their competence was somewhat limited with the creation of large national monopolies (*Électricité de France - EDF*, and *Gaz de France GDF*) around the mid-1900s. With the energy crisis of the 1970s and 1980s, new opportunities emerged for local authorities, who began acting in parallel with public policies defined at the national level by state organizations (such as the *ANAH* or *ADEME*[39]). At that time, municipalities initially focused on improving the energy performance of their own asset (e.g., sports and cultural facilities), and later extended their efforts to social and private housing through two key programs: *Opérations Programmées d'Amélioration Thermique des Bâtiments (OPATB)* and *Opérations Programmées de l'Habitat (OPAH)* (Debizet, 2011). These actions primarily addressed disadvantaged situations, tackling issues of energy poverty. In the 1980s, during the economic crisis, the state required EDF and GDF to establish a financial aid system. Another example is the *Fonds Solidarité Logements (FSL)*, where municipalities are crucial in implementing various systems for managing arrears.

The 1990s and early 2000s marked **the growing involvement of local authorities (regions, departements and intermunicipalities) in the energy transition**, facilitated by a new regulatory framework that defined the perimeters for energy-climate planning. However,

[37] https://www.labanquepostale.fr/bailleurs-sociaux/actualite/rehabilitation-logement-social-pret-vert.html
[38] The creation of such an *ad hoc* institution was already suggested in the framework of the housing task force (*Conseil national de la refondation*) formed in 2023, and the special commission at the National Assembly (*Mission d'information commune sur la rénovation énergétique des bâtiments*).
[39] It supports national and local ecological transition policies and is overseen by the Ministries of environment, energy, and research.

despite the growing involvement of local authorities in policy implementation and horizontal coordination among local institutions and organisations, the national level continues to play a primary role by defining key objectives, elaborating regulation framework, and setting the corresponding implementation tools (see Table FR3).

	Roles and responsibilities	**Actors**
National level	Define the roadmap for decarbonisation of the housing sector (SNBC) Set the financial tools (MPR, CEE, PTZ., etc) and support tools (e.g France Rénov') to implement energy retrofitting policies Coordinate the public service for housing retrofitting (France Rénov)	Ministries (DGALN) ADEME ANAH
Regional level	Since the *Loi Transition Énergétique* (2015) the regions have been assigned the responsibilities of energy performance of buidlngs and housing and renewable energy production The regions are responsible for developing the Schéma Régional d'Aménagement, de *Développement Durable et d'Égalité des Territoires* (SRADDET), introduced by the Loi NOTRe, which aims to consolidate existing schemes, including the *Schémas Régionaux Climat Air Énergie* (SRCAE)[40]. The regions are also responsible for creating a *Programme Régional de l'Efficacité Énergétique* (PREE) to formalize a strategy for energy renovation.	Régions
Departemental eleve	Departments take the lead on issues related to energy poverty. Coordinating with intermunicipalities as well as local actors and organizations that operate directly on the ground.	Departements
Intermunicipal level	At the level of intermunicipalities, the Grenelle II Law (2010) allowed for the "greening" of the *Schémas de Cohérence Territoriale* (SCoT)[41] by integrating climate-related issues into these documents[42]. The *Loi Transition Énergétique* (2015) introduced the *Plan Climat Énergie Air Territorial* (PCEAT), which sets an action program to improve energy efficiency and reduce climate-changing emissions within the territory.	EPCI

[40] Introduced by the Grenelle II Law, the SRCAE has provided regions with a global vision to mitigate the effects of climate change and adapt to it.
[41] urban planning document that, at the scale of a territory, project, or living area (inter-municipal perimeter or beyond), defines the spatial organization and the main development directions of a territory.
[42] It also enables the definition of additional rules, such as determining areas where urbanization is conditional on meeting strengthened environmental and energy performance criteria.

	Finally, the *Plan Local d'Urbanisme Intercommunal* (PLUi) operationalizes the guidelines set out in the *SCoT*, which must be compatible.	
Municipal level	Supporting households through information tools, counselling or technical assistance Coordinating renovation programs at the local level with engagement and awareness rising activities	Communes

Table FR3. roles, responsibilities and actors in housing retrofitting organized by governance level

4.5 Achievements, assessments, and challenges

Despite national ambitions, the pace and performance of energy renovations remain insufficient to meet goals set by the National Low-Carbon Strategy. This target is 370,000 “deep” retrofits per year, increasing to 700,000 per year after 2030. This is ambitious given the 2022 pace of 66,000 deep retrofits (Fack & Giraudet, 2024). Even the main national scheme, MaPrimeRenov', has highlighted several critical issues, such as the focus on replacing heating systems rather than comprehensive renovations, which are more costly and can reduce usable space. Additionally, the long payback period for these renovations, often exceeding the lifespan of the equipment, poses a significant challenge. The cost of renovation risks disproportionately affecting lower-income owners, who may see their property values decline.

Overall, the pace and performance of renovations remain below the national targets set by the horizon of 2050 (Reseau Action Climat, 2021). In fact, energy renovations are rarely carried out comprehensively and are often done in small steps that have minimal impact on the building’s overall performance. On average, considering energy labels, in 60% of cases, only one energy class is improved after the work, and two classes in 40% of cases (Valranges, 2018).

As Defay and Driant (2023) highlighted, *MaPrimeRenov'* raised several critical issues. Firstly, the works implemented so far mainly relate to replacing heating systems rather than comprehensive renovation, which primarily targets the overall insulation of buildings significantly more expensive than those involving only heating[43]. In addition, comprehensive renovations can lead to a loss of usable space, which means sacrificing valuable square meters for owners, affecting both the quality of living and the resale value. Another significant issue is the theoretical payback period of these renovations, often longer than the expected lifespan of the equipment and materials used.

These issues overlap with concerns related to the recent *Loi Climat et Résilience* and the progressive ban on renting out energy-inefficient homes. Defay and Driant (2023) argue that the outflux of these now-deemed energy-inefficient homes from the market could lead to a shortage of rental supply in major cities. In this context, the high cost of effective renovations raises the risk of a growing divide between renovated properties and those that will remain unrenovated due to the owners’ lack of financial resources or the absence of a clear return on

[43] According to data from the first half of 2022 published by the ANAH, only 6% of applications are for comprehensive renovations, compared to nearly 70% for individual heating systems.

investment. Lower-income owners are the ones most likely to bear the brunt of these challenges, gradually seeing the value of their properties erode, often after having invested much of their life savings into them as a form of retirement security. As one interviewee pointed out, those most affected by this loss are often people who already face long and expensive commutes, bearing a double burden of transport costs and the shrinking value of their properties. Moreover, as underlined by a recent study about the risk of renoviction in France (Barry and Sabrinni-Chatelard, 2024), renovation works may pose a threat to tenants, who may face the landlord invoke energy renovation as a reason to simply evict them from their homes.

	Potential Impacts
Territorial disparities in accessing resources	National subsidies might be complemented with local subsidies, but the availability vary greatly across territories, risking to exacerbating existing territorial inequalities
Renovation costs and housing quality	The high "out-of-pocket" renovation costs and long payback periods risk deepening the divide between renovated properties and those that will remain unrenovated due to the owners' lack of resources
Lower-income homeownership vulnerabilities	Increased likelihood of property devaluation might imply higher risks for lower-income owners who invested life savings, especially when compounded by peripheral location and high transport costs.
private rental sector	Landlords may use renovation as a pretext for eviction, exposing tenants to the risk of *renoviction* and potentially reducing the supply of most affordable housing
Social rental sector	Limited financial resources may lead social housing providers to adopt strategies such as diversifying social housing production, partially selling stock, and prioritising renovation over new construction.

Table FR4. Potential impacts of housing retrofitting policies on housing inequalities and urban and territorial dynamics.

5. Nature-Based Solutions

Nature-Based Solutions (NBSs) emerged in relation to a renewed interest in urban nature, driven by the growing ecological imperative and the recognition of the multiple benefits associated with natural elements in urban contexts (Bourdeau-Lepage, 2019). In France, NBSs have recently gained prominence in policy discussions, largely influenced by international debates (Drapier et al., 2024). Currently, NBSs are integrated into broader national policy frameworks for climate change adaptation, biodiversity protection, and water management. Moreover, policies and projects not explicitly labeledas NBSs may still involve or translate into nature-based initiatives (such as *politiques de végétalisation*). Despite strong national support, local implementation remains challenging.

5.1 The policy cycle: emergence of the issue and policy decisions

NBSs have become part of national environmental policies over the past decade (Guerrin et al., 2023). Before that, other policies integrated the issue of nature, albeit in a more transversal manner. The *Loi Grenelle II* highlighted the importance of the blue and green infrastructures, while the subsequent ALUR law placed particular emphasis on the issue of urban sprawl (see section 6.1). However, the institutionalization of NBSs in France within public policies is a more recent process. It has driven by key integration vectors (Drapier et al., 2024), including: the French Committee of the International Union for the Conservation of Nature (CF IUCN), the *Direction de l'Eau et de la Biodiversité* (DEB) of the Ministry of Ecological Transition (also through the *Agences de l'eau*), and the *Office Français de la Biodiversité* (OFB)[44]. In parallel, some institutional actors in the housing sector have begun integrating nature-based solutions (NBS) into their professional practices. The HLM organizations formally committed to this approach in 2022 by signing the Manifeste pour la Biodiver*sité dan*s le secteur HLM[45].

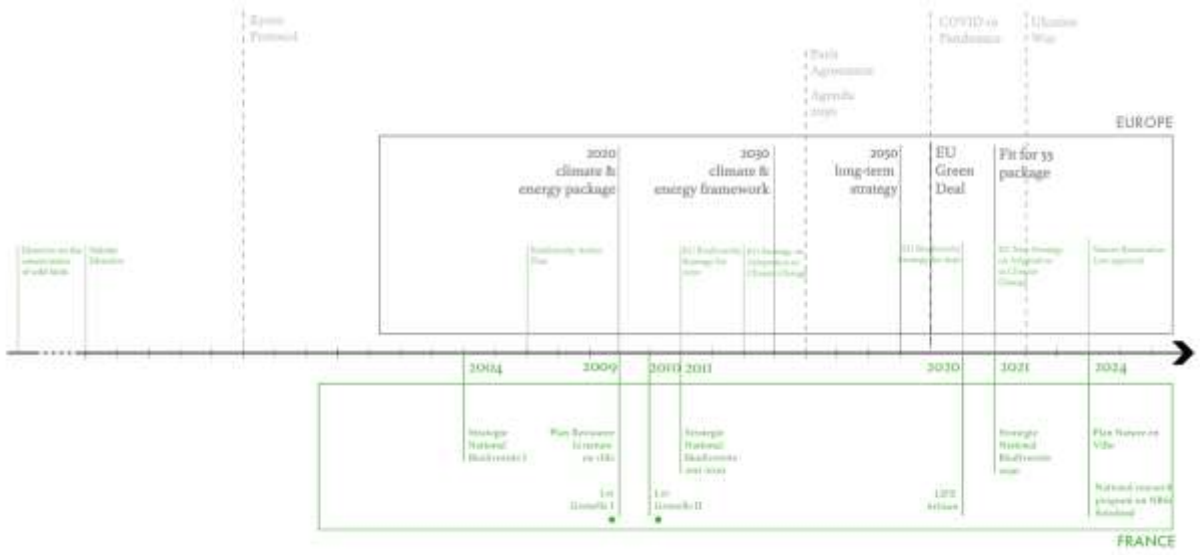

Figure FR6. timeline illustrating key policies and regulation in France and EU related to NBSs.Binding documents are marked with filled green dots.

Since the 2015 Paris Climate Conference (COP21) the **French Committee of IUCN** has been instrumental in introducing and promoting NBSs, particularly . They produced reports, organized working groups, and actively advocated for NBSs in various policy spheres. The IUCN and the European Commission rely on different definitions of NBSs, while sharing common ground (Hanson et al., 2020). The European Commission relates the concept to the three pillars of sustainable development and gives higher priority to innovation and economic

[44] Public institution, formed in 2020 from the integration of *Agence Française pour la Biodiversité (AFB)* and Office National de la Chasse et de Faune Sauvage (ONCFS)

[45]https://www.union-habitat.org/centre-de-ressources/patrimoine-maitrise-d-ouvrage/manifeste-de-l-ush-pour-la-biodiversite-dans-le

dimensions; while IUCN focuses more on human well-being, the use of existing ecosystems and the protection of biodiversity (ibidem).

In parallel with this, the Ministry of Ecological Transition, particularly through its water and biodiversity directorate (*Direction de l'Eau et de la Biodiversité* - DEB)[46], has explicitly incorporated the European notion of NBSs into national strategies and plans. This includes the ***Stratégie Nationale pour la Biodiversité 2030*** (SNB)[47], published in 2021, which aims to integrate biodiversity objectives and NBS into key sectoral policies. Among the flagship actions of SNB 2030, the *Plan Nature en Ville 2024-2030* aims to combat biodiversity collapse in cities and to mitigate and adapt cities to climate change. The plan defines a roadmap by identifying key axes: improving knowledge, preserving and restoring nature in territorial strategies, and promoting nature in urban planning projects. A fourth cross-cutting axis of the plan involves bringing together stakeholders to foster a shared culture.

From 2020 the OFB[48] pilots the ***LIFE Accroitre la Résilience des Territoires au changement climatique par l'Inciation aux Solutions d'adaptation fondées sur la Nature* (ARTISAN) program**, that aims to promote NBSs as a key strategy for climate adaptation across the country. It is funded by the European commission through a call for projects, to which the OFB responded at the request of the Ecological Transition ministry. The project's approach includes a demonstrator program featuring ten pilot projects across mainland France and its overseas territories (Annex 3). The projects are primarily funded by EU funds, with a small share of local co-financing over a 5-year period. In addition, LIFE ARTISAN has established a network of regional coordinators who play a crucial role in facilitating local NBSs implementation (organizing events, and connecting project leaders with potential funders and support structures, etc.). Concrete examples of the project's work can be seen in pilot sites like Martinique, where mangroves are being used for coastal protection against sea-level rise, and in Les Mureaux, where urban heat islands are being addressed through the greening of school grounds. These examples illustrate how NBSs can provide multiple benefits, addressing climate challenges while also enhancing biodiversity and improving quality of life for local communities.

5.2 The implementation process

At the national level, there are no regulatory or financial tools explicitly referring to NBSs. Incentive-based tools prevail, including the enhancement of existing projects, the dissemination of information, guidelines and more. The lack of shared definitions, regulatory instruments, and, above all, financial tools makes the implementation of NBSs particularly challenging (Ershad Sarabi et al., 2019). However, local actors can benefit from resources

[46] The DEB is a directorate that is part of the *Direction générale de l'aménagement, du logement et de la nature* (DGALN)
[47] The first *Stratégie Nationale pour la Biodiversité* was elaborate in 2004, with subsequent revisions in 2011 and 2021.
[48] Public institution, formed in 2020 from the integration of Agence Française pour la Biodiversité (AFB) and Office National de la Chasse et de Faune Sauvage (ONCFS)

linked to European initiatives specifically targeting NBSs or from local funds more broadly dedicated to the greening of urban spaces.

5.2.1 Financial tools

There are no national tools specifically providing funding for NBS implementation. However, since 2023, the Ministry of Ecological Transition has launched the *Fonds d'accélération de la transition écologique dans les territoires*, also known as the *Fonds vert* (literally: Green Fund)[49]. This fund aims to finance projects submitted by local authorities and public or private partners in three areas: environmental performance, territorial adaptation to climate change, and improvement of living conditions. The fund's balance report at the end of 2023, states that "*Endowed with 2 billion euros, it has enabled massive mobilization of stakeholders across the entire national territory. With 10,683 beneficiary projects in the first year alone, supported by more than 6,800 local authorities and territorial actors*[50]*.*

The Institute for Climate Economics (2016) analyses financing tools for urban greening projects in Europe and America. The report notes that overall "*The deteriorated state of public finances places a constraint on the amounts and distribution of local government budgets. This pushes local authorities to mobilize resources and/or expertise from the private sector and individuals".* This dynamic has clear implications at the national level as well, fostering public-private partnerships (see sections 5.3 and 5.4).

5.2.2 State-owned financial institution

A primary role in the promotion and financing of NBSs is played by *CDC Biodiversité*[51], a established in 2008 by the *Caisse des Dépôts* that manages the financing of mandatory ecological compensation within the ERC (*Eviter, Réduire, Compenser*[52]) (Guerrin et al., 2023b). In addition, in 2016, *CDC Biodiversité* launched the Natura 2050 program, a national initiative that promotes, funds, and oversees the implementation of NBS. The program gathers voluntary contributions from both public and private actors (CDC's website lists the main contributors) in support of biodiversity. Finally, CDC works closely with the *Office Français de la Biodiversité* (OFB) and the French Committee of IUCN within the framework of the European LIFE ARTISAN project.

5.3 Size and role of the market

Among the incentive-based benchmarking tools, the proliferation of awards and green labels for cities has gained prominence since the 1990s, both at the national and European levels (Guerrin et al., 2023b). As Epstein (2013) highlights, their development has taken on a dual role over time: on the one hand, they contribute to differentiating territories in a competitive logic; on the other, they can foster forms of cooperation and the dissemination of good

[49] Led by the Direction générale de l'aménagement, du logement et de la nature (DGALN)
[50] Available at the following link:
https://www.ecologie.gouv.fr/sites/default/files/documents/Bilan_Fonds_vert_2023_compresse.pdf
[51] CDC Biodiversité is a subsidiary of the CDC group, a state-owned financial institution.
[52] https://www.ofb.gouv.fr/mettre-en-oeuvre-la-sequence-eviter-reduire-compenser

practices. However, as Bourdeau-Lepage (2019) points out, the promotion of NBSs awards and green labels for cities in urban environments might become a territorial marketing tool, contributing to the attractiveness of a territory—often to the benefit of more affluent population groups

5.4 The multi-level governance process

As reported in section 5.2, NBSs are mainly promoted in the form of non-binding recommendations. The financial resources allocated to NBSs at the national level remain limited. Therefore, the implementation of NBS policies is entrusted to local communities, leading to a heterogeneous landscape shaped by local political will (Guerrin et al., 2023b).

On the other hand, EU programs and national initiatives tend to foster public-private partnerships. In this regard, the ARTISAN LIFE project includes around 27 public-private partnerships. As noted in the OFB report (2024), external partnerships—bringing together private actors, public institutions, and research organizations, among others—are often more developed than inter-service collaborations (e.g., between public offices in different sectors such as education, public works, etc.). Similarly, the Nature 2050 program, promoted by CDC Biodiversité, encourages voluntary public and private funding (see section 5.2.3).

On the one hand, there is the emergence of "exemplary cases" where urban greening is a priority axis in the political agenda (Rochard, 2024). For instance, since the early 2000s, the City of Paris has developed several programs and initiatives strongly oriented towards urban greening. In this regard, initiatives such as the *Permis de végétaliser* and the platform *Végétalisons Paris* have become instruments for legitimizing the policies promoted by Anne Hidalgo between 2014 and 2020 (Deschamps, 2024). More recently, the Hidalgo 2021-2026 mandate has been characterized by tools aimed at increasing urban canopy, notably through the *Plan Arbre*[53].

Additionally, a cross-cutting issue concerns definitional debates and the local appropriation of the NBS concept. Some initiatives and policies that could qualify as NBSs are often categorized under other terms (green infrastructures, ecosystem services, nature restoration, etc.). Furthermore, even when the term NBS is adopted, there is an ongoing "*work of definition, translation, or reinterpretation of the concept*" depending on the period and the social groups engaging with it (Drapier et al., 2024). For instance, in the case of the ecological restoration and adaptation targeting the Salins de Camargue site, "*the qualification of these projects as nature-based solutions became a source of local tensions, and the term was eventually abandoned*" (Guerrin et al., 2023b).

5.5 Achievements, assessments, and challenges

While much of the existing work focuses on broad environmental policies, fewer studies specifically examine the intersection of NBSs policies, housing affordability and socio-spatial inequalities (Institute for Climate Economics, 2016). In addition, there is a prevalence of reports

[53] https://cdn.paris.fr/paris/2021/12/13/daf6cce214190a66c7919b34989cf1ed.pdf

and research on green spaces policies in a broader sense, including green and blue infrastructures, ecological services, compared to those specifically exploring NBSs. No studies or reports have explicitly analyzed the impacts of NBSs on housing rental and selling prices.

A number of studies addressed environmental justice issues, green spaces accessibility and the social sustainability of ecological transformations (Blanc et al., 2024). In this regard, Clerval (2011) emphasizes the role that urban transformation processes and green spaces can play in gentrification processes at the city scale, particularly in the context of Paris. Similarly, Newman (2015) talks about the contestation and negotiation behind the transformation of Jardins d'Éole in northern Paris as an example of a "*post-industrial brownfield repurposed as a sustainable landscape*." The contribution shows how ecological policies and public space planning in Paris interact with cultural and social inequalities, revealing a disconnect between sustainability objectives and the lived realities of marginalized groups.

Fewer studies specifically explore Nature-Based Solutions and socio-spatial inequalities. Herivaux and Le Coent (2023) examine the acceptability of NBSs in relation to the urban-rural gradient in Basin-Versant du Lez, Montpellier. As a result, residents in urban areas with limited access to nature and higher exposure to summer heatwaves tend to be more supportive of NBSs. In contrast, residents in peri-urban areas, with better access to nature but greater dependence on cars, show less support for NBSs that might reduce space for vehicles. In this regard, Cardinal (2023), demonstrates how NBSs can actually exacerbate existing inequalities in terms of the distribution of environmental risks and benefits, based on a study conducted in the La Bouillie area (in the Loir-et-Cher department).

	Potential Impacts
green spaces and eco-gentrification	urban transformation processes and green spaces (eco-neighbourhoods) can play a role in driving gentrification processes in urban and metropolitan contexts
spatial disparities implementation	the implementation of NBS policies mainly entrusted to local communities, leading to a heterogeneous landscape shaped by local political will
acceptability and policy fragmentation	differing acceptability of NBS along the urban-rural gradient may generate tensions between territories and hinder coordinated supra-local strategies

Table FR5. Potential impacts of NBSs policies on housing inequalities and urban and territorial dynamics.

6. Densification

Urban density and densification issues have long been subjects of debate over time (Fonticelli, 2018; Touati, 2010). From the late 1990s and early 2000s, the topic gained renewed attention also in relation to energy and environmental sustainability of urban transformations (e.g reducing energy consumption, limiting car use, etc.). European-level impulses regarding densification mainly focus on measures aimed at reducing land consumption, partly due to the fact that the EU has competencies primarily in environmental matters (see Green Deal note). A pivotal moment came with the EU policy recommendation in 2011, which set the goal to halt land consumption by 2050. This same objective was later reaffirmed by the EU Soil Strategy in 2030. **France is one of the few European countries that has integrated this objective into national law, thus setting stringent goals regarding the reduction of soil artificialization at the national level (under the *Loi Climat et Résilience* of 2021).**

6.1 The policy cycle: emergence of the issue and policy decisions

In France, a number of policies were developed promoting densification processes in relation to environmental and climate change issues (Figure FR7)[54]. The 2000s, marked a crucial moment in time, with urban renewal becoming an 'official doctrine' (Charmes, 2010). These policies gained momentum throughout the 2010s, focusing on the densification of urban areas, and the reuse of industrial sites or vacant buildings near public transport. By 2021, policy priorities evolved in response to European policies and growing 'political pressure' on ecological issues (Charmes, 2021), emphasizing the fight against soil artificialisation and the protection of natural and agricultural spaces (where densification represents one possible area of intervention)[55]. At present, the term "densification" is subjected to criticism, as it tends to be associated by residents with an increase in concrete construction, according to experts (Cremaschi et al. 2025[56]). Instead, mainstream policy discourse tends to shift toward the principle of land sobriety (*sobriété foncière*) giving priority to the reuse of vacant housing and the redevelopment of brownfields.

[54] Fonticelli (2019) highlights that policies that are not necessarily framed as densification may still imply and translate into densification actions.

[55] See also Fondation Abbé Pierre and Fondation pour la Nature et l'Homme, 2024 for a timeline of policy initiatives aimed at reducing land artificialisation

[56] It is an unpublished document reporting on the first Policy Lab held in March 2025 at SciencesPo, Paris. It offers insights into current policy debates on the social consequences and trade-offs of green policies, as perceived by key stakeholders in France.

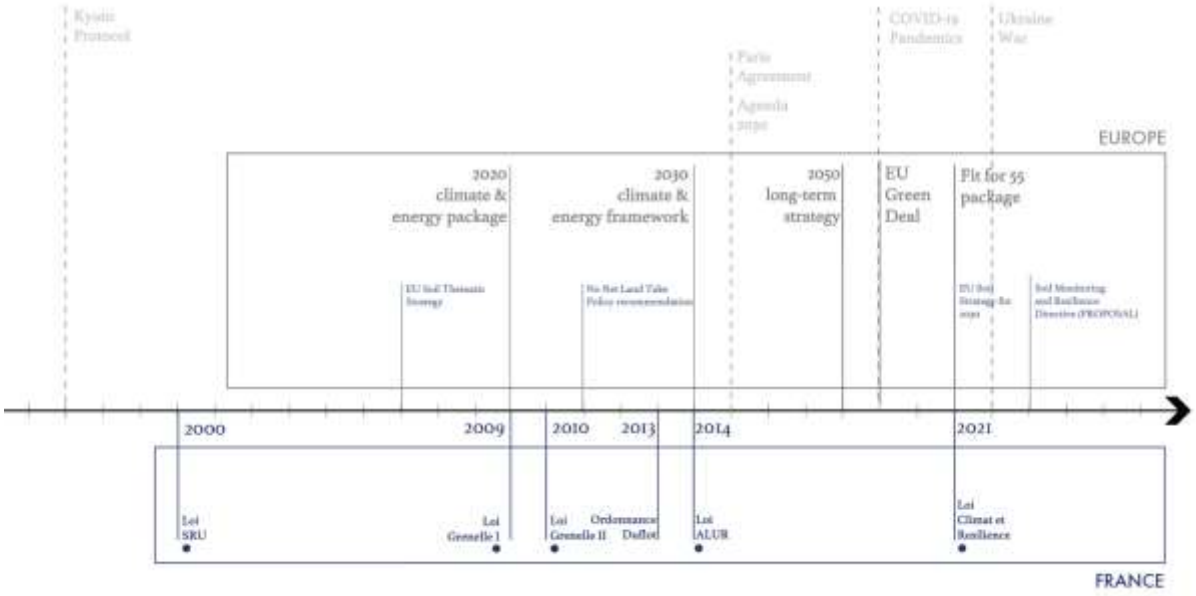

Figure FR7. Timeline illustrating key policies and regulation in France and EU affecting densification. Binding documents are marked with filled blue dots

The ***Loi Solidarité et Renouvellement Urbain*** **(SRU)** of 2000 was the first national law to promote densification (Fonticelli, 2018). The law stems from the recognition that certain urban areas with high urban stakes were rapidly deteriorating, that urban sprawl had negative consequences and that the sustainability of urban development needed to increase. Overall "*the provisions clearly mark a shift: they pave the way for a densification policy without imposing it*" (Lebreton et al. 2015, p. 47). The SRU law addressed the issues within the framework of general principles for urban planning documents and removing some barriers to densification[57].

This policy was then reinforced with the Grenelle I and Grenelle II laws during Sarkozy's presidency (2007-2012). **Grenelle I (2009)** set the goal of combating the artificialisation of agricultural and natural land in favor of nature protection (considering densification as a tool). The main aim was "*to fight against urban sprawl and energy wastage, as well as to enable the revitalization of city centers*". It provided local authorities with the tools to: 1) link new development projects (residential or commercial) to the creation or improvement of transport infrastructure and 2) set minimum density requirements and higher energy performance standards than existing regulations (Article 7 II b). After that, **Grenelle II (2010)** defined densification as both an objective and an obligation also through some reforms of planning tools (mainly the *Plan Local d'Urbanisme* – PLU and the *Schéma de Coherence Territoriale* - SCoT) (Table FR4). However, the tools introduced by the reform remain optional, as it depends on "the willingness of the EPCI in charge of the SCOT to strengthen densification" (Fonticelli, 2019).

[57] Such as the Plafond Légal de Densité – PLD (the legal density cup), which allowed higher density in urban areas; and the contribution for exceeding the Coefficient d'Occupation des Sols – COS (the floor area ratio), which lightened the financial burdens and facilitated densification

After the Loi Grenelle II, the **Duflot ordinance (2013)** introduced measures aimed at stimulating housing construction, notably through the vertical extension of buildings and the harmonization of building heights[58]. The ordinance also established exceptions to PLU to encourage the densification of "*dents creuses*" (urbain voids and interstitial spces).

In 2014 the ***Loi pour l'Accès au Logement et un Urbanisme rénové*** **(ALUR)** represented, in continuity with the SRU and the Grenelle laws, a further step to accelerate densification (Lebreton et al., 2015, Charmes, 2011). The law ALUR operated by integrating reforms of the PLU and the SCoT, as well as of the regulation of plot subdivisions (Jeannin and Carcian, 2015). At the municipal level, the law set the removal of two articles that previously allowed for density control[59]. In fact, it encouraged the administrations responsible for land-use planning through PLU to better combine the other tools available to them (setbacks from property lines, height, placement relative to roads, etc.) to define urban forms adapted to their territory (Tahier and Conreaux-Mantziaras in Touati and Crozy, 2015). At the intermunicipal level, the law required the SCoT to identify the areas in which PLUs should analyze the potential for densification and transformation, taking into account the quality of landscapes and architectural heritage.

	SCoT (intermunicipal level)	**PLU (municipal level)**
Grenelle II (2010)	- defining objectives for reducing land consumption; - conducting studies on the potential for densification in already urbanized areas before new development projects; - the possibility to include additional regulation for 1) opening new areas for urbanization conditioned by proximity to transport or 2) allowing urbanisation only if the land in urbanized areas equipped with networks has already been used.	- introducing a diagnosis of the consumption of natural, agricultural, and forestry land; - defining objectives for reducing land consumption - the possibility to impose "a minimum density of construction in areas served by public transport or collective facilities"

[58] The competent authority, whether the mayor or the president of the EPCI, can grant exceptions to the PLU to facilitate residential densification projects in four specific ways: exceeding the height limits set by the PLU, allowing vertical extensions, converting existing buildings into residential units, and adjusting parking requirements based on project needs (for developments located within 500 meters of public transport with good accessibility).

[59] Specifically, the setting of minimum plot sizes for construction and the Coefficient d'Occupation des Sols – COS (the floor area ratio). This "mathematically strengthens the possibilities for densification" (Charmes, 2011), although other regulations in urban planning codes have been used to limit densification (Fonticelli, 2019).

ALUR (2014)	- dentifying the areas where the PLUs should analize the potential for densification and transformation, taking into account the quality of landscapes and architectural heritage. - the SCOT has the authority to set minimum density thresholds that are enforceable against the PLUs, or to designate areas where local urban planning regulations must impose a minimum construction density.	- integrating an analysis of the potential for densification and transformation, taking into account the quality of landscapes and architectural heritage - introducing a diagnosis of the consumption of natural, agricultural, and forestry during the 10 years before the approval of the plan; - defining quantified objectives for reducing land consumption

Table FR6. Overview of the main elements introduced by Loi Grenelle II and the Loi ALUR regarding planning documents and regulations (the PLU at the municipal level and the SCoT at the intermunicipal level).

Finally, the ***Loi Climat et Résilience*** (2021), with its implementation further supported by the subsequent law of 2023, sets ambitious targets for land artificialization: a 50% reduction by 2030, followed by the goal of no net artificialisation ("*Zéro Artificialisation Nette*", ZAN) within 50 years. In this context, densification is one of the key strategies, among others, to achieve these objectives (Pele and Chategnier-Mizzi, 2024). Operators should prioritize redeveloping urban and already artificialized land (vacant housing, brownfields, urban voids, interstitial spaces,etc.) over consuming agricultural, natural, and forest areas. However, some aspects of the law do not ensure an equitable distribution of efforts to reduce artificialization across territories. As highlighted by Doré (2023), while distinctions can be made in interregional planning documents (SCoT and PLU), the goal is defined uniformly at the regional level, which may not address regional disparities. Furthermore, the lack of a precise definition leaves room for varying interpretations of the policies aimed at reducing artificialization, allowing different stakeholders to adapt these policies to suit their own priorities (Charmes, 2021). Financial concerns also arise, particularly regarding supporting local authorities in achieving these objectives (Fédération National des Agences d'Urbanisme - FNAU, 2023). This law is subject to intense political controversy, mainly between the central government and local authorities, regarding its implementation and implications for urban development. As a consequence, the law undergone delays and adjustments in its implementation and goals. In March 2025, also in response to pressure from small municipalities association (Association des Petites Villes de France APVF), the Senate approved a law aimed at easing local constraints, raising concern about the weakening of land preservation national goals[60].

6.2 The implementation process

6.2.1 Planning documents and regulation

The national regulatory framework, developed over the years, encourages densification while protecting natural areas. More recently, it has set an ambitious goal of achieving zero land artificialization on a national scale. The national regulatory framework shapes the national urban planning code, which is implemented through territorial governance tools operating at

[60] https://www.ecologie.gouv.fr/presse/proposition-loi-trace-maintenir-assouplir

various local scales. National regulations on densification primarily affect intermunicipal and municipal planning tools. However, the Île-de-France region stands out as an exception, with national policies granting the regional authority a central role in steering densification efforts (Touati, 2015).

At the intermunicipal level, the SCoT (Schéma de Cohérence Territoriale, as defined by Grenelle II and the ALUR law) establishes objectives to limit land consumption by setting minimum density requirements and densification goals. Over the years, the central government aimed to strengthen the integrative role of SCoTs by expanding their scope to address various cross-cutting issues, such as promoting compact cities (Lévêque, 2015, in Touati and Crozy, 2015). More specifically, SCoTs identify areas where PLUs should analyze the potential for densification and transformation, considering the quality of landscapes and architectural heritage. Moreover, the SCoTs define zones where urban development is conditioned on their connection to public transportation and set minimum density thresholds to encourage the urbanization of vacant spaces (dents creuses) and promote densification in new developments. Fonticelli (2019) highlights some limitations that challenge the effectiveness of SCoTs in controlling land consumption. First of all, the elaboration of SCoTs is optional and depends on the willingness of intermunicipal entities (EPCIs). In addition, SCoTs define density thresholds only for undeveloped areas (new developments) and not for already built areas.

Exceptionally for Île-de-France, the 2014 Schéma Directeur de la Région Île-de-France (SDRIF) sought to control land use by establishing quantified objectives at the regional level to reduce the consumption of natural, agricultural, and forested areas. More recently, the SDRIF-e, adopted by the regional council in September 2024, aims to manage an ambitious trajectory of "*urban development limitation*." It prioritizes residential development within existing urban areas, based on density thresholds, and designates preferred urbanization zones according to specific contextual conditions (Annex 4).

At the municipal level, zoning plans (PLU) offer less leeway than intermunicipal planning documents when it comes to regulating the densification of areas. Where SCoTs exist, the prescriptions they define are binding for local PLU documents. Nonetheless, PLUs have certain tools to regulate densification (e.g., minimum building heights) and retain the authority to assess the capacity for densification and transformation of specific areas. They are also responsible for setting quantified objectives to reduce land consumption at the local level.

6.2.2 Financial tools

Over time, several financial tools have been developed to encourage densification and limit urban sprawl (*Fondation Abbé Pierre* and *Fondation pour la Nature et l'Homme*, 2024). These are mostly fiscal, such as:

- since 1999, the *taxe annuelle sur les Logements Vacants* (TLV) has been in place. As of 2022, this tax is allocated to the general state budget, whereas previously, it was directed to ANAH. Municipalities or intermunicipalities can also impose the *Taxe d'Habitation sur les Logements Vacants* (THLV) in areas where the TLV does not apply (typically in so-called zones non tendues)

- the versement pour sous-densité (VSD), created in 2010, is a tax on new constructions that fail to meet a minimum building density threshold set by the municipality. However, the tax was abolished in 2021, as it was rarely used by municipalities
- since 2012, the taxe d'aménagement allows municipalities to set different tax rates depending on the characteristics of the construction or renovation project. It can be adjusted to encourage higher density developments;
- since 2015, municipalities where the TLV is in effect can apply a surcharge on the taxe sur les propriétés foncières non bâties (tax on undeveloped land).

More recently, France has implemented various financial instruments to promote the reuse of *friches industrielles* (brownfield sites). For instance, the Plan de Relance allocated €750 million over 2021-2022 to in grants for projects involving the redevelopment of brownfields and, more broadly, of already artificialized land[61].

6.2.3 Monitoring tools

At the European level, ongoing debates highlight the lack of a shared definition of *land take* (Decoville and Feltgen, 2023), leaving member states with significant leeway to interpret and adapt concepts such as artificialization, soil sealing, and land consumption (Fédération National des Agences d'Urbanisme - FNAU, 2023). Similarly, at the national level, the definition of "artificialization" remains highly debated —particularly following the adoption of *Loi* ZAN— with no widely agreed-upon meaning (Charmes, 2021). The definitional challenges are closely linked to the elaboration of quantitative and qualitative tools for measurement and monitoring. Moreover, depending on the territorial scale at which density is measured or monitored (regional or more local), the narratives and conclusions may differ (Darley in Touati and Crozy, 2015).

Since 2000, the CORINE Land Cover database (Coordination of Information on the Environment Land Cover) has provided publicly accessible data on land use across European member states. In France, the *Loi Climat et Résilience* establishes the obligation to create **land and housing observatories** (*observatoires de l'habitat et du foncier*) no later than three years after the adoption of a local housing program (*programme local d'habitat*) (Pele and Chategnier-Mizzi, 2024). These observatories are intended, among other objectives, to identify sectors where density falls below urban planning thresholds, vacant properties, and developable brownfields, as well as opportunities for building elevation and demolition-reconstruction. Moreover, the Ministry of Ecological Transition highlights the importance of making monitoring tools available to promote sobriété foncière (land-use sobriety). In this regard, the national platform *Data Foncier*, developed by Cerema, offers a number of tools for analyzing and observing land use at the national level, using datasets such as land files (*fichiers fonciers*), DV3F, RFP, and LOVAC (Table FR7).

Beyond the above-mentioned national tools, territories also develop their own systems for measuring and analyzing land use data—for example, the cartographic atlas *Mode d'Occupation des Sols* (MOS) for the Île-de-France region. However, challenges arise concerning the interoperability of these datasets across different territorial scales and levels of detail, as well as their effective use to leverage the value of this information (Thépot, 2023).

[61] https://www.economie.gouv.fr/plan-de-relance/mesures/fonds-recyclage-friches

	Database	Main information	Year of data update	Accessibility
European level	Corinne Land Cover	Land use	2000 (first release) then every 6 years (2006, 2012, 2018, 2024)	Open access
National level	Portail de l'artificialisation des sol	Land consumption of natural, agricultural and forester areas (ENAF)	From 2011 untill 2023	Primarily intended for local authorities (*collectivités*), state services, and their partners
	Cartofriches	Redeveloped brownfields (*friches reconverties*), brownfields with projects (*friches avec projet*), and brownfields without projects (*friches sans projets*).	Created in 2021 (last update: 2024)	Open access
	Zero Logement Vacant (based on multiple databases such as LOCAV)	Vacant housing and rental properties in the private sector according to their energy labels	2020, 2021, 2022, 2023, 2024	Primarily intended for local authorities (*collectivités*), state services, and their partners

Table FR7. Summary of some of the data available on land use and consumption at the European and national levels.

6.3 Size and role of the market

Although market dynamics in densification are regulated by a national framework, they tend to vary according to the land and real estate situation in different areas and/or the type of (re)development. Different submarkets can be distinguished, such as:

- **"Build in my backyard" (BIMBY) initiatives** located in periurban areas: since the mid-2000s, the densification of periurban housing (*pavillonaire*) has been framed as one of the major components of EEPs. Indeed, it represents up to 75% of the urban fabric at the national scale, even more in some areas, with the internal division of existing houses representing up to 25% of the supply of new housing in 2001-2011 (Touati and Crozy 2015). With the funding support of the State, BIMBY initiatives have become a commercial entreprise in its own right, ending as a trademark owned by two architects-engineers (Miet et Le Foll 2013). This initiative has raised many some heavy

controversies within the planning and architectural field (Robin 2013; Biau, Fenker, et Macaire 2015).

- **Turnkey urban regeneration projects** in metropolitan areas, led by large-scale developers: France has traditionally been characterized by a strong public intervention over land development, based on the combination of i) significant public landowners less geared towards rent extraction, ii) para-public urban development corporations (EPA, SEM, SPL and SPL-A, EPF) acting as intermediaries between former public/private landowners and developers, using iii) legal tools to acquire land (e.g. eminent domain purchase, zone d'aménagement concertée aka ZAC), determine future land-use, and negotiate contributions (e.g. planning gains) from developers willing to acquire it for redevelopment in order to pay for public spaces and amenities (e.g. schools). However, over the past 20 years, this model has been undermined by a number of major shifts, including the development of rent-seeking behaviours by public landowners turning into real estate developers, such as the railways (Adisson, 2018; Piganiol, 2017); and urban redevelopment practices based on the direct purchase of large tract of lands by large-scale developers acting as 'ensembliers', i.e. taking care of housing development and public space (Citron, 2017; Guironnet, 2016). This has gone hand in hand with the introduction of new legal tools to allow local authorities to negotiate contracts (PUP) with private developers for the provision of public space (Thibault, 2017).
- **Transit-oriented developments (TOD)** in metropolitan areas, such as the Grand Paris Express: in the Paris city-region the massive public investment into the creation of 200 km of new rail infrastructure in the periphery and 68 new neighborhoods around the train station is likely to drive up land and real estate prices, therefore pushing out working classes (Clerval & Wojcik, 2024).
- **Office-to-housing conversion schemes**: this form of densification policy was initially put on the agenda by public authorities in the 1990s to fight against what was then called the "housing crisis," and has been reframed over the past decade as a lever for green transition. However, the interest of developers and investors seems to have been limited so far. Between 2013 to 2023, this type of densification contributed to 2.5% of the supply of housing (Coulondre et al. 2024). In the Paris region, 32% of the operations were concentrated in the core (City of Paris), especially in outer districts (*arrondissements*) where the value gap between housing and office is positive, and is supported by a proactive engagement of social housing providers (Trouillard and Quatrain 2022). However, this represented only 3% of the official objective of 70,000 new units per year set by the Grand Paris law in 2010 (over the period 2013-2021). There have been many reports advancing different solutions to try to unlock this. Besides the usual zoning instruments, this policy is mostly based on symbolic (e.g. a prize was created in 2019, but short-lived) and tax instruments.

- **Air rights (*surélévation*)**: the construction of additional floors on top of existing buildings has been pushed as a tool of densification, both supported by arguments for the compact city and housing affordability that would result from an increase in the supply (Bouchet-Blancou 2020). In that regard, the ALUR law (2014) was the main milestone as it suppressed the floor area ratio (*coefficient d'occupation des sols, COS*) that used to regulate the construction capacity of a given plot, and sought to facilitate

projects with co-owners as direct contractors (*maîtrise d'ouvrage directe*) rather than selling air rights to developers. However, this did not fundamentally alter the structural bias of the French legal system in favor of outsourcing to developers (Ibid.). This form of densification has been identified by the City of Paris as a key intervention in its new zoning plan (*PLU bioclimatique*), as well as by social housing providers in Lille and Rennes.

6.4 The multi-level governance process

Historically, the state has been responsible for the development and implementation of spatial planning policies (Touati, 2015). Following the decentralization policies initiated in the 1980s, urban planning competences—including densification policies—were transferred to the local level. As noted in Sections 6.1 and 6.2, since the 2000s, the national regulatory framework has promoted densification and influenced the urban planning code, which is implemented through territorial governance instruments at various local levels (mainly intermunicipal and municipal). While densification regulations primarily affect local planning tools, their implementation remains optional and depends on the willingness of local authorities (Touati, 2015). In this context, Île-de-France represents an exception, as it establishes quantified objectives at the regional level to limit the consumption of natural, agricultural, and forested areas.
Moreover, various actors—including private stakeholders, para-public entities, and third-sector organizations, among others—support densification policies (Fonticelli, 2016). As highlighted in Section 6.3 and WP4, para-public urban development corporations play a key role as intermediaries between former landowners and developers. Additionally, grassroots mobilization can be crucial in combating land artificialization. This is the case of the Triangle de Gonesse, where strong opposition from local elected officials, farmers, and associations led to the abandonment of a planned mega tourism and commercial complex in 2019 (Tonnelat, 2022). Furthermore, Fonticelli (2016) notes that the actors involved in densification in urban areas differ from those operating in rural contexts. In the latter, for instance, developers tend to be smaller-scale operators, constructing a limited number of housing units and specializing in specific territories or types of development.

6.5 Achievements, assessments, and challenges

Since the 2000s, densification policies have yielded varied outcomes depending on the degree of urbanization of the targeted areas (metropolitan, peri-urban, rural, etc.) and their interplay with other policies not explicitly focused on densification (e.g. policies promoting homeownership). The recent study of CEREMA (2024) provides data on land consumption from 2009 to 2023, alongside population growth, which has proceeded at a slower pace during the same period. Overall, 66% of the urbanized land by 2023 was allocated for housing. At regional and local levels, this phenomenon is highly polarized, primarily driven by metropolization and the attractiveness of coastal areas (see annex 5).

Several studies have examined the effects of these policies on peri-urban areas, particularly in single-family housing neighborhoods (*tissus pavillonnaires*), where they might take the form of plot subdivisions or the construction of accessory dwellings (see part II of Touati and Crozy,

2015). Fonticelli (2019) observes that densification has been more pronounced in Île-De-France (IDF) than in other peri-urban areas of France (where housing development generally aligns with the objective of diversifying housing options). The author further notes that exceptional regulations limiting urbanization in Île-de-France (see section 6.2.1) have driven up housing costs, inadvertently fueling urban sprawl beyond IDF. Focusing on Lyon, the second most important urban agglomeration in France, Rousseau (2017) has highlighted the tension between the two main goals of urban renewal, namely land densification and social mix. This tension had led to discursive changes in regional planning, and the introduction of social housing in some territories due to regulatory quotas. However, the political consensus between municipalities and the Metropolitan Council has led to a preservation of functional reproduction, i.e. densification under control in the wealthy municipalities of the West vs. post-industrial densification in the East. In the latter this includes new-build gentrification that aims at attracting middle class populations in formerly working-class areas.

Other studies have focused on the effects of policies densification that favour the renovation of public transit proximity areas (primarily in metropolitan and peri-urban areas). In 2010, the Loi Grand Paris introduced a framework for transit-oriented development, setting an annual target of 70,000 housing units and establishing *Contrats de Développement Territoria*l (CDTs) to spatially organize production and "control urban sprawl". However, as underlined by Clerval and Wojcik (2024) the Grand Paris transit-oriented development project is accompanied by large-scale urban renewal initiatives, characterized by evictions in the private housing market under eminent domain purchase, demolitions and upgrading of social housing, and rising property prices.

In already dense areas, local authorities might also engage in densification through elevation (*surélévation*), i.e. by adding additional levels to existing buildings through the commodification of air rights. Focusing on the city of Paris, Bouchet-Blancou (2025) has found that elevation is likely to lead to real estate speculation, and thus to hinder affordability that it was supposed to bring through a rise in the housing supply. However, the number of these operations remain quite limited (120 per year in Paris, i.e. 1.33% of the plots identified) so that the effects of densification through air rights does not have the expected impact on prices. More fundamentally, this results from relying on the private market: due to the technical and administrative uncertainty tied to these operations, private developers tend to require a higher return, translating into a higher sale price leading to housing unaffordability. While supporters of this form of densification advocate for further fiscal advantages that are expected to generate price decrease, Bouchet-Blancou argues that this would only have a marginal impact.

Regarding the recent ZAN policy, Charmes (2021) suggests that its implementation might disproportionately impact rural areas by restricting single-family home construction, thus shifting the housing market in favor of cities at the expense of villages. He also associates ZAN with heightened land tensions, exemplified by the *Gilets Jaunes* protests. As Defay and Driant (2023) highlight: "*ZAN seems to be just the tip of the iceberg of deeper, structural land issues that have been affecting housing production for several years*." According to the authors, the issue is not—or at least not solely—the scarcity of land itself, but rather the tools currently available to local governments, particularly in terms of price regulation, land acquisition, and

the separation of land from property ownership[62]. As one interviewee pointed out, the ZAN highlights a paradox between ecological transition goals and the current local economic model. Small municipalities remain partly dependent on a local tax system tied to new construction (e.g. *taxe foncière*), rather than to land preservation.

	Potential Impacts
urban renewal and social mix	demolition of social and most affordable housing stock; risk of displacements for low-income households, new social housing often oriented towards middle-income
transit-oriented development and eviction risk	TOD might trigger evictions particularly in urban and periurban areas and rising property prices in working class areas, affecting affordability
zero artificialisation nette law (relaxed)	risk of disproportionally affecting small municipalities partly dependent on local tax system encouraging new construction over land preservation
air rights (limited so far)	particularly in *zones tendues* it might fuel real estate speculation and housing unaffordability; technical and administrative uncertainty might induce the increase of sale prices

Table FR8. Potential impacts of densification policies on housing inequalities and urban and territorial dynamics.

7. Summary and discussion of results

This report provides an overview of the regulatory systems of Energy and Environmental Policies (EEPs) in France. The note specifically focuses on housing retrofitting, nature-based solutions, and densification policies which are framed within the context of national climate change mitigation and adaptation policies. A number of considerations arise concerning both the evolution and key changes of these three types of EEPs over time, as well as the relationships and trade-offs between each EEP housing affordability and equity issues.

7.1 Summary of changes in EEPs

When examining the three types of EEPs for France, some differences emerge in their trajectories, changes and implementation processes. Key milestones that have accelerated the move towards the three EEPs includes the *Grenelle* I and II (2009, 2010), the *Loi de Transition Énergétique* (2015) and, more recently, the Loi *Climat et Résilience* (2021). While emission reduction goals have been strengthened over time, implementation remains challenging, hindered by political instability, budgetary constraints, and global crises. Recent regulations, such as the ban on renting poorly insulated homes and limits on land artificialisation, have also triggered forms of backlash or resistance.

Housing retrofitting policies have been integrated into the national regulatory framework since the 2000s, also as a result of European directives on the subject. Over time, housing retrofitting

[62] the ongoing research programme Le foncier et le logement abordable 2022-2025 aims to further advance reflections by integrating issues of densification, land consumption, and affordability. More information at: https://recherche-foncierlogementabordables.fr

policies have favoured incentive-based instruments (such as direct subsidies, tax deductions, or subsidised loans). In recent times, direct subsidies have mostly prioritized owner-occupiers over private renters, while social housing has received fewer subsidies for renovation. Additionally, housing retrofitting policies have also been gradually integrated in local and national urban regenerations policies. Although local authorities have progressively gained competencies related to energy renovation and energy poverty, their role remains mainly focused on support and coordination within a vertically structured governance system.

The institutionalisation of NBS is relatively recent and still lacks a common reference in terms of conceptual definition and implementation tools. NBSs are integrated into broader national policy frameworks for climate change adaptation, biodiversity protection, and water management. The absence of shared definitions, regulations, and targeted funding makes the implementation of NBS particularly complex and uneven. Overall, NBS has gained significant traction in national policy circles but faces considerable challenges in practical, local-level implementation.

Densification policies have their roots in the 2000s, linked to urban regeneration strategies, transit-oriented developments and efforts to counter urban sprawl. More recently, the focus has shifted towards achieving zero land artificialisation and preserving open and agricultural areas. Though their outcomes vary depending across metropolitan, peri-urban and rural areas, different financial instruments have been promoted for the reuse of industrial sites and vacant buildings. However, densification policies are still applied discretionarily unevenly, with a significant influence from local political will. Furthermore, zero land take goals recently caused political opposition and strain relations between the federal and local governments, especially in rural and small towns.

7.2 Relations and trade-offs between EEPs and housing policies

The relations and trade-offs between EEPs and housing policies appear to be shaped by institutional, political contexts, and the evolution of the national housing systems (see D4.2 for more details). This section presents some hypotheses on how EEPs might create tensions with housing affordability and social equity, across different housing tenures, territorial configurations, and diverse forms of urban regeneration.

Different dynamics can be observed in housing retrofitting also depending on housing tenure, existing policy tools and the regulatory framework. In addition, the lack of territorial differentiation and the uneven distribution of local energy renovations funding may exacerbate territorial inequalities.
Upfront energy renovation costs and complex administrative procedures tend to benefit households with saving or access to credit to the detriment of economically vulnerable ones. Moreover, a growing divide might emerge between deeply renovated properties and those left unrenovated or lightly renovated due to owners limited resources or a lack of clear return on investments.
The recent law stating the ban on renting poorly insulated housing may may impact low-income owner-occupiers who rely on renting out part of their property for supplementary income. If

their dwelling becomes non-rentable, and they are unable to afford renovation, they may face a loss of monthly income and be pushed to rent informally or sell the property.
These dwellings might then be acquired, renovated and re-rented at higher prices. Furthermore, the lack of weakness of rent control measures after energy renovations works might tend to rent increase and to displacement of low-income tenants.
In the social housing sectors, limited financial resources and public subsidies may push social housing providers to adopt strategies to ensure financial viability of energy renovation operations. These may include diversifying social housing production, partially selling the stock, or prioritising the renovation of existing units over new construction.

Among the three type of EEPs considered, NBS policies appear to be least developed and more recently institutionalised. There is a limited number of studies and policy debate on their potential impacts on housing inequalities. However, urban transformation processes and green spaces (eco-quartiers) have shown to drive gentrification dynamics in urban and metropolitan contexts.
Additionally, the implementation of NBS policies is mainly entrusted to local communities, resulting in a fragmented landscape shaped by local political will and resources availability. The varying exposure to environmental risks across different regions and populations is often overlooked, potentially leading to uneven distribution of environmental benefits and deepen existing inequalities.
Lastly, the acceptability of NBSs might vary depending on urban gradient, urban areas with limited access to green spaces and nature might be more supportive of NBSs, while other territories might express resistance. This may generate tensions and hinder coordinated supra-local policies (inter-municipal, metropolitan. etc.).

Various configurations of densification might result in different effects on housing affordability issues in relation to national housing policies system and evolution and local political contexts (see also D4.2).
Urban regeneration and social mix can lead to the demolition of social or most affordable housing units, potentially causing the displacements of low-income households. In some cases, newly built social housing tends to mainly target middle-income groups.
Massive investment into rail infrastructure and neighbourhoods around the train station (such as TOD approaches) is likely to raise land and real estate prices, pushing out working class residents, particularly in urban and peri-urban areas.
BIMBY approaches may reproduce or reinforce existing spatial disparities, where wealthy areas remain unchanged and only lightly densified, while working-class neighbourhoods undergo major transformations attracting more affluent residents.
Zero Artificiliastion Nette may disproportionally affect small municipalities and rural areas, which partly rely on local tax system linked to population growth and new construction over land preservation.

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9. Annex

9.1 List of interviewees

Name of the institution	Type	Date	Place	Length (in min)
Fédération des offices publics de l'habitat (FOPH)	Social housing provider (public)	28/04/2025	FOPH headquarters, Paris 8ème	110
Institut Paris Region (Regional planning agency for he Paris region) (IPR)	Local agency	22/05/205	online	60
Coordination gouvernementale du plan de rénovation énergétique des bâtiments (CIPREB)	National governement	22/05/2025	Paris La Défense	90
Agence nationale de l'habitat (national agency overseeing energy retrofit policy) (ANAH)	National agency	07/05/2025	ANAh headquarters, Paris 1er	80
Direction de l'Habitat, de l'Urbanisme et des Paysages (DHUP), Ministry of Ecological Transition	National government	18/06/2025	Paris La Défense	100
Fédération des entreprises sociales de l'habitat (ESH)	Social housing provider (private)	16/07/2025	ESH headquarters, Paris 8ème	80
Association des directeurs généraux des communautés de France (ADGCF)	Intermunicipal governement	17/07/2025	ADGCF headquarters, Paris 9ème	80

Table FR8. List of interviewees

	France		Europe	
	Framework	Objectives	Framework	Objectives
2000	PNLCC (in agreement with Kyoto Protocol)	- maintain emissions in 2010 at their 1990 levels	/	/
2004	Plan Climat	- reduce France's GHG emissions by at least 75% by 2050 compared to 1990 levels (Factor 4)	/	/
2009 (and 2010)	Loi Grenelle I (and Grenelle II)	- reduce France's GHG emissions by 20% by 2020 compared to 1990 levels. - increase the share of renewable energy to 23% of final energy consumption by 2020.	2020 climate and energy package	- reduce GHG emissions of 20% by 2020 compared to 1990 levels; - achieve 20% energy dependence on renewable sources - increase energy savings by 20% compared to 1990 levels

2014	/	/	2030 climate and energy framework	- reduce GHG emissions before 2020 by 40%, - achieve 32 % energy dependence on renewable sources - increase energy savings by 32,5 % compared to 1990 levels
2015	Loi Transition Énergétique + SNBC (in agreement with Paris Agreement)	- reduce emissions by 27% by 2030 compared to 2013 levels. - achieve carbon neutrality by 2050. - achieve 32% energy dependence on renewable sources by 2030.	/	/
2018	/	/	2050 long-term strategy	- become the world's first climate-neutral continent by 2050 - an intermediate ambitious objective to reduce GHG emissions by 55% by 2030 from 1990 levels
2019 (and 2020)	Loi Energie Climat (and SNBC revision)	- achieve carbon neutrality by 2050. - in the short and medium term, adhere to carbon budgets set by decree, meaning emission caps to be respected over five-year periods.	European Green Deal	- making the EU the world's first climate-neutral continent by 2050 -- an intermediate ambitious objective to reduce GHG emissions by 55% by 2030 from 1990 levels
2021	Loi Climat et Résilience		/	/

Table FR9. France and European climate and energy framework: key targets

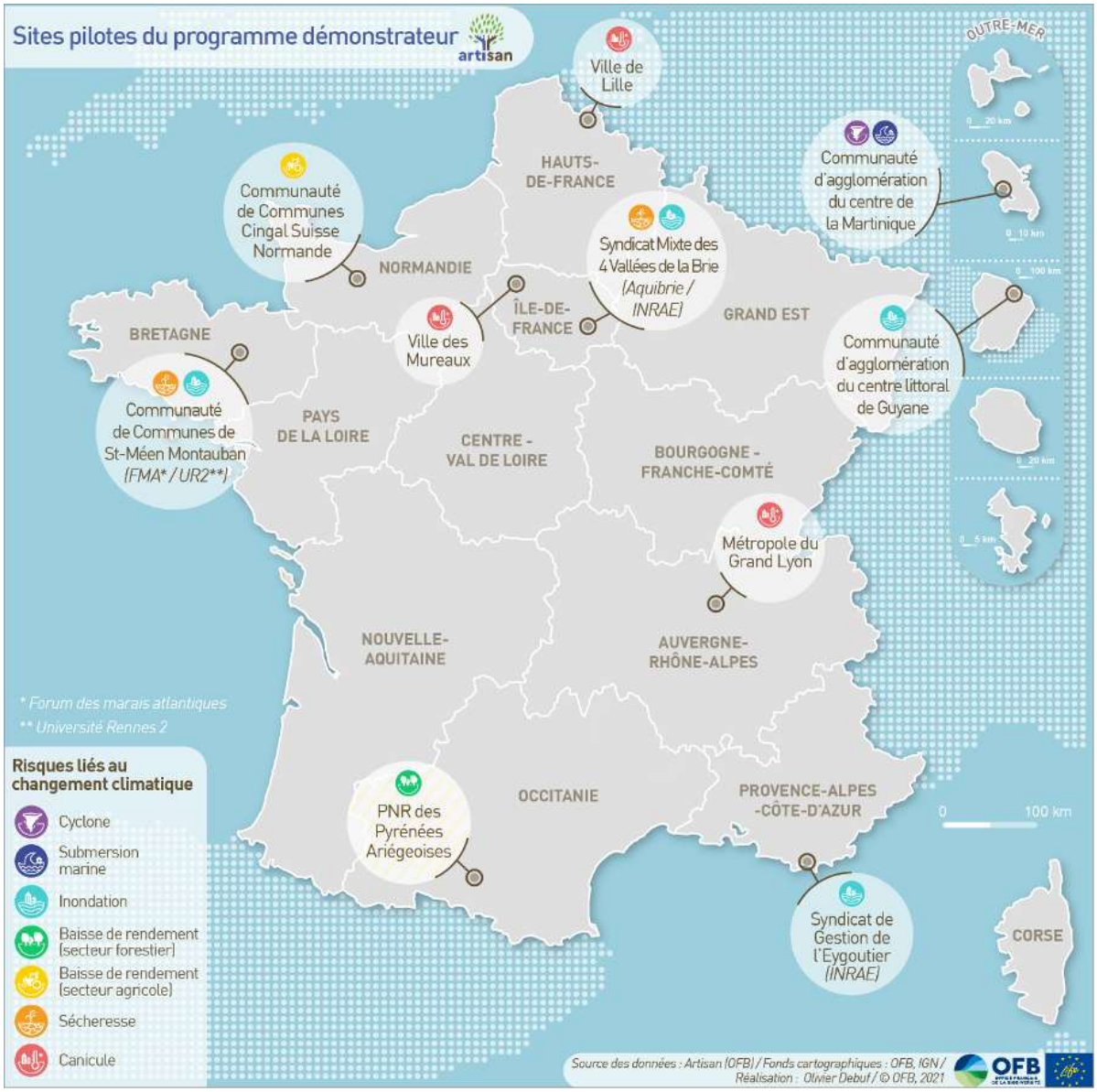

Figure FR9. LIFE ARTISAN pilot projects.

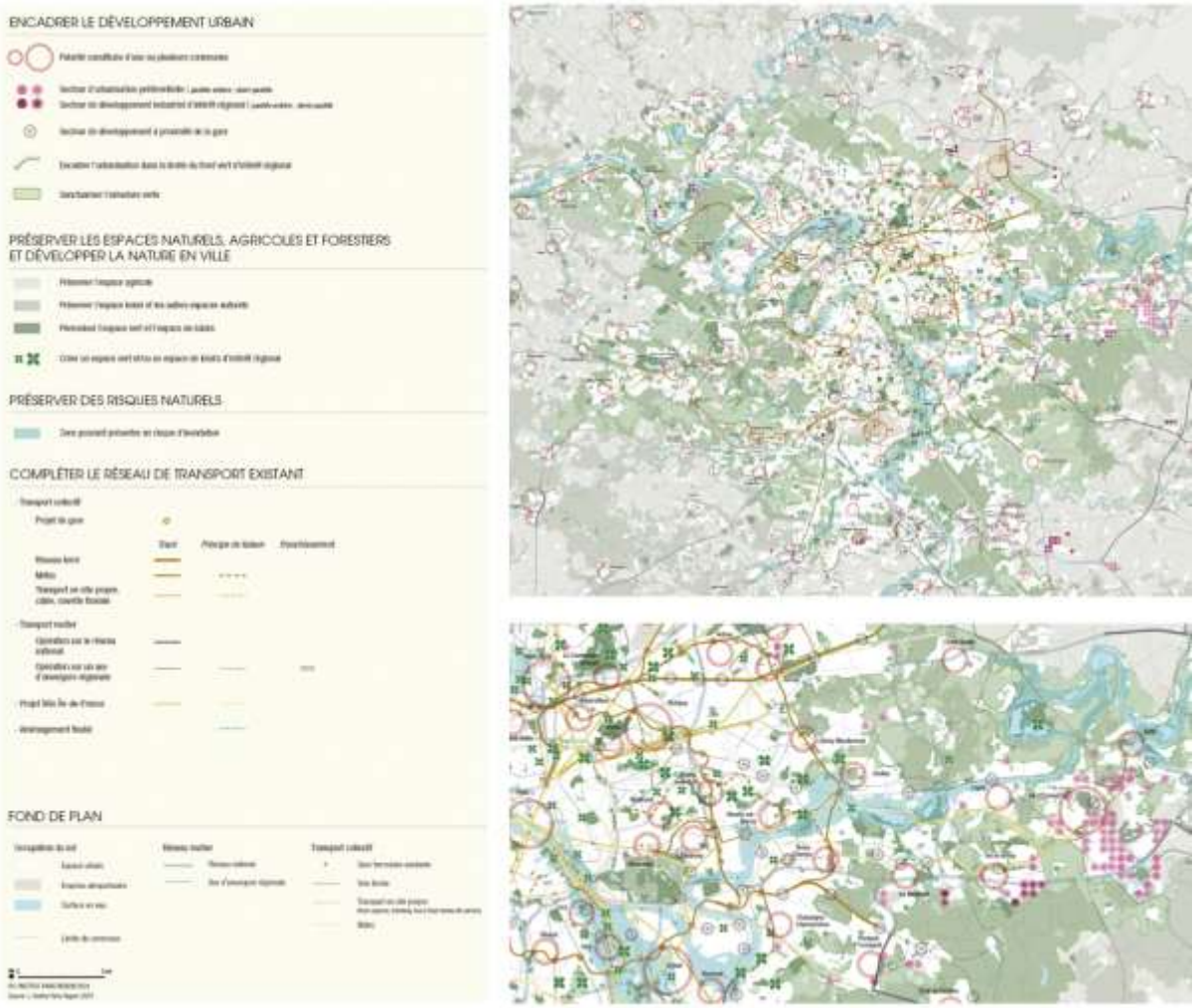

Figure FR10. Excerpt from the map Maîtriser le développement urbain of the SDRIF-E, 2024 (source: SDRIF-E, 2024)

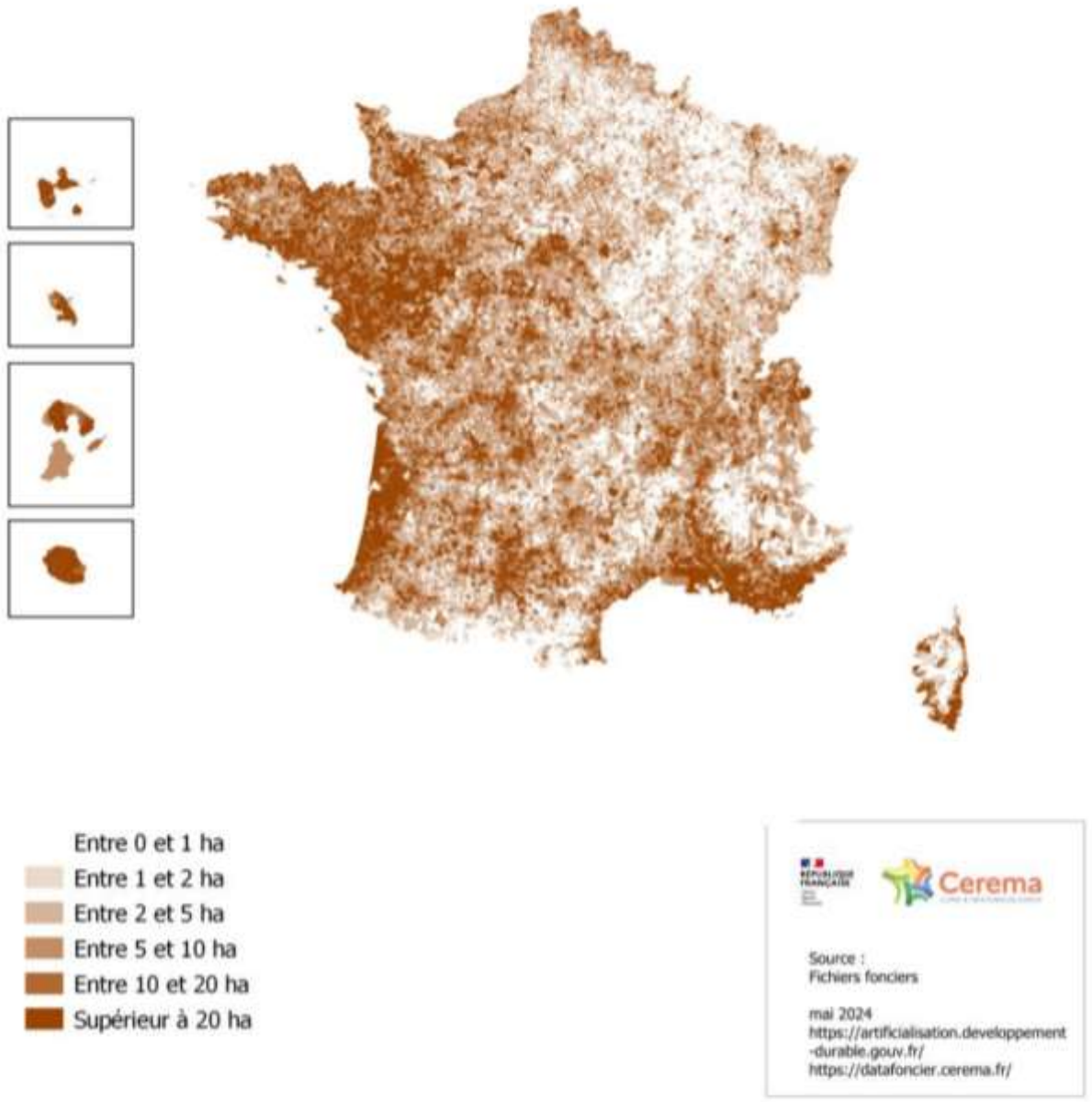

Figure FR11. NAF land consumption for housing purposes in hectares between 2009 and 2023 at the municipal level (source: CEREMA, 2024