A New Approach to Understanding the Barriers to Onshore Wind Energy in France

SET3901 Thesis Project

Susannah Duncan 4935276

Delft University of Technology

TU Delft

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by

Susannah Duncan 4935276

Supervisor:	Dr Thomas Hoppe
	Dr Linda Kamp
Institution:	Delft University of Technology
Place:	Faculty of Electrical Engineering, Mathematics and Computer Science, Delft

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TU Delft

Executive Summary

Today, the climate crisis is becoming a global concern and is even putting pressure on governments and politicians worldwide to redesign their energy strategies to reduce carbon emissions. France is no exception. In 2020, France missed its renewable energy target by a considerable margin, reaching merely 19.1% instead of 23%, which it was committed to achieving in its overall energy mix. The European Commission gave France until December 2022 to get back on track, but it failed to deliver. Consequently, the French government will face a 500 million euro fine.

The timing of these RES targets' sanctions is also significant. The Covid-19 pandemic of 2020 caused an energy crisis worldwide, to which France was not immune. In addition, the pandemic caused the program of maintenance to its nuclear plants, on which it is heavily dependent, to be delayed and extended the time they were taken offline. This marks a crossroads for the French government concerning energy decisions.

However, despite increasing government support and political incentives, France has failed to compensate for the lack of RES capacity. As one of the most mature RES technologies available, deploying more onshore wind energy has been deemed essential for the French energy transition. Yet, the French wind energy industry has been slow to take off. It would seem that, among other factors, local resistance to implementing wind energy is higher in France than in many countries.

This study offers a new approach to applying Multi-Level Perspective (MLP) and Strategic Niche Management (SNM) frameworks to identify the factors stabilising the French energy regime and the barriers to entry faced by wind energy.

A regime's stability hinges on the tight interdependencies between the actors and institutions within it. As a mature technology, seemingly stuck on the fringes of Technological Transition (TT), wind energy relies on a shift in dynamics to destabilise the current regime and insert itself. These regime shifts can occur in multiple ways; policy changes, market adjustments, and new social technology preferences.

Many previous studies have attempted to understand the underlying causes of social resistance issues for wind energy in France. Many of these point to a stronger cultural attachment to landscape and heritage than many other countries and a lack of citizen inclusion in wind projects by developer practices.

Yet, many of these studies have kept to a national-level perspective extrapolating findings from varying perspectives without a clear comparison framework. National-level barriers have predominantly been established from top-down observations made by interviewing individuals from various backgrounds within the sector. This study takes a new approach by solving these issues from the ground up and comparing barriers at national, regional and local levels of governance. By collecting and correlating the experiences of developers, national wind energy specialists and local actors all within a coherent MLP and SNM framework, this research provides a new perspective to resolving issues with onshore wind planning in the sector in France and beyond.

The data collection for this project had two phases. First, a desk-based literature research approach was undertaken to search for France's most cited barriers to wind energy deployment. This includes an in-depth investigation into the best practices for gaining social acceptance and recommendations for involving communities in developing more wind projects.

A second research phase involves participatory work with a project developer within a French renewable energy company, la Compagnie Nationale du Rhône (CNR). The focus is developing joint-owned wind projects between the developer and the host community. In this phase, the best practices found in the national-level research were applied empirically to the local level to solve acceptance issues and secure a new project for development. In parallel to the participatory work, interviews and discussions with consultants, actors, investors, Mayors and local administrators involved in the French wind sector were also conducted to complement the outcome from a developer's perspective.

All the data collected was sorted thematically into the respective dimensions of MLP and SNM, and comparisons were highlighted between national and local level findings. Conclusions regarding the barriers to wind energy deployment were drawn from the findings, and recommendations to remedy them are outlined for developers, policymakers and future researchers.

The national-level MLP and SNM analyses of the sector showed that many incentives and support for developing onshore wind energy were already in place. Nonetheless, it revealed that it was not making as much progress as expected with so many enablers. At this level, political involvement, market and technological maturity seemed sufficient for the niche to expand. However, most barriers came from 1) high grid connection costs and 2) social resistance.

When looking closer at the social acceptance of onshore wind energy, several themes were recurring; 1) visual impact on the landscape, 2) inconsiderate developer practices, 3) bothersome noise and blinding caused by rotating blades, and 4) little benefits for host communities. To address several of these elements, community inclusion in projects is a widely recommended solution by many academics and has also been increasingly popular among policymakers.

A national-level SNM analysis of community inclusion in wind projects in France follows this. The focus was on finding solutions to expand this 'sub-niche' and improve social acceptance to overcome the seemingly greatest barrier to onshore wind energy deployment. The results of the desk-based research at this level revealed that communities' inclusion in projects in France was minimal. Citizen-led Renewable Energy Projects (CREP) initiatives are growing and receiving increasing support from the government. However, they still lack recognition to integrate into the energy market and, importantly, lack the funds to build a wind project. Alternative partnerships with developers also exist under two forms, co-ownership and participatory. In brief, both offer communities an opportunity to invest in a project financially, and the former gives investors a greater say in the planning and running of the project. However, neither offers anything more than financial returns and is more complicated for developers to carry and manage. To remedy this, though, the government has added a new 'citizen participatory' bonus available to developers who involve citizens in their projects in this way.

These national-level findings provided a goal to be achieved at the local level: designing new strategies with best practices to help developers build a joint-owned project with a community. Yet, local-level barriers were different to the expectations found at the national level. These barriers included: 1) limited land availability for building wind turbines due to aviation constraints, 2) difficulties making contact with local decision-makers, 3) discrepancies between mandatory national-level energy transition goals and non-binding local ones, 4) uncoordinated action between local actors involved in the energy transition and 5) lack of a strategy for building hybrid developer-community projects. All of which prevented developers from applying the national-level recommendations to their practices.

Insights from industry specialists made in parallel also highlighted other barriers, many of which had been ignored in previous work, such as the threat of a political shift of interest towards offshore wind energy or hydrogen energy generation, a lack of political leadership supporting wind energy, media bias towards unpopular wind projects and a lack of energy education among the population and local decision-makers about the transition to RES.

Throughout this study, the findings were all subjected to the same MLP and SNM frameworks for consistent and coherent comparison. As a result, the study concludes with recommendations to developers, policymakers and future researchers for new approaches to promote onshore wind farm planning. For developers, these guidelines help them communicate better with communities by using alternative local knowledge sources. For policymakers, recommendations aim to make the energy transition a national priority across all sectors, including energy, education, media management and cooperating with the military forces. Finally, there are suggestions for researchers to explore more options for increasing a shared responsibility between local and national levels for the energy transition, among others.

Contents

Abbreviations

Here is the list of abbreviations used in this report, and their definitions are presented throughout.

ADEME: Agence de l'Environnement et de la Maîtrise de l'Energie

ALE: Agence Locale de l'Energie et du Climat des Ardennes

ARENH: Accès Régulé à l'Électricité Nucléaire Historique

CA: Communauté d'Agglomération

CC: Communauté de Commune

CEREQ: Centre d'étude et de recherche sur les qualifications

CLER: Réseau pour la transition énergétique (Comité de liaison pour les énergies renouvelables)

CNR: Compagnie Nationale du Rhône

COCOPEOP: COnseillers à destination des COllectivités pour le développement de Projets ÉOliens et Photovoltaïques

CRE: Commission de Régulation de l'Energie

DREAL: Direction régionale de l'environnement, de l'aménagement et du logement

DSO: Distribution System Operators

EPCI : Etablissement Public de Coopération Intercommunale

EU : European Union

FEE: France Energie Eolien

FRTE : Association Fonds Régionaux pour la Transition Énergétique

GECLER: Réseau Grand Est Citoyen et Local d'Énergies Renouvelables

IFER: imposition forfaitaire des entreprises de réseaux

LCV: Loi de la Croissance Verte or Law for Green Growth

MLP: Multi-Level Perspective

MTE: Ministère de la Transition Écologique

NOME: Nouvelle Organisation du Marché de l'Électricité

PCAET: Plan Climat Air Energy Territorial

PPE: Plan Pluriannuel Energie

RED II: Renewable Energy Directive II

RES: Renewable Energy Source

RTE: Réseau Transport Électricité

SDE: Syndicat Départemental d'Énergie

SEM : Société Économique Mixte

SER: Syndicat Energies Renouvelable

S3REnR: Schémas Régionaux de Raccordement au Réseau des Énergies Renouvelables

SNBC: Stratégie Nationale Bas Carbone

SNM: Strategic Niche Management

STS: Socio-Technical System

TPN: Tarif de Première Nécessité

TSO : Electricity Transmission System Operators

ZIP : Zone d'Implantation Éolienne

1
Introduction

In the context of climate change, the increase of renewable energy sources (RES) in the French energy mix is becoming more important. France has been a world leader and a pioneer in nuclear technology since the 1980s. Consequently, it has the strongest reliance on nuclear energy worldwide, making up 70% of its electricity mix. For years, nuclear has been prized for its high power capacity, continuous stable output, cheap electricity prices, and lack of emissions. Thus, given the already relatively low-carbon nature of France's power mix, there has been less pressure to transition, which largely explains the country's lag in implementing RES, such as wind and solar [109].

The French government has been enforcing new policies to support and nurture RES development via support mechanisms like Feed-in tariffs (FIT) for smaller projects such as solar power and Feed-in-Premiums (FIP) for larger ones such as wind energy. Yet, the energy transition is slower than expected, and the wind energy industry is feeling the strain [50].

In 2020, RES accounted for only 19.1% of France's electricity energy mix 2020, which fell significantly short of the 23% target imposed by the country's renewable energy directive in 2009. Consequently, it was also the only European country to miss its RES goals as part of the European Climate and Energy package. The French government is running out of time to readjust its trajectory or face a 500 million euro fine [98].

Since 2020 increasingly ambitious energy transition goals have been made in France, including increasing RES to 32% of the energy mix by 2030. Onshore wind should account for 40% of the RES installed according to France Energie Eolienne [10]. However, after experiencing a significant annual growth of capacity installed between 2010 and 2018, numbers have started to stagnate and even drop [129]. While capacity is still expected to increase owing to planned projects already in the pipeline and the retrofitting of older wind farms, the loss of momentum is heavily felt by wind developers. In fact, despite general political and social support in favour of wind energy, French developers are still confronted with massive social resistance and significant project planning delays. They are continuously subjected to ever-tightening legal constraints [49] [102].

This Thesis looks at France's past and present energy regimes to better understand the reasons behind France's delays in RES deployment, why the RES sector around wind energy is still so underdeveloped and why there seems to be more social resistance to wind turbines compared to other European countries.

1.1. Background

The background of this research stems from a wind developer's interest in finding better strategies to manage the difficulties they regularly encounter in their projects. The developing firm in question is a French energy company, ”la Compagnie Nationale du Rhône” (CNR), which has largely contributed information sources, networks and resources to this project.

CNR is a French 100% exclusively renewable energy company founded in the 1930s by the France state as a hydro energy firm. It has expanded to become 50:50 privately and state-owned and branched out to new energy sources, namely, wind and solar, since the early 2000s. The company has just set itself the ambitious target of increasing its total energy generation capacity from 4000 MW to 7000 MW by 2030, with wind, in particular, growing from 740 MW in 2020 to 1850 MW in 2030 (an 1100 MW increase). However, finding new sites is already proving more challenging than in previous years due to increasingly strict boundaries imposed by the national army's air force, stringent environmental rules, administrative delays, and ever-rising local resistance. Many of these challenges are encountered in the siting phase before a project begins to take shape. Furthermore, CNR developers have learnt from experience that for every 20 prospective sites found for a wind farm, only one project acquires the final permit to construct [127] [38].

The company is not alone in experiencing such difficulties. According to several authors [104] [109] [49], this raises two central issues to the diffusion of wind energy in France: centralisation of administration and strong social resistance. Researchers also support this statement, such as Feurtey [56], who discusses the excessive administration process required for wind farm development in France. The French government subjects wind farm siting to strict regulations. As a result, phases from site prospecting to commissioning a turbine take, on average, eight years instead of the expected four years. Further, court rulings due to social resistance can extend the process by another one to 3 years if successful [49].

1.2. France a Centralisation Problem

Above all, due to its strong attachment to nuclear power, France has one of Europe's most centralised energy systems. This is a challenge for decentralised RES, such as wind energy growth. However, the country's energy infrastructure is merely a reflection of the country's political structure centralised around national-level decision-makers. This means that the French centralisation problem is two-fold, 1) from an energy perspective, it is dominated by monopolies (such as EdF) [103], and it is unsuited to distributed energy sources [50] but also 2) from a political perspective, local decision-makers are very reliant on powers higher up the political scale for taking case-by-case decisions and responsibilities [104].
Landscape protection rules are also stringent in France. Each Ministry in government can give their legal requirements (such as set distances from heritage sites, army aviation bases, airports, and wildlife reserves ...) to wind farm planning, without any mandatory consultation. This resulted in drastically reduced areas available to wind developers [104].

Nadai, a well-published senior researcher at Centre International de Recherche sur l'Environnement et le Développement, has written many papers exposing the burden of the centralisation of French policies regarding the energy transition. He holds the government responsible for refusing to invest in effective support systems and for holding back information from local actors, who then lack the transparency of information to make fully informed decisions faster without seeking answers further up the chain [101] [103].

1.3. Social Acceptance

Social acceptance is also renowned as a great barrier for wind developers in France and abroad [11]. Many papers go into great depth about various factors influencing social acceptance, such as individual attitudes, social context, perceived impacts, and process-related issues [42]. The following section reviews the literature, which addresses the issues raised and strategies for obtaining social acceptance of wind turbines.

First, the authors are keen to point out that social acceptance is not just a matter of being (un)supportive towards technology but more about rejecting any such projects near home. One of the most influential authors of social acceptance, such as Devine-Wright, argues rethinking NIMBYism (Not in my back yard) beyond the most often pejoratively perceived place-protective action of locals towards new projects [36]. Instead, he suggests, it is a form of place identity protection, and outsiders who wish to initiate new projects in the area should seek to connect more personally with the locals it would affect. They should also objectify the project and treat it as an asset contributing to place identity rather than transforming it.

Meanwhile, others blame the notorious 'planning problem' [44], [130] where most social resistance to wind projects occurs during the planning phases before any commitments are made. In a paper by Szarka and Cowell, this is described as an issue of 'societal engagement', and governance [131]. This group starts with the assumption that planning problems arise due to comparatively low approval rates for wind energy development and delays in decision-making. However, they conclude that the core of the problem is the 'misrepresentation' of social acceptance in planning decisions. They suggest developers should be required to work together with communities and local planning authorities and take more care to acknowledge specific reasons for any project refusal. Thus, approaching the opposition respectfully and open-mindedly, for example, early during pre-application discussions. The priority should be to assess social acceptance in the decision-making process on a case-by-case basis.

Finally, Ellis [43] supports that solving social acceptance of wind energy requires going beyond 'simple fixes' on a case-by-case basis. This issue is strongly related to the many challenges of transitioning to a low-carbon economy that inevitably involves all levels of society. Therefore, the tensions arising from the social acceptance of wind are just one of many. In the long run, fundamental transformations to existing institutions will be needed to overcome these social challenges. In particular, the dynamics of relationships between communities and the energy sector need to change [43].

1.4. Social Acceptance in France

Many authors discuss reasons and suggestions for tackling social resistance to wind energy; some are even more specific to the case of France. Enevoldsen [49] offers a list of guidelines for improving the likelihood of social acceptance for onshore wind project development in France. His research suggests that social acceptance varies throughout a project's development and is usually lowest just before the construction phase. However, he proposes that various activities can achieve social acceptance by informing and involving various stakeholders and local non-stakeholders. He defines the reasons for opposition and acceptance of wind projects. Most importantly, he demonstrates that wind projects in France rely on public support, especially the willingness of local inhabitants and the mayor, more so than in other European countries. He draws up a recommended list of actions, such as seminars and exclusive meetings between project planners and a specific group of stakeholders at a time, including local stakeholders. He concludes that community involvement is crucial to project acceptance [49].

Finally, Jobert [77] states that the policy framework in France means that developers do not have any legal rights to enforce the construction of wind turbines in suitable areas, unlike in other countries. Thus, developers are more dependent on local social acceptance. Consequently, networking is vital to developers in France. In his studies, developers could lift much of the opposition by expanding their local knowledge and using contacts to integrate politicians, associations, local enterprises, and others.

1.5. Community Involvement

Given that social acceptance is a great barrier to wind farm development in France, many authors would recommend community involvement as the best solution [49] [42] [43]. Yet, while many discuss effective communication between developers and communities, few mention project collaboration between them and only a few papers could be found about community-owned projects in France.

Large-scale Community Renewable Energy Projects (CREP) in France are slowly emerging thanks to supportive policy schemes. However, policy framework varies significantly between regions [141]. Unfortunately, these schemes can only offer a return on financial investment, whereas tools like collective self-consumption or reduced energy bills are non-existent. The limited incentives make it challenging to involve people who are not already ecologically minded. Further, little is known about the motivation and socio-demographics of the CREP members and investors who lead or partake in them [125].

To increase ownership and economic incentive to CREPs in France, two suggestions have already been made:

- to make FITs available irrespective of the energy suppliers who buy the power. This would allow locally produced renewable energy to be more competitive and create opportunities for alternative energy suppliers to create value propositions specifically for CREP owners. [125]
- policymakers should further promote and facilitate collective prosumption for all RES technology. More than anything else, it would make citizens' contributions more tangible and create a greater sense of ownership. [125]

1.6. Knowledge Gap and Research Questions

Finally, it seems that the common agreement between the authors and experts cited above is that siting and planning of wind farms are increasingly difficult due to heavy administrative constraints, the centralised nature of the French grid and institutional infrastructure, and social resistance and significant delays.

They also agree that greater community involvement and transparency, proactive communication, and creating community energy projects from the start are most important for gaining acceptance. However, promoting a better community involvement system is at odds with the current centralised political and energy infrastructure.

In summary, on the one hand, previous research largely reviews policy frameworks for wind energy at a national level, including subsidies and other financial incentives. On the other hand, research at the local level has been carried out about contentious relationships between communities and developers. Some even include steps to improve social acceptance, including many examples of community involvement and early citizen participation. However, there is yet to be research to provide developers or other wind industry stakeholders with a process that would overcome their current difficulties and help them to fulfil the national energy goals.

Overall, social acceptance is considered problematic for onshore wind energy. To remedy this, researchers argue strongly in favour of increased community involvement early on [144] [33] [93], as well as for more community renewable energy projects (CREPs) [125] [11] [73]. Yet, few papers have been published about community renewable energy in France, and even fewer about community wind energy. A few academic publications have been written about CREPs in France, but most of these projects are small solar clusters due to the existing support schemes. Similarly, the context for active support is poorly documented, and the emergence of CREPs is independent of wind developers' involvement.

Unlike previous papers that focus mainly on social acceptance [42] or on successful policies in discrete case studies, [94], this research investigates the context-specific factors contributing to barriers to wind energy deployment in France within a broader socio-technical perspective. In particular, the difficulties in creating social involvement in the energy transition. In addition, the influence of power and economy on the current relationships between stakeholders influences the French wind industry. The scientific contribution is to not only create a heuristic vision using MLP to identify any bottlenecks at national and local levels but also to provide recommendations to developers and policymakers, which has yet to be done.

These objectives led to the following main research question: "What is constraining the deployment of onshore wind energy in France?" and subsequent sub-research questions:

1. Where does the onshore wind energy niche stand concerning the current situation in the French energy sector?
2. What are the main drivers and barriers experienced by the onshore wind energy industry at a national level?
3. What strategies can be used to overcome national-level barriers?
4. How should include governance and regulatory issues at the regional/local level be addressed?

Given the sustainable transition context of this research, these questions are solved using renowned socio-technical transitions analytical tools, Multi-Level perspective (MLP) and Strategic Niche Management (SNM) to provide a national scale perspective, followed by a case study of a regional level 'microcosm' to illustrate of the dynamics and barriers met by developers at the local level.

1.7. Outline of the Report

Following the introduction, the report is laid out in six chapters. It begins with the theoretical and methodology chapters, then two chapters dedicated to an MLP And SNM analysis first at the national level, and then of a case study at the local level. The research closes with a discussion about comparing the differences found and potential solutions, conclusions, and recommendations to future developers' policymakers and researchers.

The chapters contain different tools and elements that contribute to research.
Chapter 2: Theoretical Background is dedicated to describing the analytical frameworks used throughout the research. Starting with MLP and SNM concepts, followed by a description of the local microcosm approach and ends with a description of how these concepts are well suited to be combined.

The Methodology chapter 3 describes how MLP and SNM approaches were adapted and integrated into this project. It begins with detailing the standard MLP and SNM procedures, then justifies the addition of the case study and describes the applied double SNM method. This chapter also includes a detailed description of the background to the study case, the standard siting procedures and best practices known to French wind developers. Methods regarding stakeholder analysis, data collection and qualitative data analysis close this chapter.

Chapter 4: Socio-Technical System Analysis and Chapter 5: Case Study, contain the two bodies of research, at a national level and at a local level, respectively. The national-level desk-based study analyses the three layers of MLP, Landscape, French Energy Regime and Niche level. The analysis of the niche level is further investigated under SNM aspects of expectations, learning and actor networks. In the local-level case study chapter, there are three distinct cases. The chapter presents the three cases at local and regional levels of onshore wind planning. The first case is a practical experience of a developer searching for prospective wind projects in the Grand-Est region of France. This is an illustrative 'microcosm' of the national-level findings from the previous chapter. The second case is the account of the Project Manager in charge of the company's only co-owned wind project with a community. The third case is a couple of interviews with specialists from national wind associations, ADEME and SER. It gathers their perspectives on barriers and solutions to promoting onshore wind energy in France. The second part of the chapter takes an MLP and SNM perspective to compare the findings, and the differences between national-level barriers and those met at the regional by developers. The findings are of both chapters presented thematically, within the dimensions of MLP, to keep the analysis consistent for comparison. This closes the research part of this thesis, and the following chapters are dedicated to discussing and suggesting solutions to the barriers found.

The discussions chapter 6 discusses key recurring themes found in the research, including the best practices for developers, the importance of scale (national and local), media influence and management, and desired regime changes. This chapter also presents the benefits of using an atypical application of the MLP framework and its meaningful contributions to future studies of onshore wind planning and other energy transition studies.

The final Chapter 7 Conclusions begins by answering research questions, then elaborating on the scientific contribution of the research, and finally addressing recommendations to companies developing wind energy, to policymakers and for further study.

2

Theorectical Background

This chapter overviews the core concepts and framework used throughout the thesis. The chosen analysis tools have been narrowed down to the Multi-Level Perspective analysis, which is intrinsically linked to Strategic Niche Management theory. Combined, these methods will address the research problem and solve the research questions.

2.1. Multi-Level Perspective

Multi-Level Perspective (MLP) is a descriptive and heuristic framework commonly used to analyse socio-technical transitions (STS) to sustainability within a given time frame. It is known for two main points. First, for using three hierarchical layers to illustrate the transitions' dynamics. These levels are cited from top to bottom: Landscape, Regime and Niche, as illustrated below in figure 2.1. Second, describing the interactions between players acting within each level (people, institutions and networks..) and structural changes (to infrastructure, policies, technologies...) within the layers that contribute to the transition. The following section presents the three levels in more detail.

2.1.1. The Three Levels of MLP

A dynamic representation of the three MLP levels in Figure 2.2 At the top level, the **Landscape** is exogenous to the STS but includes shocks and crises, such as decisions taken by the European Union. These Climate Change catastrophes exert external pressure on the current regimes below. Thus, the landscape influences the two lower levels but is even more stable than the regime and is consequently very slow to change and respond to innovation feedback.

The bottom level, the **Niche**, is a protected space for new technologies that still lack the means to compete within the incumbent regime. In this space, technologies show potential to out-compete current dominant technologies but need time and financial support via research funding and subsidies to experiment. They seek to mature enough to withstand the regime level and earn their stability and financial independence.

The main level of study is the **Regime** level, in which incumbent technologies are hard-set into networks of actors and regimes. These regimes exist due to past events, laws, technological superiority and dominant market trends. They are stable due to a virtuous circle by locked-in incumbent technologies and mindsets, further reinforcing inter-dependencies within them. Inter-dependencies are visible between actors across all areas of society. MLP analysis of the regime level is subcategorised into seven dimensions; science, technology, politics, markets, user preferences and cultural symbolism, which are used for analysis.

Geels provides examples of lock-in mechanisms for incumbent STS [65]:

1. Techno-economic lock-in mechanisms: (a) sunk investments, such as education or competencies, factories and readily accessible components, existing infrastructure, all of which steer paths for transitional change back to the incumbent system, (b) existing technologies that are low cost and high-performance characteristics, which deter new technologies using economies of scale and many more decades of accumulative experience from learning opportunities.

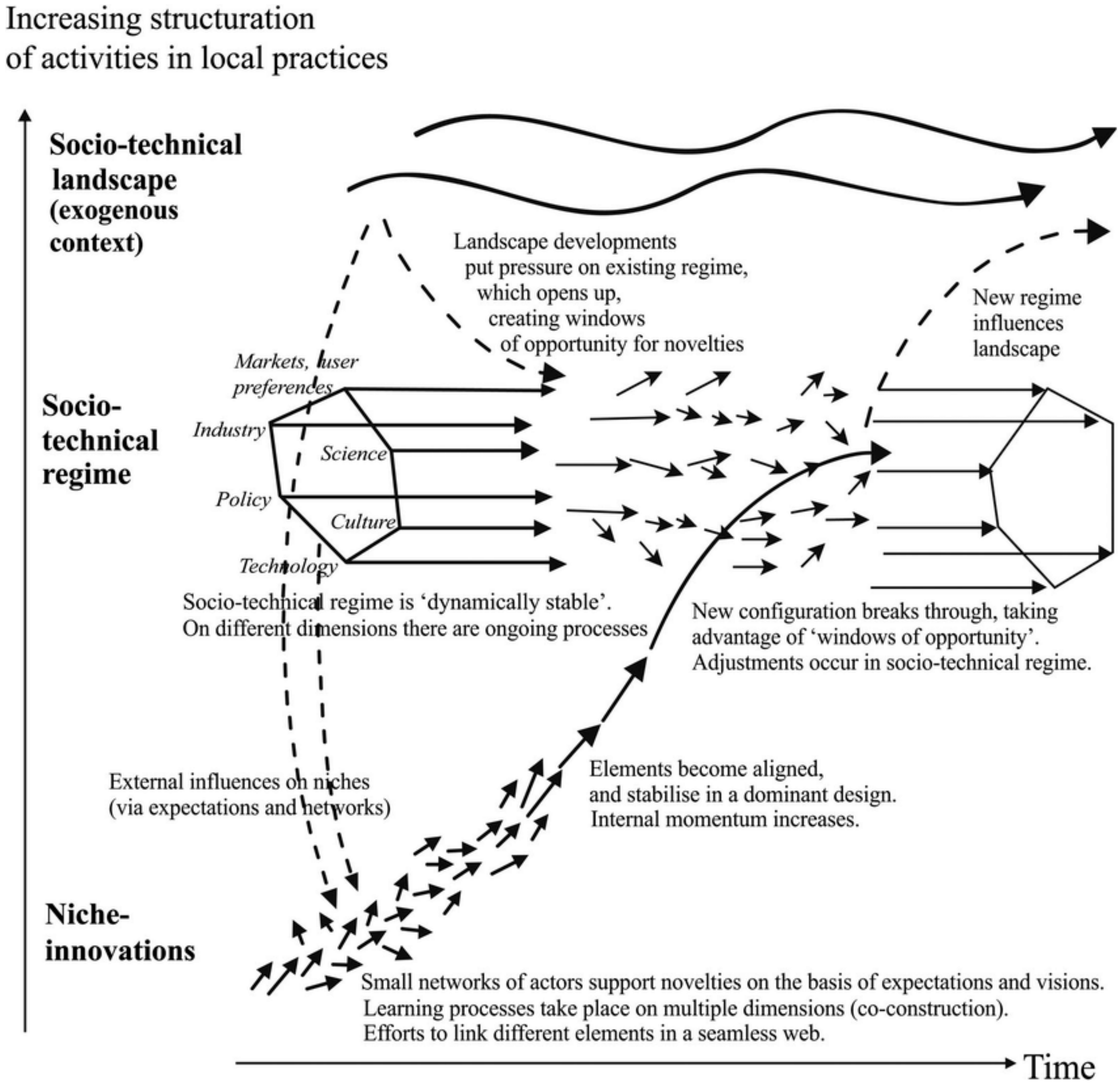


Figure 2.1: The MLP three-layer structure by Geels [66]

2. Social and cognitive lock-in mechanisms: (a) habits or shared beliefs that precondition actors to stick to what they know, (b) present networks of relationships among people that enable the harmonious function of society, (c) user practices that have become reliant on a specific technology.
3. Institutional and political lock-in mechanisms: (a) established policies and regulations that favour incumbents and create more difficulties for new entrants; (b) use of policy network for more significant financial by keeping to ready functioning technologies and slowing regulatory change hindering radical innovation.

Regimes are stable but not fixed; they are animated by constant interactions between actors that produce interdependencies and abrupt disruptions in the regime. These disruptions weaken long-lasting relationships and create opportunities for new technologies at niche levels to step up and insert themselves within them. Experts argue that overall, all STS remain stable over time. Therefore successful innovations must meet specific requirements [65]. For innovations to succeed, they must 'scale up' and grow into the regime incrementally by making minor adjustments until they have built stable trajectories.

However, innovations may seize their chance at opportune moments at varying levels of technology maturity. Such innovations may continue to evolve as they shape themselves to the regime dynamics by various means of learning. However, other older technologies or more established technology, such as wind turbines, are considered concrete innovations stuck in their niche but at the fringes of Technical Transition (TT) caused by transition bottlenecks. [68] TT can be described as a long-term co-evolution

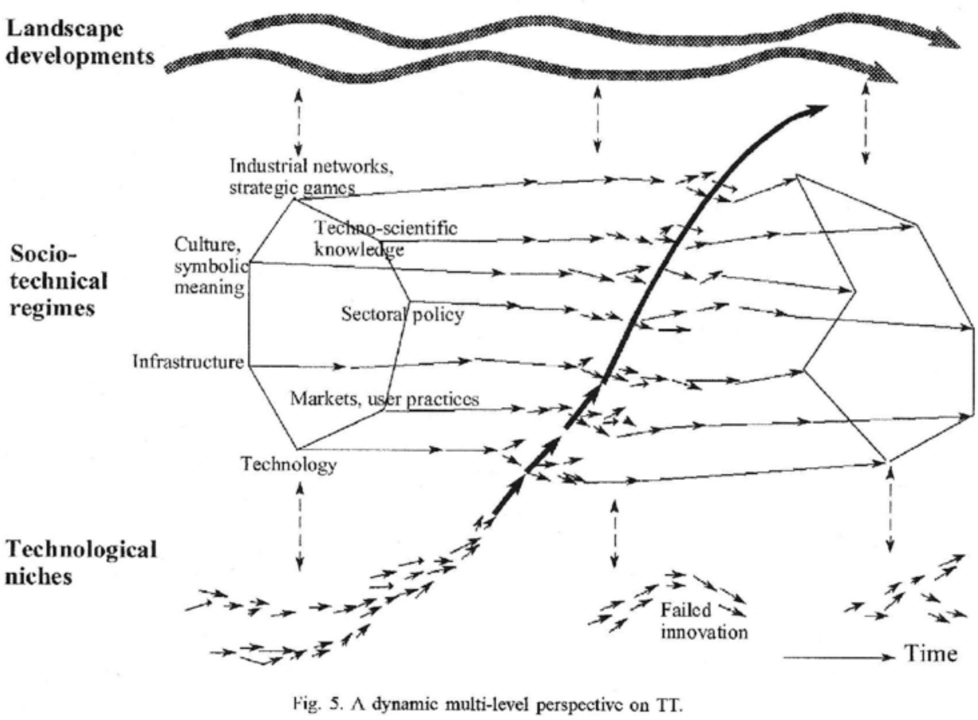


Figure 2.2: Dynamic MLP by Geels [66]

of social and technological relationships. Unlike newer innovations which have steeper technological learning curves, TT cannot rely only on technology development but must pay greater interest in the evolution in other regime dimensions such as; user practices, policy regulations, industrial networks, infrastructure, and symbolic meaning or culture set in a change of context. [66]

MLP regime dimensions provide a well-rounded guiding tool for visualising transition processes and giving recommendations for achieving effective change at regime and niche levels. Typically Multi-Level Perspective analyses of current states show that transitions are slow due to regime lock-ins and niche technologies that lack the momentum to overcome these 'transition bottlenecks'. However, scenarios can be designed based on the present findings. They can show how social interactions, learning processes, and changes to institutions and policies could help relevant actors change their beliefs and approaches to improve chances of successfully transitioning from niche to regime. [17]

2.2. Strategic Niche Management

A niche is a protected space for innovations free from regime market pressures. This enables stakeholders in the technology to experiment, learn more about its robustness, quality and specifics, and adjust accordingly. To complement the overall vision provided by MLP analysis, another more niche-centred approach is also used, known as strategic niche management (SNM), a framework used to qualitatively analyse the internal process of niche innovation [138]. These analyses are from three processes: 1) Actors and Network formation, 2) Learning Processes and 3) Visions and Expectations. The SNM approach is more insightful for concrete technologies that have already had some experience in a local environment. An essential notion in SNM is “scaling up”, which is understood here as “moving sustainable practices from experimentation to mainstream” [20]. This notion is used to help assess the trajectory of the niche into a more global niche and market. Scaling up is the goal for the niche, and SNM factors are used to identify what could prevent it from succeeding.

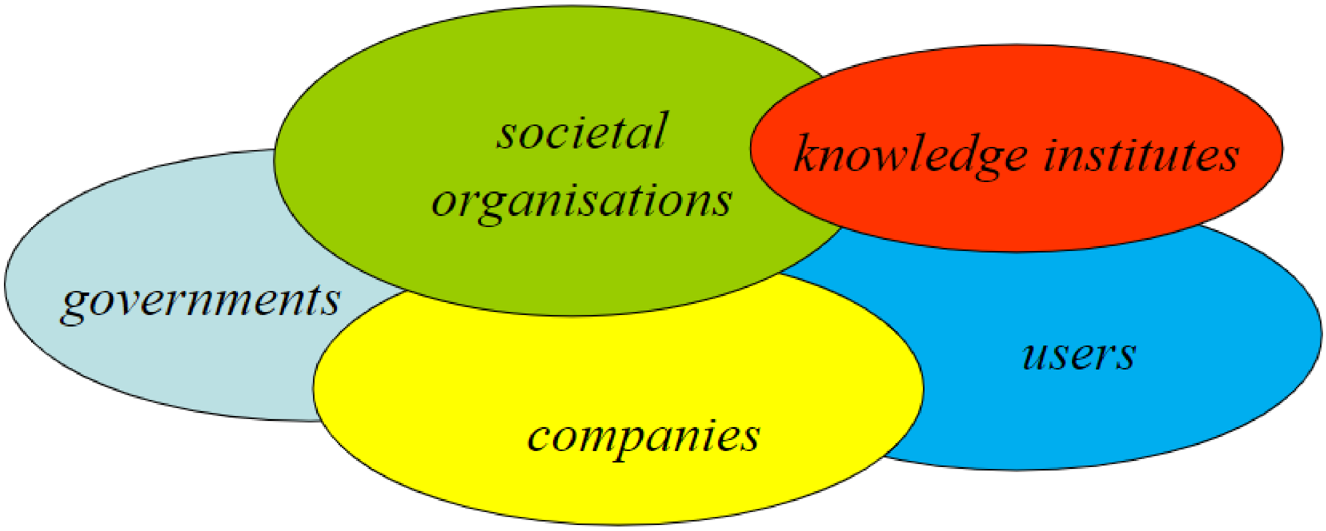


Figure 2.3: Network composition of actors in SNM Analysis (Source: TU Delft learning material [79])

2.2.1. Network Formation

First, network formation between different social groups surrounding a niche is essential to understand which types of actors are most involved with technology, how many of each comparatively and how varied their expertise is. The actors' types are presented in Figure 2.3 and are spread between five groups; Governments, Social Organisations, Knowledge Institutes, Companies and End Users. The relationship between them determines the social structure around the innovation and is used to understand behavioural influences. To best understand network formation, the analysis encompasses the power relations between actors, how strongly dependent they are on one another and whether the intentions of their actions or goals lead to pushing the technology in the same direction [115].

2.2.2. Learning Processes

Second, learning processes look at learning from five aspects within the MLP context: technical, user context, impacts, industrial development, policy & regulation. Learning processes are important for the emergence of market niches because they enable adjustments to be made and stabilisation in niche development. [115] There are different kinds of learning to consider, too, including; learning by searching, learning by doing, learning by using and learning by interacting. [80] Technologies such as wind turbines need to function in varying social and environmental contexts, so learning by using is particularly important. [80]

Beyond different types of learning, there are also types of learning, but for SNM, only first and second-order learning is used. First-order learning refers to learning about the effectiveness of a certain technology in achieving a specific goal. First-order learning aims to test and verify pre-defined goals and occurs through the learning types and processes mentioned above, e.g. by conducting experiments to validate a theory. Higher-order learning, or second-order learning, reflects norms, values, goals, and procedures changes. The latter can neither be tried nor tested but manifests as a shift in beliefs and mindset about technology and people's adaptions to their lifestyles as innovations become increasingly common. Second-order learning is thus about questioning these norms or changing the rules. [115]

2.2.3. Visioning and Shaping Expectations

Expectations cover the same MLP aspects as learning but take a futuristic perspective. It is important to understand what the actors associated with each aspect expect and envision for the technology's future to identify how each actor group could steer its development. For this, the most commonly used indicators are those of robustness (the support required), quality (evidence of performance), and specificity (its focus), always within the context of the MLP model. Robustness testifies to a technologies capability to withstand market pressures with support. Quality measures a technology's effectiveness compared to market competitors, for instance, and improves actors' expectations the more experiments are carried out. Finally, specific expectations are when it becomes clear which steps should be taken in developing the technology to meet the expectations. The purpose of the three indicators is to show that the more robust and specific the expectations are, and the greater the quality increases, the higher the chances of successful niche development. [115]

Geels [66] argues that MLP can provide a suitably organised framework in terms of niche innovations with, on the one hand, particular attention to learning processes, social networks and shared expectations and, on the other, awareness of struggles against existing regimes (incumbent actors, institutionalised structures).

2.3. Critics of the MLP and SNM Framework in Energy Transition Studies

While MLP and SNM have been widely used for sustainable transition studies, they have received some criticism. Some critics argue that there is a lack of empirical evidence to support the claims made by the MLP framework. [14] [67] Other critics argue that the MLP framework doesn't provide a clear and consistent method for linking the different levels of analysis. This can make it difficult to draw meaningful conclusions from the data and make it difficult to evaluate the framework's effectiveness in addressing social and environmental issues. The framework has also been described as "too descriptive and structural, leaving room for greater analysis of agency" [68] and lacking analysis of power and agency between actors as a result [140]. Some also argue a lack of empirical evidence to support the claims made by the MLP and SNM framework [67]. Deemed by some for being too favourable towards the bottom-up approach to transitions, in which new entrants and outsiders challenge the dominant position of incumbent actors and regimes. The academics making this claim suggest including incumbent firms and policymakers from neighbouring regimes to accommodate the possible role of incumbent actors in niche development. [138] Finally, critics argue that these frameworks do not sufficiently consider the power relations between actors and the influence of these relations. This increases the risks of overlooking the effect of incumbent actors in the regime on niche development [138]

This research takes a novel approach to remedy several of these shortfalls. It uses multiple case studies at varying levels of power: national government and policymakers, the power of local governance and the power of incumbent actors such as developers. The analysis framework is the same for all cases and levels of action, national, regional and local. The novelty of this approach aims to: 1) include more significant consideration for power and agency within the socio-technical regime, 2) include incumbent actors in the study, 3) empirically test solutions for empirical evidence, 4) include the power relations between local actors, those in the industry and national and local governance.

2.4. Theoretical Background Conclusion

The use of multi-level perspective analysis for studying barriers to wind energy deployment in France is a valuable tool for understanding the various social, contextual and technological factors that influence the adoption and implementation of wind energy in France. The framework helps to identify the complex interactions and dynamics of the interrelationships at play. Using the subcategorised dimensions observed at the regime level provides a strong visualisation of the transition bottlenecks and which actors are involved. The dynamic overview of MLP shows the respective evolution of each landscape, regime and niche level. It can also serve as a legitimate basis for founding pathways or recommendations for future changes. On the other hand, the strategic niche management analysis provides a framework for understanding how actors within the wind energy sector can navigate and shape the barriers to deployment by focusing on niche-level factors used in network building, learning processes and structure expectations. By combining these two approaches, it is possible to gain a more nuanced and comprehensive understanding of the barriers to wind energy deployment in France and develop strategies for overcoming them at each level. Ultimately, the gains from the analysis can inform policy and other decision-making efforts aimed at promoting the wider adoption and deployment of wind energy in France.

3
Methodology

By using the aforementioned theoretical background from the previous Theoretical Chapter 2, this chapter details the methods and research approach used in this project.

This research is focused on solving one main question, 'What is constraining the deployment of onshore wind energy in France?'. In doing so, the following sub-questions shall be addressed:

1. Where does the onshore wind energy niche stand about the current situation in the French energy sector?
2. What are the main drivers and barriers experienced by the onshore wind energy industry at a national level?
3. What strategies can be used to overcome national-level barriers?
4. How should include governance, and regulatory issues met at the regional/local level be addressed?

3.1. New Adaptation of the MLP and SNM Frameworks to Case Studies

MLP and SNM frameworks are commonly used frameworks for studying sustainable technology transitions within the context of a country or the case of a niche technology. This research includes a national-level study and a regional-local case study as an illustrative 'microcosm' of the effects of national-level policy at the ground level. SNM is also applied to onshore wind energy in France and a sister niche, community wind energy projects in France. While the frameworks used are unchanged, the methodology is adapted to produce more relevant results. The arguments for this are 1) Several national-level barriers were ongoing and not resolved despite having apparent solutions, 2) the Regional-Local level scope provided a closed area to experiment with the proposed solutions and obtain direct feedback on their effectiveness, 3) applying the same framework to all levels of governance allowed for a more credible comparison of all barriers identified between them.

These adaptations are described in the following section.

3.1.1. Integrating MLP and SNM

As described in the previous chapter 2, the multi-dimensional facets of MLP analysis are well suited to describing the present state of a socio-technical system. Thus, here the three levels, landscape, regime and niche, are used to describe the current state of onshore wind energy in relation to the French energy regime surrounding it. The framework has two purposes 1) to extract and identify the networks and relationships between stakeholders within the French power sector and 2) to gain an overview of the effects of national decisions on the onshore wind energy niche.

Following the MLP analysis, the onshore wind energy niche is closer inspected using SNM analysis tools. The niche is dissected into the three components of SNM; network formation, learning processes and expectations, and the feedback loops between them.

3.1.2. Integrating Case Study

The national-level MLP analysis provides a basis for best practices and expectations about local-level barriers and interactions between actors. The case study is an illustrative case of actual problems and solutions applied at the local level that could otherwise be overlooked and misunderstood when taking a purely national-level perspective. The case study also allowed for the national-level research's learnings to be applied in a 'microcosm' and test which cited 'best practices' found in literature indeed prove the most effective in practice.

The overall step-by-step research process can be summarized as follows:

- STEP 1: MLP of onshore wind energy at the national level
- STEP 2: Empirical Case study
    1. Work experience: building a network as a developer
    2. Account of successful co-ownership
    3. Views of national wind industry specialists
- STEP 3: MLP of the Case study and SNM of Community wind energy
    1. MLP analysis of Regional/ Local microcosm
    2. Comparison with expectations based on National Level MLP
    3. SNM of CREP as a micro-niche of onshore wind energy
- STEP 4: Discussions about recommended changes
- STEP 5: Recommendations and Conclusions

Step 1: dives into the current state of the French wind energy industry, using a study case as support. This step includes an MLP analysis, in which there is a regime and stakeholder analysis, followed by an overview of the established problems and trends. The objective of the first step shall be to obtain an overview of the French energy regime and identify the difficulties developers met and the best-known practices for increasing social acceptance of wind energy.

Step 2: includes the case study, which serves as means to give practical examples of the reactions to these best-known practices by a variety of actors involved in building wind energy projects at a local level. This part is carried out at the company using all the known successful company methods for prospective and initiating new projects. The case study includes two sub-cases and interviews with specialists. The first case involves the initial siting phase in the Department of Aube chosen because it could be considered representative of many other regions in France. The second accounts for lessons learnt by the Project Manager of a successful co-owned community wind farm between CNR and several local community stakeholders.

Step 3: takes the same approach to MLP analysis at regional/local and national levels to facilitate comparisons. SNM is steered towards onshore wind energy in the context of community wind energy projects - a less mature and more innovative technology niche.

How should governance and regulatory issues met at the regional/local level be addressed? **Step 4**: Discuss the lessons learnt from national and regional/local studies. Including adapting best-known practices given to developers, adjusting enabling policies, managing catalysts for change (such as media or participants for successful projects) and desired regime changes for a TT in the future.

Step 5: Answers research questions and gives recommendations to developers given the current context, recommendations to policymakers for future policy changes and recommendations to future researchers.

3.2. Case Study

This regional case study acts as a 'microcosm' and illustrative case of how niche-regime dynamics play out at the regional level. This helps further understanding niche development, particularly when compared to how things play out at the national level, as seen by using the socio-technical transition tools MLP and SNM presented in the previous chapter 2.

The case study provided by CNR serves as a foundation to experience the current approach and experiment by putting novel initiatives into practice. This study of wind energy from the perspective of the niche involves the initial phase of developing wind parks and prospecting new wind sites. The study is carried out in the Department of l'Aube, in north-eastern France. The region is considered relevant for the study because it already has more installed wind than most other places in France, yet it is still behind its onshore wind energy target. This was an opportunity to understand how and why some projects are successful and why others fail or are not initiated. The study is further detailed later on in chapter5.

3.2.1. Case Study Selection

A case study of l'Aube was chosen because it can be considered representative of the energy transition in France. Specifically for wind energy, it is located in the Grand-Est region, which has the second-highest installed capacity after Les Hauts de France. The region is known to share divided feelings about technology. The average wind speed is not exceptionally high in l'Aube (between 5-6m/s), but the wind is frequent and sufficient enough to attract developers. The wider region is known for having fewer environmental constraints and radars than many other regions in France, as is the case for Rhone-Alpes and Occitanie, respectively. Another more favourable factor is the population distribution, where residential areas are relatively concentrated around towns which opens up space for developing projects.

3.2.2. Methods of Investigation

The true purpose of a case study was to observe the problems met by developers at the local level. Therefore, after having carried out desk research on what to expect, a case study offered the opportunity to put recommendations by researchers into practice. Thus, a prospecting phase was carried out using company tools for identifying new locations. All best practices from Company policy and literature were used to achieve two goals: 1) build a network of local 'capacity-builders' keen to collaborate in a co-owed community project with CNR, 2) Initiate the next phase of developing a project with a community.

The prospecting phase was carried out from a developer's perspective by integrating a team of Project Developers at CNR and approaching local stakeholders in the company's name, under company policies and best practices.

3.2.3. Wind Energy Planning in France

Work experience as a developer at CNR followed company methodology and guidelines. While prospecting methods may vary between developers, the following section is a detailed perspective of the step-by-step process taken by developers at the company and the constraints all developers in France consider for building a wind farm.

Wind farm siting and planning can be divided into five parts with four gateways: Site Prospection, Pre-study, Development and Consultation, and Permitting phase. Each phase involves new stakeholders, and each gateway requires the approval of an elected official at a local level.

1. Site Prospection Phase
    (a) Mapping prospective sites using Quantum GIS (QGIS), an open-source Geographic Information System
    (b) Initiate contact with Mayors and local authorities of areas with high potential.
    (c) Start of public consultations

Gateway Mayor and landowners give their consent for pursuing studies

2. Pre-study Phase
    (a) Eliminate risk: Verify no constraints were missed during siting phase
    (b) Request confirmation from Army
    (c) Inform Locals: flyers

Gateway If no constraints are found, Mayor is still in favour of carrying out further studies

3. Development Phase
    (a) Wind Measurements: installation of a mast
    (b) Biodiversity impact studies
    (c) Technical Studies

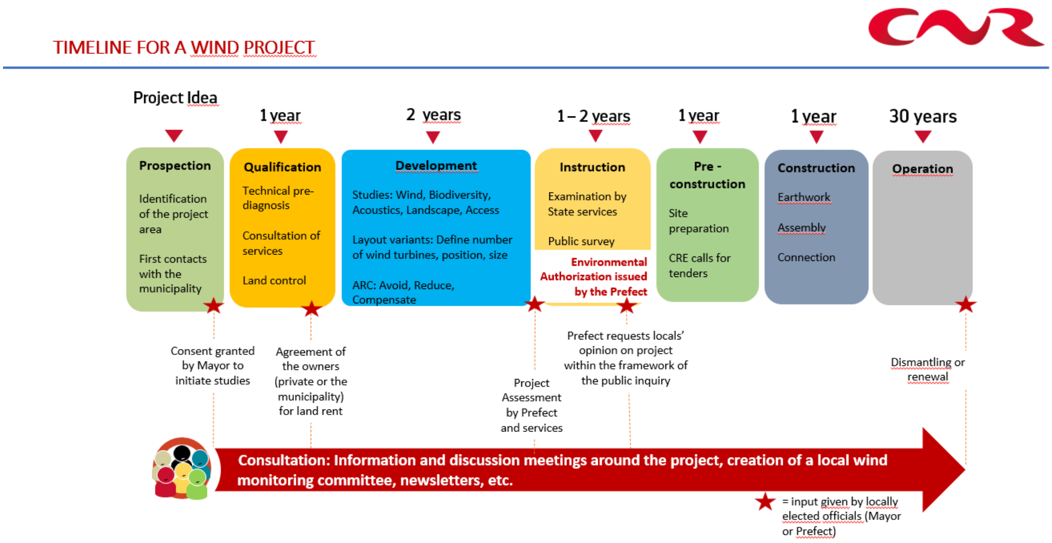


Figure 3.1: Timeline for developing a Wind Project (source: CNR)

(d) Inform and include locals: On-site meetings

Gateway Wind is sufficient, no significant impact on the biodiversity found, theoretically, technically and financially feasibility wind park design. Submit an application to Prefect.

4. Permit and Authorisation Phase
   (a) Apply Prefect
   (b) Prefect and public services assessment of studies
   (c) Court hearings / Public Appeals

Gateway If Prefect and the following court hearing grant the 'Environmental Authorisation' is won by developers, they can submit a bid for tenders.

Site prospecting is the first siting phase, where developers scout new wind project locations using digital mapping tools. This phase involves initiating contact with local representatives, building relationships with other regional actors and, importantly, obtaining the consent of the landowner(s) and the Mayor before further studies can occur. In the second Phase, Pre-study, here, any extra constraints that could jeopardise a wind farm project are checked. Once the land is considered suitable for designing a wind farm, the next stage, the development and consultation phase, can start. This stage involves all necessary project designing and environmental and technical studies. It is the most expensive and carries the highest financial risk of all the planning phases. This is mainly because in-depth studies may reveal the less obvious reasons stopping a project (nearby endangered species, less favourable wind conditions than expected, the rise of social resistance...). All results are collated in a report assessed by the Department Prefect, who then consults with his services before accepting or refusing a project. Before accepting a project, the Prefect must allow for a secondary public consultation by an independent investigator and then dedicate six weeks to processing public appeals. If no court hearings proceed, they can grant an 'Environmental Authorization' for a wind project. Once a project has the Prefect's authorisation, it must win a bid at the CREs' call for tenders to be allocated a Feed-In Premium and, consequently, a permit to construct. A project can be built and implemented once complete after winning a bid. This lengthy process typically lasts between 5-8 years in France.

3.2.4. Standard Siting Procedures

The first step to planning a wind farm is to identify a suitable area for constructing and operating a Wind Farm. In practice, this means using mapping software with a database of the known constraints of wind turbines.

Constraints can be categorised as follows:

Macroscopic:

1. Army aviation (training corridors, 70km distance from army radar, low flight zones)
2. Aviation (low flight zones) and telecommunication antenna
3. Biodiversity
4. Cultural heritage
5. Acoustic or noise
6. Set-back Distance from residential areas (500m in France)

Technical:

1. Distance by road from grid connection point (less than 20 km by road, sometimes more for larger areas)
2. Accessibility (road type)
3. Wind resource (above 5,5mps annual average)
4. Possible number of turbines (area size)4.2. French Energy Regime Analysis 26

Other:

1. Failed or competing projects nearby
2. High-risk factors (safety distance from overhead power lines, underground pipelines)
3. Area suitability (other social factors)

Once an area has met the criteria mentioned above, a developer's next step is to contact the Mayor of the community to which the land belongs. If the Mayor shows interest in a project, more meetings can be organised, and project planning (securing the land, feasibility and environmental studies..) is discussed. The next phase, Pre-study, can begin once the Mayor and landowners of the affected area have officially given their consent by signing a deliberation and land rental contracts. Suppose the Mayor is not in favour, but the area is still considered of high interest. In that case, the decision is made to revisit the area after the next municipal elections in 2026 and try again.

3.2.5. Best Practices

From previous developers, experiences[127] and recommendations found in literature[49], a list of best practices was added to the siting method for the study case:

1. Prefer extending projects that are already in place
2. Avoid designing projects that could encircle residents with turbines
3. Keep over 1000 m from the nearest houses (rather than 500m)
4. Contact the municipality Mayor before any other stakeholder
5. Offer community involvement from the first meeting/exchanges
6. Offer community participation in the project planning
7. Offer and pro-actively provide information to the local population as early as possible

3.2.6. Academic Purpose

The chosen case study serves as a real-life descriptive illustration, providing more depth and insight into local wind park planning and implementation. It is a concrete example of what industry employees face daily. It illustrates how problems and practices with wind energy planning and implementation play out at the regional level. It can be considered a microcosm at a local-regional level to balance out claims discovered in the MLP analysis at the national level.

3.3. Stakeholder Analysis

The stakeholder analysis brings together the actors in the MLP and case study to define the actors and their respective levers needed for achieving the technical transition.

To do so, stakeholder analysis can be broken down into three steps: i) identifying stakeholders; ii) differentiating between and categorising stakeholders; and iii) investigating relationships between stakeholders[117]. Researchers have often argued that sustainable management of natural resources requires a soft system in this context of shared resources, land, and energy between varied actors, developers and inhabitants, for different intentions and their respective livelihoods. This calls for using instrumental research, a more pragmatic approach aimed at understanding how organisations, projects and policy-makers interact to explain and manage the behaviour of stakeholders to achieve desired outcomes. [117]

In the chosen method, stakeholder identification shall be carried out using an iterative process across the five categories used in the MLP and SNM framework: Governments, Social Organisations, Knowledge Institutes, Companies, and End Users [67] [115]. Through this process, new stakeholders are added as the analysis continues, found either by research or in the case study, until no major actor is left [117]. After this, a qualitative description will be made of the composition of the stakeholders involved in wind energy and their areas of (mis-)alignment. The findings from MLP and SNM shall be used to help establish key players and their inter-relationships with others to build more effective networks.

3.4. Data Collection

3.4.1. Desk Study

The first round of data collection started with an online based study on the history of the French energy industry to begin the MLP analysis at a national level, and the findings are broken down into three parts. First, a history of the French energy sector to set the context for the analysis of the present day. Next is a thorough investigation into the landscape, regime and niche levels and the six regime dimensions of MLP: Market and user Preferences, Knowledge and Science, Technology, Infrastructure, Policies and Culture. This part is rounded with a description of the networks of stakeholders and their inter-relationships.

3.4.2. Case study

The second round of data collection involves the case study offered by a renewable energy company. This study serves as an illustrative case of the overall MLP niche-regime analysis. It provides more depth to the interactions between niche organisations and external regime factors at the local level. For this, two perspectives are used: actors at the forefront of wind energy deployment, a wind farm developer and national wind energy experts responsible for relaying information about information at the local level to the government.

This study is made up of three cases; first, the experience of scouting and securing sites for new wind farms in Aube, a department of the Grand-Est region in France; second, the account of the project manager responsible for a successful co-ownership wind project between the community and the developer and the part discloses some personal opinions and advice taken from national wind energy experts at the federal environmental agency (ADEME) and the national Syndicate for Renewable Energy SER. Each case offers specific data towards understanding relationships within the niche-regime analysis. The first part gives concrete examples of developers' current practices, the best practices used and the resulting achievements and examples of barriers they meet. The second sheds light on one example of how joint ownership and social acceptance were achieved and offers a basis for replicating valuable practices. The last is the opportunity to gain expert insights on wind energy development in France from a different perspective than a developer's.

Participation in Project Developing

Much of the data for the case study chapter was gathered during work experience at CNR between December 2021 and April 2022. Over this period, the author actively partook in company meetings, project prospecting and other company activities. Therefore data came in several forms. Most were accumulated as a result of trial and error when conducting fieldwork, such as contacting local authorities for approval of prospective projects. Many of these insights came from telephone or email exchanges made with regional and local actors on behalf of a project developer applying best practices and trying to maximise early community inclusion in a future project.

Municipalities were usually contacted by phone, and exchanges lasted from five to fifteen minutes, starting with a brief presentation of the company, the wind potential found in their community and if the Mayor had or would consider building a co-owned community wind project. From there, either the Mayor was absent, or the secretary would give their opinion on the situation and provide a better time to call back to hear from the Mayor in person. Otherwise, when speaking to the Mayor, the call was an opportunity to elaborate on the benefits of Community energy projects and listen to his feelings and experience with wind developers. These exchanges were unscripted and differed per case, but the goal of obtaining the local Mayors' views on wind energy was always achieved.

Inter-municipalities could often only be reached by email. The email specified what areas of the inter-municipality were suited to building a wind project and asked them if they were interested in collaborating in a co-ownership set-up. Some replied, stating that it was not their decision but that of the Mayor's of the municipality in question; however, others suggested an online meeting. Online meetings would last an hour and would be supported by a slideshow. The presentation always began with an introduction to the company, followed by national-regional-local climate objectives involving wind energy, when possible, the local RES target (as laid out in their PCAET) and what was still to achieve, the different variants of community energy project set-ups and ended with an open discussion between the attendees.*What are your motivations or concerns about wind projects in your area? Why?*

Other NGOs, local investors, and SDE were all contacted by phone and asked questions about their willingness to contribute or participate in building a community wind project with CNR in the Department. No specific case community location was raised; they were asked if they knew any other contacts that could potentially be interested in such a project. They were asked further questions, such as whether they would be willing to help mediate between CNR employees and communities, if they would consider approaching communities independently about building such a project, or if CNR employees may cite them and use their name as a local investor willing to support a community project when making first contacts with local representatives. *What is the role of your organisation in the energy sector?*

Further observations were made during conversations with other employees about developing projects in and out of team meetings. This provided equally valuable information from a developer's perspective.

Semi-constructed interview Methods

The first round of interactions was made organisations to build a wind park in partnership with a community. These conversations concerned a range of stakeholders and were aimed at 1) Assessing interest in the joint ownership of a wind project, 2) learning about their pasts experiences with developers and wind projects, and 3) gaining insights into local networks. An important distinction was made between interactions made with a)local stakeholders from the case study, Mayors of affected communes, Department Syndicates of Energy (SDE), mixed public-ownership companies (Société d'économie mixte in French, or SEM), wind developers, and community energy associations, who were contacted as part of the prospecting phase carried out by a project developer, and b) Experts who's advice was sought after the case study, were informed that their input was being requested for this thesis project, after having had experience working in wind project development at CNR. The purpose of the round of semi-constructed interviews with specialists was to gain insight into 1) the relationship of the interviewee to onshore wind energy, 2) the industry's view on community energy, 3) successful enablers put in place for onshore wind, 4) reasons for social resistance to onshore wind in France, 5) suggestions for increasing the uptake of onshore wind energy in the future.

The stakeholders were categorised as suggested by Reed[117] [139] for targeted questions: National level, more relationship and policy-related questions were kept for specialists, whereas local actors were asked questions targeting more personal experience and feelings towards wind energy. Interviewees were asked specific questions based on their relevance to wind projects. The questions were open-ended such as 'How do you feel about supporting a wind project in your area?' or 'What do you think should be done to facilitate community energy?' and always followed a semi-constructed structure.

Due to varying levels of availability, stakeholders' interactions in the first phase varied from emails, a single ad-hoc phone call (with or without follow-up) and a few online meetings.

However, the second phase involving semi-constructed interviews involved inviting each of the specialists for an online meeting scheduled for an hour. To be more time efficient, they were sent an email, including a description of the thesis project, the findings to date and four open-ended questions specific to their area of knowledge. The interviews included a description of their organisation's role in the wind energy industry, answering the questions and discussing the answers as and when, and finished with a final broader question enquiring what three factors they would change in the French energy regime to improve the prospects for wind energy. *What would be three things to change to achieve an ideal scenario?*

The second case of the study includes the account of the successful co-ownership wind project between CNR and the municipality. This was taken from an in-person interview with the Project Manager from CNR responsible for overseeing it. The conversation lasted an hour, and she was asked to describe how the location was identified, how they approached the community for the first time, the timeline of the sequence of events, what were the factors of success, in her opinion, how they build trust between all actor involved, and what lessons could be taken forward when approaching municipalities in the future?

The expert meetings were pre-planned and recorded with the permission of the organisation. They agreed to include information from their interviews in this Thesis so long as they were cited appropriately. Transcripts were made in their original language, French, and proofread by the interviewee for any misinterpretations or sensitive information. A summary of the interactions can be found in the Appendix, in Chapter 8.

3.5. Qualitative Data Analysis

The semi-structured interviews and exchanges with local actors shall yield qualitative data, which will be broken down by using thematic analysis[24]. This means categorising the data from the interview transcripts into groups of similar themes. This shall be done in two steps, the first by identifying the emerging themes after reviewing the transcripts of the exchanges, and the second step, in keeping with the overall analytical framework applied, MLP, the themes identified will then be sub-categorised into the seven dimensions of the regime level analysis. This is done to ensure that the outcomes of the interviews can be compared and related to problems and solutions identified in previous research. This can be done because MLP is a widely used tool for studying sustainable transitions, so it can be used to facilitate comparisons and enhance credibility about the research topic. In the present case, the brakes to wind energy development in France using reliable research methods for collecting the data, such as semi-structured interviews and case studies.

3.6. Research Credibility

Owing to this research's exploratory and descriptive nature, a case study seemed like a logical method. It is rich in rigorously sorted qualitative data to optimise research legitimacy. However, the author acknowledges the weakness of this kind of approach's weakness, which notably impacts the study's validity and reliability. In response, careful detail was put into elaborating a strict and transparent protocol, found above in section 3.1.2. Therefore, future researchers could adopt it and use it similarly to compare findings and increase credibility.

4 Socio-Technical System Analysis by MLP and SNM

Given the focus on energy system transformation and energy transition, this chapter applies two socio-technical analysis frameworks to better understand the interactions and dynamics between actors and factors of wind energy.

The first section is dedicated to MLP and starts with a description of the most consequential factors affecting the landscape such as historical macro-economic and political developments. The regime addresses current practices under six dimensions for wind energy: politics and policies, the French electricity market, current infrastructure, existing technologies, knowledge and science and the social and cultural context. The regime analysis closes with explicit detail of the regime barriers faced by wind energy within the aforementioned dimensions. Finally, the wind energy niche level describes the existing enablers for wind energy and dedicates a section to community wind energy developments. The chapter concludes with an SNM analysis detailing network formations, learning and expectations for the future of onshore wind energy.

4.1. Landscape

Within the MLP framework, the landscape represents heterogeneous factors and trends that change slowly and independently [66]. In France, four major landscape factors stand out for influencing the direction of the national energy sector:

1. Historical Attachment to Nuclear
2. International Commitments
3. World Wide Energy Crisis
4. Geopolitical Tensions

4.1.1. Brief History of Energy in France

To better understand the lag in RE investment in France and its dependence on nuclear power, this section offers an overview of the turning points in its energy history and when, and why, the country diverted from its European counterparts.

Starting during the industrial revolution, France's main electricity source for several decades came from steam power stations fuelled by coal, a national resource. This led to an electricity uptake among residents nationwide. However, there was an uneven distribution owing to a lack of infrastructure, notably a transmission grid and the fact that electricity was produced by multiple private energy companies [12]. Hence, following the end of the second world war, in 1946 the government decided to nationalise the electricity sector and founded EDF, Electricité de France. Shortly after, power stations (fuelled by coal and oil dependant combustion engines) increased in size as did the electricity grid [92].

However, a succession of hikes in oil prices led to more and more concern over France's dependence on petrol. The oil crisis in 1973 led to a worldwide reconsideration of finding alternative resources for fuel. Given France's limited natural resources, the government turned to developing nuclear power for energy independence. Meanwhile, other countries seized the chance to expand and diversify their energy mix [26].

A second oil crisis occurred in 1982, came at a time when nuclear power was going through a restructuring phase and required vast amounts of human and financial resources. The government seized this opportunity to use its energy monopoly, EDF, and its advances in nuclear energy research to become the world leader in nuclear energy. This is notable because, during the 1980s, many other European countries committed to diversifying their energy mixes, including investing in more research for RES. France, however, abandoned nearly all research or funding of any other forms of energy [69]. Consequently, still in the 2020s, the French power sector has been left in a technological lock-in [19], whereby all infrastructure and policies have subsequently evolved around the dominance of nuclear power.

Today, fifty-six nuclear power plants are responsible for supplying France with over 65% of its electricity. Yet, thirty-two of these power plants are part of these first-generation plants commissioned in the 1980s and have already, or are due to, reach their expected forty-year lifespan in the 2020s. So a new energy strategy is needed to replace them, and national-level decisions about how to prolong or replace certain power stations are still being debated [1].

4.1.2. International Commitments

International influence has played a more prominent role in recent years. To combat the rise of CO_2 emissions throughout the 2000s, the European Union (EU) introduced mandatory renewable energy goals in new strategies to reduce consequences on the climate. In 2015 France was one of the 192 countries to sign the Paris Agreement. The Agreement set a global framework to avoid dangerous climate change by limiting global warming to below 2°C and pursuing efforts to limit it to 1.5°C. By signing, France pledged to reach carbon neutrality by 2050, set intermediate goals to reduce its CO_2 emissions by 40% in 2030 compared to 1990 levels, and comply with carbon budgets [107]. The EU, of which France is a founder, has committed to a 55% reduction in greenhouse gas emissions by 2030 compared to 1990 levels and to become the first climate-neutral continent by 2050. In line with its commitments, the EU established the Renewable Energy Directive (also known as, RED II, as revised in 2018), designing a common framework for promoting energy from renewable sources for member states. This resulted in setting a binding target of 32% for the overall share of energy from renewable sources in the EU's gross final energy consumption in 2030. The signatories of RED II were therefore required to adapt their national policies accordingly. [2]

These international commitments have significantly influenced France's national energy strategy. While nuclear does not emit any CO_2 it can not be considered a RES because its waste could have hazardous environmental consequences if not appropriately managed. So France began to diversify its energy mix in the 1990s and created l'Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME), the French Environment and Energy Management Agency, in 1992, which became the national authority responsible for advising on the deployment of RES and increasing energy efficiency.

4.1.3. European Energy Market

France heavily benefitted from its own market, until 2000 when it was forced to join the common EU electricity market, which had been created in 1996 [111]. The aim was to build an "internal energy market" between European members which increased energy security, flexibility and affordability of power supply. In essence it had several elements [52] [41]:

1. it consisted of merging several national markets operating independently of each other to a single integrated European market,
2. it opened up all energy markets to competition, by allowing consumers to choose their supplier, for producers the freedom to establish energy transmission and distribution networks (i.e. power lines) and for all users the right to access the network under objective, transparent and non-discriminatory conditions.
3. it remained in line with European climate commitments, enforcing national contribution to the decarbonisation of the energy system through a systemic uptake of renewable energy sources.
4. Most recently, the "Clean Energy for all Europeans Package" has updated old energy market rules and introduced new ones, such as reinforcing commitments to increase RES into the energy mix

and introducing new market incentives to encourage public and private investments.

4.1.4. Pandemic Related Energy Crisis

The Covid-19 pandemic outbreak in early 2020 brought industries worldwide to an abrupt standstill resulting in a substantial drop in energy demand. However, this episode was followed by a restart almost as sudden as it stopped, for which energy providers worldwide were unprepared. This resulted in an energy shortage worldwide [54].

In addition to the international energy shortage, in 2021/2022, many of France's first fleet of nuclear power stations that had come to the end of their forty-year lifespan were scheduled for maintenance. However, the lockdowns due to the pandemic delayed much of the servicing scheduled for 2020. This resulted in more nuclear power plants being forced offline than planned at this time and for longer than expected. In early 2022, nuclear energy production met an all-time low with an exceptionally cold period when the demand for heating was high. Unfortunately, wind speeds were also low for the season, and little rain and a lack of installed RES capacity, meant that gas power plants, even coal plants, were reopened, to compensate for the lack of supply. [87]

Finally, the energy crisis of 2022 has highlighted France's lag in deploying RE, which 'could have been spared an energy crisis, if we had kept to the '[renewable energy deployment] plan' according to Jean-François Carenco, the President of the French Energy Regulation Commission (CRE, la Commission de régulation de l'énergie). Ironically, some opinion polls have shown that even though the lagging energy transition is under scrutiny among certain politicians, among the public, the crisis created further scepticism about the perceived intermittency of RES, in particular, wind energy [47].

4.1.5. Geopolitical Tensions

The geopolitical tensions of the Russia-Ukraine war worsened the energy crisis in March 2022. Russia is a large exporter of natural gas and oil to Europe, and these fuel prices increased. The French reliance on these resources and the political will to break all energy and financial reliance on Russia has sparked new conversations about France's ambition to become energy-independent and self-sufficient [116].

4.2. French Energy Regime Analysis

In 2021 the French energy regime, electricity only represented a quarter of the total energy supply, of which 70% was generated by nuclear power. However, the energy regime has gradually transitioned away from fossil fuels by increasing its power sector. For this, it has committed to integrating more renewable energy sources to stay in line with international commitments and in its national roadmap to carbon neutrality by 2050, known as the Stratégie Nationale Bas-Carbone (SNBC). The pressure exerted by landscape developments has caused 'tensions' within the established networks and created opportunities for emerging technologies and new actors.

This section looks at the makeup of the French energy regime, focusing on the power sector. To do so, the different overlaps between actors and networks are observed through an MLP lens, including six core elements; Markets, Infrastructure, Policies, Technology, Knowledge and Culture [66].

4.2.1. Politics and Policies

Ever since the power sector was first nationalised by the State in 1946, it has become increasingly centralised both physically (centred around the locations of nuclear power) and administratively (controlled by the State, top-down). The rise of decentralised power generation, such as RES, since 2000, resulted in a need to restructure French energy policies from national to local levels of administration.

The following section is made up of two parts. The first presents the policy changes that most affected the power sector since 1946. The second part describes the ongoing role and responsibility of the State in the energy sector at each level of governance, from the national down to local levels of administration.

Timeline of Policies

Starting with the most influential French policies on the power sector, this section reveals policy adaptions to technology and social changes since the mid-twentieth century.

Nationalisation of the Power Sector in 1946

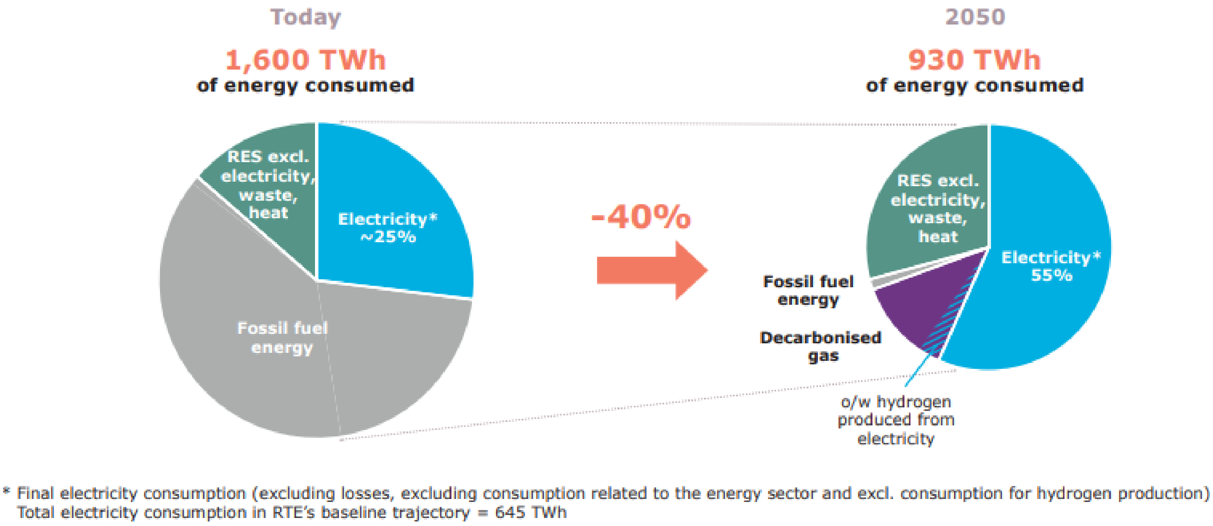


Figure 4.1: Final energy consumption in France in 2021 and under the objectives set in SNBC

Electricity became a commodity to the French population and industry throughout the first half of the 20th century. By the 1940s, over 1300 companies were producing, transporting and supplying electricity at varying prices and unevenly across the country. This meant that the electricity supply was less reliable and more expensive in rural areas [78].

After World War II, France's industry needed to rebuild its industry and economy. In an attempt to gain more control over electricity generation, prices and supply, in April 1946, the State made the decision to nationalise all but a few energy companies under one new company; Electricité de France (EDF) [95]. EDF became the engine of industrial reconstruction and was used to accelerate the electrical network across the country. It took on the development of hydroelectricity by constructing more dams, extending power lines, as well as, building coal-fired power stations. It also became responsible for setting up the French nuclear power program. In 1957 it launched the construction of the first reactor at the Chinon nuclear power plant (70 MW) [1].

Price Equality Law passed in 1957 and updated in 1963

Following the nationalisation of the power sector, there was much debate about setting a fair price on electricity nationwide. The first law regarding geographical equality, known as "péréquation tariffaire", of domestic electricity tariffs, was passed in 1957. This law divided France into three homogeneous zones from a cost perspective and offered equal prices between rural and urban areas within each. In 1963, this law was updated and required the same prices to be offered to all consumers [135]. The law aimed to make electricity access fair and even to all. However, in recent years it has shown to be a hindrance to RES deployment incentives, as discussed in more detail in Section 4.2.6.

Law for the Modernization and Development of the Public Electricity Service, 10 February 2000

Since the power sector's nationalisation in 1946, EDF had been the country's sole energy guarantor. However, France was required to open its sector to competition to comply with new European laws in the early 2000s. So EDF was forced to end its monopoly for supplying industries but not for households [19].

However, the law required opening all production and marketing of electricity to competition. It also considered electricity a commodity and priced it according to "social rates". This law demanded that the main functions of the power sector (namely, generation, transmission and management, and supply) be separated to avoid monopolies [135].

Consequently, the functions that were carried out by EDF were then broken down and shared between new actors. Transmission and grid management was entrusted to Réseau de Transport d'Electricité (RTE), the current French electricity transmission system operators (TSO). Its role included managing energy exchanges between regions and foreign countries and regional distribution to areas of high electricity demand (such as industries). Downstream, the distribution networks became the property of local authorities, which represent 93% of power lines in France [135].

This law also marked the creation of the Energy Regulation Commission (CRE) and the first market protection schemes for RES, including wind energy.

Law of the New Organization of the Electricity 2010

In July 2007, competition in the electricity market expanded from industries and companies to all end-users. Consequently, households were given more choices for their energy supplier [135].

However, this was not without complications because EDF owned more baseload power plants (i.e. high capital, low operational costs), and they could offer more competitive prices than alternative suppliers. Thus, they still dominated much of the market share. So, the European Commission deemed it insufficient to comply with the European electricity market laws and threatened to sanction the French state.

Therefore, in 2010, a new law was implemented to increase competition between suppliers under the 'New organizations of the electricity market law' (known as la Loi NOME in French).

The objectives of the NOME law were to increase competition by allowing alternative suppliers access to established nuclear production units and guarantee fair prices to end consumers.

This law requires EDF to sell a specified amount of their electricity to other suppliers at a regulated price, known as the Regulated Access to Historic Nuclear Electricity tariff (or ARENH). Suppliers could then access baseload electricity from existing nuclear plants priced at the internal transfer cost of the incumbent [111].

Law on Energy Transition for Green Growth (LTECV)

The energy transition law for green growth (LTECV) was enacted on August 17 2015 and is aimed at helping France to contribute more effectively to the fight against climate change. It also aims to strengthen its energy independence and guarantee access to energy at competitive costs.

The law set the first French roadmap to meeting carbon neutrality by 2050. The plans encompass the National Low Carbon Strategy (Stratégie Nationale Bas Carbonne, SNBC), with which the Multi-annual Energy Program (Programme Pluriannuel d'Energie, PPE) must comply.

The PPE set out the pathways that all public energy services must follow. This was the first time all the pillars of energy policy (control of energy demand, renewable energies, security of supply, networks, etc.) and all energy sources were included in the same strategy. Its main objectives with regards to the power sector, were to reduce the nuclear share to 50% of electricity production by 2025 (which has since been pushed back to 2035 by the incumbent government) and to increase the share of renewable energies to 32% of final energy consumption in 2030 and 40% of electricity production [136].

Political Administrative Layers and the Power Sector

The following is a brief overview of the levels of administration in France related to the energy sector from a national scale down to community interactions.

Since the 1990s and again in 2009, the French state has increased its decentralisation of State services to the Regions and Departments. This major reorganization, known as 'territorialisation', aimed to transfer certain powers from the State to the local authorities. As a result, below the national government, the state authorities are made up of three territorial layers of administration: the region, the department and the municipality (or 'commune' in French) [143].

France is one of the countries with the most municipalities, so an inter-municipal level was created to deal with the risk of diverging local public policies. This intermediate level, allows several municipalities to pool the management of certain public services and policies. To do this, Public Establishments for Inter-municipal Cooperation (EPCI) are created, which are public entities without being local authorities [35]. They are administrated by the Mayors of the municipalities involved. EPCI have certain rights, but no more power than that of a municipal Mayor.

The decentralisation process of national powers is incomplete, however. While each was assigned respective responsibilities and the foundations for directly electing a Prefect or Mayor were instated, the relationships between these new levels remained horizontal. This means that these regional, departmental, inter-municipal and municipal representatives share the same amount of power and have different responsibilities for public services. All regulatory power for policy adaptation, even locally, remains with the national government [143].

As with other responsibilities and public services, national climate objectives relating to the energy sector have also been transferred from the national to territorial levels of administration. The following section offers an overview of the responsibilities of each level concerning the energy regime [23].

National Energy Strategy

The energy regime in France, including the power sector, is subjected to the National Low Carbon Strategy (SNBC), which sets out the objectives for France to mitigate global warming. It has set limits for CO_2 emissions in the short-medium term, with “carbon budgets” established for five-year periods up until 2033 [35].

The Multiannual Energy Program (or PPE), is based on the SNBC, and lays out France’s energy strategy with objectives for controlling energy consumption, electricity production and security of supply.

Yet, neither strategies nor the proposed measures to achieve the targets within them are legally binding. This could partly explain why France is already behind on its RES goals.

Regional to Municipal Energy Strategies

The New Territorial Organisation of the Republic law or NOTRe law, enacted in 2015, is the most recently updated territorialisation law that entrusts new powers to the regions and to each local authority. Following the LTECV, where national targets and pathways to energy neutrality were set in the SNBC and the PPE, the NOTRe law made regions responsible for transposing the national policies at the territorial level. For climate-related issues, each region was required to follow a Sustainable Development and Territorial Equality Scheme (SRADDET), which integrates several planning documents with regard to housing, energy management, the development of renewable energies, and policies for reducing climate change.

The national and regional levels set targets for RES development, but the implementation occurs locally at the municipal and inter-municipal levels. The implementation targets are written in Territorial Climate, Air and Energy Plans (PCAET). PCAET was made compulsory for all EPCIs with more than 20,000 inhabitants. However, for smaller intermunicipalities, its implementation is not mandatory, it is strongly recommended by national authorities [35]. The PCAET serves as a reference document for all of the territory’s stakeholders and consists of a carbon footprint of the EPCI, a strategy and quantified objectives to achieve. In practical terms, this involves emission reduction targets for the designated area and specific goals for increasing the share of RES in the local energy mix. Each PCAET must be the subject of a mid-term review and updated every six years.

A simplified representation of the relationships between national, regional and municipal level energy plans can be found in Figure **??**.

4.2.2. Electricity Market

One energy producer and supplier, Electricité de France (EDF), once monopolised the electricity market. Still, since 2000, all functions have been broken up and shared among different actors [111]. These market functions include energy producers and suppliers. In between, there is a wholesale market to balance supply and demand at a national level and a retail market between suppliers and end-users. The French market is also strongly linked to the European Electricity Market [84].

Actors involved in the French Electricity Market

The Energy Regulation Commission

The Energy Regulation Commission (Commission de Régulation de l’Énergie, CRE) is an independent regulator founded in 2000. It is responsible for setting the prices of regulated tariffs for electricity and natural gas on the market, which it defines with the Ministry of the Economy and Finance [111]. The CRE encourages fair competition between competing energy producers by abiding by three main principles:

- Independence: the decisions taken by the CRE must be neutral and objective;
- Impartiality: it must ensure that it does not favour any actors in the energy sector;
- Transparency: As a public body, all of its work is public and freely available to everyone.

Concerning RES, CRE is responsible for defining the rules for energy subsidies such as Feed-in tariffs and organising tenders launched at the national level. At these bids, it is in charge of indicating the energy volumes to be awarded.

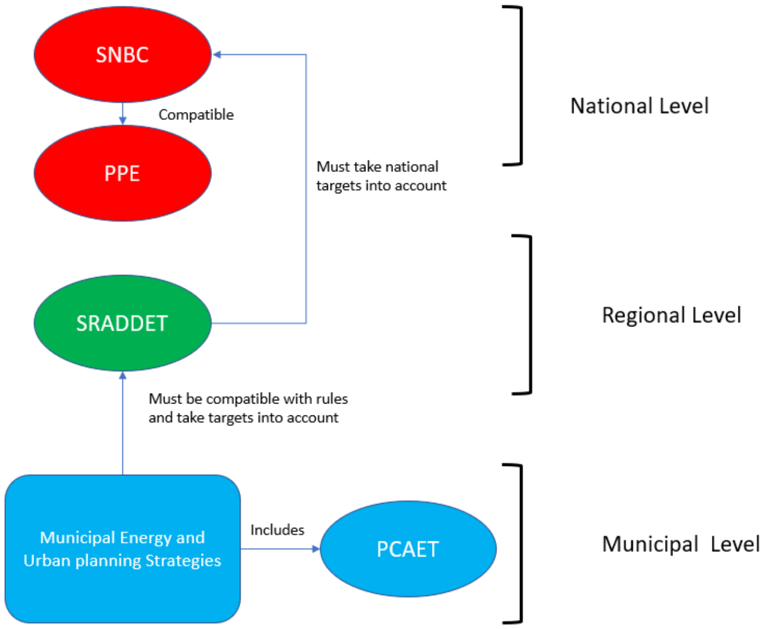


Figure 4.2: Relationships between national Energy Strategies (Own Source)

Electricity Generation

Electricity is generated by energy producers operating power sources. Some are conventional power plants such as nuclear or other fossil fuels (natural gas, coal, ...). Others use renewable energy sources such as hydropower plants, wind turbines and photovoltaic panels. These producers sell "wholesale" electricity to suppliers in France or Europe since the electricity networks are interconnected, and France has been a renowned net electricity exporter.

Although the French generation sector is entirely open to competition, three companies: EDF, Engie (made up of the Compagnie Nationale du Rhône (CNR) and Société Hydraulique du Midi (SHEM)) and Endesa France, generate almost all non-imported electricity.

Electricity Suppliers

EDF is one of the world's oldest providers in the electricity market. It was created in 1946 following the nationalisation and merging of almost all French energy companies. Until 2007, it still supplied 95% of the French population's power. In 2021, EDF was still the main electricity supplier in France, with 75% of the market share. It is also the only provider to offer "regulated sale tariffs" - tariffs set by the State, as opposed to the freely priced energy offers by alternative providers.

Alternative electricity providers are new entrants to the electricity market since the liberalisation law in 2007 and are EDF's competitors. They make offers to compete with the state-regulated electricity tariff and do so by setting their prices based on the demand and supply, optimising their electricity generation when they can, or reducing their profit margins. Currently, according to CRE [111], more than 160 players compete for 25% of the market share in the residential consumer segment. Alternative providers often offer better deals to their customers than the regulated sale tariffs, but the latter is most convenient because it is provided by default. So customers can be deterred from looking for alternative options because of the inconvenience of researching and comparing prices between other providers.

Wholesale Market

The wholesale market ensures the instantaneous balance between electricity supply and demand. In effect, it balances the demand-supply of power in France. On the one hand, electricity is supplied by producers; it is produced predominantly by nuclear power plants, but also by hydropower and some

RES, while some electricity is imported. On the other, the demand for electricity consumed by commercial industries or households in France and any excess energy is exported to other countries connected to the European grid [111].

The electricity generated is traded on the wholesale market which involves three main actors:

- Electricity producers, who trade and sell the output from their power plants;
- Electricity suppliers, who trade and source electricity in order to sell it to end consumers;
- Traders, who purchase to sell (or vice versa), thereby helping to ensure market liquidity;
- Demand side management (or load reduction) operators profit from the energy that is not consumed.

Thus, wholesale electricity is purchased by energy suppliers who resell it to individual end users and industries on the retail market.

Integration of EU Market

The French electricity market is closely linked to the European energy market. According to the EU commission [41], an integrated EU energy market is the cheapest way to supply Europeans with secure and affordable energy. This is achieved by using common energy market rules and cross-border infrastructure. In this way, energy can be produced in one EU country and delivered to consumers in another. The rules ensure users have guaranteed access to electricity at reasonable prices by creating competition within internal national markets and allowing consumers to choose energy suppliers.

France's economy has largely benefited from this market. France has until very recently, been a net electricity exporter, due to its strong energy supply from nuclear power. However, it has often still imported electricity from other European countries during winter when consumption peaks. Figure 4.3 shows France's net energy imports and exports to neighbouring countries in 2021, where it exported 87.1 TWh, whereas it imported 44 TWh during the coldest months [119]

The EU wholesale market follows a marginal pricing system, which allows all participants to get the same price for the energy they produce at a given moment. Electricity producers bid into the market at a price that matches their production costs. RES is always the lowest since there are no generation costs. Electricity is sold from cheapest to the most expensive until demand is satisfied and all producers receive the price of the last producer from which electricity was bought [41].

Retail Market

Ever since July 2007, for both the French electricity and natural gas markets, all consumers (not just industries, as was previously the case) have been free to choose their energy supplier. This change was particularly important to new alternative suppliers, as it allowed them to enter the retail electricity market, alongside the historical incumbents. As a result, in 2022, consumers can still choose between two types of offers:

- market prices, set freely by the suppliers depending on demand and supply;
- regulated sale tariffs, set and regularly updated by the government once a year after conferring with the CRE. These contracts are only offered by incumbent operators (mostly EDF) and, in 2021, still represented 90% of households' electricity contracts.

In France, the NOME 2010 law allows consumers to cancel their contracts and switch to a new price or supplier anytime. It also protects them from incurring any additional costs, or interruption in their supply [111]. This aims to encourage competition between the growing number of suppliers.

4.2.3. French Electricity Infrastructure

The French electricity sector, once completely nationalised by the State under the historical incumbent EDF, has since been liberalised to adhere to European law. Consequently, the four functions of the sector; generation, transmission, distribution and supply are now operated by different actors. The following subsection presents the role and infrastructure used by each of the four sectors.

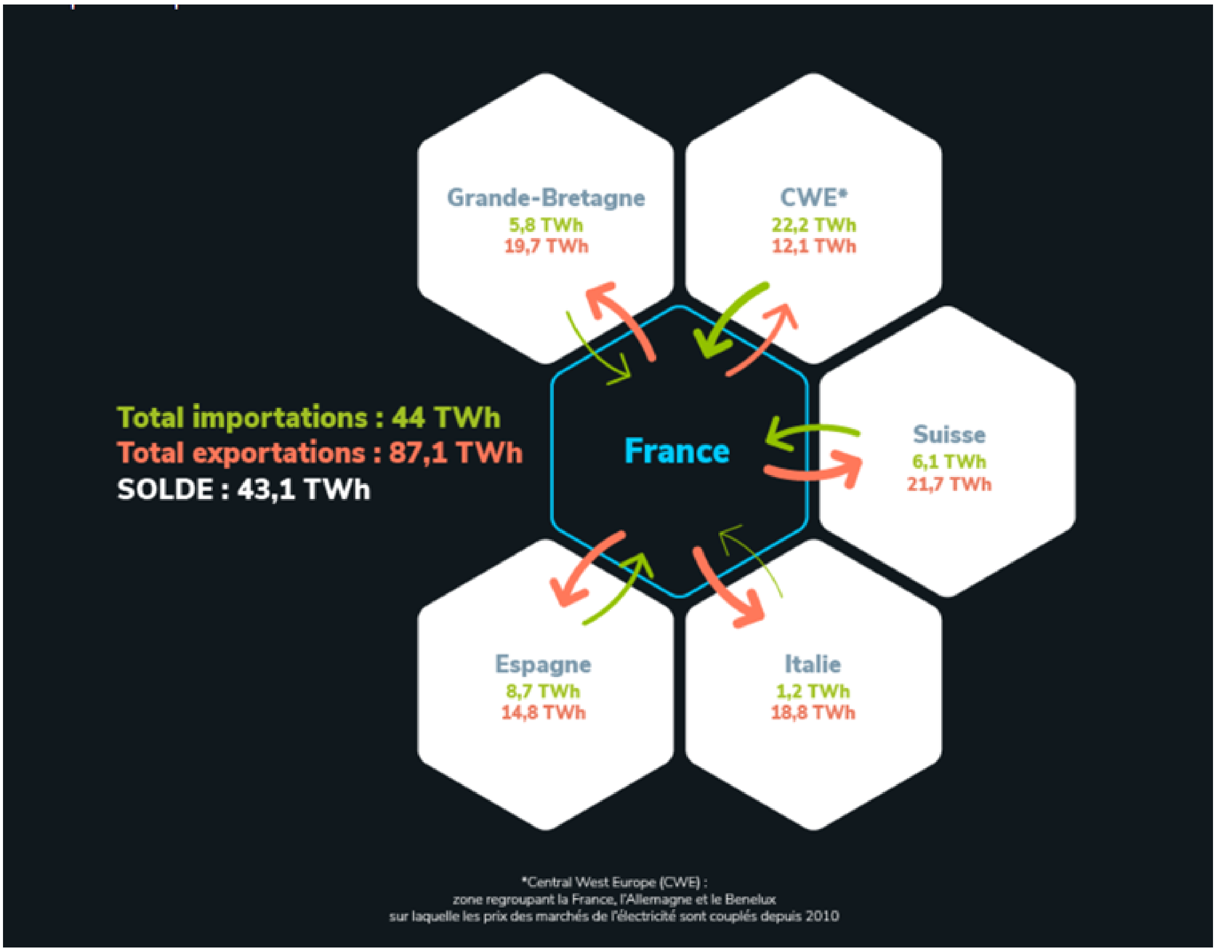


Figure 4.3: Net exports in 2021 by RTE [119]

Generation
The French electricity mix is heavily dominated by nuclear power generation. In 2021, electricity produced in France came predominantly from nuclear (69%), followed by hydropower (12%), fossil fuel (7%), wind (7%), solar (3%) and renewable thermal from waste (2%), as found in Figure 4.4 [118]. As result, generation facilities such as nuclear power stations are few and are most often in remote areas with transmission infrastructure centralised around them.

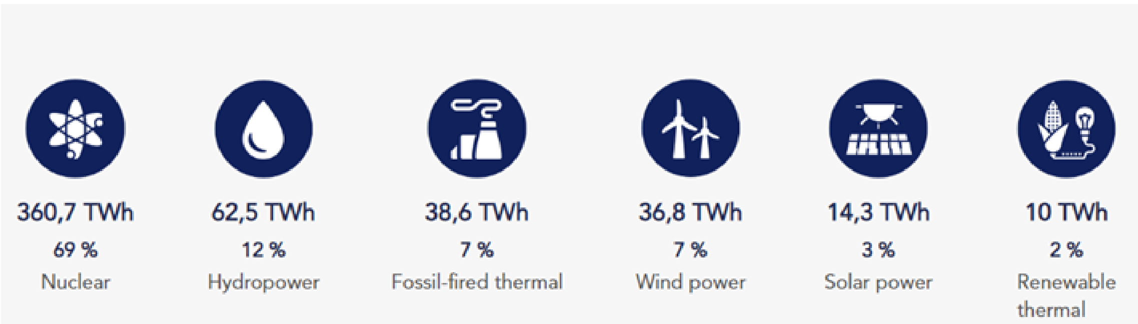


Figure 4.4: Power Generation Mix in 2021 by RTE

For the most part, electricity is produced by large energy companies, but new initiatives are emerging from communities that own RES, such as collective solar panels of wind turbines. They are, however, fewer than in other European countries, as discussed later in Section 4.3.1.

Transmission and Distribution
Transmission and distribution networks carry electricity from production facilities to the end users. The electricity grid infrastructure is laid out in a ”tree-shaped” architecture across the country. It combines overhead power lines, underground cables and transformer stations through which electricity flows at different voltage levels [119].

Three different networks make up the grid :

1. the transmission network carries large quantities of energy over long distances at high voltages at 400 kV or 225 kV. This energy is then used by regional networks or exported to other European networks;
2. regional distribution networks supply the public distribution networks and other large industrial customers at 225 kV, 90 kV and 63 kV. The energy produced by decentralised production units (such as wind or solar) is also connected to the grid at this level;
3. the public distribution networks that operate at 20 kV and 400 V and serve end-users at medium voltage (smaller industrial sites) or low voltage (households).

Transmission and Management
Electricity is difficult to store, thus ensuring the transmission network is based on managing instantaneous balances of supply and demand. This management role is performed by the Transmission System Operator (TSO) and, in France, is carried out by the Réseau de Transport d’Electricité (RTE). RTE owns the transmission grid that links the production sites to the distribution networks on the high-voltage lines. This is the largest network in Europe, with 105,970 km of lines in service in 2021, of which 6,823 km are underground and 99,147 km of overhead power lines. [119]. RTE also manages the interfaces of the networks with neighbouring countries [119].

Distribution
The public distribution networks belong to the municipalities. Some ensure the management of their distribution networks themselves, but most are managed by distribution network operators (DSO), predominantly Enedis.

Enedis, a subsidiary of EDF, is responsible for distributing medium and low-voltage electricity for private and commercial end-users. Enedis manages 95% of the French electricity distribution network. The remaining 5% of distribution systems are owned and operated by the various local distribution companies.

Consumption and Prosumers
End-users such as households receive electricity via the distribution networks at the lowest voltage. However, some end-users, who produce and consume their own electricity, are known as prosumers, who are not included in the wholesale market. Such is the case for households with solar panels, and according to Enedis, there are more than 100,000 homes in this situation and rising.

For most prosumers in France, 20% of the energy they consume comes from the electricity they have generated. The rest of the energy consumed falls under a contract with the electricity supplier, and the surplus produced is sold to the network managed by Enedis. As a reference, consumption by self-owned solar panels represents about 1,44% of total electricity usage in France.

The development of decentralized energy production (wind, photovoltaic, etc.) and new uses (prosumers, electric vehicles as battery storage, etc.) are changing the role of distribution networks, which are now becoming increasingly important to collect the energy produced by the smaller production units as opposed to simply supplying end-users. These profound changes in the energy sector make it necessary to adapt networks and energy regulations related to prosumers and community energy initiatives.

The main actors of France’s energy sector are represented in Figure 4.5.

4.2.4. Technology
This section looks at technological-related factors that are hard-set in the French energy regime today. First, it introduces the current technology used for power production and its limits. Then the options for alternative technologies currently being considered for the future of the energy mix are presented.

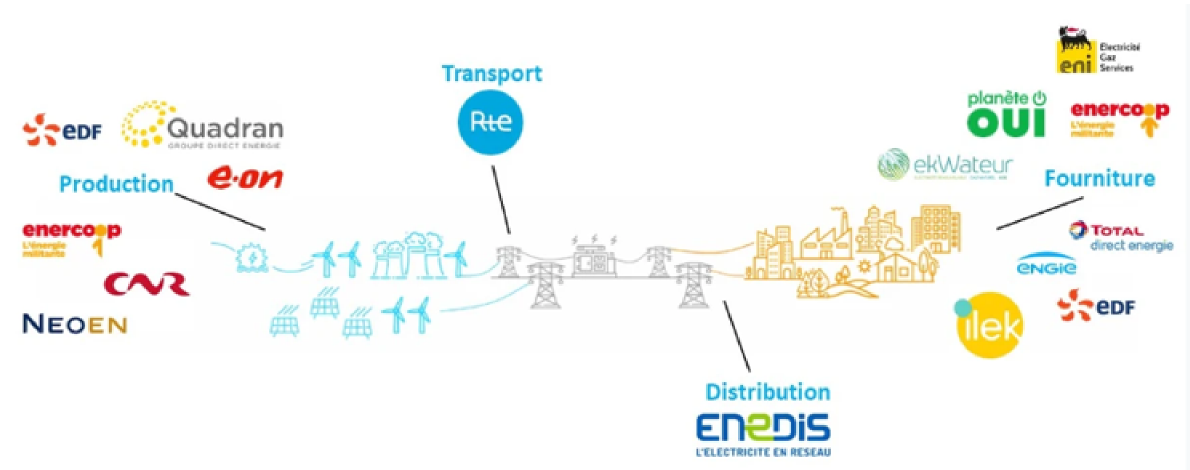


Figure 4.5: Actors of the Electricity Market by Total Energies

Current Technology
Currently, around 60% of the total energy (including electricity) used in France comes from fossil fuels. This can be broken down roughly into petroleum-based products (about 40%), natural gas (about 20%) and coal (less than 1%) according to RTE [82]. For 2020, this came to 930 TWh of final consumption that year, compared with 430 TWh for electricity the same year. However, unlike many other European countries, the French electricity system is predominantly carbon-free thanks to nuclear and hydropower sources, which count for approximately 70% and 12% of the mix, respectively. This has clear advantages for fighting climate change. However, the system's longevity has been overlooked for decades. Ageing nuclear power plants need replacing, and nuclear waste management facilities that are reaching saturation will soon need to be expanded [123].

Future Options
In the short-medium term, two options are being considered. First, to keep the ageing nuclear reactors running beyond their life expectancy because there is not enough time to build new ones. The earliest a new nuclear fleet could be commissioned is 2035 [123] [25]. A second option would be to develop RES massively. In either case, the national energy plan, the PPE, will be readjusted when that plan is revised in 2023. In the meantime, growing geopolitical tensions surrounding the hydrocarbon market are increasing the urgency [119] [25].

However, there is ongoing controversy over onshore wind, leading political leaders to reconsider their energy planning strategy. New plans include massively increasing offshore parks instead because they are considered to have a smaller visual impact on the landscape. In September 2022, France inaugurated its first operational offshore wind park; another 18 GW are in construction and already planned for 2035 **SOURCE FEE???**. Decentralising energy offshore comes with new technological challenges and new infrastructure needs to be considered.

In the longer term, RTE warns that decommissioning of the second-generation nuclear will have to be seriously considered if not to hinder France's economy and industry. Replacing 380-400 TWh of annual production capacity will have to be carefully managed and will require vast changes to the electricity network [119].

Technological Debates
Future energy scenarios have already been drawn up and considered by RTE [119]. Six scenarios presented in Figure 4.6 include variants of "renewable + nuclear" or even "100% renewable" for France's energy mix.

Beyond the social and environmental controversy caused by RES deployment, technical debates are ever-present across all scenarios. While the consequences of a high percentage of RES integration to the grid is still a major topic of research in many countries, France does not have the means to build nuclear reactors at the same rate as it did in the 1980s.

Considering that a third-generation nuclear facility will not be ready until 2035, RTE points out that

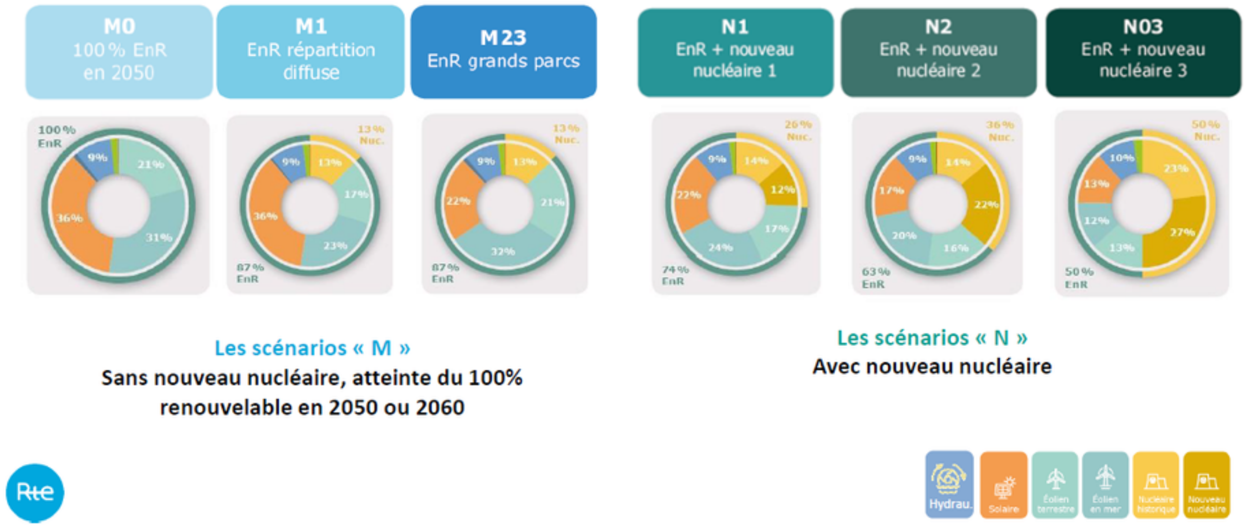


Figure 4.6: Six generation mix scenarios for 2050 by RTE [119]

no matter which scenario is chosen, at least 40 GW of wind power will be necessary to ensure energy security [119].

Technological Updates needed

However, so much intermittent power requires further technical development, especially power flexibility. Such solutions would mean increasing interconnections between France and neighbouring power networks, building further thermal plants (as backup) and increasing demand side management, hydro storage and batteries to manage fluctuations. This implies vast technological adaptations and costs to upgrade the present-day grid.

As for the network, transforming the infrastructure to accommodate more intermittent sources, like wind power, requires a substantial budget. Also, several years to conduct studies and secure construction permits from planning authorities. RTE has already invested in new infrastructure shown in Figure 4.7 to facilitate RES integration, especially in more remote areas for wind and solar energy.

Building new cross-border grid connections would likely be a technical challenge, given the size and lengths of the infrastructure envisioned. Also, a great organisational challenge because of the increased number of stakeholders involved. Stakeholders would be numerous on both sides of the border and have varying backgrounds (local authorities, industrial sector, energy producers, associations...) [16].

Concerns with Technological Transitioning

France's unexpectedly fast deployment of nuclear energy in the 1970s resulted in considerable overcapacity, which led EDF to campaign for electric domestic heating. Consequently, up to 70% of newly built homes were equipped with electric heating in France between the 1970s and 1990s. Even in current circumstances, the French grid still faces the greatest seasonal changes in power consumption than any other European country [128].

This justifies the rising concern, about the vulnerability the French grid could have to weather patterns if more RES is deployed. Most notably during cold spells, since much of residential heating in France is electric, for every 1°C drop in temperature, 2,4 GW nationwide more are needed for heating. Thus, the colder it gets and the more RES is used, the more the grid would depend on wind and other less controllable sources [119].

Promising technological solutions by incumbents

RTE invests 60 M€ annually to develop power-system software that increases automated power flexibility solutions. These investments have given rise to innovative projects such as RINGO, a smart

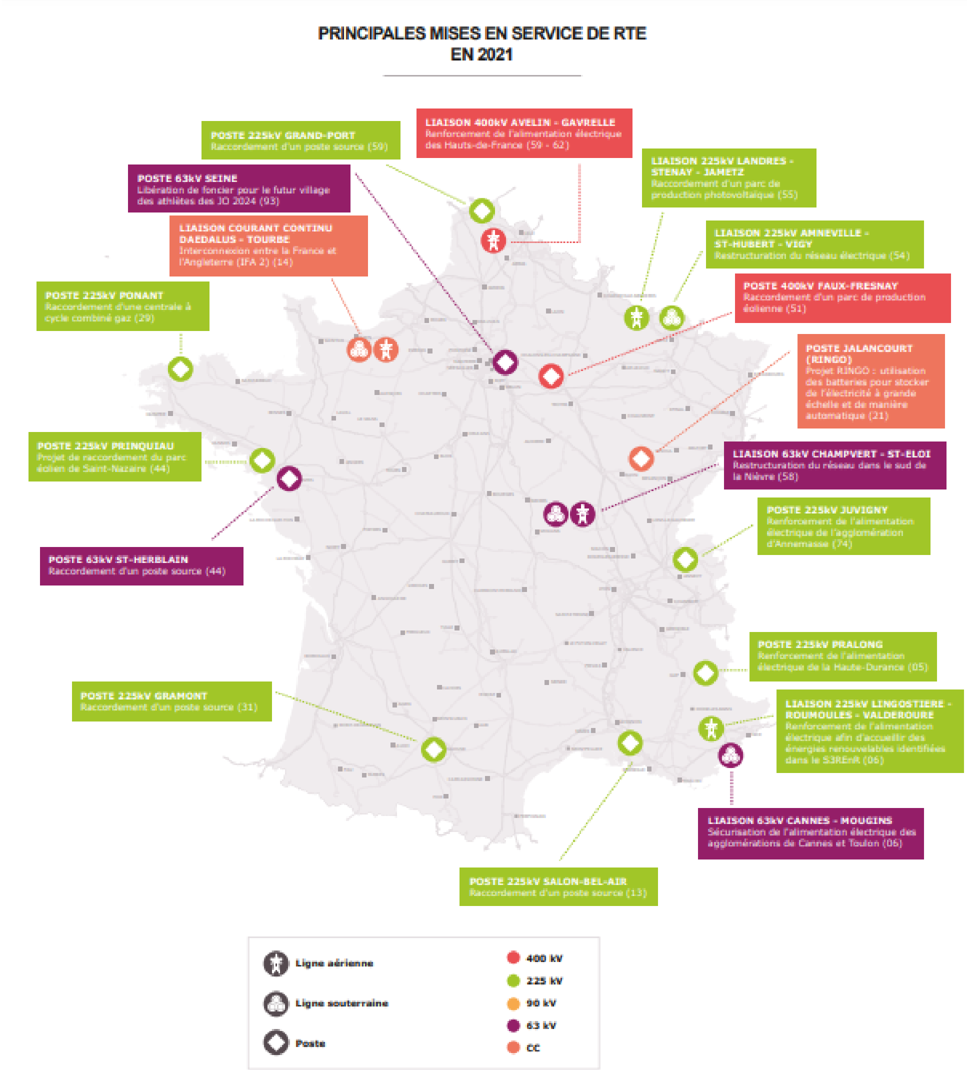


Figure 4.7: Recent Network developments made by RTE in 2021 for integrating RES by FEE [51]

system which controls remotely, automatically and simultaneously the batteries and the power converters connected to its network. It aims to efficiently use all the renewable electricity produced [51].

Enedis is also preparing to transform its networks to integrate more RES. It is already undergoing many changes by becoming bidirectional, digital and decentralised. These changes come at a high cost if the path to fully power the grid with RES is chosen. Concretely, these technological transformations relate to [51]:

1. Finding means to speed up connection times.
2. Investing in renewing the network.
3. Developing "Express Source Substations" to act at substations for decentralised energy sources.
4. Implementing local flexibility options to integrate more renewable energies
5. Adapting the size of existing substations to facilitate the integration of RES.

In 2021, 90% of French homes had installed Enedis' smart meters called Linky, . It communicates automatically with the DSO and informs users of real-time energy consumption and the peak and low hours. This helps them manage their consumption with informed choices guided by price signals [45] [31]. The new smart meter was made mandatory by the LTECV law in 2015 to encourage the population to become more aware of their energy consumption and aid the integration of RES. This is especially helpful to solar panel owners, who have the added benefit of using high energy-demanding devices when panels are generating the most to minimise energy costs.

4.2.5. Knowledge and Science

This subsection addresses the key aspects of research and development and the diffusion of knowledge about electricity systems within the evolving energy regime.

Research and Development

The two principal grid operators, RTE (the TSO) and Enedis (the main DSO) recognise that the current energy regime in France is unsustainable and has been investing large sums into research and development to support the energy transition. For instance, between 2021-2024, they allocated, 60M€ out of 90M€ and 130M€ out of 227M€ of their respective annual budget towards research and development, specifically targeting challenging areas of the transition [82].

Both these organisations are involved in ambitious long-term research projects and building more partnerships with regional stakeholders and a variety of other actors (from industries, SMEs-SMIs, start-ups, universities and laboratories) to collaborate in building the electricity network of the future [106].

According to RTE [119], the four necessary additions and changes for a future power grid are:

- Using mature technological solutions that can maintain the stability of the power system without relying on conventional generation.
- Deploying large-scale deployment flexibility options needed to offset variability.
- Improving means to control and develop reserves to guarantee stability.
- Upgrading of national electric grids by reconfiguring transmission and distribution networks.

All of which require substantial and sustained research and development.

France has several research and development centres specialising in developing onshore and offshore wind technologies, as well as any related grid integration technologies.

Retraining for New Skills

RTE anticipates the future through (re-)training its workforce. For the TSO, including more intermittent energy sources means changing technologies and the skills of their workforce. Much of their research and development capital is spent on developing digital solutions to increase grid flexibility and training current employees to adapt their skills ahead of the technological shift [106].

This has resulted in two main courses of action. First, delivering the means to train present employees with new skills. Second, tightening connections with the academic world to highlight values required in jobs linked to the energy transition. Third, they contribute to educational institutions by helping design more appropriate skill sets to be taught in technical and engineering diplomas.

Other institutions are also preparing future employees for job shifts in the energy sector. Céreq is a public institution aiming to create better links between education, training, work and employment across many fields. In preparation for the energy transition, it is already evaluating two employment consequences: 1) new job openings and the need for more qualified workers 2), it identifies the gradual shift of competencies needed in existing jobs and which sectors are more likely to need retraining to sustain the energy transition successfully.

4.2.6. Barriers for Wind Energy in France

The regime presents several barriers to wind energy diffusion in its current structure. This short subsection summarises the main barriers observed in the MLP analysis at the national level.

Political barriers

The following briefly overviews wind energy's political barriers in the current regime.

- **Complex regulatory framework**
  The regulatory framework is too lengthy and complex, taking French projects years longer than in neighbouring countries before becoming operational. According to FEE (the national French wind association) [51] it needs to be simplified to increase the deployment of wind turbines. Installed wind capacity will have to increase by 140% by 2028 compared to 2019 to meet national targets.
- **Strong political attachment to nuclear energy**
  Many French politicians still argue that France already has a competitive and low-carbon power system, through its centralised nuclear energy program. France is a world leader in nuclear

technology, and the State and much of the population commemorate the technology for providing the cheapest electricity in Europe [109]. Thus there has not been the same urgency to act as in other countries. Therefore, policies to support RES, such as wind energy, are slow to be introduced as are policies supporting alternative energy structures, such as citizen-led energy projects. [144].

- **Lack of Political legitimacy to RES**
  As argued by Nadaï and Labussière [86], it seems that the French government's position on the energy transition depends critically on the political party in power and its ability to win parliamentary battles. A left-wing government initiated the first wind energy support scheme, with a Feed-in-Tariff. However, many regulatory constraints were put on wind turbine development between 2005 and 2012 when a right-wing government was elected and showed little interest in the energy transition. In 2012, the government changed back to a left majority and proposed new laws to support wind energy. Major commitments to the energy transition finally occurred after the EU in global climate negotiations, as France was required to define a minimum target of 27% in the energy mix by 2030 with the UE Third-Climate Energy package[57]. However, the frequent changes had already concerned investors about the future stability of the French wind industry.

  The government's goal to phase out nuclear energy, as in the Paris climate agreement, is still unclear. While the government had promised to reduce the nuclear share in the energy mix by 2030, energy shortages in 2022 are causing the current President to reconsider. *'It is impossible to replace all our nuclear power with renewables'* Président Macron declared during his presidential campaign, at the same time as promoting his will to build six new nuclear power plant models known as Evolutionary Power Reactors by 2035. [27]

  Furthermore, the current political climate has been particularly tough on the wind energy sector. Policies for the climate were almost entirely overlooked by many candidates in the presidential elections in 2022. However, nearly all candidates positioned themselves in favour or against more wind turbine deployment, as a point in their campaigns to gain more votes [98]. The standoff between the last two candidates, Le Pen and Macron, was anti-onshore wind energy. The former promised to 'remove all existing wind turbines' if she were elected, and the latter claimed he would push the wind energy objectives for 2030 back to 2050 and prioritise solar and offshore wind development instead because 'they integrate into the landscape better' [34]. This lack of political legitimacy of renewable energy is evident on many national media platforms and is relayed to the population, which feeds a strong opposition to wind power [144].

  Furthermore, since his re-election, Macron's incumbent government has shown interest in reducing national CO_2 emissions. According to La Vie Publique [1] [61], their energy transition priorities lie in three pathways:

  1. Promoting the energy-saving renovation of buildings
  2. Developing clean transportation and setting the national objective of becoming the world leader in green hydrogen
  3. Promoting the development of a circular economy and of renewable energy, but with no mention of onshore wind energy

- **Policies focussed on centralised energy**

  Energy production has been centralised for so long that new models, such as community energy projects, have very limited scope for action and can only offer people the possibility of investing money. Alternative rewards schemes such as collective self-consumption, or reducing electricity bills for residents who live near a wind turbine or infrastructure (pooled storage) available elsewhere are forbidden in France [125] because of the price equality law (péréquation tarifaire) for electricity, presented in Section 4.2.1. Yet, such schemes could help increase the tangibility of their energy ownership and contribution to taking climate action. This is considered a barrier to diversifying the forms of RES projects [125] [141]

- **Unstable policies**

  France has seen many policy changes since the first wind support scheme « Éole 2005 », in 1996. The first scheme was a purchase obligation with a fixed subsidy. However, it proved unsuccessful

[1] La Vie-Publique is a government-run information site dedicated to public policies.

for several reasons, but primarily due to the top-down approach adopted by the State to support the technology deployment without consent at the local level. Problematic changes included the creation of Zones for Wind Turbine Development (or ZDE in French) in 2010, which intended to appease views of anti-wind movements with the need to develop wind energy. However, it proved detrimental to the industry and policy adjustments conciliating developers, and anti-wind protesters have been made almost yearly since [132] [131].

Consequently, the instability of the policy system has also led to the loss and delay of numerous projects. Moreover, the complexity of administrative procedures for building permits and grid connections is another source of delays, culminating in up to eight years to develop a wind power project in France, compared to three years in Germany. These additional delays and complexities result in an unwillingness for many banks to invest and thus constitute a significant barrier for projects developed by small actors and CREPs who rely on their financial support to exist [37].

- **Height constraints**

  Regulatory constraints concerning height restrictions from aviation, prohibited areas surrounding military radars, and tighter biodiversity checks are harmful to deploying wind turbines. In 2020, the unit power of wind turbines installed in France was one of the lowest in Europe at 2.7 MW compared with the 3.3 MW average. This is despite having installed the highest number of turbines standing at 477, as illustrated in Figure4.8 below. This lack of efficiency is symptomatic of the height restrictions experienced by the industry since larger turbines are more powerful and could reduce the cost of wind power in the country [51].

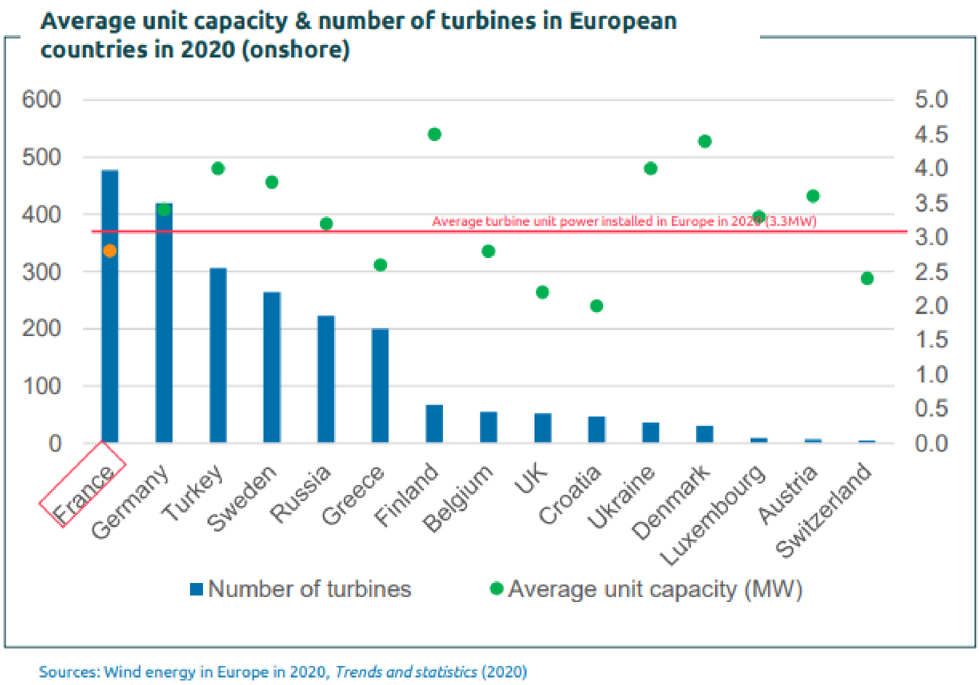


Figure 4.8: Unit capacity Installed per country by FEE [51]

Infrastructure related barriers

Infrastructure requires better preparation to accommodate more decentralised and intermittent energy sources. This includes building new substations, deploying more decentralised 'Express Source Substations' in more remote areas, and adapting existing substations to accommodate more intermittent sources.

Grid connection is an essential barrier to most projects, especially new entrants such as community-led renewable energy projects (CREPs) in France. The cost of a grid connection can vary between 1000 € and several 10 000 €. Even if a project makes sense locally, the cost of grid connection can be the most significant barrier in many rural areas. This comes down to its historical design around large centralised power plants that generate power to be transported unilaterally towards remote rural areas, not the reverse. Thus, leaders must pay for grid reinforcement when a new RES is connected to the grid [96].

Developers and CREPs are entirely dependent on the will of the grid operators. Operators are not bound by legal obligations regarding the deadlines for grid connection, which sometimes results in significant delays and unpredictable high costs. This is a limiting factor for any project with a fixed budget [96].

Culture: Social acceptance

Social acceptance is largely recognised as a barrier to wind development in France. This section describes some of the reasons for its inacceptability.

Early bad experiences with developers

Since the introduction of wind energy to France in the late 1990s, it has been a controversial topic. Social resistance has been fuelled by bad experiences with developers taking an industrial approach to wind farm development. These experiences include hiding information, unforeseen consequences (e.g. not fully dismantling the turbines after decommissioning the park), and interactions between developers and landowners without consulting local inhabitants or the community representative's approval. Owing to their head start on the French industry, foreign companies would also choose to develop in France and to use resources and workforce from abroad instead of contributing to the French economy, and employment [89] [15].

As early as the 2000s, developers were met with severe resistance from well-organised anti-wind associations [33]. Legal challenges between residents and large developers have been frequent and seem to have left hard feelings towards each other ever since. Stricter regulations to obtain higher levels of consent, such as increasing distances from residents, have had little effect [131].

Place attachment, identity and natural heritage

France is the top tourist destination worldwide owing to its location and varied landscapes. Culturally, the nation also has a powerful attachment to its unchanged heritage [48]. In this context, the appearance of new decentralised energy infrastructure on the natural landscape frequently triggers "Nimby-type" reactions. Resistance to wind turbines is often a reflection of their large size and conspicuous demeanour, which is considered by many as an eye-sore and a threat to tourism and their long-lasting heritage [146].

The PPE energy plan may be national in scope, but always locally implemented, and planned in agreement with the different actors involved. Currently, the energy system is highly centralised and concentrated in relatively few areas with nuclear, hydro and some thermal plants. All the incumbent technologies and their infrastructure has been around for decades and, with time, have been socially accepted. Depending on the chosen scenarios, wind turbines could account for anywhere between 14 000 to 35 000 turbines, which would take up considerably more land and consequently be more visible in the landscape [119]. This has sparked new debates about the artificialization of land for the use of RES.

Hierchical society - Expectations of top-down responsibility

Many successful examples of RES deployment abroad have emerged from community energy ownership. However, such independent thinking is not innate in France, and there is a high expectation of top-down responsibility of government for commodities such as energy [109] [143]. In particular, the energy sector has been centralised for so long, people struggle to visualise what a more democratic energy system could be [125].

No common goal

While many countries are transitioning to RES to reduce CO_2 emissions, that argument is less justified in France, since their electricity mix is already highly decarbonised thanks to nuclear. It is thus harder to convince the French politicians or the public that there is an urgent need to contribute to fighting climate change, since RES would only be replacing an already low-carbon source of electricity. In that sense, it is also more difficult to unite communities to create CREPs around a common goal, because they do not believe in the benefits. "*French consumer, even if he has pinned to his body the* *conviction that it is necessary to fight against climate change, thinks that after all, it will be some time before France strongly contributes to* CO_2 *emissions*” [125]

Cultural paradox

There appears to be a ”paradox” about wind energy in the French population. On the one hand, surveys by France Energie Eolienne [51] regularly show that 70% of people think positively of wind turbines. Yet, there is strong opposition locally where nearly 70% of projects are subject to court appeals [64]. The same is found in the development of community energy projects. A recent survey found that 75% of French consumers are interested in buying electricity directly from local producers and that half of the French population is interested in investing in renewable energy communities. French citizens are highly supportive of their ’localism’, yet, this trend is not reflected in a willingness to participate in or support CREPs. [100]

Technology

Wind energy faces technical barriers owing to limited infrastructure and its effort to reconcile performance optimisation with suitability to varied environmental factors.

Owing to technological maturity, the wind turbine has reached its performance limits and any scope to reduce visual and noise hindrances is limited. Nonetheless, more attention is being paid to designing the blade acoustics in the manufacturing phase to reduce noise. Other adaptations include blade clamping in certain conditions to mitigate ”shadow flashing” and blade whistling in some wind directions. However, these technological adaptations all come with a cost to technological productivity and reduce its price competitiveness [51].

Institutional

Some financial institutions put in place by the State are available to incumbent wind developers. This is not the case for all types of new market entrants, which affects RES projects involving communities.

It is widely acknowledged by researchers, including Sebi [125], Vernay [141] and Wokuri [145] that French CREPs face difficulties raising sufficient capital, especially for the early high-risk costs in the pre-planning stage. There are too few established institutions for guidance, so many are managed by volunteers, which comes with organisational problems. French CREPs are not yet recognised as energy actors, so most banks consider their projects too complex and risky. Combined with regular policy changes, they usually develop small projects eligible for the simplest subsidy schemes, because larger projects, such as wind energy, are too costly and competing for subsidies is too complex.

Market

The French energy market has created specific protection schemes for wind energy, detailed in Section 4.3.2. Nonetheless, there are several drawbacks.

The main market shielding mechanisms for RES are FIT (with purchase obligations) for smaller and FIP (tendering procedures) for larger projects, such as wind turbines.

Policymakers and researchers acknowledge that the FIP scheme has successfully increased wind energy’s cost-effectiveness. Yet, it is recognised for being complex and highly competitive by project managers and has other downsides: 1) under-subscribed auctions and 2) the creation of ’chaotic clusters’ of parks in the windiest and most profitable areas resulting in an uneven distribution across the country [125].

There is also a growing concern that wind energy is under pressure by the MTE to become too competitive, too quickly, and subsidies are gradually being phased out [44]. If so, it risks making projects unprofitable to their owners and could discourage future investors.

In addition, new market entrants such as CREP rely on the same national support schemes as other RES projects. CREPs in France have been predominantly small solar clusters thanks to the simplicity of the support offered to smaller projects via FITs and facilitated grid connection procedures which enable citizens to do so autonomously.

To build a wind project, CREPs must compete with project developers for FIPs. This is risky because developers have more experience with such procedures. Moreover, tenders favour cheaper projects, which are more frequent in regions with abundant biophysical resources (e.g. wind and solar radiation), which are not always available to all communities. Therefore, FIPs are a daunting process and discourage citizens from initiating them. This partly explains why community-led wind energy initiatives are still struggling to take off [96]. French policymakers are still designing a strategy to have more collective prosumers in the energy sector and CREPs niche.

4.3. Niche: Onshore Wind Energy in France

Compared to the regime, the niche level has fewer interdependencies and is, therefore, less rigid. It is designed to be sheltered from the regime and landscape dynamics to enable it to learn, mature and co-evolve until it is ready to scale up. This section presents the various enablers for the onshore wind energy found in the regime analysis. As described in the introduction in Chapter 1 of this report, there are several directions for onshore wind energy in France. Developing companies lead most, and citizen-led community energy projects have a less established approach. A third form is to include citizens in developers' projects.

This section begins by outlining the different forms of ownership onshore wind energy projects can take. Then it describes the enablers of the niche using the six regime elements from Sections 4.1 and 4.2. Finally, the wind energy niche analysis closes with an SNM breakdown of different networks of actors, learning aspects and future visions.

4.3.1. Forms of Wind Energy Project Ownership

From the literature research above, community energy ownership is the most frequently cited answer to social resistance. Beyond resolving the political and technical constraints faced by wind developers, it seems that social acceptance is proving one of the most challenging to overcome. For this, other research and experience from other countries, such as Germany and Denmark, have shown that community involvement is the recommended way of increasing local acceptance of wind energy.

This subsection investigates the various forms available for wind energy deployment in France. It begins by presenting the situation of community-led renewable energy projects and follows with a description of the different options possible for community involvement in developers-led projects.

Community-led Renewable Energy Projects

Community Renewable Energy Projects (CREPs) are becoming an increasingly common approach to overcoming social resistance to wind energy. Although this niche is still small, community and crowdfunding projects in France seem to be emerging. This is most often the result of growing resistance to the centralised nuclear energy strategy in place and a will to promote "French localism" [125]. CREPs are nonetheless far scarcer in France than in other European countries. In Germany, citizen projects represent 40% of renewable electrical power whereas, in France, it is only around 1%, but rising [53].

In France, CREPs follow one of two governance structures. The first grants voting rights to each of their investors independently of their capital investment and is based on the principle of equality; "one member, one vote" for running the project. The second offers members legal and/or financial responsibilities proportional to their financial input. These communities are driven mainly by citizens, often activists looking for alternatives to the centralised nuclear regime.

Smaller projects have access easier access to bank loans and citizen investments, regional grants and subsidies to help finance the feasibility studies. This is partly because support schemes such as FITs have a straightforward application and present lower risks and upfront costs for investors than for larger projects. The added complexity of answering tenders for FIPs for wind projects often requires external support from partners from the industry. This is a barrier for many communities that would rather operate as autonomously as possible.

Consequently, most CREPs develop solar rooftop power plants (76%), whereas wind power plants represent 16% of all CREPs. However, owing to their greater size, in terms of total installed capacity, wind plants still represent the majority (64% of total installed capacity of French CRE), followed by solar, which accounts for 22% [88].

According to EPA's database, 381.65 MW of installed wind capacity, compared to 164.23 MW for solar, is considered community owned [88]. This figure does not include partnerships with developers, which are difficult to estimate. However, in the latest tenders published by the CRE, over 50% of the accepted project bids included the 'citizen participation' bonus.

There are two main strategies for building and financing CREPs. First, citizen-led projects revolve around the support of Energie Partagée (EPA) and Centrales Villageoise (the latter is reserved for smaller projects, eligible for FITs). EPA is an NGO that promotes citizen-led CREPs by providing financial and technical support throughout the project. To do so, it uses a fund partly financed by the State and mostly by other citizen investors all over France that wish to invest in community energy. They offer investors a 4-5% return on investment. Second, is a joint partnership with developers, which is detailed next.

Company owned: Developer-led and possibilities for community participation

Wind developers scout for prospective wind farm sites, which, more often than not, are home to communities. They must ask for permission from the locally elected officials (Mayors and eventually Prefect) to conduct feasibility studies, among others, before applying for permission to construct. This process occurs in an area considered a shared resource between the community residents and the developer. Most often, this leads to a conflict of interest between the two, because of the communities' attachment to the landscape and the developers seeking to make as much profit as possible by building a substantial wind park in its place.

For this reason, developers have noticed the importance of involving citizens in their projects to reduce opposition and consequential court rulings. Citizen participation can come in several forms. The most basic form is community participation in approving the developer's project plan, but they have no more involvement once the project construction has begun. Another alternative is to develop a partnership with a developer.

There are two possibilities for partnerships with a developer: crowdfunding ('participatif' in French) and joint ownership ('co-actionariat' in French). A recap of the advantages and inconveniences of each are presented in Figure 4.9

Crowdfunding, is a more straightforward process referring to projects whereby citizens and local authorities contribute financially in debt or capital. It is a short-term investment which lasts three to five years, where participants can invest as little or as much as they wish, but contributions are capped at 10 000 euros per investor. The investors carry financial risks and have no say in project design or operation. Initiatives like this are done via crowdfunding platforms (such as Enerfip).

Joint ownership refers to a more complex partnership which involves creating a joint-owned company between the developer and local investors. This includes significant financial contribution and involvement in running and managing the wind farm for its duration. EPA offers support to joint-ownership projects via their subsidiary EnRCit. The latter is a foundation *granted 10 million euros by Caisse des Dépôts, Ircantec and Crédit Coopératif and* that aims to finance 150 projects over ten years. This scheme carries the community's share of the risk in the development stage of a project. If the project is successful, EnerCit then sells its shares to local investors once it receives its construction permit. Thus, the main advantages of this setup are that the communities do not carry any risks and still share the power of designing the project. In addition, since communities own a higher share of the project, the financial returns are greater. The joint ownership lasts for the project's lifespan unless they sell it earlier [144].

Local companies known as "sociétés d'économie mixte" (SEM) are often included to raise enough capital for larger projects. They are a public–private partnership with majority public involvement (usually 51% to 85% of the capital). The SEM model stems from communities and is considered a local actor so that they can contribute to the community's share in a joint partnership with developers [125].

Nonetheless, joint ownerships can also be seen as a double-edged sword. At first glance, the advantages appear numerous for both developers and local communities. For the communities, co-governance grants locals rights to participate in the planning and running of the wind farm and greater financial returns to the municipality. For the developer, their project tends to gain greater social acceptance, which mitigates enormous costs due to the legal hurdles from local opposition. They also receive participation bonus points from the CRE when submitting their bid for a FIP. However, building joint ownership is much more time-consuming and administratively heavy for developers. Even with the support from the NGOs, as mentioned earlier, municipalities often struggle to raise the funds to significantly contribute to the investment, which can cause tensions in return on investment levels [144].

More coordination is needed between the existing actors for more community inclusion, such as building CREPs or forming joint partnerships with companies. Many researchers [125] [29] suggest that networks and intermediary organisations also play an important role by facilitating knowledge exchange

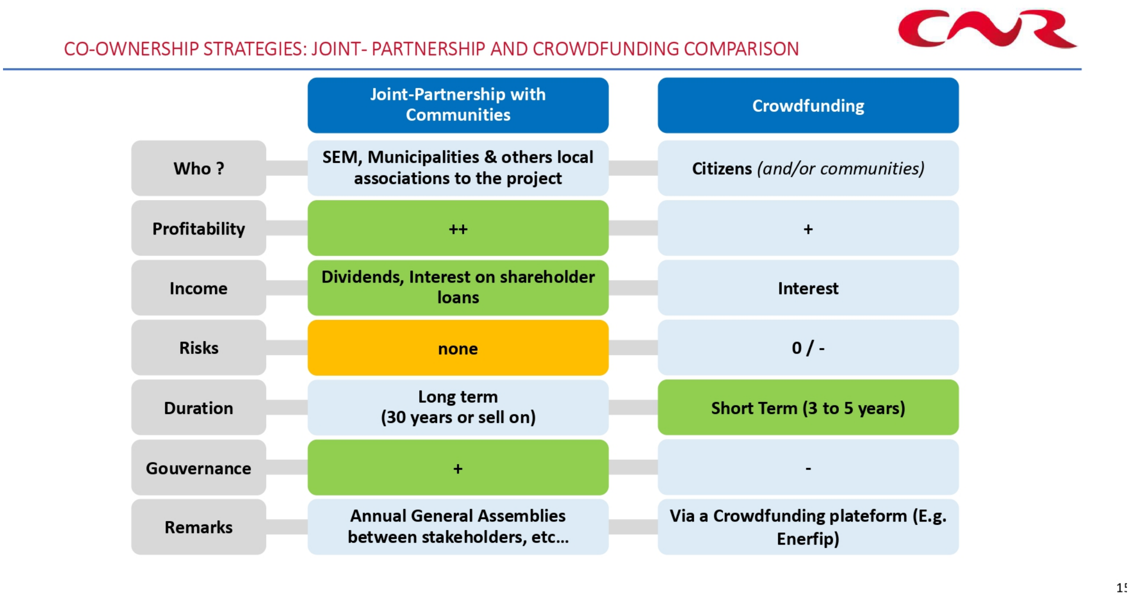


Figure 4.9: Comparison between Wind Energy Partnerships (Own source adapted from CNR shared documents) [39]

and sharing best practices or providing tools or ready-made documents. However, in France, only one organisation, EPA, can offer these services for larger-scale CREPS. At the national level, EPA offers advice, and online tools and organises training and networking events. The advantages of having all resources in one place are that they are relatively easy to find. However, this one-player option raises some concerns about the long-term viability of the structure. This reduces the community energy ecosystem diversity, which in turn could reduce its resilience to changes. The current ecosystem is centred around the support that EPA provides and national RES funding schemes. Consequently, it is very vulnerable to policy changes in the future and may find it challenging to find alternative ways to expand its business model autonomously [125].

4.3.2. Enablers for Wind Energy in France

The onshore wind energy niche has many enablers available. Having discussed the barriers earlier in Section 4.2, the same MLP elements are used for analysing the niche enablers.

Political enablers

The Multiannual Energy Programme (PPE), which set out the pathways for the energy transition in France, included ambitious objectives for the wind power sector until 2028 at which point targets will be reviewed and refined towards pathways for energy neutrality by 2050 [51].

At present, targets for onshore wind power, state that the installed capacity should reach 24.6 GW by the end of 2023, and 33.2 GW as a low option, to 34.7 GW for a high option by 2028 in France. However, France will need to install 2,000 MW per year to reach its PPE objective of 34 GW of cumulative capacity by 2028.

The urgent need to speed up the processing of appeals, an essential request made by the wind power industry, has been heard. The MTE has announced two measures which should save an average of two years on the project lead time. These changes are [51]:

- 1) Reducing the jurisdiction appeals to a one-step process by combining the national two-step jurisdiction process into one specifically for wind turbine-related appeals.

- 2) Making all legal resources must be presented within two months

The current energy crisis is a catalyst for change. Until now, the main motives for supporting an energy transition were to combat climate change, whereas now, gaining independence from fossil fuel is being considered a matter of sovereignty [106].

Market enablers

By the end of 2021, 18 783 MW of onshore wind were installed in France, which is 4th highest capacity installed in Europe. The same year, onshore wind generated 36,8 TWh of energy, which made up 7,8% of the national electricity consumption that year [119]. The relative share of onshore wind in national electricity consumption is expected to increase to 10 - 15% over the next 15 years [51].

France still has a lot of untapped potential, according to the national wind association France Energie Eolienne [51], it has the second largest wind source in Europe, and the sector offers significant economic and industrial opportunities. However, the niche still relies on market shielding mechanisms for its profitability. In France, protective pricing policies began with a ”purchase obligation agreement” in 1996 which was replaced with a combination of Feed-in Premium and the ”Open Window” mechanisms. All are presented in more detail below.

Feed-In Tariff

In 1996 France launched its first niche protection scheme, the French wind program « Éole 2005». It was based on a similar Feed-in tariff (FIT) scheme seen in some federal states in Germany [132].

To increase wind energy deployment in France, the first purchase obligation agreement was introduced in 2000 by the French state. This first act guaranteed a fixed feed-in tariff (FIT) for wind turbine electricity at a higher price than the electricity market for 15 years [132].

It lasted 20 years, during which several policy reforms were made about developing wind projects, leading to rising uncertainty among investors. Thus, to comply with European regulations and offer more stability to investors in larger RES projects, including most wind parks, the purchase obligation was replaced with a new pricing mechanism in 2017, Feed-In Premiums [132].

Feed-In Premium

Following EU guidelines, in 2017, the French government introduced a feed-in premium mechanism to support the development of larger renewable power plants that exceed the capacity threshold to be eligible for FIT. These projects are required to make bids at the tendering process launched by the French Energy Regulator, CRE, which selects projects based on the purchase price and project capacity [132].

The main conditions to participate in this tender are [132]:

1. Wind farms with more than six wind turbines.
2. Wind farms with wind turbines’ capacities of more than 3 MW.

To partly remedy the problem, CRE created alternative ways for making projects profitable in less beneficial conditions.

The first solution is the ’bonus points’ system, whereby some less competitive projects can earn extra points to boost their bid. For now, only citizen participation counts towards earning bonus points [111]. The latest calls for tenders (or ”Appels d’offre”) offer two ways of obtaining these bonuses via community participation :

- 1) shared ownership of the project with 33 to 50% of decision-making rights and equity,
- 2) crowdfunding, where public investment represents at least 10% of project capital. Crowdfunding gives two bonus points, and participatory governance five bonus points. For reference, the bid price represents up to 95 points (out of 100). [25]

The tendering process uses the ratio between bonus points received and the final price bid to give an overall score.

The second solution applies to projects built under exceptional circumstances, known as the Open Window Mechanism, described below.

The Open Window Mechanism

As an alternative, the Open Window mechanism offers more opportunities for less cost-effective projects to receive funding. It is a contract request for any project that has received the Environmental Authorization to construct and meets the eligibility criteria in the exceptional circumstances [132].

These exceptional circumstances include one of the following:

1. Small wind parks, comprising a maximum of two wind turbines of 3 MW each;
2. Parks with up to six 'small' wind turbines, of less than 125 m justifying a height constraint (such as aviation or military radars);
3. Repowering projects, by upgrading up to six small wind turbines (less than 125 m high), if the park was in operation less than three years before.

If a project meets one of the requirements, it is guaranteed a contract and a FIP set at an Open Window price. This helps because it avoids competing in the tendering process for remuneration. Therefore the Open Window mechanism reduces the risk for developers to consider sites under such circumstances. The scheme also offers higher energy prices than the tendering process, with winning bids reaching 59e/MWh at tenders on average compared with 72e/MWh awarded by the Open Window system [25].

European Market support for RES

The European electricity market, of which France is a part, supports RES above other forms of electricity generation by using a marginal pricing system, also known as a pay-as-clear market in the wholesale market. In this system, electricity generators get the same price for the power they are selling at any given moment.

In this system, electricity producers (from national utilities to individuals who generate their own renewable energy and sell into the grid) bid into the market, offering energy prices according to their production cost. This way, RES costs nothing to produce, and, therefore, is always the cheapest. The bidding starts at the lowest cost of production (RES) and goes to the most expensive, usually gas and coal. The cheapest electricity is bought first, and the process continues until the full demand is satisfied. For each given moment, all producers receive the same price - that of the highest bid for the electricity used. Therefore, RES benefit from the largest marginal profit.

Research and Development

Technological developments have led to a quadrupling of the efficiency of power of wind turbines since the 2000s. An increasing evolution of turbine design, such as the size of the mast size and rotor diameter, has played a vital role. Newer and more efficient turbines are implemented yearly, allowing for smaller parks but greater installed power per park. These advances have made it possible to reduce wind power production costs and feasibly use sites with lower wind speeds. However, it has been noted that the French market tends to feel the benefits of technological progress later than other countries due to slower project development cycles (with 7 years on average in France compared to approximately 3 in Germany) [51].

Nowadays, technical research centres for onshore wind turbines exist across the country as shown in Figure 4.10. Technical development has slowed down, though, because wind turbines are considered to have more or less reached their technological maturity, and little more is being invested into innovating their design [142]. However, research is ongoing but has changed focus to optimising the circular economy of the materials used. Today, 95% of materials used to build wind turbines can be recycled; the limiting components, however, are the blades. Finding new uses for worn blades and using new materials to facilitate recycling and move away from the use of finite resources (copper, ...) have become high priorities for the industry [51].

In addition, continual progress is being made in reducing noise nuisances caused by the turning blades [51].

Further research on wind turbines' impacts on their surroundings and relationships between society and the energy transition is still ongoing. Many of these social impact research projects are conducted by ADEME and its associations.

Culture

The energy crisis of 2022 has led to more end-users questioning their energy bills and seeking cheaper alternatives. As the cheapest RES at present, there is hope that this could see a shift in the population's perception of wind turbines [38].

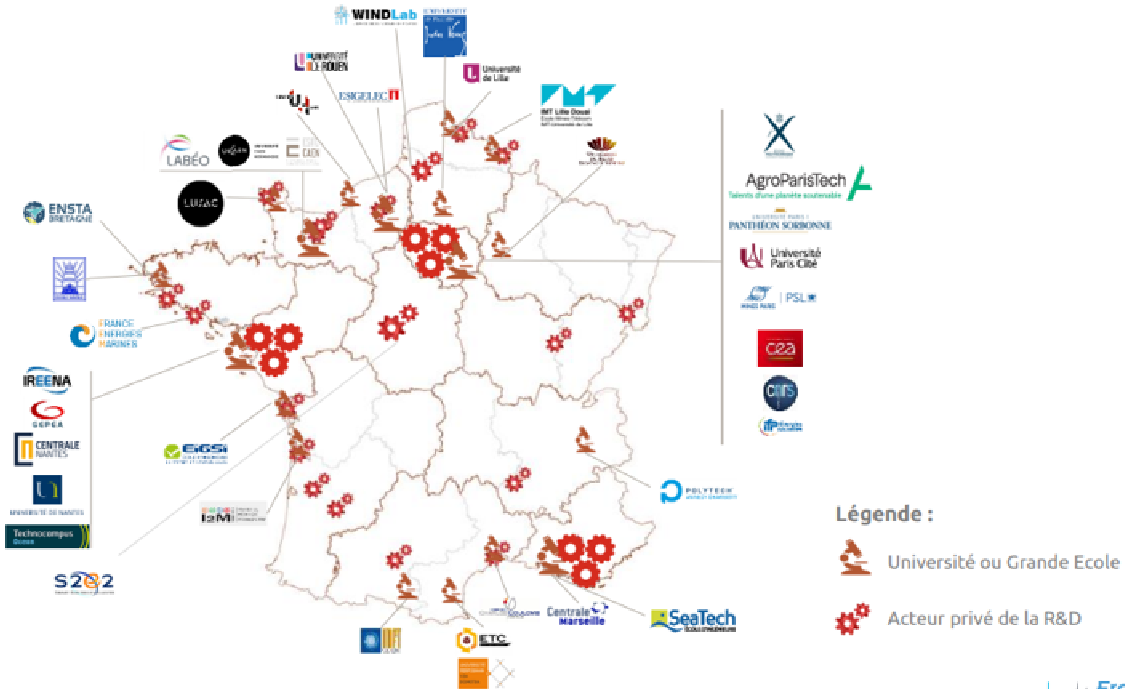


Figure 4.10: Research and Development Centres for wind in France by FEE [51]

Institutional

Developers have access to State led institutions for support, such as ADEME or SER. However, alternative project leaders like CREPs rely solely on EPA or volunteers. Greater institutional cooperation between national, regional and local levels is required.

4.3.3. SNM Analysis of the French Onshore Wind Energy Niche

The Strategic Niche Management framework is applied to the French wind energy niche as described previously in Chapter3. Staying in line with the Multi-Level Perspective analysis above, SNM pays special attention to the role of actor networks, learning processes and visions that determine paths for scaling niche innovations up to the mainstream regime level. This section presents the network of actors involved in the niche, then describes the alignment of the ongoing learning processes and finally discusses the expectations on the landscape and regime as well as on the wind energy niche itself.

Network Formation

This section highlights the strength of the social networks surrounding wind energy in France. It is broken into two parts, network composition (actors per category) and network alignment (discrepancy in goals between the actor categories). The categories have been chosen from the five actor types previously used in MLP and SNM analysis: governments, social organisations, knowledge institutes, companies and end-users. The broader the categories and more aligned the actors' visions are, the stronger the network is, and the more chance of scaling up into the free market [115].

Network Composition

As one of the most mature RES technologies available, wind energy benefits from a strong network of actors across all domains. The MLP analysis revealed the presence of prominent actors from all SNM categories.

The **Government** shows interest and support in wind energy, with actors of the State involved in climate policies that include wind energy at all levels. There are also two *knowledge institutes* responsible for promoting RES and wind energy under the guidance of the MTE.

Large companies are well established in the French wind energy market, which reflects the industry's maturity. There are energy companies, wind developers, and multiple actors within the industry.

As a sector of its own, the **wind industry** employs 25 500 Full-Time Employees and is growing annually, by 12,8% from 2020 to 2021, according to FEE. The job posts available testify a strong presence across all value chains with; 33% from Research and Development, 28% engineering or construction roles, 22% manufacturing and 17% from operation and maintenance positions [51]. Actors on French soil are multi-national; the major energy companies EDF and Engie (which includes CNR) are from France, while manufacturers are primarily German and Danish, and subcontractors (for components, construction, connection and operation maintenance) are largely French.

Knowledge and training institutes in the sector are also growing, with educational and professional training facilities across the country. In addition, even incumbent players are preparing their staff for a regime shift towards intermittent technologies. This is the case for RTE's own Transfo Campus for retraining current employees, as mentioned in Section 4.2.5.

Social organisations around wind energy are often divided between associations that are anti-nuclear and pro-wind energy and associations that consider themselves environmentalists in favour of RES but opposed to industrial wind energy development [33]. In France, anti-wind federations are better structured and more disruptive than in many other countries, which affects most wind projects. There are also emerging organisations promoting new forms of energy democracy, such as EPA for community energy initiatives at the national level, among smaller regional level organisations. Wind turbines are large structures and have visual impacts on their immediate surrounding. Therefore, residents' opinions need to be accounted for within social organisations.

The **user** context for wind turbines is growing beyond the incumbent electricity producers. New entrants, such as communities, are creating a new market segment but are not yet fully established. Both use wind turbines to produce electricity to be sold to suppliers. In France, electricity users (households and industries) use wind-generated electricity no differently than if produced conventionally. However, consumers can choose 'green energy' contracts from suppliers, which supports the deployment of more RES.

A recap of the actors involved in the French wind energy sector is shown in Figure 4.11.

Actor	Role
Governments	Ministries, Localised State Authorities (Prefects, Mayors), Lobby Groups, Syndicates, Local energy authorities (SDE, DREAL….)
Social Organisations	Environmental groups, anti-wind associations, communities, CREP (EPA), Citizen energy funding associations/ Platforms (EnRcit, Enerfip), Regional RE funds (FRTE…)
Knowledge Institutes	National agencies and associations (ADEME, SER, FEE…), universities, Operator training centres (RTE training campus, Enedis research centres), Citizen
Companies	Energy Producers (EDF, CNR, Vattenfall…) Energy suppliers (Engie, EDF…), Grid Operators (RTE, Enedis, …), Manufacturers, Engineering firms,
End Users	Households, Prosumers, Commercial and Industrial sites

Figure 4.11: Network Composition (Own Source) [39]

Network Alignment

While the network composition of actors is vast and varied, there is a significant misalignment of their objectives.

The greatest alignment can be found in research and development, where most actor groups co-operate and invest in knowledge institutes. The government works closely with ADEME and SER. Dominant regime actors such as grid operators RTE and Enedis are also prepared to invest much of their budgets into research and infrastructure for accommodating more intermittent technologies such as wind in the future, as seen in Section 4.2.4.

Misalignment, however, is more common. The most apparent conflicts between actor groups are presented below:

- **Government - Society - Knowledge institutes:** Government has an economic incentive to retain popularity among voters. A fast transition to integrate RES would result in higher costs in the short term, which could affect its popularity. In the meantime, knowledge institutes in France and Europe have a longer-term vision and see the energy transition with more RES as crucial for France's and Europe's future energy security.
- **Government - Developing Companies:** The Government has set high ambitions, but limits wind developers' progress with complex regulations and unstable support policies that concern investors.
- **Developing Companies - Social Organizations (local population):** Developers want to develop more and increasingly profitable wind parks, which impact local surroundings. This presents a conflict of interest with local communities over shared resources with different visions and purposes. Local communities prioritise the aesthetic impact on the landscape and attach more importance to place attachment and identity.
- **Developing Companies - Social Organizations (anti-wind activists):** Anti-wind associations a well established in France, and most wind projects are subject to court appeals. This is problematic for developers who lack the time and financial resources to defend every project.
- **User - User conflicts:** French CREPs only interact with incumbent actors out of necessity. At present, developers barely contribute to the community energy ecosystem. Developers seem to see CREPs as amateurs and time-consuming. Communities worry about developers' incentives when they initiate or offer a partnership. As a result, CREPs have had to develop as a separate niche and compete for resources with the rest of the RES sector. A competition in which CREPs lack the power, the experience and the financial resources to win [125]. Further, as suggested by previous researchers [70], partnerships between larger companies and communities are going to be increasingly necessary for RE, and wind energy to make a more significant contribution to the overall energy industry. As stated in one paper, [70], "We're going to have to find a way of marrying the community perspective with the private sector interest. Otherwise, it will always be a niche activity".

Organisational barriers also prevent actor alignment. Among many other factors, social coordination and networking between actors building CREPs are lacking in France [125]. Bottom-up initiatives like CREPs evolve from social organisations that manage other regime actors. The coordinators are often given the term, 'Local capacity builders' and contribute to developing CREPs locally by fulfilling four main functions [125] [141]:

- 1) lobbying
- 2) networking and knowledge-sharing
- 3) technical and commercial support
- 4) financial support.

In France, many of these social functions are carried out at the national level by a single organisation, EPA, because local actors and associations are usually less effective. Existing local associations are poorly structured, rely on volunteers and demand high levels of participation. Consequently, they have high participant turnover and a struggle to retain the knowledge and experience that the volunteers have accumulated from past experiences [125] [141].

Learning

Learning plays an essential role in integrating new technologies into socio-technical regimes. By using alternative options to incumbent technologies, networks of actors involved learn about different aspects, such as technological performance or economic feasibility. From these practical applications, these actors can use their findings to adjust the technology or adapt elements of the regime in which the technology aims to transition. These changes can be made thanks to five select learning criteria to improve the alignment between the regime's socio-technical configurations with the experimental technology's characteristics [75]. These learning aspects include technical learning, development of user context, societal and environmental impact, industrial development, government policy, and regulatory framework, as presented in Figure 4.12.

Learning Type	Learning Processes
Technical development and infrastructure	The necessary design specifications and what other technologies and infrastructure could be required to support the innovation.
Societal and environmental impact	All relevant safety, energy, and environmental aspects that a new technology could have on its environment.
Development of user context	Society/user perception of the innovation, their requirements, the values they associate with the new technology and the practical or perceived barriers to using it.
Industrial development	The production chain and maintenance network needed to increase the large-scale deployment of the technology.
Government policy and regulatory framework	The roles of all institutional structures and legislation in the deployment of the technology. The government's importance in introducing incentives for use in the start phases and the role in the introduction process, and possible levers public authorities could implement to encourage technology adoption.

Figure 4.12: Learning Processes from SNM (Own Source) [39]

Government Policy and Regulatory Framework

Government policies are still unstable and reflect signs of ongoing learning. Much of the instability of the regulatory framework for wind energy between 2005-2012 came from national anti-wind energy lobby's influence and an unsupportive right-wing government in power [57]. Since 2012, a predominantly left-wing government has tended to favour wind energy. Yet, the current regulatory framework is deemed unsustainable by developers and wind energy specialists, and spatial planning issues will require policy experimentation to find answers. Also, as a result of frequent policy changes over the last decade, increased scepticism among investors [25]. According to FEE [51], the main regulatory challenges to overcome further policy learning are:

1. Accelerating permission processes to grid connections, which includes anticipating regional capacity needs and reducing connection times;
2. Revising spatial and height constraints - an adaptation of aeronautical height restrictions and enabling coexistence with the army to open up new areas for wind farms.
3. Facilitating the installation of newer, larger and more powerful turbines at lower production costs and reducing the number of turbines installed for the same capacity.

Technical Learning

Since wind energy was introduced in France in the late 1990s, much has been learnt about the technology and its direct and indirect impacts on the surroundings. Technical learning includes vast technological improvements in the efficiency of the technology itself, resulting in cheaper energy generation. According to ADEME, the levelised cost of onshore wind energy has reduced by 55% since 2010, reaching an average of 60,5 euro/MWh in 2020. The price drop results from technological progress and the ability to build higher hubs and longer blades resulting in greater load factors while lowering operating and maintenance costs [6].

In addition to the technical improvement to wind turbine technology, grid innovations are also evolving to accommodate decentralised energy sources better. Until recently, building a source substation, which is necessary for grid connection, took about two years (preceded by three years for administrative procedures). Enedis, the leading DSO, has designed a new 'Express Source Substation' that requires half the building time, is modular and can be easily deployed in remote areas. The first of its kind became operational in July 2020 in Montpinson, a municipality in Champagne-Ardenne. Five more have been distributed in the nearby communities and will be activated by 2025 [51]. More technical learning is needed in this area, but deploying more of these substations sooner could facilitate ongoing grid connection problems and contribute to the research for optimisation with learning by using, not just researching.

Learning about User Context and Societal and Environmental impacts

User context and societal and environmental impacts are closely linked. At present, most learning from using wind turbines in France has come from larger energy companies. However, the emergence of CREPs is changing that perspective and has reflected other barriers to use. Large-scale wind turbine users are mostly private renewable energy companies that develop wind parks. From an economic perspective, these energy companies require the highest energy production at the lowest production, installation and maintenance costs. By contrast, hosting communities attach increasing importance to using wind projects to create and use local resources such as:

- new jobs for locals
- raising enough capital for turbine ownership
- directly consuming the energy produced
- increasing financial benefits for community purposes

Therefore, for all wind turbine users (developers or host communities), more user and social context learning are needed to make wind projects more attractive. In particular, more could be learnt about and contribute to changing aspects such as:

- regulations on collective self-consumption
- competition with incumbents at energy auctions
- administrative procedures for creating joint ownerships of projects
-

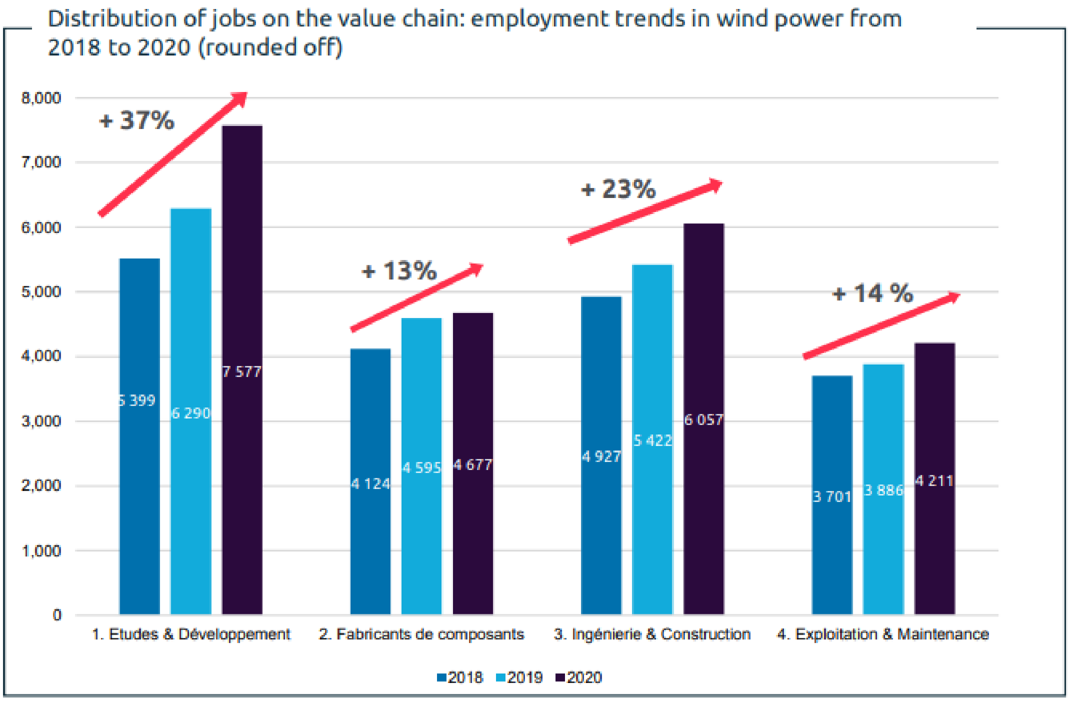
Industrial Development

The wind turbine industry is well established in France and has been expanding consistently over the last decade. It is also preparing for its future by offering more apprenticeships and undergraduate training programs oriented towards manufacturing wind turbine components, technical training in maintenance and new engineering programs focusing on the future decentralisation of energy deployment. [10]

As shown in the figure 4.13, in France, all employment sectors are growing, and according to FEE, [10], the jobs offered are becoming more localised. Most wind turbines are still manufactured by other European companies (predominantly Vestas and Enercon). However, owing to a growing network of training programs in recent years, French companies Scheider Electric and Valorem carry out most component manufacturing and maintenance. [10]

Incumbent grid managers such as Enedis, the biggest DSO and RTE, the TSO, are also strengthening and adapting their staff training programs to prepare their employees for greater RES integration into the electricity grid. This is an important learning step for the industry. If incumbent major grid operators' employees understand wind energy requirements, it will broaden the chances of its survival in a changing the regime [10] [51] [119].

Institutions also play an important role in wind energy deployment. There is powerful lobbying against wind farms by dominant energy utilities, which are still mostly State-owned, resulting in weaker



Source: FEE study, data processing by Capgemini Invent

Figure 4.13: Overview of Jobs in French Wind Industry by FEE [51]

decentralised energy development [110]. Lobbyists in favour of RES, such as SER, FEE and ADEME, are active. Still, their attachment to the MTE weakens their agency. According to Nicolas Hulot, a past Minister of Ecology, the MTE has some influence but little political power. [32]

Second Order Learning

Second-order learning questions society's willingness to change to integrate new technology into their lives [122]. In recent years, the media has brought awareness to energy issues with topics like the post-pandemic energy crisis and increasing concerns about climate. Consequently, behavioural changes towards energy are noticeable, even if the population's view on wind energy is still paradoxical, as discussed in Section 4.2.6.

In particular, the implementation of previously mentioned Linky devices in Section 4.2.4 has helped raise awareness of the fluctuations of energy prices throughout the day. Thus it is already proving successful at encouraging consumers to use energy-intensive devices (electric vehicles, washing machines,...) outside of peak hours (settings timers for after midnight). This new lifestyle adaptation to energy prices and availability will become increasingly crucial as the share of RES in power generation grows in the decades to come. On the one hand, for the owners of solar panels, Linky has been effective at increasing flexibility in demand due to the tangibility of the price signals it provides. These prosumers can directly benefit by plugging in more devices when their energy generation is highest to save money [45]. On the other, this learning is yet to be felt by most of the population that does not experience the benefits of RES production peaks. For many, the benefits of RES, such as wind and solar energy, are unnoticeable, yet their visual impacts on the surroundings are expanding and undesirable. Thus, for anti-wind attitudes to shift and for the general behavioural changes in energy consumption to become more widespread, feedback on the effects of different energy resources on price and other factors is needed [71].

Visioning and expectations

In the early stages of niche development, stakeholders invest time, money and effort in the hope of committing to successful future innovation, even if expectations are not clear in the beginning. Over time, expectations evolve due to external factors in the regime and landscape and internal circumstances within the niche, resulting from niche experiments [115].

The expectations of the French wind energy niche are presented below. They are given based on SNM criteria, starting with the robustness and quality of the technology, followed by the expected evolution of factors of the landscape and energy regime. Finally, consideration is given to the expectations the wind energy niche could have for scaling up to the regime level.

Robustness, Quality, Specific

Wind energy is already a robust niche that benefits from multi-actor support in market protection from incumbents. Support exists via government subsidies and auctions, niche-associated learning via research institutes and a well-developed industry. The ongoing energy transition preparing for more intermittent RES also empowers the wind energy sector.

Onshore wind energy technology is mature enough to have proven its quality and capability of producing enough energy to be financially competitive among established fossil fuel technologies.

Today wind energy technology is still reliant on complementary technologies for creating more grid connection opportunities and managing the unpredictability and stability of its intermittent energy production. While some of its environmental impacts (on birds, for instance) are being addressed, the social and visual ecological impact it causes is yet to be resolved and could limit its ability to scale up in the future.

Expectations on the Landscape and Regime

Nonetheless, landscape and regime developments are expected to evolve and could create more opportunities for the wind industry. The relative share of onshore wind power in national electricity consumption is expected to increase over the next 15 years to represent a percentage ranging from 10 to 15% of total consumption. France has the second largest wind source in Europe, and the sector offers a significant untapped economic and industrial opportunity for the country. However, to develop, wind energy needs a stable economic and regulatory framework, and long-term visibility [51].

National Low Carbon Strategy, SNBC, following the Energy Transition for Green Growth law in 2015, lays out France's future energy goals. It serves as France's policy-making road map regarding climate change mitigation to reach zero emissions by 2050. Concerning the energy sector, the PPE, established by the French MTE, sets out the government's energy targets over the period. The plan was revised in 2018 and is set to be revised every five years, the current one covers 2019-2023, and its sequel for 2024-2028 is being prepared. It includes ambitious RES goals and sets a time frame to reach them [99]. Yet, today, France is the only European country to lag on its annual targets for the development of renewable energies, for which it risks being sanctioned at the European level [28].

Policymakers have heard the urgency, and at the time of writing, the newly instated Minister for Energy Transition, Agnès Pannier-Runacher, announced emergency measures to accelerate the development of renewable energy production [8]. This includes urging Prefects to unblock up to 10 GW of onshore wind, solar, and biogas energy sources combined, all of which were stuck in the latter development stages although many had already signed connection agreements with DSOs. In the same period, the government unveiled another ambitious energy target; to reduce energy consumption by 10% in two years to protect itself from further energy shortages. To achieve this, new measures include reducing heating to a maximum of 19°C in offices, encouraging people to carpool and introducing more RES. However, onshore wind energy is the only RE not mentioned in these new measures, with more interest turning towards offshore wind energy instead. Furthermore, none of these target measures is legally binding. Thus implementation may not happen as planned [8].

Expectations for the Niche

Wind farm development by incumbent wind developers is reaching its limits due to many regulatory constraints and rising social resistance. Thus, citizen inclusion in wind projects will have to grow considerably in a few years to increase acceptance and enable France to reach its energy targets. However, to do so, CREPs will likely need to evolve and become less dependent on EPA, which offers a singular business model, and find more suitable national RES support schemes [96]. The niche must adapt to new business models to include citizens to survive.

Such a shift could foresee developers being more open to citizen participation, not just financially but also for project planning, as early as possible. On the one hand, large wind developers need more local knowledge to aid in designing more acceptable wind parks. On the other, CREPs often rely on developers' expertise, and financial stability to carry the risks of a project and their support to facilitate a grid connection. Developing competing and symbiotic relations between communities and incumbents could induce changes in the perception of both organisations. For one, it improves the credibility of CREPs in the eye of DSOs to obtain access to the grid; for the other, it increases community trust with the developers. Thus, it has the potential to destabilise the current energy sector. [141].

Visions and expectations for wind energy in France are unclear. Onshore wind is cheap and scalable. Since France is already behind on its renewable targets, onshore wind is an ideal way to move forward. It is the fastest way to increase its renewable capacity. It would help secure the energy supply, which is under pressure due to the current problems with existing nuclear reactors [62]. The TSO is urging the government to take action to increase RES, including onshore wind, but it is unclear how they will react [82].

4.4. From a National MLP of Wind Development to a Local-Level - the Microcosm of Wind Developers

This chapter has primarily contributed to understanding the overall state of wind energy within the past and present context of the French energy regime. However, much of this work was desk-research based, so to strengthen knowledge about the niche, a case study of a 'microcosm' involving practical work is needed. The following chapter is an illustrative case in a relatively resourceful region of France. The chosen case allows investigation of practical barriers met and solutions used by the predominant actor in the wind industry: developers. This microcosm concerns mainly wind developers and projects in the Grand-Est region of France. Its purpose is to demonstrate how regime barriers block the development of this niche differently between national, regional and local levels of governance.

5

Case Study: Developing wind energy in the Department of l'Aube

This case study acts like a window onto a microcosm within the national French energy regime. It sheds light on how the struggles identified in the previous chapter play out on a more local level. It gives practical regional examples of the general trends perceived at the national level by using the MLP framework. The purpose of the case study is also to draw on lessons learnt and recommended practices (mostly community inclusion in projects) noted in the MLP analysis to solve the challenges met by developers. The intention is to find new methods to overcome common barriers that could be more widely applied and subsequently increase wind turbine diffusion in France.

The chapter flows as follows; an introduction to the context of the case study, starting with the subject of the case study, the two examples used and why these locations were chosen. Next, the contents of the case study are presented. This comprises two parts; first, a developer's practical experience of siting prospective areas for new wind farms in the department of Aube. A second retrospective account of how a successful joint partnership between the wind developer and a community came to be. The third part includes experiences and advice taken from interviews with industry experts. A fourth section is dedicated to applying the same MLP framework used for the energy regime in the previous chapter, to the specific regional case experienced by the developer. Fifth, the regional case's community wind energy projects are closely considered under an SNM lens. Then comes a discussion about the similarities and differences between the barriers perceived at the national level in the previous chapter and those experience at a regional level in the case study. Finally, the chapter closes with a conclusion regarding the practices to take forward and some of the missing links to wind energy diffusion in France.

5.1. Context of Study

Wind developers have been the main players in wind energy diffusion in France. They scout out sites with high wind potential, plan the necessary site studies and finally develop wind farms to generate electricity to sell to the wholesale market. However, in recent years, new projects have stagnated due to a rise in social resistance. Therefore, wind developers have been looking for ways to improve the social acceptance of their potential projects through community inclusion. Yet, integrating communities into projects has not been as fruitful as hoped. This study illustrates the barriers met by wind developers attempting to find new sites for wind farms when using the best-known practices to include citizens in their projects.

The practical examples of this research were taken from the author's experience working as a wind project developer for the Compagnie National du Rhône. It offered two first-hand experiences: 1) prospecting for wind farms in the department of l'Aube in the Grand-Est Region located in North-East France; 2) the lessons learnt from their first (and only) successful joint-owned community wind project located in Souilly d'Air, in the department of Ain in Rhône-Alpes.

This case study centres on finding new sites for wind projects in l'Aube. This department can be considered a good reflection of challenges met by French developers, because of its relatively low biodiversity constraints, presence of few aviation radars and suitable average wind speeds. The Grand-Est region has the second highest installed onshore wind capacity (3 861 MW), after the Haut-de-France (4 867 MW). The regional climate goals in the SRADDET are to produce 12 000 GWh of wind energy by 2030, which would require approximately 5 300 MW of installed wind capacity spread across all ten departments. Therefore, there is still scope for wind park development.

As detailed in the previous Chapter, in Section 4.2.1, regional objectives (SRADDET) are defined locally in the PCAETs. The latter is mandatory for intermunicipalities greater than 20 000 inhabitants but only recommended by national authorities to less populated areas. Thus, below is a map in figure 5.2 of intermunicipalities with mandatory and optional PCAETs in l'Aube. Some PCEATs have been completely defined and approved by the government (in green), some still in progress (yellow and light blue), while others have chosen not to make any climate commitments at the EPCI level (red and white).

Figure 5.1: Location of the Department of Aube in France (source:Wikipedia)

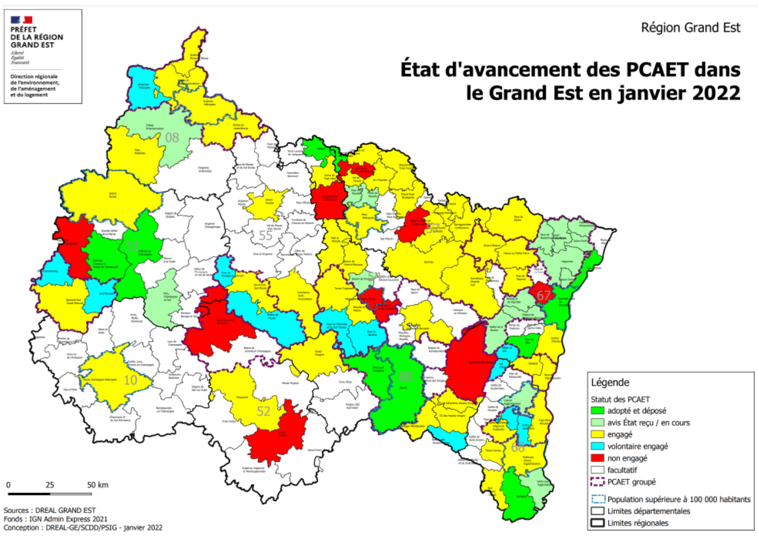


Figure 5.2: State advancement of the PCAET for every intermunicipality in Aube in France by DREAL Grand Est [137]

5.2. Contents of Case Study

This first case reflects the step-by-step process required for scouting new areas for wind farms in France and takes place specifically in the department of Aube. It only contains the first stage of wind farm development, where most potential projects fail because it is considered the stage with the most barriers to growth. This section begins by relating the experience of applying the wind developer's methodology presented in Chapter 3 into practice. It introduces the new initiatives taken to create a joint-owned project and finally ends with a summary of the barriers that the developers noted while working in the department of Aube.

5.2.1. Case 1: Siting Prospective Zones for Wind Projects in l'Aube

Finding new sites to develop is becoming increasingly difficult for French developers. To better understand why that is, this study case tackles the first of the four phases of wind project development: Site Prospecting. This is the most precarious development stage as it holds the highest financial risk and most social resistance. This phase involves prospecting areas using digital maps and initiating contacts and the local population's interest. If successful, the following phases would be the Pre-study Phase, Development and Public Consultation Phase and Planning Permission Phase, as detailed in Section 3.2.3.

The methodology used in the siting procedure for this case study is detailed in Chapter 3. Although approaches to siting prospective zones can vary, all must adhere the same constraints (legal, technical, social...) and have access to similar mapping tools such as QGIS (Quantum Geographic Information System), chosen for its variety of mapping features and data editing to scout out new areas.

The following section details the siting procedure's outcome in l'Aube.

5.2.2. Applying the Methodology

For this study, the professional prospecting method detailed in Chapter 3 was adopted for identifying new areas suitable for projects located specifically in l'Aube. It includes the first steps of contacting the local elected officials, such as the Mayor. The findings are then used as an illustration of the MLP analysis at the regional level.

Following the methodology, only three zones across the department were identified as Potential Zone for Wind Turbines (ZIP).

In Figure 5.3, the smallest grey circles represent the 500m setback distance from a residential building, the larger grey circles are the 30 km prohibited area around an aviation radar, the blue circles are the 5km and 30km 'non-interference zones' with weather radars, the red circles are the 30km and 70km army radar range (prohibited to wind turbines, except for some exemptions), the yellow areas are low fly zones reserved to the army, and small coloured dots are existing wind farms either in operation or being developed. Purple ovals mark the areas identified with potential for a wind project.

1. ZIP 1: Clérey, included in the EPCI of Communauté d'Agglomération (CA) of Troyes Champagne Métropole, situated in a pocket free of the low-fly zone (in yellow on Figure 5.3). The zone covers five communities Verrieres, Fresnoy-le-Château, Montreuil-sur-Barse, Montaulin and Clérey. The ZIP can potentially hold one or two rows of six wind turbines and could be spread along a motorway.
2. ZIP 2: Braux, included in the of EPCI of Communauté des Communes of Lacs de Champagne, situated outside an army radar's 70km limit but within the weather station radar buffer zone. However, further investigation showed that the radar would not detect any infrastructure below 300m, as other landscape features would shadow it. The ZIP is the largest, with a potential for one or two rows of ten wind turbines, spreading in the southeast through Chalette-sur-Voire, Magnicourt.
3. ZIP 3: Morvilliers, included in the EPCI of Communauté de Communes de Vendure-Soulaine, there appears to be potential for 12 wind turbines. However, a nearby nature reserve was discovered after talking with a local Mayor, which could be a threat.

The purpose of the following case study is to use best practices found in literature and create new initiatives for developers to achieve better acceptance for their projects at a local level. The areas considered for development are pictured above in Figure 5.4c, and the available construction space is

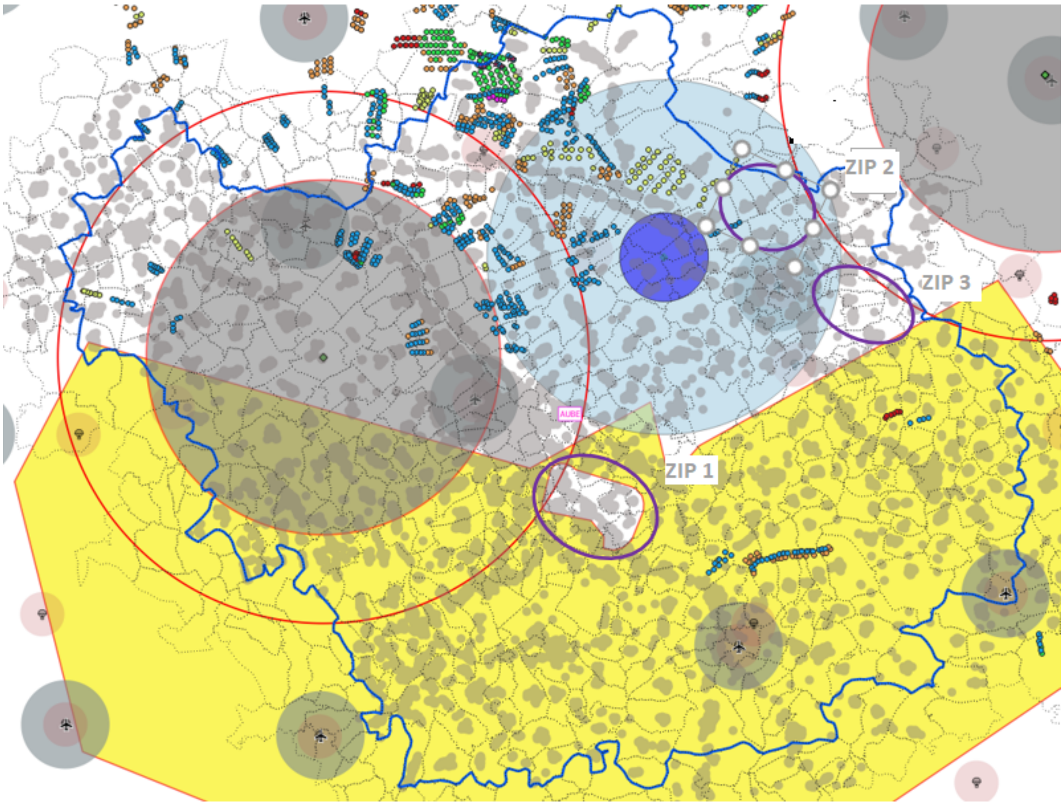


Figure 5.3: Army and Radar Constraints on Developing Wind Turbines in Aube (Own source)

illustrated within each map's blue lines. These are the only areas that match wind park suitability's legal and technical constraints. This case study aims to obtain the Mayor's and their community's approval before further project development. The barriers and enablers mentioned in the previous Chapter 4 served as a starting point for solving acceptance issues.

5.2.3. Communicating and Involving Communities Early on

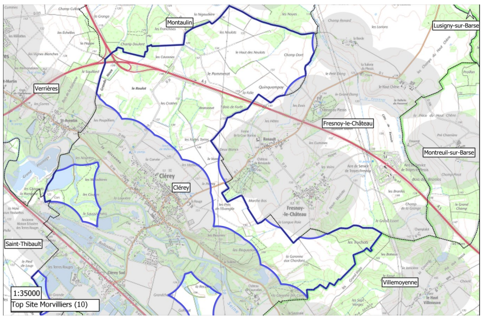
The literature strongly supports that community integration into a project and building a local network is the best solution to overcoming social resistance [49] [36]. Thus, the priority for the developers of this case study was to create a project to integrate the community in a joint partnership with CNR. To achieve this, the next goal was to identify and use a network of local actors willing to cooperate with CNR and support such a partnership.

Initial Contact with the Mayor

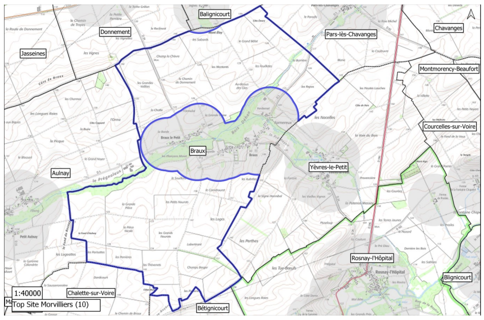
Mayors of municipalities in France have an important role as they represent their residents and the State at the local level. They are key players in project planning since they often reflect local opinions and have the authority to accept or refuse project planning. For this reason, it seemed logical that developers should make personal contact with the Mayor of a ZIP as early as possible.

Initial contact is a precarious moment for developers, as it is vital to give a 'good first impression' of the company. In the first of these cases, the Mayors of all surrounding communities were sent a letter informing them of their municipality's potential for hosting a wind project. The letter inquired if they would be interested in meeting the developers at CNR for more information. They were also sent a brochure presenting the company and possibilities for shared community investments. This was done by letter in response to previous complaints about developers being too invasive. This slower approach was intended to appear less aggressive and serve as a point of reference in case of a follow-up call or email. The letter's purpose was to appear professional, informative and approachable and to allow recipients time to reflect on the subject before pursuing further contact.

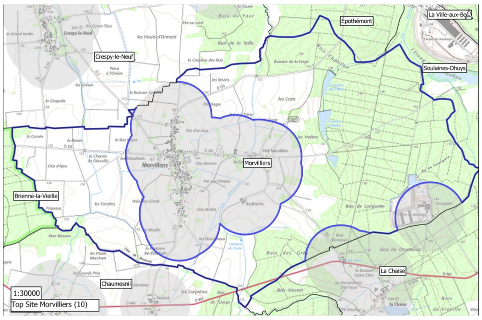
Unfortunately, in practice, this open approach was unsuccessful. None of the community representatives responded without a follow-up phone call. During the exchange, some acknowledged receiving



(a) ZIP 1: Clérey



(b) ZIP 2: Braux



(c) ZIP 3: Morvillier

Figure 5.4: Identified Zones for Potential Wind Parks (Own source)

the letter but admitted they were not interested. One was unreachable by phone, and another said they would have been interested, but that the area was already undergoing studies for developing a wind park by another developer.

This first stage of the case study demonstrated that developers struggle to communicate directly with communities despite their willingness to cooperate with locals and be as inclusive as possible. After being turned down by community mayors, there appears to be little outreach for developers. Consequently, companies are forced to put potential areas on a 'stand-by' list until the next local elections (up to six years) in the hope of a more favourable, newly elected Mayor.

The following phases of this case study aimed to find solutions to the communication barriers with Mayors.

5.2.4. New Approach taken: Building Local Networks

The national-level MLP analysis explained the barriers observed in the French wind industry. Based on these findings, it seemed logical to expect many of these barriers to appear locally.

The following approach considers new solutions to many national MLP barriers and those mentioned by the developing company. However, some barriers were more dependent on external factors than others. As a reminder, the barriers to wind and community wind energy development observed in the previous chapter were:

- Cost of grid connections;
- Administrative and juridical delays;
- Height and radar constraints;
- Limited 'niche' affiliated networks and 'local capacity builders'

Given the time and resources available for the project, these initiatives focused primarily on 'building a local network' since it was identified as the most flexible barrier to resolving the issue and it is recommended good practice by many researchers [33] [42] [49]. The next part describes the initiatives taken to build a local network.

Building a local network by looking for associations involved in the region and department energy transition at a local level. In Aube, three organisations were found; La Société d'Economie Mixte Energie (SEM) de L'Aube, Syndicat Départemental de l'Energie (SDE) de Aube and Climaxion.

- SEM is a public-private partnership created in 1989 that melds local authorities with private associates. In their own words, ”SEMs are companies serving local communities, territories and their inhabitants. SEMs are characterised by their nature as a commercial enterprise and by their vocation to satisfy the general interest and to favour local resources.” [46].
- SDE Aube, is the local authority for the public distribution of electricity and gas. It delegates the management of electricity distribution by concession to a DSO; either Enedis, or to the ’Société d'intérêt collectif agricole d'électricité’ of Précy-Saint-Martin.

  Local regulators SDE have several responsibilities [22]:

  - Controlling the electricity and gas distribution networks, as well as ensuring that the services carried out by the concessionaires are fulfilled satisfactorily; energy quality, maintenance and renewal, repairs, etc.
  - Mediating between consumers on the one hand and electricity and gas dealers and suppliers on the other.
  - Providing information and raising awareness for sustainable energy use.

  SDE Aube owns the public electricity and gas distribution networks, making it a key player in the social and economic development of the department. Therefore, it is responsible for any work necessary to promote economic growth and improve local services. Such works include extending networks to serve new buildings, reinforcing rural electricity networks to meet the changing needs of consumers, and enhancing renewable energy potential, mainly hydropower and photovoltaics [90].
- Climaxion, is an ADEME-led initiative in collaboration with Grand-Est. The organisation's role is to contribute to achieving the objectives of the SRADDET. They act on behalf of the local actors (communities, companies, associations, building professionals, individuals, etc.) and deal with climate-related topics such as energy efficiency and environmental quality of buildings, renewable energies and circular economy [112]. Climaxion encompasses three associations that support community energy projects. These are:

  - Conseil en Énergie Partagé (EPA advisor)
  - Agence Locale de l'Energie et du Climat des Ardennes (ALE)
  - Réseau Grand Est Citoyen et Local d'energies Renouvelables (GECLER)

The attempts to build a local network began by directly approaching the Mayors' local municipalities, all three organisations mentioned above, and the three associations supporting local CREPs.

The summary of outcomes from exchanges is summarised in the table below.

Responses varied:

- Mayors and/or Mayors secretaries':

  - Uninformative reply, unwilling to discuss the options for community energy in the area.
  - Was willing to discuss wind energy, but most of the discussion explained why other wind projects had been refused.

Table 5.1: Outcome of Contacts made in L'Aube

Interviewee Affiliation	Position	Location	Mode of Contact
SEM Energie de L'Aube	President of SEM	Troyes	Phone call
GECLER	Network Manager	Charleville-Mézières	Email
Mairie Braux	Secretary	Braux	Phone call
Mairie Morvilliers	Mayor's Secretary	Morvilliers	Phone call
Mairie Maizières-lés-Brienne	Mayor's Secretary	Morvilliers	Phone call
Mairie Crespy-le-Neuf	Mayor's Secretary	Morvilliers	Phone call
Mairie Juzanvigny	Mayor's Secretary	Morvilliers	Phone call
CA TCM	Advisor of Energie Partagée	Troyes	Video meeting
SDE Aube	Renewable Energy Manager	Troyes	Phone call
ADEME	Advice and Inquiries	Online	Email

- SEM: Interested in investing and running a CREP once a wind farm has been authorized, but would not position themselves during the siting phase, nor aid in searching for new projects.
- Intermunicipality of Troyes: The four employees present were interested in promoting wind energy and were proud of their intermunicipality (CA Troyes Metropole) for exceeding its PCAET wind target. They would support further projects but did not wish to approach their communities to suggest a partnership project.
- GECLER, EPA advisor, ALE: Every association member was interested in supporting a community wind project. However, they required a host community to reach out to them, not a developer. They did not wish to approach the community themselves.
- ADEME: Automated and uninformative reply.

5.2.5. Concluding the Developer's Experience in l'Aube

Below is a conclusion of difficulties met while working as a project developer in l'Aube. It highlights five problems that developers commonly encounter and have not yet managed to solve.

Best Practices Proved Insufficient

Despite following all known best practices for siting and offering communities the opportunity to participate in developing a project, the initiatives were unsuccessful in all three ZIPs identified in the prospective stages of the case study. The adopted practices included: contacting the Mayor before anyone else, involving communities early on, offering additional financial returns from a partnership, including local investors, providing transparent information and providing the communities with contacts for independent sources of advice (ADEME and other environment protection associations).

Local Knowledge is Internalised

The Grand-Est region is considered one of France's more 'favourable' regions for developing wind energy, as it has fewer biodiversity or radar constraints than other regions [25]. Yet, in Aube, most of the surface area was unsuitable. Only by speaking to the President of one of the inter-municipalities was it possible to find out that there were plans to extend the national park's boundaries. This was problematic because communities who wished to belong to it would not be allowed to host wind turbines. Therefore, the areas were further diminished than estimated on the maps used in Figure 5.4c. This was considered a loss of time and effort for the project developers. Also, the map marks out large areas where wind turbines with blade tips must be less than 130m altitude. This would drastically reduce the productivity of any wind turbine installed there since the stronger wind speeds are found higher up.

The biggest constraint to finding areas for new projects was the number of army, weather and aviation radars to consider. However, some radars (and low fly zones) are not prohibitive under some exceptional circumstances. These zones are not clearly defined and can therefore be negotiated in discussions between the developers, the local authorities, and the army. For instance, radars could be overlooked if a wind turbine:

1. is built next to wind farms that were operational before the radar was installed.
2. is built in the shadow of an existing wind turbine that already interferes with the radar.
3. is built in areas where two radars overlap because each side of the turbine would still be visible by one radar.
4. is built in places where they are hidden in the radar shadow of an already-existing landmark that obstructs the radar's visual.

So while some of these exceptions open up more opportunities for developers, studying an area for obscured openings or constraints is very time-consuming and risky. Notably, some limitations are known only by certain local representatives. These conditions may not be published, so developers must rely on locals' willingness to share this knowledge, which is also risky. So areas under radars that could apply for exemptions are only investigated if other factors, such as wind resources or open terrain, are exceptionally favourable.

To solve issues related to local knowledge, a new initiative was taken by the MTE. They requested all departmental Prefects to map out areas most and least suited to building wind turbines. In practice, it proved unfruitful. Maps often took much longer to be made than promised, owing to internal debates

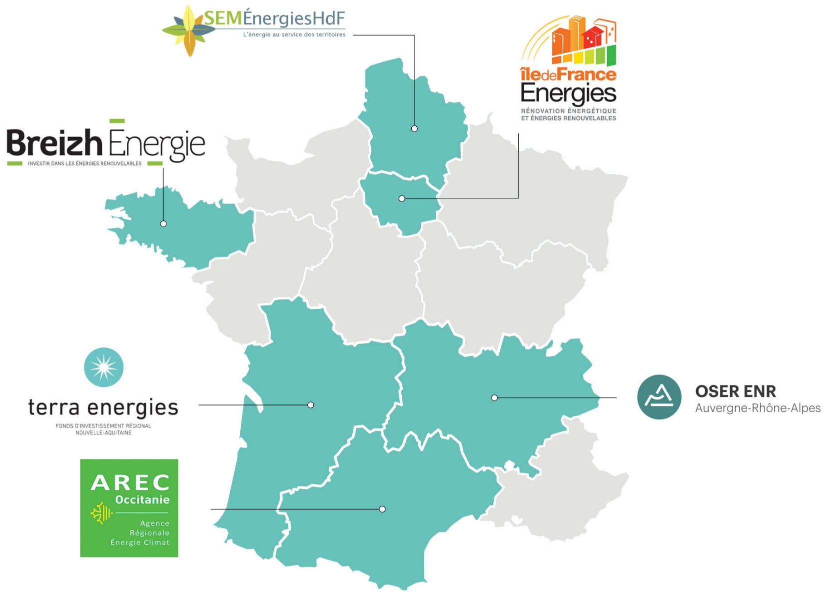


Figure 5.5: Association Fonds Régionaux pour la Transition Énergétique (FRTE) by FRTE [**fond**]

and numerous problems with the finished versions. Not only did maps include very few areas open to wind farm construction, but these areas often clashed with hard constraints, such as low-fly army zones prohibitive to wind farm planning to which Prefects were oblivious [38].

National and Regional Support at Local Level

Even government-funded agencies and associations, ADEME and Climaxion, the key territorial players for a local energy transition, were unavailable to offer advice, by email or phone. Interactions with these associations remained impersonal and inaccurate and seemed automated. This is contradictory, given that one of ADEME's primary responsibilities is to inform the public and give unbiased advice. This is a local reflection of the understaffed and volunteer structure found at the national level for supporting community energy networks [125].

Regional funds, often NGOs, such as the GECLER, are available but unevenly distributed across the country [25]. Some regions have established several support mechanisms, investment funds initiated by a range of local residents, and networks of subsidiaries of l'ADEME of varying sizes. Much of this support is in place to support local communities to build projects and requires the municipalities to take the initiative.

Difficulties Communicating about Community Energy

Even participants in successful partnerships or joint ownerships do not easily share their experience [125]. This case found that even key investors in local energy projects, such as the President of the SEM of Aube, did not actively communicate about their work. When asked for information about the SEM's other wind projects, they admitted that nothing had been published since it had been built. Except for an article in the local newspaper on the day the wind turbine was launched 2010 [46].

More Intermediaries and Advisors

The MTE announced in October 2021 the creation of a job for 'wind turbine mediators' to act in an unbiased role to help open up and encourage conversations between developers and communities [4]. However, after in-depth research during the first six months of 2022, no mediator was found in the Grand-Est region or in France. This is problematic to the wind industry because mediation between developers and communities is becoming increasingly necessary. On the one hand, such announcements are positive because it shows a government's initiative to listen to and support developers. However, on the other hand, the lack of clarity on how the solution is implemented results in no changes for the industry, whereas the policymakers view the issue as solved and may not be willing to reassess the problem.

5.3. Case 2: Successful Joint-Ownership of Souilly d'Air Wind Project

In addition to the practical work experience of scouting new areas and connecting with local networks, CNR offered to share their knowledge of building a joint-ownership project. This second case relates to an interview with a CNR project manager responsible for building their only successful joint-ownership project. It can be seen as an example to understand better how to create a co-owned wind project between a local community and a wind park developer in France. This case is about a project called Souilly d'Air, located in Saint-Trivier-de-Courtes as seen in Figure 5.6, in the Rhône-Alpes region just south of the Grand-Est.

Figure 5.6: Location of Souilly d'Air wind project by France Geo

5.3.1. Local Leadership from the Start

The wind park project began in late 2016; a CNR project developer scouted a relatively small but suitable area using the usual siting methods. They contacted the municipality's Mayor, who showed immediate interest in building a wind project. The Mayor became particularly keen to find a means for the community to receive additional income to l'IFER tax, the standard benefits offered to host communities. Consent for land use was given within a short period, a few months. This triggered the 50/50 co-governance partnership between CNR and local stakeholders. The shares in the Soully d'Air wind farm company are distributed as follows: 4% Saint-Trivier-de-Courtes (municipality); 15% Grand Bourg Agglomération (intermunicipality of the nearest town); 10% Fonds OSER (a regional RES funding scheme); 21% EnRciT (EPA subsidiary, that carries project risk on behalf of the community) and 50% CNR (developer) [59].

This was made possible by three factors:

1. the local Mayor knew the Mayor of the nearest city, Bourg-en-Bresse, personally and ensured the city invested in their community project;
2. the investment RE fund OSER, present in Rhône-Alpes region, invested and carried all the risk of the development phase (two years of resources, biodiversity, technical studies)
3. the Mayor proactively sought advice from his personal network and delegated many tasks to his municipality counsel, to gain time and increase local involvement.

This also shows the importance of word of mouth; the Mayor relied on his personal network before contacting professional organisations for advice.

5.3.2. Overcoming External Factors

The project was not without its problems, however. The first significant delay occurred in the mid-development phase, owing to the Covid-19 outbreak in early 2020. Site feasibility studies and in-person visits were postponed due to lockdown rules. Shortly after, municipal elections occurred before the postponed studies could be completed, so the signature of the contracts was further delayed while waiting for the election results. In addition, following the environmental studies, an endangered bird species was discovered, which required a second round of investigations and observations.

The project took five years to take shape, with only some local resistance but without any delays in formal public appeals. As of early 2022, the construction was about to begin.

5.4. Case 3: Experiences from Industry Specialists

The third section of the case study considers two interviews with specialists from the French wind industry associations, namely, ADEME and SER. These interviews were conducted to obtain an outsider's expert opinion on wind development in France and to receive advice on how developers could improve their practices and what other regime factors need addressing externally. This section starts with a brief presentation of the two associations that the interviewees represent. A summary of the topics discussed with each and, finally, a discussion of the factors they believe need to evolve for wind energy to succeed in France.

5.4.1. Roles and Goals of ADEME and SER

ADEME: ADEME is arranged into two layers, and located across three main sites, in Paris, Anger (west) and Valbonne (southeast) and seventeen regional offices (including four in France's overseas territories). The centralised services typically involve financing environmental and RES projects in France, developing partnerships with more local associations and overseeing sectoral studies. On the other hand, employees at the regional level have more local assignments. Unfortunately, they would appear to have minimal resources and consequently focus most of their budget dedicated to energy issues on optimising renewable heat generation and building efficiency. Across the three main sites, only three people are responsible for working on wind power and marine energies. They are split between onshore wind, fixed-bottom and floating offshore wind structures and other renewable marine energies. In addition to their area of expertise in each technology, they share cross-cutting issues about appropriating renewable energies.
As a whole, ADEME has three assignments:

1. Providing expertise: technical advisors must write reports for the public and the ministries. They carry out detailed studies on controversial subjects, such as, most recently, the impact of wind power on the evolution of the price of real estate. [108]
2. Research and development support: providing financial support to projects from a Postgraduate thesis to industrial prototypes. For wind power, funding for technical research is more relevant to floating or fixed-bottom offshore wind power projects. However, onshore projects relating to learning about interactions between wind power and environment or landscape integration are also included. For instance, employees receive a project proposal and then will offer financing (or not) and commit to following the project throughout its life.
3. Animation, information and awareness: creating partnerships, providing professional consultancy or training for certain businesses, partaking in professional events, promoting and publishing research to make it more accessible. For example, ADEME has supported the EPA structure from the beginning and the Amorce Association (which aims to raise local authorities' awareness of RES) with financial, but also serviceable, support (e.g., co-writing a presentation on received ideas related to wind power).

SER: Syndicat des Energies Renouvelables (SER, Syndicat for Renewable Energy Technologies) represents professionals in all renewable energy sectors, particularly in heating and electricity. Its principal task is to speak on behalf of the industry, which are companies for the most part, and to liaise with the Ministry of Ecological Transition and other stakeholders. SER is run by its members, with consultations and elections between the members to ensure that everyone is represented. They take decisions on which problems can be raised with their political representatives. There is also a role of documenting and communicating via press releases, organising events (e.g., SER annual conference) and creating forums for exchanges between members to share good practices.

5.4.2. Interview

The interviews with specialists were semi-constructed and included questions about; how to understand the social perception of wind energy, what could be or is being done about it, and what could be done about the discrepancies between national and local level climate policies. Both interviews ended with the specialists' hopes and recommendations for changes for the future of the wind industry. It should be noted that these interviews took place in March 2022 before the Presidential election in June 2022.

Interviewee Comment 1: Improving social perception of wind energy

Community energy is a very fashionable solution for social acceptance at the moment and the strongest lever being used politically. Yet, it is not suitable for all communities for various reasons. It is very timing consuming for Mayors, and some lack the funds to own a large enough share of the project, to name two [25].

However, there are other means for increasing social acceptability through self-consumption or collective self-consumption, known as prosumers. Unfortunately, in France, regulations limit "prosumption" to private solar energy users and owners under the 'pérequation tarifaire' or 'price equality law' which allows all French citizens to access energy at the same price where they are situated. Consequently, neighbouring residents are not allowed any preferential energy bills [25].

Recent energy auctions for wind and hydropower are opening up to the idea but require 100% of the energy generated to be consumed by the owners at all times. This usually exceeds what a community is capable of consuming at any point in time. Another new auction option is to introduce collective storage, allowing communities to use up to 10% of the energy stored. However, this does not offer developers any bonus points towards obtaining a bid as described in the MLP Chapter, regarding support schemes described in section 4.3.2. Nonetheless, including communal storage would increase project complexity, so there is no incentive to adopt it. As an alternative to collective-prosumption, developers can offer 'energy checks' to neighbouring residents. This is a yearly sum for several years, indirectly contributing to paying off energy expenses [25].

While project feasibility is directly correlated to wind resources and turbine size, these are not the only factors in France. Social acceptance also seems to have risen from the uneven spread across the country, leading to a very high concentration of wind farms in clusters in some areas and next to none in others. The 'open-window' system is designed to help develop parks in less favourable locations, but it has limits. Too many projects are constrained by army aviation height limits and radars, while others are subjected to communities' preferences for smaller turbines. In both cases, the technology's capabilities are reduced and restrained from exploiting stronger winds that only tall and larger turbines can catch high up [25].

Another reason for the 'chaotic clusters of wind farms' is less about wind resources but merely about space availability. Regions where biodiversity and aeronautical restrictions are low or where the population is more tightly grouped are rare but highly prioritised by wind developers. This is the case for Grand-Est and Hauts-de-France regions, which host more wind parks than any other region in France. While wind resources in these regions are good, they are not the best in the country, but biodiversity restrictions are relatively light compared to others (Occitanie and Auvergne Rhône-Alpes, for instance). On the other hand, Bretagne is known for its windy conditions. Still, the population is thinly scattered across the region, thus reducing large spaces available to wind parks significantly [25].

Any technological adaption to wind turbines to suit the environment reduces their efficiency, whether it requires clamping to minimise noise or flashing sensors that slow the rotor speed to protect birds or lower masts for aviation constraints. Subsequently, increased costs and payback time for developers impact the final energy cost [25].

Hosting communities do not see the direct benefits of hosting a project. Even though the industry has seen a significant boost in employment, most of these jobs are located away from where the parks are built. Tax returns, known as IFER, for communities are pretty significant, standing at approximately 20 000 euros per MW installed, but are hardly noticeable because the money goes to the local council and not the residents. Another way to approach this could be to relabel the tax benefits as a 'Fond Patrimoine' or a 'preserving cultural heritage fund', whereby all financial benefits from the wind turbine would go straight to improving existing communal spaces and structures or climate change adaptation. The wind energy installation would then provide more tangible benefits to a community [25].

Interviewee Comment 2: Need for more mediators
More mediators between actors, such as the developers, state electives and locals, have been requested by industry players for many years, and recently the MTE has reacted. ADEME already has a network known as ”Cocopeop”, soon to be restructured and renamed ”Les générateurs”. ADEME has supported the creation of positions dedicated to advising local authorities on developing solar or wind projects. In its new format, new wind energy advisors in each region of France will be structured around existing structures (most often local energy authorities, SDE), of which ADEME will finance part of the workforce, provide information that is as neutral as possible on the subject of project engineering or project techniques for example. ADEME supports the network, but the network members shall be employed by the host organizations, which will most likely be the local SDE or regional associations linked to energy and climate. In early 2022, the network was starting up, and a decision is yet to be made on where the network members will be positioned.

Interviewee Comment 3: Policies need more guidance and incentives
PCEAT: MTE is responsible for setting PCEAT targets, but nobody is accountable for meeting them. Missing them is only punishable by the EU and then only financially and nationally. However, the alternative of making the target legally binding and punishable at a local level could be perceived as oppressive by residents and a breach of their freedom rights.

SNBC: Nonetheless, the roadmap laid out in the SNBC, and subsequently PPE and PCAETs, is not just setting objectives but is also necessary to ensure France’s power supply in the long term. If it is not implemented, France will lack power generation by 2028 and become reliant on importing it abroad. New nuclear power stations may be in the pipeline but will not be operational no sooner than the early 2030s. If more RES is not deployed, the energy generation will be so critical that it would leave no option but to re-introduce coal and gas plants in the short-medium term [25].

Even local government authorities do not proactively seek to meet PCAET or SNBC targets by increasing RES shares in their designated areas. For instance, DREAL members and state representatives are under the authority of the regional prefect. DREAL are responsible for developing and coordinating state policies about sustainable development and planning [137]. However, this organisation is not monitored, has disproportionately strict dogmas against wind energy, and still seems to favour land use for biodiversity and residential purposes. Consequently, annual regional wind targets are persistently missed without any incentives to strike a new balance between these shared land resources [25].

Interviewee Comment 4: Improve knowledge and Information concerning renewable energy and wind farms
One interviewee expressed concerns about how the energy sector needs better understanding by those who can affect it and voters. They strongly feel that there is a lack of general knowledge and awareness of what the energy sector is or does [142].

One of ADEME’s roles is to look to the future and consider the energy mix broadly without focusing on a particular technology. ADEME has conducted studies independently of RTE to deliver the four possible pathways to achieving carbon neutrality by 2050. These scenarios are used to draw up visions of the impact of carbon neutrality on different levels of society. In each pathway, ADEME researchers were confronted with the need to considerably increase the share of renewable energies, including wind power, in the energy mix. Moreover, these scenarios required choices forcing citizens to reduce their energy consumption or rely heavily on technological transitions.

Interviewee Comment 5: Need to Shift Cultural Perceptions
Interviews with specialists from ADEME and SER revealed other aspects regarding social resistance. Wind turbines are no longer a novel technology and have passed the phase of capturing the public’s fascination [25] [142]. Their imposing presence on landscapes, due to their size, could be considered ’the straw that broke to camel’s back’ after the local landscape had been gradually saturated with power lines, power plants, industrial farming, or even high-speed railways (such as the TGV) which were accepted with little but increasing resistance and wind turbines have been the latest to arrive [142]. In addition, wind energy began to expand at a similar time to the rise in popularity of social media. Such platforms enable personnel to share their opinions and information (and misinformation) with more people faster than ever before. Such venues did not exist when any other ’disliked’ landmarks and infrastructure were being debated in the past. [25] [142]

In the words of one interviewee: *”We may have chosen the wrong message by saying that we have to do wind power because it’s ecological, says an interviewee, but in reality, we need wind power because, in the next ten years, it’s our only way to have cheaper and carbon-free energy. Regarding electricity, if we don’t have wind or solar power, gas will be unaffordable, we will be left with coal...”* [25]. The debate has further been distorted by those who still believe France to be an electricity exporter, so the general belief has become that there is no need for additional electricity generation. In the same breath, most electricity generated is already carbon-free, so there is a consensus that no *need* for RES. Meanwhile, it is difficult to explain that the debate has to be concluded now and not in 2030 when the older nuclear fleet will have shut down, and other technologies will be called upon to make up capacity. [25]

Interviewee Comment 6: Better management Media and Knowledge diffusion
Onshore wind energy is already economically competitive compared to other technologies, yet the media only report on projects that don’t work, damaging the industry’s reputation.

There is a dilemma between those protecting the environment and those defending the climate. Unsuccessful debates are more highly reported than those that are successful. ADEME acts via its partnerships by involving biodiversity-focused associations like ”la Ligue de Protection des Oiseaux”, among others, to provide an environmentalist’s opinion on developing wind in a designated area [142].

Furthermore, energy has become a political topic because of its visibly changing the landscape, and many candidates have chosen to make a point of it in their political campaigns in the lead-up to elections. This wrongly gives people that energy choices are a matter of preference.

Both interviewees suggest that wind energy is a victim of cognitive bias by media platforms. Several representatives of municipalities complained about past experiences they had had with developers and were thus reluctant to consider a new project, even with shared control on project planning and guaranteed returns on the project. This suggests that best practices are still not commonly used by developers. Some are still too aggressive in their approach, whether they seek to include communities in their projects. Unfortunately, these word-of-mouth stories catch the media’s eye and are remembered by readers [142].

A major cultural barrier to wind energy lies in the influence of media. Media cognitive bias could be responsible for much of the damage caused to the sector. There is nothing unsurprising to report about wind energy’s benefits to the environment. It has long been sold as a climate-friendly means to generate electricity, which can be considered common knowledge. Thus, it is now only mentioned in media if something is wrong, with devastating titles about killing birds, ”Wind turbines not so green after all”, or ’wind turbine syndrome’ (where victims living next suffer inexplicable physical pathologies for living to near a turbine) to catch more readers’ attention. Unfortunately, as of yet, there are no counter-arguments to defend the industry in wider media. If representatives speak out, their arguments are disregarded or considered biased, and actors outside the industry do not have enough at stake to defend wind energy. [25]

When asked *”Who could finance positive publicity for RE to defend its reputation?”* Interviewees replied *”The political timing is not good... The current government prefers developing wind power but does not want to say it too loudly. This government has always had this ambivalence, but there are possibilities for changes with the new government because even if it has a second five-year term, a second is often different to the first. A second allows you to do more daring things in terms of communication. On the other hand, what can change very quickly is a government’s perception of the ecological issue transforming into an economic issue which would change the debate. In that case, SER could intervene and provide information, but first, it must wait for the new government. Suppose we can convince that this is not just an ecological issue but also has economic stakes. In that case, we may find allies beyond the Ministry of Ecological Transition. If so, we could unlock more government resources for our sector over time. We must give everyone better visibility on the costs of energy alternatives such as importing energy in the future, showing the need to be more resilient to economic shocks such as supply chain disruption.”* [127].

5.4.3. Opinion and Expectations

At the end of the interviews, experts were asked what they saw as the most pressing issues to solve within the French wind industry and what solutions they would like to see implemented.

1. **Accelerate and Simplify:** *"The President already announced a need to simplify and accelerate the energy transition to gain more energy independence, for which France will need RES. However, due to the long application and examination times for studies and lengthy court appeals, steps must be taken to simplify the application processes and accelerate court cases. In short, to achieve this, more resources are needed for the DREALs so that more applications can be processed simultaneously. Then Prefects should be pushed to make faster decisions on accepting or refusing an environmental authorization because too many are pending. "The question remains, where the increase in resources should come from - the State or the wind industry? National wind energy organisations are currently understaffed - the workforce has not increased in years, while the volume of projects has risen. So the current situation is not sustainable." Simplification procedures have been debated for years, but many changes have only added complexity when intended to save time. For instance, the LVC law enforces intermediate time-caps on the process of the response by the Mayor and Prefect to the developer's non-technical summary."* [25]
2. **Finding space:** *"There are too many constraints - development of wind parks is forbidden 43% of land in France. This is particularly relevant when considering a more even spread of parks over the country, for which there is a need to find a new balance between the different local requirements and constraints. Energy must be made a major public interest. Ecology must become THE priority, the limiting criteria of the economic system. We need to reform our economic system as it currently is - we are touching the system's limits as it is today. We must raise awareness and restore the order of priorities with reality. The next President would surely be responsible overall for it. The Prime Minister's orders should be given to several ministries. For example, they could require that the Ministry of the Armed Forces prioritises the ecological and energy transition as much as possible without sacrificing military functioning (cf. radar as mentioned above notes in MLP Chapter 4 in section 4.2.6), and take into consideration the importance of the development of renewable energies. For this to occur, France needs better political leadership in the matter. Currently, the signal for change is not strong enough in France."* [25]
3. **Communication:** *"Cognitive bias is strong, and wind power gets a lot of bad press, but it's also a sign that the technology is reaching maturity. New technologies are often more popular before they are no longer a novelty. Once the novelty wears off, the only way to attract people's attention is to put forward something to criticize. Unfortunately, this media bias continues to accumulate with the economic pressure on the media. The new model of media distribution via social networks, which works with 'clickbait', restricts them in their role of disseminating information and puts them in a difficult situation. For example, take an interview with the SER about wind energy. The article may be well reported, even positively and well referenced, etc., but it will be given a devastating title even if it is reasonably positive. It is noticeable that journalists do not necessarily choose the title of their article but rather their editor. This is disastrous for public information because too many people read the title and the heading without reading further. As the message on the ecological benefits of the wind turbine has become common, it no longer interests readers, compared to the more questionable aspects like 'blades cannot be recycled, and we've been lied to because it's not even environmentally friendly!', which can make less knowledgeable people feel deceived by wind turbines (cf. Comment 6 about press and media above in Section 5.4.2). Also, anti-wind articles often closely relate to the nuclear energy sphere with popular figures like Jean-Marc Jancovici, who resonate very strongly with a vast audience. In particular, he is a highly respected engineer and a popular figurehead on national television that speaks out on the decarbonization of society. However, he has strong supportive views on nuclear energy. With such a wide circle of influence, such an orator can strongly dissuade people from supporting RES and wind energy because the sector has yet to find a figurehead equivalent to defend RE in the same way. The problem is that wind power has become a controversial political debate. It is currently difficult to find someone with a strong enough following willing to expose themselves."* [25]
4. **Broaden energy education:** *"They [the French government] should make a reformed energy a compulsory subject in education so that the public and political leaders can form their own unbiased opinion, even if it is a short course. It must focus on energy essentials, not just consumption and production, but also include each technology's economic issues and the impacts and benefits. These elements should also be taken from a national and local perspective. It would be most interesting to enforce this learning at the municipal level of authority by educating Mayors on the needs and resources of their municipality. Equally, bring residents into these discussions before*

any projects are put to local debate. There is a need to open conversations about the environment and energy as citizens will have to get involved in these subjects in the coming years. Today, information found online or in the newspapers is often incomplete and has an underlying opinion. Broader energy education should be unbiased and suitably targeted to each audience. Such a change could be driven by the Prime Minister to jointly coordinate the Ministry of Education and MTE, who would make a strategy. Still, the changes should reverberate in all ministries." [142]

5. **Simplify exchanges**: *"Democracy works when you have enlightened citizens. So, to avoid manipulation in respect of energy advice, citizens need to be educated about energy, ecology in general, and basic related societal problems. Once this is achieved, political decision-making could be made more locally without requiring higher information, simplifying things. Today, too many documents with guidelines and objectives depend on each other at different territorial levels. While there is certainly an awareness of their existence, they are too complex to be used to their full capacity. There should be a stronger push towards using institutions already in place and giving power to local authorities rather than creating new ones that need to learn their role. In the future, energy will need to be produced locally if France remains energy independent for all our needs, food, energy and trading in the broad sense."* [142]
6. **Regionalize PPE objectives:** *"The case-by-case profiles of energy consumption of local intermunicipalities need to be better understood. At present, energy analysis is very top-down. International agreements on greenhouse gas emissions are made at a European level and are translated to the national level. After this, there is a loss of scale as the objectives get submerged in heaps of documents that are not always very clear nor decisive at the local and territorial levels. Therefore, setting up objectives on a regional scale could empower local populations concerning climate and energy objectives. In any case, the national objectives are too broad and do not give enough responsibility to empower territorial levels. These regionalization strategies have already been outlined and promoted by the MTE, but no decisions have been made."* [142]
7. **Add an environmental footprint criterion to PCEAT, not just a carbon footprint:** *"This should show all indicators linked to the impact on resources, water, biodiversity, etc. and provide evidence that all these aspects are accounted for in local energy transition objectives. This would take the focus away from the only indicator currently used, carbon emissions, which is not tangible and is just one of many reasons the energy transition is needed. We need to work globally on human activity's cumulative impact to understand what weighs most on our environment and how to limit our impact."* [142]
8. **Proposal to remedy misinformation:** *"There needs to be more awareness about misinformation, and there needs to be a recognised, reliable, unbiased information base available to all. Unfortunately, this cannot come from any actors within the RES sector since their views would be considered biased by definition. It has to come from the government. The strategy should not be to convince the anti-wind protesters but to look towards people without a strong opinion who could be forming their opinion on readily available articles that are not fact-checked. An information base is necessary; it should also relay and diffuse information about the sector from a different, neutral perspective. It is more complicated because the ecological transition has become so obvious that we do not feel the need to defend it; for many, it is very distant. Only recently has energy returned to consider a combination of ecology, economy and daily life. For a long time, it was something automatic - just a switch without worrying about whether it came from nuclear."* [142]

5.5. Case Study MLP Regime Analysis

The empirical local-level case study of l'Aube above is a helpful illustration of some tangible barriers met by wind developers in France. This regional-specific case can be seen as a regional-level microcosm within the national-level MLP study in the previous chapter. The following section returns to the same MLP and SNM frameworks to analyse this regional-level case. Since the landscape elements are the same, the analysis dives straight into the core regime elements that differ or add the most to the national-level findings.

5.5.1. Politics and Policies

As in the previous chapter, political actors and policies affect the development of onshore wind energy at the local level. This section highlights which decision-makers had the most effect using the empirical evidence found in the three case studies above.

SNBC to PCAET: An Example of Discrepancies Between National and Local Objectives
PCAET (Plan Climat Air Energie Territoire) results from national goals widely applied locally. They set the energy goals for the inter-municipality, and these commitments are considered and confirmed by the Mayors that make up the intermunicipality. Their only obligation is to stay in line with the government's fixed regional goals written in SRADDET. The PCAETs lack a concrete structure and involve many actors who do not serve a clear purpose. Not all intermunicipalities have to commit to the regional climate goals, especially if there are less than 20 000 inhabitants. In addition, targets are not territory-specific enough for the larger intermunicipalities or "Communautés d'Agglomeration" (CA, or Communities of Urban areas). Therefore, goals are written in official documents as a 'one size fits all', which makes some points more relevant to some regions than others. Finally, there are no legal sanctions for missing targets. As a result, three years after the PCAET law was voted in, over two-thirds of intermunicipalities are yet to commit to a climate trajectory, let alone keep to one [97].

To decentralize and to tackle the climate goals at the local level, the PCAET was established for regions and their communities to have more incentives to participate in the energy transition. However, this has had far less effect than initially hoped for several reasons. First, while national goals align with EU targets, they have not been evenly divided between the regions. They do not always consider a region's current state or their specific resources. The national scope does not account for the implementation at the local level. Also, the power of each administration level passed down from the State works horizontally and not vertically. Therefore, the region receives the goals to spread among their inter-municipalities, but has no power to enforce them locally. Consequently, municipalities have no obligation to contribute to the goals set by the PCAET, and the inter-municipality has no way of enforcing a plan of action or increasing incentives. In the PCAET, inter-municipalities are given an energy target with an energy mix to meet by a certain year. How these targets are divided between the municipalities and when there are met depends on the Mayors involved. Therefore, there seems to be a lack of shared guidance and coordination between levels of administration.

Limited Roles of Decentralised Civil Servants in the Energy Sector
Most decentralised civil servants employed at sub-regional levels (such as'Pôle Environnement Développement Durable') in the energy industry seem goalless. Most are willing to talk to developers and offer advice when asked, but they appear passive and work individually outside a defined network. They nearly all required the developers to, play the intermediary role by asking the municipalities to contact the organisations for advice. In essence, they are in place to advise communities that seek, but do not proactively inform them, about the importance of the energy transition.

Yet, from observations throughout the empirical experiences in Case 1, there appears to be a substantial budget for civil servants in the energy transition at the regional level. This was evident from the number of employees readily available for meetings to discuss the possibility of building a network ahead of a potential wind energy project. However, from the exchanges with them, it became more noticeable that these public organisations have no power to act. In a specific example from the first case study, four employees at the sub-departmental level* *(from the 'Pôle Environnement Développement Durable du Collect Metropole de Troyes')* were available for an hour-long interview. Yet, despite being tasked to lead climate action at the sub-departmental level, none of these employees felt legitimate enough to seek out and encourage communities to engage in energy projects. This can be considered an illustration of a restricted passing of power from the State to local authorities managing the energy transition. Moreover, the authorities at a sub-departmental level were aware of communication barriers between developers and communities, and whilst they favour more wind projects, their position does not give them any right to incite communities to start such a project. As representatives of the State, they may not force communities to take action because it is against French democratic values [143].

Interactions with Departmental level authorities leave the impression that any initiatives contributing to the PCAET by communities must come from the bottom up.

Mayors: National and Local Representatives
Mayors have a vital role in French community politics. They are elected by residents and hold all the power in their municipalities. This is an important factor in French culture as it reflects democratic values [143].

It seems Mayors have more influence on the energy transition at the local level in ways that had not been identified in previous research. Mayors in France have a unique role because they are the only civil servants to have a “double hat” (”Double Casquette” [143]) or dual role. They act on behalf of the municipality as a local community representative, but they also work on behalf of the State in certain administrative and judicial roles. This gives them the power to take decisions in their municipalities and for smaller municipalities, they can override inter-municipality climate commitments, such as the PCAET. Therefore, RES goals exist at all administrative levels but are not legally binding. Thus, even inter-municipalities with PCAET targets have no means of enforcing them and Mayors must choose to commit to them.

However, fieldwork with CNR exposed other less apparent issues when dealing with Mayors. In reality, for smaller communes, most Mayors have an additional third, personal function to pursue as they follow other careers consisting of 9 am to 5 pm jobs on weekdays and carry out their communal responsibilities outside their working hours.

The town halls or ’Mairies’ of rural municipalities, more likely to have substantial open spaces suitable for wind turbines, have odd opening times. This is because Mayors have other jobs and are only present a couple of hours a week in person and often after working hours, i.e. from 5 pm- 6 pm, once or twice per week or during the weekend. Therefore, making direct contact with a principal decision-maker is very difficult. In the little time that a Mayor may have, they often do not want to spend it researching any further information on building a potential community wind project that would exceed the duration of their mandate before being operational. The whole process is very time and energy-consuming due to requiring intensive networking, administration, consulting, etc... It would appear to be too much effort for too little reward for a project that is also likely very controversial among their peers. From developers’ experiences, unless Mayors have an innate strong ecological conscience, there seems to be very little leverage to entice them to host a wind project, with or without co-ownership [127].

Current Political Climate
In the last year, wind energy has become more contentious due to presidential candidates’ views on wind turbines. Even national-level syndicates, like the SER, motivated to act on the wind industry’s behalf, have been sidelined. At the time of writing, they were still waiting for the new government to be instated before they could take any further action [25]. This further illustrates the weak administrative weight that SER has, given that its strongest ally is ADEME which is merely a State agency, not a ministry. The ministry they depend on, the MTE, has some influence but little power and a small budget for policy changes that restrains its agency. This is not the case for other ministries that have more influence on the energy sector for economic reasons [109]. The Ministry of Finance, for example, has both stakes in nuclear and fossil fuel subsidies and works closely with the CRE to adjust regulated tariffs for electricity and natural gas to households to counter inflation during energy shortages.

The interviewees confirmed [25] that the 2017 government supported RES development but was never very vocal about it. They passed several laws to boost price competition among RES by proposing Feed-in-tariffs to smaller projects and Feed-in-Premiums to larger ones. However, although the auctioning policy for FIPs has been proven successful in driving wind energy costs down, it has also led to competition for the windiest spots because other places cannot offer such competitive prices. This unexpectedly reduced area available to developers, that cannot develop projects unless they win a suitably profitable bid. In addition, it also leads to clusters in windy regions, as opposed to an even spread of wind farms across the country which are less accepted by local populations.

Regional elections in 2021 made wind energy a contentious topic, used by some candidates as a potential ‘vote winner’ by promoting France’s strong nuclear sector and making claims against the effectiveness of wind energy. Although this seems to have had a little direct impact on the wind sector, it stirred up sleeping anti-wind feelings among the population ahead of the national elections in 2022. It has become a dividing topic amongst candidates. Despite talks about reaching climate neutrality, few candidates are voicing their visions for the wind sector, increasing the hesitancy of investors [38].

Local and National Elections
Another under-recognised administrative issue found while working with developers is the timing of local, regional and national elections. They affect all levels of governance in wind project planning

- the municipal Mayor (the first decision maker in project planning). Local elections occur every six years; the latest took place in 2020 to elect the municipality Mayor with the power to accept or refuse a project at a local level
- the regional Prefect (who is required to give an Environmental Permit before constructing any wind project)
- the Government (responsible for supportive RES policies). National elections, every five years, directly influence the national energy strategy and consequential policies for the sector.

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Contracts for projects are vulnerable because they are only definitive once the Prefect has given out an Environmental Permit, usually between three and five years after the feasibility and environmental studies have begun. Given how long it takes to plan a wind project, the process nearly always includes a change of leadership and can jeopardise planning if the newly elected official is not in favour of seeing the project through. This issue was made clear in the delays experienced in the Souilly d'Air case above in Section 5.3, where contracts could not be signed until the Mayor was reelected [59].

5.5.2. Culture

In the three cases studied another dimension was introduced to the cultural rejection of wind energy, beyond notions of 'nimbyism' or local identity mentioned in the previous Chapter 4.

The notion of '*ugliness*' associated with wind turbines is no more than just a criticism of industrialising the rural landscape. Still, it shows a shift in the land's identity, place meaning and attachment [58]. This is reflected in the shift in ideology between Mitterand's two Presidential campaign posters in 1965 and 1985 as shown in Figures 5.7a and 5.7b. The former is that of a young man surrounded by power plants and heavy industry. At the time, France was in mid-economic growth, and the words of the order at the time were; 'employment' and 'industry'. However, his last campaign poster gives a different feeling, that of an older man in a tranquil meadow in the rural countryside, as society shifted its priorities to more leisurely activities. Thus, to overcome the "eyesore" perceived by anti-wind campaigners, adapting the technology is unlikely to solve the issue. However, gaining a better understanding of people's current state of mind and their relationships with the landscape could subsequently lead to marketing the technology accordingly and hopefully proving more effective.

Furthermore, interviewees in Case 3 also suggested that even using recommended best practices would not necessarily be sufficient to help developers overcome social resistance [25]. They argued that many people are put off by the mention of the words 'wind turbine' and do not wish to have one in their community. To open conversations, people need to be better informed of the stakes to take an interest or make more founded choices. This resonates with the developer's experience in Case 1, where 'ugliness' was the most used word to justify rejecting the possibility of wind projects by contacts at the municipalities. This was still apparent after all efforts were made to keep to best practices, including [127]:

1. Keeping wind turbines substantially further than the required 500m away from residents.
2. Designing parks that do not encircle residents.
3. Attempting to include the communities in the project design at the earliest stage possible.
4. Targeting places already less aesthetically pleasing, such as along main roads or landfills.

Therefore, cultural prejudice towards wind turbines is still a limiting factor, regardless of current best practices.

5.5.3. Knowledge Institutions and Science

While desk research showed that knowledge institutions are varied and spread across France at the national level, the practical experience in Case 1 suggested that the population and other actors at the local level appear detached from them.

(a) 1965 **(b)** 1981

Figure 5.7: Mitterand Campaign Posters (source: Wikipedia

The case studies also showed that onshore wind-related knowledge institutions struggle to inform the broader public of their existence and share knowledge unless the receiving organisations or individuals were already interested in RES deployment.

This became apparent during the exchanges with Mayors or other local authorities. Communities and their representatives seem to know very little about the French energy system, energy mix, and the associated ecological and economic impacts. Therefore, it was difficult for developers to explain the potential benefits of a co-owned community wind project. In many cases, from developers' experiences [38], and the interviewees suggested that offering so much new information seemed to either overwhelm or disinterest them. It seems that there needs to be a readily available unbiased source of information that is worded and accessible to all [142].

Knowledge and Awareness
From conversing with employees within the wind energy industry [38], developers and experts alike feel that the combination of unknown rewards and ignorance about the French energy system appears to be one of the most damaging factors to local energy decision-making. Mayors have the power to accept or refuse projects, but they seem to lack a broader perspective. Many will turn wind project developers away out of personal convenience. Unless a Mayor is energy-educated enough to know otherwise, the benefits of hosting a RES are not obvious, and yet there are plenty of visible downsides (loss of popularity, time-consuming networking, many extra tasks...) to agreeing to a potential wind project.

5.5.4. Technology and Infrastructure

In France, the technological performance of wind turbines is strongly related to available space and infrastructure. The technology is close to reaching its optimal performance limits [51] and has proven its effectiveness at generating power. However, there are still difficulties in connecting wind parks to the grid because the infrastructure is difficult to access.

Administrative processes for new grid connections still take too long, even with government policy changes made to accelerate them. For example, in December 2021, even with an ongoing energy crisis, over 10 GW worth of wind energy requests to connect to the grid were still pending [126]. Of these, only two GW had already signed a contract with a DSO for a grid connection (who have up to 3 months to answer a request); all the others were either:

1. waiting for the environmental authorisation from the Department Prefect)
2. subjected to legal challenges and waiting for an answer to a court appeal
3. waiting for other administrative verification processes, such as verifying the thoroughness of the impact studies, after having applied to Department authorities.

Furthermore, radars for aviation and military low-flying training zones, in addition to biodiversity and cultural constraints, mean that 47% of land in France is prohibited from wind turbines [5] [135]. Some foreign companies choose to keep manufacturing smaller outdated turbines specifically for France. Although older models are less powerful than their more prominent successors, they are the only turbines to be operational below a height limit of 130m [127]. Such height constraints not only limit planning options for developers but could be damaging to the public's perception of the technology's capabilities [25]. According to Pauline Lebertre, general delegate of FEE, in some cases where height restrictions have been lifted, up to four older models could be replaced with a single, larger and more powerful turbine for the same installed capacity [9].

5.6. MLP Lens Comparison

The three related case studies act as a window onto a microcosm within the French energy regime and expose more struggles outlined in the national-level MLP study previously in Chapter 4.

The following section is divided into two parts. The first compares findings found at the national from the previous chapter and the local level as discussed in the three case studies. For simplicity, the exact regime dimensions are applied to keep comparisons straightforward and comprehensive. The second part of this section uses the SNM framework to assess the barriers to scaling up perceived by niche from the desk-based research and practical experience with the company.

5.6.1. Politics and Policies

Researchers and specialist energy reporters have noted that the French government hesitates to support wind energy and move away from nuclear power. However, on paper, government policies are supportive of wind in the long term, and the technology is widely included in local (PCAET), regional (SRRADET), and national (SNBC and PPE) plans towards carbon neutrality.

In practice, it appeared that while policies could be more supportive, the main political hindrance comes at the most local level of governance. Climate targets exist, but the roadmap to reaching them is poorly monitored between the national policy level and the local implementation level. This appears to be one factor that makes many local decision-makers, Mayors and Prefects, feel removed from any energy transition responsibilities and are not supportive. However, other non-energy-related policies could also be to blame. In developers' experiences, even when Mayors show interest in wind energy, they frequently discover that the area in or around the municipality is subject to army aviation constraints. This limits the space available for construction and, more often than not, has brought the potential sites closer to residential areas causing a local uproar. This, subsequently, puts an end to any further site investigation [38].

As noted in Section 6.5.2, decentralizing energy transition responsibilities has not worked as hoped. There are too many discrepancies between the national-level SNBC and the PCEATs at the local level. The case studies pointed to the lack of guidance on how national goals should be achieved locally. There was also too little coordination between local actors to compensate for the lack of political leadership.

During the period at CNR, the "Ten measures for responsible and controlled development of onshore wind" [4] that had been long-awaited by the project developers was published by the MTE. Beforehand there had been a lot of hope that the government would take new measures to lift several barriers they faced. However, the result was rather disappointing. Instead of omitting obstacles to development, it tightened environmental regulations, made some best practices mandatory and gave local electives more rights to veto projects.

The practical changes put in place by the MTE and the consequences felt by developers were:

- It gave prefects more rights to apply even stricter environmental and local compatibility requirements and map out their preferred areas for development. However, as seen in the conclusion of Case 1 in Section 5.2.5 above, these maps do not account for existing constraints such as radars or low-flying training zones).

- It requires developers to remove infrastructure altogether at the end of a project's life and has made recycling compulsory. This was a relief to many because developers could prove to any doubtful residents that the area would be restored and all turbine equipment removed by law.
- It requires developers to consult the Mayor before starting a project, not just the landowner. This was already used by most as part of best practice.
- It necessitates clamping to be activated on turbines in case of excessive noise and means of managing the light pollution caused by the turbine (to switch on only when planes pass by, for instance).

Some help and relief were included, though;

- The measures announced and promised to instate a national-level mediator. However, by late 2022 there appeared to be only one at the national level, which can only intervene for the more advanced projects.
- They also provide more help for CREP funding and bonus points to projects that include citizen participation - but this was not a significant change.
- They create communal funds from the money received from wind energy. The funds would contribute towards protecting cultural and heritage sites, which would increase the visibility of the return on onshore wind energy to the hosting municipality, instead of the current IFER tax returns to the community.

The list of measures illustrates the inconsistency of the political will to encourage onshore wind development and its reluctance to deliver changes to developers that could really help them proceed with more projects.

5.6.2. Market

As seen throughout Section 4.3.2, the current energy market already has several schemes for more traditional forms of wind energy generation (usually parks owned by developers), which require competing at auctions for the best prices. However, the current system is reaching its limits for geographical and social reasons. The market needs to be adapted to better include citizen-supported projects.

The citizen participation 'points bonus' that developers can apply for was created to encourage larger companies to include the hosting communities in their projects. Unfortunately, as found in practice in Case 1 and shared by interviewees in Case 2, developers feel that Mayors now perceive offers for joint ownership as a ruse to increase their chances of winning a bid. So if anything, it has created scepticism towards the genuineness of some developers [38].

Shortly after the "10 measures for responsible and controlled development of onshore wind" [4] was published, another ten measures for CREPs were also published [3]. It has so far proved, at best ineffective, at worst, counterproductive as it has raised greater suspicion towards partnerships with developers. At the national level (Chapter 4), there does seem to be growing support for CREPs, with objectives to reduce grid connection costs, increase regional networks of advisors to better communicate on projects, and adjust the existing open window mechanism (presented in Section 4.3.2) to give CREPs more market leverage. Whilst these initiatives favour citizen-led projects, they are only effective for groups that intend to create a CREP. Yet, there are no signs of conciliation between communities, CREPs and more prominent industry workers.

5.6.3. Infrastructure

While grid connection costs are a reoccurring barrier mentioned in published research [49], although this claim was confirmed during Case 1, in practice, infrastructure had other challenges. Developers appear to struggle the most with minimising cable lengths between the location of the wind parks and specified grid connection points. This is mainly because substations are usually located closer to urban areas, and wind parks in rural areas with open spaces. These cables can be very costly because they are priced by length. A project is usually only financially feasible if it is within 25 km of a grid connection point - not as the crow flies, but by road because cables must be laid underground. The second problem is that substations are only designed to cope with a set percentage of intermittent RES. If the RES capacity has already been met, developers must find an alternative substation to connect to, often further away. This is something that the Express Source Substations introduced by Enedis should help to solve, but numbers are still lacking.

5.6.4. Industry

From the numbers released by FEE, the French Wind Association [51], the onshore wind projects still seem to be growing incrementally, with new capacity installed annually and creating new jobs in manufacturing to engineering and new learning centres. However, on the ground, developers feel that many of the projects currently coming online result from past projects finally being authorised. They are now running out of space and struggling to find new areas. A project takes years to find, study and design, and the delays experienced in the final authorisation stages cost these companies too much.

To help ease social reticence towards these projects and reduce legal challenges in the final authorisation stage, citizen inclusion schemes have been created via the 'bonus points' system for FIPs or via the creation of regional-level advisors for CREPs. However, none of the schemes have been as effective as hoped. The low number of CREPs and citizen inclusion in France has been frequently blamed on grid connection costs and feasibility study costs associated with high risk. However, Case 1 revealed that these issues were not the most problematic for developers seeking to include citizens. This case showed that national and regional schemes exist whether a community wants to fund a project or an energy company needs funds from a third party to share the ownership with a community that lacks funds. Examples include many setups in place at the national level to finance the riskiest stages of a project (EnRcit'), by local investors (such as SEM), or in the form of regional financial and advice (Association FRTE). Not all these organisations are equally spread across the country. Still, the project developers that participated in Cases 1 and 2 seemed to believe that alternative funds can be found to solve financial issues in most cases.

So the most significant challenge to keeping the wind industry in France still seems to be administrative delays and social acceptance.

5.6.5. Knowledge and Science

The research at the national level proved that knowledge institutes, such as universities, research and development centres, and energy-related training centres, are advanced and well spread across the country, as seen in Section 4.2.5 [51]. Together they cover all areas of research, information, lobbying and staff (re-) training for a future decentralised grid. These institutes are numerous, but none are large enough to hold any significant political effect and exert little influence. Even national-level institutes are understaffed and lack financial resources, as explained by the interviewees in Case 3. These structures have qualified, well-informed employees, but only people already supportive of developing more wind projects would know about them. Therefore this knowledge is poorly shared [25] [142].

In the field in Cases 1 and 2, more local capacity builders exist (advisors in the SDE, regional community energy associations...) than the results of the desk-based research suggested in Section 4.3.3. However, the experiences in Case 1 indicated that many of them are bound by a rigid political structure and lack the freedom to initiate alternative solutions.

All intermediaries from the empirical study in Case 1 with local knowledge and experience with RES could only direct developers (and local inhabitants searching to build a CREP) towards the same networks for general advice. Unfortunately, these intermediaries do not have enough authority or information (which is kept by their superiors at the national ministry or by regional decision-makers) to offer case-by-case support. Their roles seem constrained to giving out advice and official information. Most noticeably, they can only act unidirectionally and must wait to be sought out by communities that wish to become CREPs, with or without creating a partnership, instead of suggesting projects to them.

Also, the developer's experience in Case 1 revealed that even in regions where supportive networks of organisations exist, like the Grand-Est, there is no coordination between them. This creates confusion for communities and developers, who can be uncertain about which organisation they should turn to for unbiased local information.

This was most obvious in the prospecting stages before projects even began. In the current climate, developers struggle to initiate projects due to the role of the Mayor. Developers have to approach them directly because intermediaries (such as SDE, SEMs..) act unilaterally and can only help the community find a developer or investor, not the reverse. In addition, a common observation was that Mayors do not feel a sense of duty towards energy transition because they have other more priorities for which they may feel a greater sense of responsibility.

5.6.6. Culture

As already stated in much previous research [49] [104] [33], social acceptance was confirmed to be the biggest challenge in all cases above. Many previous research papers and common perceptions of the issues have often blamed the resistance to the conspicuous demeanour of wind turbines encroaching on the local landscapes. However, the interviews in this study emphasised the growing distrust towards wind energy created by public media and a lack of energy education. Their feelings were that there were no signs of efficient neutral or pro-wind networks to advocate for its benefits or improve trust [25] [142].

Wind projects require shared resources and depend on stakeholders with varying specialisms and priorities, many outside the energy sector. Therefore, experts strongly advise promoting energy education well beyond the energy sector. They believe this is critical to reducing chances for misinformation to be spread and ensuring independent opinions and well-considered decision-making. For similar reasons, citizens could better understand PCAETs, which could help shift these begrudging feelings towards a sense of satisfaction and ownership for contributing to the energy transition [6] [147].

Finally, the cultural paradox perceived in Section 4.2.6 between the French population's attachment to their localism and not to locally generated energy, was confirmed in the local-level experience in Case 1.

5.7. SNM Analysis of Wind Energy including Community Participation

The following is a similar SNM analysis as in the previous Chapter 4. The MLP comparison carried out above confirmed that the onshore wind sector led by project developers is struggling, and greater citizen participation is needed. Therefore, this SNM analysis focuses on onshore wind energy projects with community involvement. The SNM framework is used to sort and analyse the opportunities for this sector thematically. The options for community involvement taken from the case studies above are compared to and complement the desk research at the national level in the previous SNM in Section 4.3.3.

In this section, the SNM analysis is broken down into four parts; niche enablers, niche actor networks, niche learning and visions and expectations for the niche.

5.7.1. Enablers

The first part of the niche analysis looks at the enablers needed for niche development under MLP and SNM framework, namely, nurturing, protection, and empowerment.

Nurturing and Shielding

The niche for community involvement in onshore wind projects falls under a fully community-led scheme such as a CREP and joint ownership between communities and developers. The most notable form of nurturing and shielding of this niche is the creation of intermediary roles to facilitate communication between developers and communities. This novel approach to building wind energy projects is receiving more support from policymakers and government organisations than ever.

Interviews with experts from ADEME and SER [142] [25] confirmed that even though no intermediaries were found during the case study as a developer, there is a national initiative to create networks of intermediaries of two kinds.

In 2021, the Government provided ADEME with a budget for a network of four to five representatives per region to advise on wind and solar energy. This network was to be piloted by the ADEME network called Cocopeop and, since 2022, is being revised and renamed 'Les générateurs' [7]. However, specialists warn this is probably still too few to alleviate the existing tensions between local communities and developers at present [142]. Nonetheless, these new intermediary positions are still only on trial and will need to prove their effectiveness before becoming permanent positions. French wind experts are hopeful that these intermediaries will prove helpful in overcoming several communication problems and that more jobs will be created in the next few years. [142] However, given their novelty, their role is still somewhat unclear. The network layout differs between regions; some are integrated into existing structures, such as the SDE, and others are part of new structures. The first case illustrated that even as a developer of joint ownership or a community member, these inconsistencies could make them hard to identify and ask for support. Another concern from industry experts is that mediation is a soft skill, with limited ways to measure performance and quantify how effective the mediators are. If there are no obvious improvements by using intermediaries, wind lobbyists will struggle to convince the State to appoint more of them [142].

These advisors are different from the national-level mediators who are not yet in place. The mediators promised by the MTE will not be charged with giving advice but with intervening in the advanced projects that meet unforeseen resistance. For this kind of intervention, the studies for the development phase of a project must have already begun. The mediator's role would be to facilitate communication between the project leader and the actors at a local level [142].

Nonetheless, it is still unclear who is responsible for initiating the role for either intermediary role, and that remains to be seen. [25]

Until recently, permits for 100% self-consumption were strictly reserved for solar power, but are now applicable to large wind farms and hydro plants upwards of 10 MW. New shielding mechanisms are also being put in place for CREPs. However, as previously stated 5.4.2, consumers would be required to consume 100% of 10 MW at all times, which is logistically very challenging for small communities, mainly because storage is not included. Furthermore, no premium bonuses incentivise project developers to pursue the format.

Empowerment

This niche is gradually receiving more government attention and being granted more means of empowerment to grow and gain independence. Even though this case study identified several barriers, it showed that more support for community wind projects is available than previously documented:

1. Community energy is receiving more support and recognition from the government, with a recent publication of "Ten measures for the development of citizen renewable energies" [3] alongside those above "Ten measures" to support wind energy that already steered developers towards involving communities. Financial support mechanisms are already available for the riskiest and most expensive stages of project planning at a national level via Enercit. Regional help is often available via FRTE, which helps reduce investment risks for communities.
2. Various new policy changes are also empowering communities. Modifications include; shifting collective self-consumption rules gradually for wind energy, and the latest open windows mechanism will be available to all community-led projects to spare them additional administrative procedures of tendering for FIPs and to protect them from competing against larger incumbents.
3. The MTE has managed to override authorisation delays for over four GW of projects on standby at the end of summer 2022. Nonetheless, more legal changes must be made to the procedure for the benefits to be longer-lasting.
4. mMdiators have been instated, which suggests that recommendations by the wind associations (SER, FEE, ADEME...) are being implemented by policymakers. However, some aspects of the roles of the intermediaries and mediators still need to be better defined. [25]

5.7.2. Network Formation

A niche needs to be supported by enough actors from varying backgrounds working towards a common goal. This section presents the network between actors responsible for the community wind energy sector by using the analytical framework mentioned in Chapter 3. The network formation consists of two parts, beginning with network composition and then network alignment, before being summarised in a conclusion.

Composition

The following describes the composition of the network of actors involved in wind energy and community wind energy niches. The more actors and the broader their backgrounds are, the stronger a niche's network is.

Many wind **companies** in France present opportunities for developing projects with or without community involvement because they are financially stable enough to carry much of the project's risk autonomously. However, some of these developers have been problematic because their practices have been considered inconsiderate towards residents and consequently badly affected the reputation of other, more considerate developers. Furthermore, as shown from the experiences in Case 1 above, even companies using the best practices are struggling to find new projects to develop due to social and policy barriers. Available land is limited due to aviation constraints, which leads to fierce competition between developers in certain areas. The competition occasionally leaves communities feeling targeted and strengthens anti-wind feelings among the local population.

Social organisations are numerous and have a variety of backgrounds. There are many support organisations for RE projects, especially CREP and yet there are not so many for encouraging a fusion of the two in joint-ownership projects. The national organisation supporting CREPs is Energie Partagée, which has several national subsidiaries, such as Enercit and many regional networks, such as GECLER in the Grand-Est for citizen-led projects. Other platforms for citizen financial participation also exist — Energie Partagée Investissement (EPI), which helps organise crowd-equity-raising campaigns and manage the distribution of dividends to shareholders. Other organisations support renewable energy development indiscriminately between community energy groups or developers, such as Négawatt, Association Fonds Régionaux pour la Transition Énergétique (FRTE) or even ADEME (although not financially for the latter). Other national government-led financing schemes for RES also exist to help companies or private owners implement more renewable energy sources, including wind energy. All the while, none explicitly helped the emergence of joint-ownership projects among the organisations listed above. An increasingly apparent consequence is the new competition between citizen-led projects and developers instead of cooperation. Also, unlike some anti-wind or unsupportive social organisations that exist, and actively communicate about the negative impacts of wind energy, members of successful joint-ownership projects do not easily communicate about their achievements.

Energie Partagée (EPA) was created in 2010 and funded by Enercoop. This energy provider sells 100% community energy-sourced contracts and prides itself on a clear objective of producing a new form of energy independent of incumbents. These sister organisations lead the community energy movement in France and subsequently promote a single framework where citizens are encouraged to build their CREP and sell the energy to Enercoop. While EPA can financially support joint-owned projects with developers, the organisation is much less vocal about it, and the idea must come from the community first, not the developer.

Knowledge institutions are numerous from the national level like ADEME and even more local institutions such as departmental SDE and DREAL or other local environmental networks or consultancies.

ADEME is the national reference for information about ecological and environmental issues. Unfortunately, as shown by the experience of trying to contact the association as a developer in Case 1 and later in a private interview in Case 3, the organisation is spread too thin and needs more workforce [142]. As a result, they cannot oversee and process as many requests and projects that they are tasked with and have to delegate by creating subsidiaries, such as the Climaxion network found in the Grand-Est partnerships with other organisations such as Energie Partagée or the Bird Protection League (la Ligue de la Protection des Oiseaux, in French). By delegating specific tasks and responsibilities, the national agency loses some direct control and influence in particular sectors. For wind energy, ADEME circulates research results and information about controversial topics. Still, it leaves case-by-case problems to its new advisory network, ”Les générateurs”, which is just starting.

As the first of the case studies found, most SDEs have a team dedicated to advising on RES and, specifically, wind energy deployment. Their role varies between maintaining the local grids, managing public lighting and advising their communities on energy-saving and renewable energy projects. The employees are also well-informed about community energy projects. Soon more SDEs will also host advisors from ADEME's ”Les générateurs” network.

DREALs act as regional-level representatives of the national MTE. They are appointed to steer sustainable development policies at the local level. Consequently, they can also be considered a source of information about their designated area's environment and climate mitigation plans. They are also tasked with increasing citizen awareness of energy and climate issues. [137]. These objectives seem in alignment with renewable energy and CREP objectives. Yet, Case 1 above found that developers used these organisations to find where *not* to build wind farms. Even national-level experts suggest that, more often than not, DREAL representatives prioritise landscape integrity over cohesion between residency and energy infrastructure [25]. For the department of Aube, this can be seen in the articles published by the DREAL in Grand-Est, where wind energy targets are presented but seem immediately contradicted by a chapter dedicated to the problems wind turbines can cause and locations where their development should not take place [121].

Many **Government** or local state representatives are involved in the niche at many levels: national MTE, Regional and department prefects, town Mayors, and the associated DREAL and local energy authorities SDE. Media is also a key player in wind energy diffusion.

The position taken by the government in the wind energy niche is still unclear. There are too many layers to consider, without any linear vertical hierarchy, which consequently lacks strong leadership. Currently, the highest level of government involved in RES deployment is the MTE, which is supportive of wind energy deployment with and without community involvement. However, the MTE's policies often come second to other ministries' preoccupation, such as the Ministry of Defense's need for training zones for the airforce or the Ministry of Finances' links to the nuclear industry. Given these inter-ministerial tensions, the government struggles to deliver strong leadership signals in favour or against wind energy development.

Regional and Departmental Prefects and Mayors have pivotal roles in approving or refusing wind projects in their area. If supportive, these actors can strongly influence their communities and massively increase the chances of a wind project emerging. However, if any of these representatives are unsupportive, there is little a developer or a motivated community member can do to bring a project to light. Experts interviewed in Case 3 find it all the more problematic that none of these representatives is required to have any training or knowledge about energy or RES. Also, from a prefect or mayor's perspective, planning a RES project is very timing consuming given the numerous studies and level of verification each must undergo before the final approval stage. Community involvement only increases the workload. Prefects and Mayors also have many other responsibilities that fall under their specific competencies and that are more likely to take priority.

As seen previously, DREALs oversee the energy transition at a Department level. However, developers and industry specialists alike, from all three cases above, find DREALs' methods outdated and that they cannot be considered drivers of change but instead act more as a source of local documentation and report on the progression of RES deployment concerning the goals previously set.

Media streams are primarily responsible for spreading news and informing the masses. Information flows can powerfully shape the future of niche-level energy technologies, public perceptions and expectations created by media coverage. However, journalistic content is often under pressure to attract readers by giving a biased opinion that can over or under-report specific facts to catch more interest. Owing to human cognitive bias, notorious events make for more potent headlines than uneventfully successful ones. French media is dominated by stories of anti-wind campaigners that use people's confusion and ignorance about technology to their benefit by creating more unfounded rumours damaging its reputation. The French media coverage of wind energy is ambivalent to the resource. On the one hand, wind energy is represented as a preferable, environmentally friendly energy technology that should be promoted. On the other hand, it is heavily criticised for being a nuisance to residents, its impacts on biodiversity and in worst cases, some discuss the ”scams” that wind energy projects can be [33] [63].

As for **Users** that in the case of onshore wind energy, would be all end users of the grid, but there is potential to create a new user segment for host communities of wind energy projects. Currently, users do not receive any benefits from using electricity from a nearby wind turbine as opposed to power from other traditional forms of energy. If anything, 'green energy' contracts are more expensive but can offer climate-conscious customers some moral relief. In the meantime, communities surrounding wind farms experience intrusive infrastructure on their daily landscape. Even in the best-case scenarios, these residents only receive greater financial benefits paid either to the communities via an energy tax (IFER) or individually as a sum paid by the developer (known as a ”chèque énergie”) during the first few years of operation. There are still too many barriers to collective consumption and storage for these uses to become more widespread. This differs from the German village of Feldheim, where residents enjoy some of the cheapest electricity rates in Germany. [133]

Alignment

From an SNM perspective, the network wind and community wind energy seem to benefit from various actors within their networks. Nonetheless, these networks are hindered by the misalignment of actors' objectives and cooperation to achieve them. This next part explains the key players' differences in goals and agency.

There are many interdependencies for information and different objectives regarding wind or even community wind energy:

This study demonstrated a lack of alignment between political actors. The government has been promoting the uptake of wind energy with and without CREPs, as shown by the publication of "Ten measures" [4] [3], which support these niches. However, these measures were not welcomed as helpful changes by actors in the sector, such as developers or motivated local authorities. Other decision-makers, such as Mayors and Prefects, showed little support or enthusiasm towards contributing to community energy projects. In most cases, local energy authorities, the SDE, can offer advice and plan out PCAETs for willing intermunicipalities. Yet they cannot initiate any RES projects in their designated areas, even if they have not met their energy or climate targets.

As for other bodies supporting wind energy development, such as the citizen energy association in Case 1, GECLER, or RE investors such as the SEM Energie, their goals are the same. Still, they do not coordinate directly with one another and rely on being approached by communities because they lack suitable intermediaries. Other local authority bodies, such as the SDE, showed a reluctance to proactively create a network for raising awareness of the different opportunities for community energy projects. Despite already lagging behind their local energy transition goals, this case showed that when asked, the employees responsible for advising on energy matters in the area were also unaware of their communities' feelings about wind energy. Interestingly, they were not solicited for advice by their respective communities on the matter, even after a developer had approached communities. Meanwhile, communities have expressed concerns about being pressured by developers and feel limited in their options for seeking unbiased opinions or advice. This lack of trust or use of alternative advisors often gives way to a sense of 'self-preservation' and refusing any initiatives with developers in case they are taken advantage of.

More communication between actors is needed to increase the alignment of ideas and objectives, and more intermediary roles could breach gaps in beliefs. Networks for starting wind projects barely exist and are made up of multiple individual organisations with none or few shared intermediaries. Intermediaries are essential for network formation and niche survival. Without means of sharing knowledge and learning, aligning objectives between the actors is increasingly difficult.

Networks of intermediaries are not so evident in France. The effect of the newly instated RES advisors from "Les Générateurs" is yet to be seen. Their role is to share their knowledge and offer unbiased opinions on projects. However, they are likely to be too few, and it is unclear for which existing institution they will work - most likely the SDE, but not in all cases. If they are poorly identifiable, it could prove more challenging for RE developers to rely on them.

Outside of partnerships, citizen-led projects are all led by the same organisation, EPA. Having all the necessary network and intermediary functions for the emergence of CREPs in one national organisation has its practicalities. However, it does hinder the development of alternative frameworks, such as a more hybrid approach and developer-community cooperation. This confirms some of the concerns and shortcomings already noted in the MLP at the national level Section 4.3.1 regarding the lack of diversity of projects offered by EPA.

EPA is the only organisation in the country, so the State relies on reinforcing its existing approach to bring out more CREPs rather than creating new initiatives. Other countries like the Netherlands have found a hybrid structure (between part volunteer-based and part employee based) for their local capacitors, allowing them to operate a more stable organisation of advisors [141]. Meanwhile, France still relies solely on volunteers or ad-hoc local public funding. It is much needed because any state services (ADEME, SDE...) are understaffed and have little to no resources (no power nor rights to intervene unless their advice has been requested) to carry out crucial communication tasks and networking.

Conclusion of Networks

As seen in the previous Chapter, niches are more likely to succeed the more varied actors are involved, and the more aligned their goals are.

Case 1 was particularly enlightening in illustrating the network formation issues observed at the national level in Section 4.2.6 in the previous chapter. This may only have been the case for this microcosm within the greater French regime, but the examples were taken from actual observations. Even the ”capacity-builders” for the Souilly d’Air project in Case 2, came from the Mayor’s personal network before involving professional regional organisations. Therefore, key actors gave their support for free, which is not a method that could be easily replicated in other cases.

The case study showed that associations working in the energy sector at the local level hardly interact with one another. This was illustrated by the interactions with community energy associations such as GECLER or CREP investors such as SEM Energie de l’Aube. The case study demonstrates that even in regions like the Grand Est, where a framework of support is present, there is a significant lack of coordination between the actors. This results in a lack of actions taken by community energy intermediaries, as was demonstrated by the poor coordination between employees of the SDE responsible for RES diffusion and community integration in energy projects. To fulfil their functions as local capacity builders [125], there need to be more initiatives taken to raise awareness and more intermediaries responsible for coordinating and managing partnerships with larger companies. This could encourage these incumbents to collaborate with communities more fairly.

5.7.3. Learning

The five aspects of SNM learning are much the same as those used for community wind at the local level as in the previous national-level study in Section 4.3.3. Yet, more differences can be seen in the learning processes, so the following will dive into a summary of these processes.

Summary of Learning processes

Many learning phases for wind energy are mature or on track, but much learning is yet to be made in the technology’s relationship with society. There is a strong awareness of the required **technical developments** in terms of complementary infrastructure, for instance. The **industry** is already strong and growing, with incumbents even retraining staff to suit roles dealing with more RE integration. Many studies have been carried out on the **social and environmental impacts** of wind turbines on the environment, human health, biodiversity, birds, house prices, and technology have evolved accordingly. One debating question left for the industry is, whether bigger and fewer or smaller and more wind turbines for the same capacity is more socially acceptable. It seems it is less about adapting the technical aspects of the technology and more about changing perceptions and limiting the impact on the landscape. **Governments** are still yet to find their role to drive the industry forward, and there is still much to learn in respect of harmoniously sharing resources between society, companies and climate goals.

Technical and policy regulations need to align. Policies call for more capacity yet have restricted surface area available to wind turbine development by reserving it for low fly zones or clearance areas for radars. This results in wind farms being clustered in the few pockets of available space left, often closer to residential areas and with lower and less effective turbines. The closer wind turbines are to homes, the more communities feel the farm’s negative impacts, damaging in a **user context** that is already prone to much social resistance.

First and Second Order Learning

More first-order learning could be achieved by intermediaries sharing knowledge and experiences between people and organisations with expertise in CREP. Higher learning could come from more important education and knowledge about the direct benefits of CREPs to the host communities. This could contribute to a more positive perception of wind energy and result in a constructive shift in beliefs. Media could also help shift beliefs. More energy education is needed in politics and society.

Conclusion of Learning processes

Much of the learning in France has come from reviewing forms of learning by searching through research and development. This has led to a strong establishment of institutions and technical knowledge about wind turbines and infrastructure, for instance. However, other forms of learning, e.g. learning by doing, learning by using and learning by interacting, occur as by-products of activities performed for different goals. Some know-how can only be accumulated by using technology. This is particularly relevant for learning by interacting between producers and users [80]. In wind energy, research and development have been fulfilled, but to overcome contextual barriers, interactions need to increase between developers and users of the technology. These users could be communities or community energy associations, such as EPA, to create new strategies that fairly inform and include citizens in projects in the just proportions for all. Working together could prove fruitful for finding an effective communication strategy to promote the benefits of wind and community wind energy and contribute to changing collective biases and perceptions on the matter.

5.7.4. Vision and Expectations

Shaping future visions and expectations is vital for niche survival as it justifies participants' commitments to helping the technology scale up.

Specific aspects of the niche

France still has much-untapped wind potential, so the basis for supporting wind energy is favourable. However, the development direction needs to be more tailored to meet community-level needs. Every location is unique, and national objectives do not translate into local differences in the landscape; community identity requires wishes. French "localism" is intense among the population, and the will to produce 'local energy for the locals' is appealing to many [33] [125]. So the premise for supporting community wind energy is there, but the current framework is unsuited (e.g. no direct collective consumption nor interactive reward from hosting the technology). For such changes to occur, common ideas between policymakers, companies (developers), social organisations (community energy supporters, pro and anti-wind activists) and users (the general French population and affected communities) need to be discussed to converge towards a unanimous conclusion. The more this is put into practice and the lessons learnt shared among participants, the more credibility the niche would benefit from.

Even specialists in other countries see the ambivalence of the French Government towards wind energy. Take WindEurope's CEO Giles Dickson, for example, when he said: *"The volumes proposed for onshore wind are inconsistent with a rapid energy transition. Onshore wind is cheap and scalable. It is the fastest way to produce large amounts of additional renewable energy, and most French people support it. Other European countries have successfully shown how to reconcile onshore wind, biodiversity and public acceptance. And France has made good progress in this area: they have 19 GW of onshore wind providing 8% of its electricity, and the Government has recently agreed to ten measures for the "responsible development" of onshore wind. The latter provides a good basis for the further expansion of onshore wind in France. But President Macron's plans fail to benefit the huge potential of onshore wind for France's energy transition".* [62]

Wind Europe also reports that *"despite objections by politicians, onshore wind can also work in France [...] Other European countries have successfully shown onshore wind works and can be combined with biodiversity and public acceptance. With the guidelines on the "responsible development" of onshore wind energy, this can also happen in France."* [62].

Landscape expectations

France's current energy regime cannot last [109]. A solution needs to be found to make up for the capacity that the retiring nuclear plants will leave behind. This is a chance to ramp up RES capacity, including biogas, hydrogen, wind and solar, even if new nuclear is scheduled for operation by 2035.

Yet, onshore wind developers choose to remain cautious given the recent varying stance the French President has had on the matter. In 2020 he expressed concerns about the social acceptance of onshore wind power. In February 2022, in Belfort, he halved the forecast rate of onshore deployment in favour of increasing offshore wind energy [21]. In September 2022, France launched its first offshore wind park, and another 17 wind parks representing 10 GW are expected to be operational by 2030 [51]. In reaction to the President's reluctance *"The Prefects no longer know what attitude to adopt and when in doubt, many of them prefer to block the projects"*, according to Mattias Vandenbulcke, the strategical director of France Énergie éolienne, to which he added that there was a lack of civil servants to approve ongoing projects [21]. As a result, Political leaders are being urged by key players in the wind sector to take a definitive stance on the technology and give clear signals to the industry. [85]

Niche expectations

The wind energy niche is unlikely to evolve technically because it has already matured and is approaching its engineering performance limits. So far, any technical additions to reduce impact have lowered efficiency. The annual rate of new capacity installed is also experiencing a decrease owing to understaffed authority representatives, the strictest environmental and noise requirements in Europe [33] and increasing social resistance. This situation is unsuitable for the industry to scale up. The community energy niche is still too new to save the wind industry, but it seems clear that stand-alone companies developing projects cannot grow without community support.

Although CREPs may be seen as a possible solution to improving the acceptance of wind energy, in practice, this is yet to be seen. CREPs are growing in numbers, but most still choose to develop solar panels on roofs of public buildings or car parks rather than wind turbines to promote local energy. Also, the administrative burdens take up a lot of indefinite time. These are most often related to appeals for conflicts of land use, other nuisances or changes to the landscape. All these can discourage communities, even the most motivated, from completing projects that require a lot of voluntary commitment and are not encouraged enough by public support.

Conclusion of visions and expectations
France still has much wind energy potential to unlock, and the current energy climate means it is running out of options to compensate for the power deficit left by its ageing nuclear plants. All future energy scenarios recently written by independent energy specialists (RTE, ADEME and Négawatt) include high shares of onshore wind. This is because it is seen as the most mature and affordable option.

However, as seen in the previous papers [49] [131] [57] and confirmed by the reactions of developers in the present study, experts and communities in Case 1 there is no clear direction for wind development at present.

The community wind energy niche is unlikely to grow unless the discourse on wind energy changes. A more effective communication strategy about its benefits also needs to become more widespread if this 'niche' is to become an enabler for onshore wind energy to scale up.

While there is still hope from wind specialists in France and abroad, government policies could enforce the existing energy strategies to include more onshore wind. However, there is an ever-increasing risk of losing out further to offshore wind development instead.

5.7.5. SNM Conclusion

While the technology is mature enough to have created a varied network of actors, including regime actors, which have developed from years of learning experiences, expectations still show that political leadership and social acceptance are still lacking to help it to break into the regime market.

Community integration or ownership may be the highest recommendation for solving social acceptance, but this concept in France is still in its early stages. There are strong signs of support for the niche, including actors in all domains and spread at different scales of action (local, regional, national). Nonetheless, the novelty of community inclusion is reflected in a lack of structured networks and actor alignment surrounding this niche. This also shows there is still much experimenting and learning to be done before more varied frameworks can emerge to be tested before the niche finds a suitable equilibrium and stability to compete at the market level. Without more incentives to diverge from the current community energy options on offer either by EPA or the existing partnerships with incumbents, it is difficult to foresee the CREPs niche scaling up sufficiently to be a lever to wind energy promotion in the future.

5.8. Case Study Conclusion

This case study closes with a conclusion to emphasise the barriers observed by actors in a local microcosm of the French wind industry. This section briefly highlights the barriers that could have been expected based on observations in the national level MLP. It summarises five key barriers found and the local level seemingly missing at a national scale.

This study offered insights into the differences between barriers to wind energy observed at a national level in contrast to a local level. The MLP analysis from a national perspective emphasised various challenges, such as the high costs of grid connections; administrative and juridical delays; height and radar constraints, and limited local networks for supporting wind turbine deployment. Yet, at the local level, it was evident that while these issues persisted, they were secondary to the first barrier, that is, finding and initiating a project.

This study showed that more enablers were in place for supporting wind energy, and even more initiatives are being taken to facilitate community wind energy projects, such as the ten supportive measures for supporting CREPs [3]. However, it also demonstrated persistent, under-acknowledged barriers at the local level, without which the national energy and climate goals cannot be attained.

The first issue encountered and scarcely mentioned in previous research relates to the role of the municipality Mayor. In short, they hold a position of power in local decision-making, including energy-related decisions. Yet, the energy sector is highly complex, and many lack the technical expertise to make informed independently. Even if a Mayor shows his support, the timing of elections is also problematic for developing projects. The average project planning (eight years) takes longer than a Mayor's mandate (six years), and a newly elected Mayor may not be willing to collaborate with developers like their predecessor.

Second, while local and regional networks supporting RES exist, many lack agency. They are either understaffed, such as l'ADEME, or can only act unidirectionally to aid communities in approaching developers, such as GECLER or SDE Aube. Others local supporters or investors can only intervene once the community, such as SEM Energie Aube and other funding platforms, have officially accepted a project.

Third, national climate goals are theoretically diffused to a local level, but local goals are unclearly defined in practice. The discrepancy between regional and intermunicipality objectives laid out the in the SRRADET and PCEAT, respectively, not being defined at a municipality level is problematic. No single stakeholder is responsible for attaining the climate goals locally. The municipality Mayors have the power to contribute to achieving these goals by hosting RES, such as wind or solar, but they are not held responsible if the targets are missed. Only national objectives are law binding, under threat of being fined by the European Commission, which has no local impact.

Fourth, developers still find it difficult to explain to communities what partnerships in community energy projects are. Interviewees described the challenges of explaining to town Mayors the benefits and purposes of building a community project with or without partnerships. Their impressions were often that the Mayors felt removed from any energy responsibilities and had very little knowledge on the subject, which made it more difficult to capture their interest. Developers interviewed added that even when they have rather successful joint-ownership projects in their portfolio to show as examples, only already the ecologically minded were willing to listen further. [125] [59] [127]

Finally, interviews with experts revealed new explanations for growing social resistance, much of which stems from the power of the media. The first observation is the effect of cognitive bias and the seeming appeal for more shocking or bad news that attracts more readers. The second is the lack of an unbiased and popular representative for the wind industry in France. Nuclear energy has several public speakers from outside the nuclear industry, such as Jean-Marc Jancovic and several politicians. In contrast, the wind industry relies on support from national wind lobbyists (SER, FEE, ADEME...).

6 Discussions

This chapter discusses the most significant differences observed between the barriers and solutions observed in previous research and those experienced in the present local-level case studies. Indeed, the national MLP led to several expectations and made recommendations for solutions to apply at a local level. Yet, a number of the solutions could not be applied or did not yield the expected result. This chapter reflects on how to understand these differences and adapt or make new suggestions accordingly.

The first discussion starts with the best practices for developers, followed by the importance of understanding tensions between national-level laws and local-level implementation, then managing media influences and the last point discusses options for widening energy education to a broader public. The second part uses empirical evidence from the present studies and policy experimentation logic to design regulatory and institutional changes needed for onshore wind energy to scale up. The third and final part concludes the discussion and highlights elements required for answering the last two research questions.

6.1. Best Practices for niche growth

The content in this section is built from the practical experience in the studies and the barriers noted in the MLP analysis at national and local levels. As the most prominent key players, much advice has been directed at developers and local actors motivated by wind energy projects. The findings below are directed at internal niche actors and present direction to help optimise factors within their control.

This study has revealed different barriers to onshore wind deployment between national, regional and local levels. The desk-based study of national-level barriers, detailed in section 4.2.6, includes grid connection costs and issues predominantly with social acceptance [49] [131] [57]. However, this national-level study also showed that solutions and best practices have already been implemented for both problems, mainly by incentivising developers to incorporate fairer and better practices towards host communities and including greater citizen participation in project ownership. [49] [131] [57]. However, the results have not been as successful as expected if France is still lagging on its onshore wind energy targets [62], and developers are still struggling to secure new projects [127]. This led the author to question whether the proposed solutions were being sufficiently well implemented, or if there were other underlying issues.

For this, the practical experiment at a developing company at local-level presented in Chapter 5, intended to use only best practices and implement all known recommendations to wind developers to initiate a new project.

The empirical evidence found in the case studies in Chapter 5 identified different barriers to those at the national level. Some prevented developers from carrying out the recommended best practices. Problems met by developers at the local level are described in Section 5.8. In brief, the most unexpected difficulties for developers included contacting and communicating with local groups of authority and governance and limited space available for projects. Other obstacles observed were; wrong preconceptions about wind turbines, the cognitive bias of the media managing the topic and weak administration and political guidance for the implementation of RES.

The next part discusses possible measures developers could take to overcome some of the obstacles met during the participatory phase in Case 1 of Chapter 5. Yet, it is important to acknowledge that every case is different. Existing best practices have been published by ADEME [124] and by other researchers such as Feurtey [55] [57], Nadai [104] [102], Enevoldsen [49]) which offer valuable advice. Still, they should be freely adapted on a case-by-case basis [33]. However, while some practices should be prioritised, others could be useful starting points. [42]

6.1.1. Optimising Initial Contact

The national-level MLP study found that most recommendations for project developers called for them to improve their practices and include communities in project planning. Studies often linked social resistance to a lack of transparency by developers and the exclusion of residents in their projects. As a result, many best practices called for more community participation via activities (information meetings, surveys...) and transparent communication [49]. However, many of these practices may only be relevant once an area has been identified and a local actor (landowner or Mayor) has agreed to find out more. Therefore, there is little guidance published about overcoming the initial barrier of a) finding a suitable area, b) obtaining agreement to go further or c) securing local actors' interest in a project before any official documents can or have been signed.

The case study proved what had already been suggested by developers [127], that the most challenging development stage is before a project has even begun - finding and securing a site to develop. This stage starts with the first contact with the community. This section gives a few recommendations based on the case study findings for optimising this first contact between the developer and Mayor.

In literature, a common best practice is to contact the Mayor first, before approaching the landowner to show respect and willingness to cooperate with the community. In the past, too many project developers have chosen to communicate directly with potential landowners, which has led to conflicts of interest within the community and subsequently damaged developers' reputations. [49]

In case 1, however, it appeared that making contact with the Mayors was more of a recurring issue. They had limited opening hours and calls were frequently answered by secretaries. Furthermore, once successfully reaching them, it appeared that many were aware of the new laws that benefit developers seeking to include citizens in their projects which made them sceptical. For that reason, developers need to find other ways to prove their integrity when they offer project partnerships. From experience at the company and other researchers' suggestions [125], a good start could be to work on creating a network ahead of time and collecting as much specific local information as possible. Recent work by Boyer [22] argues that a safe place to begin could be to contact the SDE. This was tested in Case 1, which showed that SDEs were supportive towards wind project joint ownerships, but had little agency. Nonetheless, they could provide valuable information about past projects that fell through or other local-specific knowledge about energy actors in the vicinity.

The developer's experience also showed how personal and sensitive the interactions with local Mayors can be. French society's attachment to their 'localism' is also well recognised in research about social acceptance and place attachment [103] [104]. For that reason, developers could prepare themselves by learning about the municipality and intermunicipality's interests and priorities in advance. In this study, the most successful interactions involved discussing topics such as the intermunicipality's climate commitments PCAET, TEPOS and any wind energy targets. Another consideration should be what aspects of their supply chain could be undertaken locally and be sufficiently prepared to mention the possible local employment a project could create. This information can be found by inquiring about the local area at the SDE first. They can inform developers if the area is already conscious of the energy transition and has strong feelings towards wind energy.

Additionally, interviews from Case 3, revealed that the SDE is the most likely place to find one of the ADEME's mediators from their network, 'Les Générateurs'. Although it may not be fully operational yet, there is hope among industry experts that it could provide valuable allies for advice on how best to approach local communities in the future.

6.1.2. Capturing Interest

The next best practices involve the second step towards defining a project, once the Mayor has shown some interest and agreed to find out more. This is another precarious step as it involves consulting residents early on before the development and study phases when no official agreement has been reached.

Knowledge Sharing

Fieldwork from the present case study and by others [33] showed that project managers are often the best informed because they must consider regulatory constraints in their work. Elected officials are aware of some changes to the framework, but they can feel ill-prepared to take such decisions and must rely on the developer for information. So, throughout the process developers should be aware of their position of knowledge and take on the responsibility of being as transparent to communities as possible and as early as possible. [33]. In the present experience, developers found that it was important to share knowledge in a way that is simple enough to be relatable to all, yet, not too simple in order to sound credible, not dubious. They also criticized the 'standard' format of their interaction with communities which most often occurs in public meetings, where not all residents felt they could speak freely [127]. It is essential that local residents feel that their opinions really matter, and the public meeting may not be the most suitable tool. Word-of-mouth has been shown to be more effective, therefore, finding new spaces where developers can appear more approachable and individuals can express themselves more easily should be a high priority. [33].

Learning about the Community

Further, interactions with company employees and other papers by Dechamp [33] showed that the developer must understand what kind of community resides there (such as age, job types, and economic activities) because tourism and farming have different priorities for land usage. Also, developers at the company in Case 1 found it helpful to check if there were any other undesirable constructions affecting the landscape already in place (i.e. landfill or high-speed railway). These landmarks could be areas to target placing wind turbines, as they are already of little interest to the public, or in reverse, the communities may already have a strong feeling about not wanting any more infrastructure built in their municipality since they already feel victimised and treated like a 'dumping region' ('une zone-poubelle')[127]. This was a recurring sentiment identified bu developers working in 'la diagonale du vide' - a wide strip of France stretching from the Meuse in the northeast to the Landes in the southwest where population densities are relatively low compared to the rest of the country. Many of the inhabitants already feel a sense of political neglect in other policy domains such as access to health care or the internet [127][114].

Visualising Projects

Researchers also point out the conflicts of interest between local residents, for whom the impact on the landscape causes the most fear, whereas for the company energy production is the priority and the views could be subjective [33]. Therefore, as a developer, it is important to take into account locals' concerns and be prepared to redesign possible park layouts to better suit their needs. For this developers found that using tools such as 3D modelling tools or photomontages of a wind farm design can help communities visualise the project and reassure them in their decision-making process [38][127] [33].

French Localism

Throughout this project, interactions inside and outside of the company about wind energy confirmed the importance that French localism should not be understated [38]. Several French cases also revealed that a developer's personal attachment to the area reassures local residents. This is not possible in all cases but considering developing in areas that are familiar to project managers, or where the company is known to locals, helps them appear more genuine when empathising with locals. [33]

Communicating about Energy

As seen in Section 1.2, owing to the centralisation of teh French energy sector, most of the population is poorly informed about energy issues and do not feel responsible for energy decisions - for many, these decisions should be left to the state. Nonetheless, wind energy is a controversial topic in France, on which most of the population has an opinion, as seen in Section 4.2.6. Interviews in 3 explained that although wind energy has been used for centuries, its modern form is somewhat unknown and disturbing, which is conducive to rejection [25]. More comprehensive views are generally split between pro-wind activists highlighting the ecological virtues of wind energy (virtues whose benefits, such as less carbon emission for future generations – will only be felt in the long term). In contrast, opponents mention immediate threats to natural landscapes, biodiversity and noise pollution. When confronting long-term ideas with direct impacts, the latter is often more convincing to the masses because it is immediately tangible.

Following conversations with employees at the company, they also disclosed that developers are often confronted with controversial arguments during public events around a project. They found to overcome them; it is important to remain simple and factual in their answers (values for official noise limits and energy costs) and avoid diverging arguments (including other environmentally friendly arguments) that could be criticised. [38] Facts should include the income for the municipality and the residents that would be directly affected and how also local industries could benefit from employment opportunities, particularly during the operation phase [33]. Regarding noise-related concerns, some researchers have suggested offering first-hand experience instead of straight figures [33]. For instance, a chance to visit operational wind parks in similar conditions that those resident volunteers could expect in their communities and allow them to see and hear for themselves. Research has shown that direct experience, such as having personally seen or visited wind farms, may influence the acceptance towards wind energy [42].

Lessons from a Successful Joint Partnership

As for the successful case, even the CNR project manager of the Souilly d'Air project admits that it could be considered an exceptional case. The Mayor was heavily involved throughout and used his network well. He was very charismatic and successfully steered his sub-committee towards supporting a community wind project. Notably, the context was also different in 2017; wind turbines were a far less contentious topic, unlike since the summer of 2021 when almost all candidates for the 2022 presidential elections took a stance on the technology. The project manager recognised that perhaps the Mayor of Saint-Trivier-de-Courtes would not have dared to be so vocal about his support in the current political climate. Also, a sizeable enabling factor came from the Regional RES investment fund OSER, which contributed considerable finance and offered unbiased advice. Therefore, developers and the community considered them a trusted source. The fund carried nearly all the risk in the project development phase and then offered all their shares back to the community at low prices to increase community benefits. Such funds are not available in all regions in France, so equivalent networks of actors can be more challenging to find [59] [38].

6.2. The Importance of Scale

Both MLP studies highlighted challenges relating to energy decisions made nationally by the government and yet implemented in local communities. This research has highlighted the precarious relationship between decision-makers at the national and local levels. On the one hand, researchers recognise that national-level guidance is needed to set goals and arbitrate how the rules are played out [91]. On the other, the present case study in l'Aube found that at the local level, there is a better knowledge of the needs and concerns of their specific case. This discrepancy has already been noted in other studies in France by Fournis [60] and abroad in case studies from the Netherlands [72]. Interviews from 3, however, explained that as long as the government is the sole, it will be forced to make challenging decisions to apply to all cases. Such blanket decisions would either tighten the rules for everyone, by making climate and energy targets mandatory and consequently oppressing their citizens' freedom rights [25]. The more often chosen alternative is to be more lenient towards citizens rather than prioritising RES deployment, by giving them the freedom to decide. In this latter case, policies would likely need to make RES more attractive to persuade citizens to adopt them free willingly. For that, the environmental and social impact of development has been minimized - by tightening noise and distance regulation, for instance. This helps to shelter communities from too much landscape change. Unfortunately, wind industry experts, such as SER [25], ADEME [142] and European academics such as Ellis [42], widely recognise also sacrifices large numbers of potential projects.

The recurrent issue developers from the case studies found were that the current legal framework means that the final decision makers (i.e. national lawmakers) are too far removed from the actors in the debate [38]. This is also a frustration and warning given by French academics in political energy decisions, such as Poupeau [109]. This situation means that local authorities and state representatives may have the knowledge and the intentions to support or adapt project proposals, but they lack the authority to participate actively. Therefore, insights from developers and wind energy industry representatives, strongly argue that a better balance must be found between forcing decisions to be made locally for developing wind energy but allowing for enough leniency for it to be managed on a case per case basis [60] [25] [38].

This is a strong argument for empowering local authorities and allowing decision-making to be made at a local level. However, interviewees warned that this would require multiplying the number of employees with energy expertise and necessitate educating local decision-makers on the matter [25][142]. Either way, it would demand a significant financial investment by the government and trust in decentralising power - something that many academics, West [143] and Poupeau [110] [109] among others[105] have noted the French state has been reluctant to do in the past.

6.3. Media Influence and Management

According to the interviewees in 3 [25], wind energy suffers from both its maturity and novelty, making it dull and misunderstood. Media is full of this ambivalence, so much so that even reputable and trusted information sources discuss the matter and make mistakes. For example, Franceinfo, the principal radio broadcaster for news in France, hosted a debate called ‘Project to install wind turbines near you: what are your rights?’ in October 2022 and the interviewee built his arguments based on laws that have changed since 2015 [40]. This misinformation harms the wind industry because it gives the general public a sense of knowledge and feeds unjustified strong opinions about it [38].

Wind energy was a controversial topic building up to the 2022 elections, but it is seeing new media attention peaks due to the ongoing national energy crises [39]. Media content has been suggested to be a strong factor influencing the lock-ins and transformations of energy production and consumption [83]. Also, media content is often affiliated with political views, and empirical studies by researchers including Ellis [42] suggest that political beliefs correlate with the acceptance of different low-carbon technologies. A conservative attitude has been considered a relevant factor concerning the theory of adoption of technology innovation [42]. Furthermore, as discussed in Section 1.1 the role of anti-wind lobbying has always been particularly effective in France, owing to a strong internal organization that coordinates nearly 1000 local associations, is present in political circles and has media vectors at various levels [57] [33].

Observations also showed French news sources, such as Franceinfo and France Inter, regularly discussing the consequences of the energy crisis because of the reduced nuclear power generation [39]. However, there is little discussion about a medium-long-term solution for future power shortages. Amid the current energy crisis, public media, particularly television and radio, is broadcasting strong government messages about energy saving and using appliances outside of peak hours. In the meantime, some politicians such as Sandrine Rousseau, a French economist, stated, “We lack the public policies allowing transformation. Today, all the government does is refer to individual gestures such as lowering the heating,”. Meanwhile, other French politicians strongly reject the chosen pathways to an energy transition, “It is a text to revive the German wind turbine industry and the Chinese photovoltaic industry,” Olivier Marleix said, then added, “we have gone from the start-up nation to candle lighting” [18].

In recent times, developers at the company have observed that these information streams’ attention is being moved away from more common arguments about landscape impact, but moved towards the more debatable aspects of wind turbines, which provide misinformation such as; “wind turbines sometimes use energy to spin, so that people don’t think they are useless”, “wind turbines are meant to be recyclable - but their blades are not”, and “they are just too noisy”. The increasing mixed-messaged about the turbines stir feelings of mistrust [38].

6.4. Education

Exogenous pressures, such as RED II, are moving energy generation towards a more decentralised layout, likely to increasingly affect the landscape. Interviewees from Case 3, explained that landscape is a shared resource between all members of society. Its appropriation and subjectivity give rise to many social issues rather than technical issues [142]. Both interviewees argued that educating and sharing knowledge with all parts of society could help objectify these arguments.

These arguments are shared by Ellis [44] [42], in studies that suggest normative beliefs could be a strong, positive predictor for supporting RES. Studies showed that the higher the information level of the person regarding renewable energy, the more likely they will accept it. Solutions from the interviews included in Case 3, suggested that education about energy should be transparent and occur at all levels, not just a target audience [142]. Educating the public should start with audiences as young as school children, training days for decision-makers and open workshops to improve learning about decentralised renewable energy production and citizen energy. Workshops could be implemented independently of whether or not the citizens would likely be affected by the technology. [142]

From discussions considering the urgency for political change with industry players at the company, it could be strategic to target younger voters that do not yet have a strong opinion of energy technologies and could be more open to RES deployment. [142] [38] [25] In doing so, other studies have argued that existing institutions such as universities that involve students of certain socio-demographic statuses have been proven to significantly influence the acceptance towards renewable energies [42].

6.5. Desired Regime Changes

Now that there is a better grasp of the current situation and its limits for wind energy diffusion, the goal of the next section is to describe what regulatory and institutional barriers need resolving by *who* and *how*. For this, a broader stance is taken on experimentation based on policy experimentation and long-term institutional change [83]. The qualitative data used to resolve these barriers is drawn from the findings in the previous Chapters 4 and 5 where MLP and SNM frameworks identified barriers at national and regional-local levels of governance to be solved.

The following section first introduces the concepts of policy experimentation and institutional change regarding MLP and SNM and their significance in future planning. Next, it explores necessary regulatory changes and suggests policy experimentation on a national and European scale. Third, it investigates institutional adaptations to aid policy implementation to promote onshore wind in France and bridge the national and local level gap.

6.5.1. Interplay of Policy Experimentation and Institutional Change

Socio-Technical Transition studies often use niche-level experimentation within in the MLP and SNM frameworks to indicate regime change [83]. These frameworks depend on innovations or experiments to make incremental adjustments to shielded niches until the innovation is mature enough to create regime change, as described in Chapter 2. Yet, according to Kivamaa [83], these frameworks can be used in other ways to provoke change through policy. Policy experimentation is gaining increasing interest in academic literature and is based on interactions between policy and institutional changes that all rely on the aspects of SNM: networking, learning, and expectations [83]. This sub-section relies on previous SNM findings to design regulatory adjustments for policy experimentation and institutional changes to support a transition towards a more desirable regime.

Beyond technological innovations, lasting regime change can be influenced by short-term policy experimentation and long-term institutional change that choose to support certain technologies. Both are interdependent and co-evolved because institutional change is needed to provide a favourable context for policy experimentation.

Like protected niches, policy experimentation should shield civil servants and decision-makers who choose to experiment and ‘take risks’ to encourage further learning. The aim is to provide first and second-order learning to policymakers and society and, in turn, steer institutional change accordingly [83].

6.5.2. National Policy and Regulatory Changes

Regulatory changes can only be made legal by passing new laws by policymakers. Therefore, policy experimentation could be used to find innovative policies supporting sustainable energy transitions by providing experimental feedback and steering policy alterations. [83] Here, is a discussion about the regulatory changes needed to overcome barriers found in the national and regional MLP earlier in Section 4.2.6 and Section 5.8 respectively. It also includes findings from other research to suggest policies to experiment with.

Create more space

For developers at the local level [127] [38], a significant barrier to overcome is the need for open space for wind farm development. Under current regulations, according to FEE, only 57% of French territory is eligible to wind farm development[51]; this figure includes some permitted buy inaccessible areas too [38] [39]. Before 2021 many open spaces had already been reserved by the army’s air force for low-altitude training, but a change of law extended the setback distance from radars from 30 km to 70 km clearance. As a result, developers have no choice but to scout for areas closer to inhabited areas, as was found in case 1. This is not ideal for communities—alternatively, there are areas with sensitive biodiversity, which is also sub-optimal for gaining approval [38].

Defining responsibility
The problems faced by developers in Case 1 of this study and confirmed by interviews in Case 3, demonstrated that it is becoming increasingly necessary for national and local leaders to take responsibility for meeting energy targets. Interviewees [25] [142] and previous researchers such as Poupeau [110] suggest territorialising energy decisions to allow these decisions to be made by those affected by them. Yet, for example, in the Netherlands, where the policy is chosen by the province (a higher governance level than the municipality), once an area has been designated suitable for wind farm construction in a municipality, they must accept it. However, in the case of a study in Moederdijk [72], residents were unhappy about how the project was designed, and they were able to work with the developer to choose a design that would best suit their community. The residents knew that if they did not cooperate, they would risk losing a legal battle and having to host wind turbines anyway. They would also risk losing the opportunity to choose the design. In this scenario, the compromise helped increase citizen participation, and the residents' activism helped them achieve a more profitable project. The elected official in the municipality reacted well to the local discontent and helped find a constructive solution. This is important since the municipality works closely with the residents compared to regional or national level authorities [72].

Decentralising local spacial planning
One of the reoccurring issues met in the literature and the present case studies is the inability to adapt national spacial planning laws to specified local cases. At present, local electives have the power to apply the law but no authority to make exemptions for a specific case [110]. Therefore, new regulatory changes are needed to allow and protect local decision-makers from adjusting spacial planning for their community's benefit.

For example, in Case 1 of the present study, developers struggle to find suitable areas to build wind parks because residential buildings are frequently scattered in rural France [38]. However, not all registered residential buildings are used for that purpose, yet the 500m setback distance rule applies indiscriminately to all. As such, even if residents of the community, their Mayor and Prefect all unanimously agree to shift a project closer to that building and infringe the 500m limit but move it away from the main residential area, it could not be done because national law would apply the same as anywhere else. Thus, anti-wind activists would have legal reasons to condemn its construction. Therefore, the author would argue that giving more spacial planning rights to a local level could prove helpful in future debates. A similar solution suggested by Hoika [74] could be to have standard national rules while granting local governments the flexibility and legal protection to apply for exemptions if certain criteria are met.

Increase Direct Communication between Policy-makers and the Wind Industry
Observations made during the practical case study and exposure to workers in the French wind industry highlighted discrepancies between government targets and incentives and their ability to support wind developers. For example, the "Ten measures plan" to increase wind deployment responsibly and harmoniously with local communities was disappointing. It failed to lift any of the main barriers experienced by developers, and it did not provide any new tools for approaching projects alternatively. As a result, the wind industry, including developers and supporting bodies (ADEME, FEE and SER), was disappointed. The MTE listens to wind industry supporters and suggests government policy changes. It is unclear if the policy changes suggested are inadequate or denied by the rest of the members of the government. However, going forward, it seems important for developers working at the local level to communicate more effectively with national-level decision-makers with more influence than the MTE. Energy forums, including RES, will have to hold more importance in political decisions for the energy transition to happen on time.

Re-allocating local energy decisions
The practical work in Case 1 in Section 5.2.3, showed that energy decisions taken at the local level caused the most significant barrier to developing more onshore wind projects. The main reasons identified in the study were:

- Lack of responsibility for the energy transition taken by Mayors owing to their time constraints and multiple roles.
- Difficulty contacting the local decision-maker due to restricted opening times, often outside work hours.
- Difficulties in effectively communicating on energy issues with local decision-makers.
- Lack of ”local capacity builders” that have the full combination of: local knowledge, strong knowledge of the energy sector and authority to implement energy decisions.
- Disruptions caused by national, regional and local election cycles during the course of the project planning phase.

Therefore, without any definitive answers found to date, this research opens up several options for discussion, which could be resolved with policy experimentation:

- Include compulsory energy education to civil-service training for local-decision makers to create a better local-level understanding of energy issues.
- Need to assist Mayors who have three roles, by systematically providing rural areas with another form of state representative responsible for energy issues
- New points of call for developers (such as the SDE, as discussed later in Section 6.5.3) with a planned bi-monthly meeting dedicated to discussing possible RES projects at an inter-municipal level and include local RES network representatives
- Find a strategy to prevent election cycles (at every level of governance) from affecting ongoing energy projects. For instance, projects that have received local permission to carry out studies must be guaranteed the right to continue regardless of when it was initiated in the election cycle.

New CREP framework

French CREPs are still minority concepts in the greater French energy regime. The national level MLP analysis in Section 4.3.1 showed that this could reflect little innate interest in independent energy thinking. In addition, the framework in place is limited regarding rewards to participating communities (purely financial) and set-up (dominated by a singular model - EPA).

Other hybrid options such as partnerships between developers and communities, explained in Section 1.5, are also complex for all parties involved. As seen in the cases presented in Chapter 5, developers were limited in offering incentives to communities. For instance, they could not offer compensation to energy bills because of the fairness price laws, presented in Section 4.2.1. Also, experience from Case 1 showed that the government incentives to encourage developers to include communities in the projects have had the opposite effect. The optional ’participatory bonuses’ seems to create a new reason for the distrust between Mayors and developers.

Therefore it seems important that new policies are needed to broaden the possibilities for CREPs to participate in the energy transition. Research by Hoicka [74] has already suggested that a balance must be found to ensure that incumbents are enticed to cooperate with CREPs. He argues that the participation of developers in these projects is essential for niche development in the long run and should be facilitated. Nonetheless, attention should be paid to new strategies to protect co-owned projects from being co-opted by incumbents. From experience in Case 1, the author suggests there should be more enablers available that would reflect more integrity on the developers’ behalf to reduce the wariness that Mayors have towards developers offering partnerships observed in Case 1 in Section 5.6.2.

Another approach suggested by Ellis [42], could be to make community inclusion mandatory. This could be a chance to experiment with various forms of community inclusion and encourage greater citizen participation. An obligation rather than an incentive for a better price could normalise community energy partnerships and helps create innovative frameworks. Communities would have greater power and responsibility in planning for the energy transition. Developers requesting community participation would appear more sincere without an incentive to achieve more significant revenue via bonuses. As a relatable example, Denmark introduced various innovative measures in its 2008 Renewable Energy Act, including a scheme for compensating neighbouring landowners and a compulsory co-ownership system. As yet, there is no formal evaluation of the impact of such initiatives, which could be a valuable opportunity to explore the potential for policy transfer. [42]

In brief, legal frameworks must allow for more experimentation protection to communities and allow investors to encourage testing out new policies to promote further learning about the visions and expectations of the actors involved.

EU policy responsibility
EU policies, led by RED II, are the driving force behind the energy transition across many European countries. As such, the European Commission is responsible for choosing and sanctioning policies. However, the national-level interpretation of policies is not uniform across all countries. Perceptions at the local level of implementation differ widely depending on geographic, cultural, economic and political factors across the EU. The European Union is keen to show world leadership in promoting RES; it could take on more responsibilities in communicating with the most locally affected stakeholders.

Researchers [42] [74] have observed that different EU countries prioritise different targets when transposing the RED II. Therefore, while the RED II provide a common framework, it results in discrepancies between the European and national-level high-level policy-making compared to local implementation. This would appear to occur when legal energy targets have little guidance in determining responsibilities and goals associated with project-community relationships [42].

In conclusion, key aspects of policy advice can be given across several areas: research funding, increasing energy citizen science, and tailor-making national policies. Using empirical evidence from the present study cases [142] [25]and previous research studies [42] [81] [113], the following argues for several European policy adaptions to improve the diffusion of wind energy in France.

The suggested European policy adaptions are:

- **Funding cross-border research:** Further policies should seek to promote cross-border work on tackling the challenges facing the wind energy sector, and that of other renewable technologies [42]. EU policy needs to encourage collaborative research to produce a model of research and practice knowledge exchanges. This could be facilitated by commissioning studies by research funders across the EU that involve new partnerships between academics, governments, industry interests and other stakeholders. There is a need for a more integrated approach to social science research on energy systems. This should include bridging gaps between policy studies and climate science research because the disconnected findings lose their explanatory voice in politics and society [113]. Research results should help the EU assist Member States in transposing the directives. A new European platform could be created to enable practising representatives across the energy sector to share knowledge and dialogue among prosumers, CREPs, industrial partnerships and national legislative bodies [76].
- **Promoting Citizen Science**: More policies that create more opportunities for citizen science should be implemented, including funding to encourage initiatives. The European energy transition is becoming increasingly dependent on social acceptance, as experienced by wind developers in this study. Research by Kelly [81] in conservation, has shown that promoting learning, understanding, and legitimacy, contributes to greater citizen science. This helps legitimise social inclusion in project planning and can be an effective tool to achieve greater acceptability. Therefore, an objective for a policy promoting future citizen energy science may be to determine how to create a sustained interest in energy and conservation issues over the long term [81].
- **Tailoring policies to orientate national priorities**: The ”one-size-fits-all” approaches that the current EU RED II presents are not the solution according to Hoicka [74]. They argue that although the exchange of best practices between national legislators is needed, it must be noted that how national-level demands are applied, depends mainly on regional priorities. Therefore, EU policies could help national governments direct their spending to meet specific and urgent targets. For instance, members could be exempted from one or more sanctions in return for meeting other higher-priority targets, for which failure to comply would amount to a more significant fine. Best practices may depend on culture and be country-specific. Still, there is strong evidence that consistent indicators are needed to help work towards systematic country comparison across the European Member States to ensure fairness [13]. The data collected could be used to monitor each country’s target progress and understand country-specific shortfalls better. This understanding could lead to defining a new set of tailor-made regulatory guidelines for the country. Furthermore, this approach could solve the instability of national incentives observed in Section4.2.6. Indeed, these directives would be independent of the political party in power but

come from a higher international and legally binding commitment, and, therefore, could be less likely to change.

- **Enabling Frameworks for local business models**: As suggested by Hoika [74], new policies are needed to tailor an enabling framework to suit better regional business models that account for the new challenges that come with RES projects. It should encourage complementary studies among existing RES initiatives, whether technological (wind, hydro and solar...) or user types (prosumers, developers, CREPs, hybrid frameworks...) via specific incentives that are part of an overall “enabling framework”. The intention should be to encourage multiple actors, such as prosumers and producers, to cooperate, pool resources and maximise the use of local resources [74]. New incentives encourage developers to use local resources and the local workforce for their supply chain and maintenance needs, for instance, by including transport in the overall carbon footprint of RES projects.
- **Energy Justice** The EU has already embedded principles of ’energy justice’ in its policies, including fairness, transparency, self-efficacy, and participation [113]. However, the present local-level study found that carrying out these principles requires more intermediaries to aid cooperation between stakeholders. It also showed there’s scope for finding new ways to give more effective feedback on their observations to governance regimes to redirect policy changes accordingly. This should be a strong argument for policies to experiment and search for RES-supportive directives that focus on fairness between all actors. For example, alternative compensation to money could be given to communities regarding employment, revenue, common goods/ facilities, and energy independence, as previously suggested by Radtke[113].

6.5.3. Institutional Changes

Institutional changes integrate technology, policy, and behaviour to create new practices and perspectives. These changes rarely occur individually but result from the gradual (re-)organisation of structures, cooperation of actors and enabling factors [83].

From the empirical evidence found in the three case studies, this section designs institutional changes based on a basic who/what/how framework for decision-making processes. Its purpose is to identify what each decision-maker (or actor) has the agency to do, develop the relationships, and use resources to build sustainable change for wind industry development.

Leadership

As seen in Section 4.2.6 and previous studies by Feurtrey [57] have found that a lack of continued and long-term political support is a major limitation for future wind energy in France. It depends primarily on the political party in power, the balance of power between lobbyists (in favour of nuclear or RES), and the national and international contexts which sway public opinion on energy subjects. Case 2, of the present study, experienced this instability directly at local level when regional and municipal elections disrupted the environmental and feasibility studies of the Souilly d’Air project. This is a strong indicator that more political stability and leadership are needed to reassure developers and investors of 1) long-lasting incentives and 2) shield projects once studies have been initiated to reduce the chances of delays.

Another argument for better leadership is presented by Throop [134]. Present-day business models with profit-prioritising dynamics are threatened by the urgency to adjust to planetary limits. The economic system in which these models function, is also susceptible to financial crises related to fuel prices, and high inflation levels experienced by much of Europe owing to rising fuel prices and geopolitical tensions, described in Section 4.1.5. For wind energy to scale up, a shift in emphasis is needed to present it as a ’business case’ by leaders who share the same priorities as the public (purchasing power, etc.). It could contribute to shifting their values and views on wind energy. [134]

Joining the argument, Ryszawska [120] suggests that formal leadership could come from the government. He states that research has shown that a policy mix of monetary and non-monetary incentives like income, education, knowledge about renewable energy policies and belief in the environmental benefits of RES can influence the willingness to participate in RES projects.

Interviews with specialists in Case 3, also argued for formal or informal national figureheads that show partiality to technology while having credentials within another sector (engineering, economics, physics...). This outsider’s view and relatability would help reassure public opinion. This soft power could also be a form of leadership that shows that the energy transition is of economic interest outside the already ecologically minded circle. [25]

New roles for French Energy Syndicates of Communes - SDE
As the energy transition progresses, SDE competencies are evolving beyond public lighting, installation of electric vehicle charging stations and advice on energy management. Both other researchers [22] and the present case study in l'Aube showed that many of them are better financially equipped to play a role in the energy transition of their *département* than ADEME, for instance. Not only are they financially provided, but they do not seem to encounter any particular difficulties in developing their skills, budgets, or staff [22], as shown in the meeting with CA Troyes and the call with SDE Aube in the case study.

Time and time again, researchers have called for more intermediaries to take on the crucial role in mediating between national and local scales for RES project implementation [42] [70] [125]. There are several cases to be made for SDE to take on more mediator responsibilities.

- **Local Acceptance**: Public support of local authorities, such as the SDE increases the local public acceptance and could also encourage potential local investors to participate in RE project crowdfunding [30]
- **Cost reduction**: By definition, the SDE already play a linking role between intermunicipalities and strives to pool resources to offer services and equipment at a lower cost to their communities - costs that a municipality would have had to bear alone if it had been completely isolated [22]. This could reduce tensions for several reasons;
    - SDE and the community both have an attachment to the area, which increases trust;
    - SDE is an energy specialist, not just for wind energy, and is also looking to cut costs;
    - they have the means ad the network to pool together more local resources that a single community cannot
- **In-between local and regional objectives** There is increasing interest as to whether SDEs could help improve the coherence of energy transition policies at the local level [22] such as the play out of the national SNBC and PPE into the regional SRADDET down to the most local level PCEAT. In some cases, SDEs have tried to collectively work with the regional councils responsible for steering energy policy in the SRADDET towards their respective departments. In the case of Auvergne Rhone-Alpes, where the SDEs were older than the regional council, they attempted to act as a mediator between regional energy policies towards their departmental territories. They then brought concrete proposals from their experience of the territory for the SRADDET. Through these attempts to transfer information up to regional councils for the SRADDETs, but also down towards the inner municipalities with their advice for planning PCAETs, the SDEs could become one of the nodal points of the decentralisation and territorialisation of the energy transition. For the moment, however, this role of ensuring the coherence of energy transition policies is only emerging.
- **Hosting ADEME's mediators**: ADEME is also relying on SDE to host the representatives of the RES advisory network, thus reinforcing SDE expertise. In a similar way that some SDE have looked above their rank and used their local knowledge to steer regional commission SRADDET goals to suit the department scale better, they could also use their credibility to act at the local scale. In the future, it could become standard practice for developers to put forward projects in a community to the SDE. As a local worker, the SDE could approach the mayors with the projects proposed by different companies. SDE and communities have fewer conflicts of interest than between society and a developer. Yet, they have the advantage of operating locally, making face-to-face meetings possible and compatible with Mayor's working hours - which can be more difficult for many developers. Also, as an outsider, they could help a Mayor choose between several projects, empowering them. Additionally, a location which receives a high demand for projects could be perceived more positively by the Mayor if presented by a neutral party rather than developers. The high level of demand could be a testament to the strong profitability of the area. Whereas, in the current context, Mayor frequently feel harassed and overwhelmed by many different developers attempting to make contact individually.
- **Energy specialist and Local Protectors**: As active intermediaries, they could formally take on the responsibility to protect communities in the energy transition. Their role could evolve to using

their knowledge to determine the terms and conditions on which partnerships are based and ensure that partnerships genuinely benefit local community groups. Meanwhile, they recognise that undertaking these activities could come with the cost (and risk) of oversimplifying the diverse community energy sector. So precautions should be taken to prevent steering joint-ownerships with developers towards the mainstream energy mechanisms, which benefit the company more than the community [70].

Innovative partnerships

As seen in previous chapters, in section **??**, Hargreaves [70] has argued that partnerships between larger companies and communities will be increasingly necessary for RE and wind energy to make a more considerable contribution to the overall energy industry. If no harmony is found between the private sector and the community perspective, CREPs risk remaining a niche activity [70]. If EPA remains the only organisation to promote CREP in France, alternative approaches to collaboration are equally unlikely to happen [125].

Researchers such as Throop [134], have argued that exposing the niche to competition is imperative for its success and can often lead to innovative, collaborative partnerships with incumbents. These experiences can catalyze and accelerate a shift in perception, and regulatory frameworks. Such relationships have both competitive and collaborative virtues, but he also suggests that these often require steering from effective top-down leadership. Which, in the case of onshore wind energy in France, would likely come from the government.

Ellis [42] emphasises that there is increasing proof that projects that included community ownership, regarded wind turbines as community assets, and enjoyed much higher acceptance levels. Institutions must formalise new partnership options and protection, allowing for more leeway for experimenting and learning. Community ownership of wind energy projects can come in various forms, have significant variations according to the national context and can be stimulated in various ways. This is a crucial area for supporting the broader aims of the energy transition, and social acceptance [42].

Education and media campaigns

Interviewees in Case 3 believed opening energy decisions to more democratic discussions with citizens could drive the energy transition. However, they recognise that for voters to make informed decisions, they need to understand the energy sector better. Experts seem concerned that the general population is unaware of their impact on the energy sector. They also lack knowledge about how it works, which makes society more susceptible to misinformation, which is most often damaging to wind energy's reputation. [142]

Therefore, broader energy education could be helpful to combat the spread of misinformation. Support is needed for funding a public media campaign, instead of keeping the information in specialist databases, such as documents written by ADEME or SER that are already open access. These documents are often published on their respective websites and do not reach the broader public, unlike other wider media streams such as newspapers, social media, and political blogs.

Interviewees in Case 3, argued in favour of a new organisational structure within the government, including the Ministry of Education and MTE in collaboration with existing knowledge institutes and agencies to help broaden energy education. [142] They argued that broadening energy education would rely on the cooperation of national media streams to agree to share the information from their studies in mainstream feeds. They should also broadcast feedback from communities involved in successful wind energy projects. Such an educational campaign could be state-funded and help dilute and rectify the fast spread of misinformation on uncertified platforms. Nonetheless, it would still require much funding and significant institutional and organisational restructuring.

6.6. Project Originality and Contribution to Academia

By solving these barriers using MLP and SNM at a broader national level and a microcosm at the local level, increased learning about the frameworks was also achieved. The approach revealed increasing interactions and interdependencies between different actors and groups of governance. As seen in Chapter 2, these frameworks have often been criticised for their bottom-up approach and neglecting power, politics and agency. Yet, this new approach has opened new facets to MLP. This atypical approach proved helpful for several reasons. It helped compensate for several of the shortfalls in MLP and SNM frameworks described in Section 2.3. It also revealed new findings that could significantly contribute to overcoming onshore wind planning issues.

By staying focused on the regime in MLP and SNM analyses, researchers may not be equipped to offer pertinent advice for policy changes (such as increasing incentives or reducing grid connection costs - which were not the root causes to implementation barriers). Then again, the same can be said for developers who have long been requesting politicians to lift more constraints (aviation and biodiversity) and mediators. While both directions of action would appear valid given the apparent issues experienced at each level, both seem blinded by their field of activity when issues involving more significant institutional restructuring via broader energy education and retraining and investing more in the actors of agency, old and new, to catalyse change using the many enablers already in place.

This local-regional-national approach could be likened to multi-level governance theory, which highlights the importance of cooperation and coordination between actors at different levels of governance to achieve a successful energy transition. However, the approach may help understand the governance of energy transition, but it does not provide a clear and consistent method for achieving it. Also, it has been criticised for its lack of attention to the role of non-state actors such as private companies, NGOs, and citizens in shaping the energy transition process. Governance has a decisive role, but without better cooperation between actors, incentives do not always have the intended effect. This research has perhaps contributed to proving the need for increased cooperation between all levels of governance but also the necessity to include cross-sectorial actors.

Previous researchers have discussed the difficulties of translating and applying research findings to policies and practices because the frameworks are undeveloped [42]. By the present research, the author hopes to have contributed to opening a framework for studying underlying issues in energy transitions and providing a transparent method for presenting findings for further debate.

The author argues this new process contributed to policy research and academia by:

- Leading to identifying the inefficacy of single incentives (citizen participation bonuses, for instance) without opening up contingent action plans (when the available amount of land is unchanged and the local decision-making process).
- Revealing that (over-)protecting the environment and people's rights to improve acceptability can have the opposite effects on wind turbine deployment, such as stringent biodiversity and noise regulations. A more optimal compromise on shared-land usage is yet to be made.
- Showing the limits of both binding and non-binding policies. The right to decide on local planning plays an integral part in democracy in France. However, presenting local decision-makers with non-binding guidelines is detrimental to the national energy transition. Albeit, imposing national law on local communities by force could be equally damaging to freedom rights and could wide-scale social resistance to future policy changes. It seems a new balance in decision-making must be found.
- Proving that decision-makers do not have all the knowledge to make informed decisions. This leads to considering other problematic guiding decision-making processes for energy transitions. This study suggests that experts or policymakers alone are too one-sided to make a balanced choice. Therefore, new frameworks need to be considered throughout, including representatives of national and local decision-makers, the industry, researchers of the energy transition and the local population.
- Showing the potential to re-orientate policymakers' expenditure towards dealing with barriers more effectively. For instance, spending more on addressing verified sources of information flows about wind energy and increasing land availability, before spending more on incentives with limited impact.
- Demonstrating the compatibility and convenience of MLP and SNM frameworks in empirical experimentation. MLP has been criticised for an inconsistent approach between levels making it difficult to extract coherent data between them. This study showed that it is possible. The tools provided a consistent and versatile framework for comparisons at different study levels.
- Revealing that applying MLP and SNM does include a top-down political means to solve the energy transition. This is in contention with past papers that criticised MLP and SNM frameworks

as being biased towards niches transitioning from the bottom-up. In the adapted method, by including two levels of study, a national and a local-level 'microcosm' to the research, the author found that elements of power and agency were also more recognisable.

6.7. Concluding discussion points

Based on findings by previous researchers and empirical findings in the case studies, while there is scope for developer practices to improve social acceptance, they are limited by regulations that require a political address and institutional changes. Neither policy experimentation nor institutional change can be singled out as a crucial means of governance for transitions. Rather they co-exist and co-influence at any time with the current set of policy goals, strategies, instruments and processes that interact in practice.

This chapter concludes that social acceptance is a dominant barrier to developing onshore wind energy in France. However, this study shows that the centralisation of the current energy system detracts from the population's feeling of responsibility towards the energy sector and shows a lack of citizen energy science and energy citizenship. Other barriers that require more policy changes include; too many regulatory constraints to development and frequent policy tightening. The author argues that to solve many of these national-level barriers, policy experimentation which allows for changes and protections of experimental policies, could provide for more significant learning on factors that increase acceptability and true decentralisation and territorialisation of local energy policy implementation. There is also a strong case for increasing institutional energy education to allow for more energy citizenship and the accountability of energy targets all around. Management of media campaigns should also play a part in social first and second-order learning.

Another key finding relates to the governance, and regulatory issues met at the regional/local level. Citizens are increasingly affected by energy decisions as the energy transition moves towards more decentralised sources. As such, our research calls for increasing regulatory decentralisation and flexibility of energy decisions and broadening energy education to all. Increasing policies prioritising learning by doing and interacting shall provide more guidance to effective ways to harmonise local conflicts of interest between shared resources and common goods - such as landscape and energy. For this, mediators and intermediaries will be needed, of which SDE have already been identified as having the potential to partially fulfil this role. However, all these changes require more leadership at a national level and the possible influence of EU policy adaptation and intervention.

Finally, the new approach helped answer the research question "*What is constraining the deployment of onshore wind energy in France?* ". It highlighted the practicalities, and limits, of MLP and SNM frameworks as well as multi-level governance theory. The former fell short of solving national-level barriers with national-level solutions. However, results were found by working with a developer and taking the frameworks to a local level of governance. Only at the level where the implementation of onshore wind turbines takes place, did new issues become more obvious and new possibilities could be discussed for multiple levels of authority. The author argues that this study required the use of each framework and could not have been solved independently. Therefore, there seems to be scope for further research into developing adaptations of these frameworks for energy transition planning studies.

7 Conclusion

7.1. Conclusions

This thesis aimed to provide a heuristic understanding of onshore wind power difficulties in integrating into the French energy regime by conducting in-depth research into national-level barriers and local empirical case studies. It presents possible policy and institutional changes to facilitate its technical transition in France in the near future. The research involved using sustainable energy transition frameworks, MLP and SNM, and collected experimental, qualitative data from empirical case studies and interviews to determine the principal barriers to onshore wind energy implementation at national and local levels. The approach identified elements to solve the main question, *"What is constraining the deployment of onshore wind energy in France?"* and subsequently four sub-research questions. This section begins by answering each subquestion before answering the main research question. Following the answers to each research question, scientific contributions to research are presented along with the limitations of the project's findings. Finally, recommendations are made to practising developers in France, policymakers, and future researchers.

7.1.1. Answering Research Sub-questions

Where does the onshore wind energy niche stand regarding the current situation in the French energy sector?

In France, electricity represents 25% of the national energy consumption. As of mid-2022, onshore wind energy represents 8% to 10% of France's electricity production. The rest of France's power is predominantly generated by nuclear, 60% to 70%, hydropower from 10% to 15%, and the rest from a combination of solar, biomass, and thermal power plants. From a technical transition perspective, onshore wind energy has many required attributes for success. It is considered the country's most mature RES technology, and there is still scope for it to grow, with 20 000 MW installed in 2022 and official national objectives stated in the PPE, aiming for 34 000 MW by 2028. Nonetheless, this reflects France's lag in attaining its onshore wind targets. From FEE data, installation rates have been decreasing in recent years, and at the current rate, accumulated capacity will reach 27 GW onshore installed in 2028, against the desired 34 GW; this results in a capacity shortfall of 7 GW.

What are the main drivers and barriers experienced by the onshore wind energy industry at a national level?

Wind energy in France benefits from various enablers, but also barriers, which are described using the levels and dimensions of the MLP and SNM analysis.

From the top level, landscape evolution has meant that France, unlike any of its neighbours, developed a strong attachment to nuclear energy during the 1980s, shaping the current power sector on which it is still heavily reliant. However, more recent international changes have increased tensions for France to change its national electricity sector, starting with European commitment to increase RES technologies in its mix, of which nuclear is not one. Most recently, tensions have been highest due to ageing nuclear plants reaching the end of their lifespan, threatening France's energy security and independence. This is all the more concerning owing to geopolitical tensions regarding hydrocarbons, the urgency of climate change, and the efforts to contribute to the European energy transition.

On a more national level, the MLP and SNM framework used to analyse the current energy regime dimensions describes the drivers and barriers that the onshore wind sector experiences. From the first impression, the French wind industry seems to benefit from many favourable **policies**. Most of these date back to the Law of Green Growth in 2015, which includes price protection subsidies via FIP and ambitious national wind energy targets in two important documents, SNBC and PPE. However, the contentious nature of wind energy has led to new policies directed at reducing the impact of wind turbines on the surrounding environment, resulting in some of the strictest regulations for wind development in Europe. This has significantly reduced the possibilities open to developers. In addition, wide open spaces on which wind turbines are most effective (and often accepted) are usually subject to low-height restrictions or prohibited because they are reserved for army low-flying training zones or army radars. The French electricity **Market** has a specific framework allocated to wind energy amongst other RES technologies. Wind farms can use two options, tendering or the open window mechanism. However, unlike solar power generation, self-consumption is not facilitated. Also, EDF, the historical incumbent, is still the only energy producer to own France's nuclear fleet and dominates the market share. This makes it difficult for alternative electricity suppliers, including those offering alternative energy sourced from renewable or community energy projects. Given France's strong attachment to nuclear power, much of its **Infrastructure** is centralised around a few large power plants. It can be geographically challenging to install decentralised power sources like wind energy. Grid connections can be expensive, especially when they are far away (cost per kilometre of cable required). However, the grid is not well suited to the intermittent nature of wind energy and may require reinforcement.
Nonetheless, solutions such as Enedis' 'Express Source Substations' are being considered to facilitate future decentralised grid connection. **Knowledge and Science** are plentiful and are often supportive of wind energy development. Wind energy has its own national wind association; the FEE and the national union for RES development; the SER, which also pleads in favour of onshore wind energy at the highest political level possible (by the MTE) and the national environment agency also has a department dedicated to wind energy expertise.
In addition, France hosts many research facilities across the country, including employee retraining centres, which prepare workers in the current energy sector to adapt to a more decentralised layout and its challenges in the future.
However, funding is lacking in many of these institutions. Therefore, they are forced to delegate many of their tasks to more minor associations, which means they lose control and monitoring power over how the studies are performed. The French onshore wind **industry** is growing each year across all value chain sectors (impact studies, engineering and construction, component manufacturing, operation and maintenance). Yet, the industry is heavily criticised for supporting foreign companies, since Danish and German developers and constructors have been at the forefront of wind energy development. They came to France seeking new projects while France's industry was just beginning. As a result, today, only four of the ten top employers in the wind sector are French.
Culture, which includes social acceptance, is the most contentious factor in the analysis. While surveys still show that French nationals favour wind development, experience and published academics suggest otherwise. Unlike other countries, France's anti-wind lobbyists formed an active and well-organised federation from the start of wind energy deployment in the early 2000s. As a result, they have well-established media outlets and political representatives with influence and a strong following. Even in 2021, almost every wind project has been taken to court rulings by contesters delaying the project by an additional three years on average.

Research reveals numerous and varied actors among the **networks** involved in wind energy, which is representative of a strong niche. In addition, the SNM framework is applied in this study to understand the shortfalls of onshore wind energy from within its sector. It found that most alignment between the actors lies in research and development, where government, industry actors and large companies are investing in new ways to optimise wind turbine blade design, recyclability and existing infrastructure to accommodate intermittent sources like wind energy better. However, misalignment between actors was more common.

Significant conflicts were found between social organisations split between the more supportive, but less vocal groups, and the proactively 'anti' ones. There is also a noticeable misalignment between government policies and developers operating at the implementation level. Too few political actors are directly involved in wind energy, reducing political leadership in the sector. Consequently, without direction, the actors involved in the sector often take uncoordinated action and have misaligned goals reagrding the technological transition.

As for **learning**, many of the supportive actors come from research institutes which results in high levels of *learning by searching*, which yields high levels of technical knowledge and social science. Yet, the lack of coordination between actors constrains the amount of *learning by interacting* and the limited number of projects also reduces *learning by using*. The maturity of the technology has led to saturation in first-order learning. It requires more technological use by deploying more wind parks to improve outside-of-laboratory aspects of learning, including second-order, which reflects the societal willingness to change their views and behaviour to accommodate more wind energy.

Visions and expectations for onshore wind in France are still very unclear. On the one hand, onshore wind energy is mature and robust, it has proven its effectiveness, and the international context is favourable to developing more RES over any other energy source. On the other hand, the national political climate is not very favourable, and many inhabitants appear to be 'saturated' with the technology preventing its development. At the time of writing, even the power crisis in 2022 has not changed these views.

What strategies can be used to overcome national-level barriers?

The case studies and interviews show that many national-level barriers reflect under-acknowledged issues at the local/regional level of implemented projects.

National RES targets are ambitious and already include a vast amount of onshore wind energy, yet, France has failed to achieve them. While policies and targets are decided at a national level, there is insufficient guidance to implement them locally. At a national level, several barriers are to blame: grid connection costs, administrative and juridical delays owing to court appeals, height and radar constraints imposed by the army and limited local networks for supporting wind turbine deployment. However, social resistance to onshore wind energy is the most limiting factor.

To overcome this, this research suggests harmonising national and regional/local level targets via several developer practices and policy changes. First, the energy transition must become a government priority, and all cross-ministerial political decisions should be made in its favour. More political leadership is needed to drive change and realise their climate goals. Greater citizen inclusion in energy-related choices is necessary to increase awareness and acceptance. Yet, to increase energy citizenship, better knowledge and understanding of the energy sector are required to give citizens more legitimacy. Therefore, improving citizen energy science and literacy will be essential in the long-term energy transition to more decentralised RES, such as onshore wind, because the infrastructure will affect more and more people as the change progresses.

The European Union should also provide nations with better country-specific guidance for obtaining climate targets. Tailor-making policies and incentives should be considered to make transposing European laws to the national level more effective.

How should developer, governance and regulatory issues met at the regional/local level be addressed?

Harmonising national targets with local requirements begins with aiming for a better understanding of the local level of implementation. Developers can improve their practices by using more considerate guidelines to communicate better and include the nearby residents, as detailed in the recommendations below.

Yet, developers alone cannot overcome current barriers and require more government and regulatory assistance. Based on the present research and empirical experiences, several areas for policy experimentation with regulatory and institutional changes at local and national levels are suggested. The changes can be summarised as follows:

Regulatory

- Defining responsibility for energy targets at the local level
- Decentralising energy targets
- Decentralising spacial planning regulations
- Shift the benefit of the 'participatory bonus' from the developers to the community

Institutional

- Broaden energy education
- Improve media management about onshore energy topics
- Promote experiences of community wind energy projects
- Formalise new intermediaries between national-regional-local level energy decision making

7.1.2. Answering the Main Research Question

The sub-questions have laid out the foundations for answering the main research question:

"What is constraining the deployment of onshore wind energy in France?"

This study found that barriers to onshore wind energy deployment in France occur at different levels of implementation. The main barriers at the national level were:

- Social resistance and lack of community inclusion
- Poor political leadership on the energy transition and a strong attachment to nuclear energy
- Too little guidance between national climate goals and local implementation
- Limited area for developing wind farms

At the local level, however, other issues emerged;

- difficulties for developers to reach municipals Mayors (the principal local decision-makers)
- an uncoordinated network of local RES actors
- difficulties in communicating on energy issues owing to a lack of public energy education
- little sense of responsibility towards reaching climate targets at the local level and little public interest in building community energy projects

Starting with the national level, social resistance to onshore wind in France is well recognised and stems from several reasons. The population has a strong attachment to the natural heritage of the landscape. Bad experiences between communities and developers in the first rollout of wind turbines in the early 2000s fuelled anti-wind sentiments. This resulted in the creation of effective anti-wind lobbyists, and most wind projects are still subject to court appeals.

Political leaders' attitude towards RES has been unstable and contradictory ever since the first RES scheme was introduced. Unlike many other countries, France relies heavily on nuclear energy, a carbon-neutral power source, so motives to reduce CO_2 emissions were often overlooked.

In 2015 national plans to mitigate climate change were set in the SNBC and PPE, including ambitious targets for onshore wind energy. They were made in line with EU directives, and non-compliance is sanctioned at EU level. However, none of the plans included in France's roadmap to carbon neutrality are legally binding at a national level. Hence, objectives were not effectively transposed to local implementation. Consequently, no level of governance is held accountable for missing targets. This is particularly detrimental at the local level of governance, where the energy infrastructure is implemented. Local decision-makers do not feel responsible for contributing to climate goals at this level, especially when many more tangible duties burden them.

Another factor to consider is the government's attachment to nuclear energy and an energy system centralised both physically, around nuclear power plants, and politically, state-led. This mindset remains embedded in the population's beliefs and perception of the energy system - that the state is responsible for energy decisions. As a result, the French population feels little responsibility towards the energy transition and takes no interest in alternative energy projects, such as partaking in community energy projects.

However, to improve the social acceptance of wind projects, a new political emphasis is being made to encourage community participation. These incentives included partnerships with developers in energy projects and to create community-owned energy projects. Yet, the movement is slow to emerge. Community wind energy projects are uncommon, and the framework for community inclusion is poorly developed.

At the local level, the study found that developers seeking out communities to work with struggle to find the necessary contacts and networks to proceed. Several factors limited them. First, suitable areas for developing projects are very constrained due to aviation regulations prohibiting the construction of tall infrastructure, such as wind turbines.

Second, contacting the Mayor of the community with a potential site is very challenging, which makes initiating new projects difficult. This is because they have too many duties, and local RES projects are rarely a priority.

The advisory networks and mediators responsible for bridging the gap between communities and developers are still evolving, which makes it difficult for developers to use and rely on them to help include or build partnerships with local communities. In addition, local actors in the energy sector do not have the power to induce change. They are limited to an advisory role and must wait to be approached by proactive community members before offering information. Therefore there is poor coordination between local actors in the energy transition and little agency for change.

Finally, some barriers to wind energy result from miscommunication between actors at different stages of the energy transition.

There is a general lack of energy education among the population. This makes it difficult for developers or energy specialists to communicate with the public on energy issues. It also makes it more difficult to suggest additional benefits for hosting projects when communities do not understand the offer.

In addition, media management of the topic has led to an inherent bias against wind energy, which has been enforced in recent election campaigns. Furthermore, much anti-wind sentiment is fuelled by pro-nuclear energy supporters. The lack of energy education has made much of the population susceptible to misinformation and damaged the wind industry's reputation.

An absence of unanimous understanding of the energy sector and wind energy has led to many conflicts of interest between policy-makers, developers and the local population. This problem could be solved by providing sources of common knowledge about energy from unbiased sources.

Overall, it seems that developers are at the limits of what they can achieve with best practices, and community energy projects must be better understood by the greater population to scale up. Nonetheless, some practices have shown to be more effective than others, as discussed in Section 6.1. Policy changes could support regime changes to encourage more onshore wind development as found in Section 6.5.

7.2. Scientific Contribution

This research's contributions are two-fold. It provides new insights into local-level barriers to deploying onshore wind in France. It also has the academic merit of using a new combined approach of MLP-SNM with the additional consideration of decision-making at multi-levels of governance.

7.2.1. Contribution to Onshore Wind Planning Literature

To the author's knowledge, this is the first research to offer as much depth in comparing national law and local implementation. It also included perspectives and input from industry specialists, developers and a varied range of active local-level players (SDE, local councils, local RES investors and CREP networks). In particular, while other papers have included accounts of developers' experiences, this is the first time best practices for developers have been used in empirical studies to test solutions to apparent national-level barriers.

7.2.2. Contributions to Academic Research Approach

The approach to this research is also noteworthy for its unique application of sustainable transition study methodology. It adapted MLP and SNM frameworks to two levels of study, addressing the national level, common to most sustainable transition studies, and local implementation. This is highlighted in the case study in the department of l'Aube, which revealed findings beyond the typical approach using MLP and SNM variables, but also addressed governance and decision-making, most notably the dependencies between different government levels taking a multi-level governance perspective.

Alone, MLP and SNM contributed but could not resolve the barriers. Critical difficulties were visible only by working with a developer at the local level of implementation. This analysis of the local level of governance with the same framework as the national level revealed new barriers to address nationally. For this reason, combining MLP and SNM with multi-level governance strengthened the research. The author argues that it should be considered for incorporation into more sustainability energy transition studies in the future.

7.3. Project Limitations

This project aimed for the most objective observations and scientific approach possible to solve the issues presented to onshore wind energy in France. Yet, the project was subject to certain constraints described below.

7.3.1. Time and Contacts

Given the project's duration, only a few months could be spent working with the wind-developing company, which meant that further experimentation of good practices could not be carried out and tested. There is no way to quantify how effective the recommendations would be. Therefore, only qualitative assumptions could be made based on the feedback from interactions with company employees and specialists in interviews.

Time permitting, more specialists could have been contacted, particularly within the community wind energy niche. It would have been interesting to have the feedback from citizens involved in a successful community wind project with or without a co-ownership.

7.3.2. Case Specific

As with most case studies, many of the findings are very case specific, which can affect the validity and reliability of the results. Many of the local issues discussed were strongly related to the specific case of the communities encountered in the department of Aube. Therefore, they may not be accurate in all of France.

Nonetheless, the research adopted a strict and transparent protocol to be replicated by researchers in the future. Further, as justified previously in section 3.2.1, the chosen case was aimed to represent many regions of France regarding social feelings towards wind energy and the dynamics of regional institutions involved.

7.4. Recommendations

This final section offers recommendations to developers practising in France's current legal context before suggesting regulatory changes to facilitate wind energy diffusion in France. A further round of recommendations is directed at academics for future research.

7.4.1. Recommendations to Wind Developers

As discussed in Section 6.1, wind developers have long been blamed for poor practices, yet, closer observations found that the ever-tightening regulations have been restricting their options. Nonetheless, as previously discussed, certain interactions with local decision-makers and communities can be optimised.

Therefore, this brief section offers recommendations to optimise practice within the current rules, and the following sections address recommendations to policymakers to provide developers with more flexibility.

The recommendations to developers :

- **Before making contact with the community:**
  - Choose sites away from residential areas, or that include noisy infrastructure (e.g. train line or motorway).
  - Optimise initial contact with the community by communicating with the Mayor before the affected landowners.
  - Show an understanding of the local area by preparing for the exchanges before contacting the community. For instance, using SDE to acquire local knowledge about climate strategy (PCAET, TEPOS...), past/ongoing wind projects, local resources, etc.
  - Make contact with other local RES investors to raise awareness of a project and learn about other ongoing RES projects in the area.
  - Show empathy and understanding towards a community's "localism", by recognising the importance of a community's attachment to the landscape and identity.
  - Offer community inclusion to design and financial or managerial participation in the project. Be transparent about the gains and the impacts on the community.
- **After a community has shown some interest:**
  - Capture interest by offering co-ownership of the project and presenting all options for development.
  - Offer public meetings to introduce and raise project awareness before finalising studies.
  - Be personally approachable outside of public meetings to enable personal interactions with locals.
  - If possible, show a personal connection to the area to reassure locals.

7.4.2. Recommendations to Policy Makers

The discussions in Section 6.5 found that certain implementation issues could not be overcome by local-level actors alone and that policy changes were needed to create the desired regime changes. These recommendations are outlined based on the problems found in this national and local-level study and the discussion from the previous Chapter 6.As a reminder, the main policy changes relate to; defining responsibilities for implementing national targets at the local level, opening up more space to wind parks, raising awareness of the energy sector's role among the population and providing extra incentives and support to communities that host them.

For this, the following national policy changes are recommended;

- More political leadership on the energy transition via inter-ministerial collaboration for achieving RES targets. Notably, opening up areas reserved by the army for low-fly zone training to allow for more wind development. In addition, the promotion of energy education among citizens of all ages and backgrounds should be undertaken with the Ministry of Defense and Ministry of Education, respectively.
- Territorialisation of energy targets and tailoring them to the local level's environmental footprint. This would also require implementation standards and indicators for monitoring progress between all regions and intermunicipalities for a fair assessment.
- Designing and experimenting with policies to find a better balance for legally imposing energy transition at the local level. A suggestion made in Section 6.5.2 could include mandatory energy training for local decision-makers. In particular, it should be directed at those responsible for achieving the territorial energy targets, like Mayors.
- Finding new means of building trust between residents and developers. For instance, rewarding citizens more than developers for community participation in wind projects. This would defend a developer's integrity when offering the community a stake in a project.
- Resolving remote grid infrastructure and connection issues for decentralised RES by investing in new infrastructure. The aim would be to facilitate decentralised grid connections by financing research and deploying new infrastructure, such as 'Express Source Substations', so that development can occur more feasibly in more remote places.

- Supporting a national public media campaign about the need for RES and the benefits that wind energy can offer. This includes its advantages over other novelties such as nuclear fission, offshore wind energy, and hydrogen, which currently capture greater audience interest.
- Formalising a more significant role for SDE employees as intermediaries for the energy transition and providing these institutions with training to execute their new functions.
- Experimenting with new incentives in support of community energy projects and hybrid structures that can interact independently of EPA. The aim would be to encourage alternative ways for communities to partake in the energy transition and, in time, strengthen the niche initiative.
- Redistributing the current State budget allocated to advisory roles and assigning it to positions of responsibility (and agency) such as at regional and local level and increasing knowledge diffusion by ADEME.

Regime changes can also occur more promptly with external pressure. Therefore, decisions taken by the EU could also catalyse changes at national and local levels. As discussed in more depth in Section 6.5.2, EU policies coordinate the energy transition among its members by settings targets. Yet, member countries prioritise different targets when transposing the RED II, resulting in discrepancies between national goals and local implementation. This is symptomatic of too little guidance on how to approach the change.

To remedy these issues, the recommended European policy changes are:

- Funding cross-border research on complex challenges facing the wind energy sector. This should include more cross-cultural knowledge sharing of social science on energy systems.
- Promoting citizen science, by creating opportunities for citizens to learn about energy systems and understand how to participate. The aim should be to ignite and sustain citizens' interest in energy science over the long term.
- Tailoring policies and targets, by adapting sanctions according to countries' current energy regimes. This should encourage governments to prioritise specific targets under EU guidance and remove some of the dependability on the political party in power.
- Creating enabling frameworks for local business models, with a framework targeting regional business models that account for the challenges that come with RES projects. It should encourage complementation between existing RES initiatives, technologies and user types to make up an overall "enabling framework". The intention should be to encourage developers to prioritise local resources and workforce.
- Improving existing energy justice principles by exploring new ways of introducing intermediaries to aid cooperation between stakeholders. These directives should also include strategies for giving feedback on local-level observations to governance regimes who can direct policy changes effectively. The aim should be to promote more fairness between all actors.

7.4.3. Recommendations for Future Researchers

This research opened new pathways to increasing social acceptance of wind energy in France for incumbent wind developers and policymakers. Yet, several ideas could not be tested due to limited time. Therefore, there seems to be scope for further investigation in several areas;

- From discussions in Section 6.5.2, more research is needed to find ways to improve direct communication between policymakers and wind energy developers. Both parties must find ways to share knowledge and evidence that could provide a greater understanding of social acceptance. As suggested by Ellis [42], for this, more research is needed for a systematic approach to involve a wider range of parties in energy conversations to produce more constructive outcomes.
- More research is needed to understand what types of community energy projects exist in France. It would help developers, and local capacity makers better understand how most of these projects were initiated and the motives behind their creation. These answers could contribute to finding keys to increasing the popularity of CREP and social acceptance of wind energy. This could also contribute to identifying the factors that may be preventing them from scaling up from niche to regime level.
- Exploring more options for tailor-made policies at European and national level government to prioritise and accelerate specific technological transitions over others.

- The present research identified much social resistance as a result of landscape change. It could be valuable to review how other major visible infrastructures such as motorways, TGV rail lines or new skyscrapers gained social acceptance in the past. Such research should include identifying the different social factors, such as media outlets at the time of their appearance compared to now.

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8

Appendix

SUMMARY OF CASE STUDY INTERVIEWS:

Case 1: Experience as a Wind Developer

Serge Vadot, Wind Project Manager and Company mentor at CNR

Exchanges with Serge took place between September 2021 and March 2022. The information included:

- Introduction the company and a wind developer's observations of the French wind industry.
- An explanation of the sitting protocol and the methodology for scouting out new locations, such as using the QGIS software, and the best practices used by CNR.
- When to consider investigating prohibited areas and why.
- Recurrent problems that developers meet, such as 1) the difficulty contacting the municipal Mayor, 2) the necessity to put top sites on standby until a new municipal election, and 3) extended delays waiting for the army's permission to build in proximity to a low-fly zone.
- Regulatory changes that have helped and hindered the onshore wind industry in recent years
- Conflicts with Dreals

Developer interactions with local actors:

Interviewee Affiliation	Position	Location	Mode of Contact
SEM Energie de L'Aube	Président	Troyes	Phone call
GECLER	Network Manager	Charleville-Mézières	Email
Mairie Braux	Secretary	Braux	Phone call
Mairie Morvilliers	Mayor's Secretary	Morvilliers	Phone call
Mairie Maizières-lés-Brienne	Mayor's Secretary	Morvilliers	Phone call
Mairie Crespy-le-Neuf	Mayor's Secretary	Morvilliers	Phone call
Mairie Juzanvigny	Mayor's Secretary	Morvilliers	Phone call
CA TCM	Advisor of Energie Partagée	Troyes	Video meeting
SDE l'Aube	Renewable Energy Manager	Troyes	Phone call

Figure 8.1: List of exchanges with local actors

Interactions followed a similar frame :

- Presenting CNR as a shared public-privately owned energy company.
- Presenting experience in wind energy projects and willingness to create more partnerships with the local community.
- Asking about the role and experience of the interlocutor's organisation in local wind energy projects.
- Inquiring about their views on local wind energy projects and community inclusion.

- Asked if they would support a joint-owned wind energy project between CNR and the community.

Case 2: Project Manager's Account of a Joint-Owned Project

Interview with Maya Forni, Wind Project Manager at CNR

This semi-constructed interview aimed to learn more about the experience of finding and managing CNR's only joint-owned wind project to date located in Souilly d'Air.

Questions included:

- How and when did you find the location for the project?
- How long did each of the planning phases take from the moment you identified the site (known as ZIP in French) to securing a planning permit?
- What, in your opinion, were the factors of success?
- What were the riskiest stages, and how did you deal with social resistance?
- What have you learnt from this experience that could be replicated in future projects?

Answers :

- A small but feasible area was identified using usual siting methods in 2016, the community was contacted, and the Mayor agreed to find out more about hosting a project within a short period of time (a few months)
- From the start, the Mayor showed a strong interest in involving the community and building a partnership with CNR. He used his personal contacts to raise capital to increase his community's share as much as possible.
- Even with firm leadership from the Mayor, the project still risked falling through for several reasons: elections campaigns meant that the project had to be delayed until the Mayor had been re-elected to continue studies. Once studies were resumed, they revealed unexpected fauna in the area. Hence, extra biodiversity studies had to be undertaken, significantly delaying project planning.
- Much of the local resistance to the project was subdued by the charismatic leadership that the Mayor exhibited.
- The context was not as precarious for onshore wind turbines between 2017-2020. The regional and Presidential election campaigns in 2021 and 2022 gave wind more media time, and not in a good way - this damaged its reputation, according to the interviewee. The project manager fears its supporters might not have been as outspoken or proactive if the same project had been initiated today.

Case 3: Interviews with Wind Industry Specialists

Interview with Amandine Vollard Renewable Energy Engineer at ADEME

Questions included:

- What are ADEME's priorities for developing wind power in France?
- How to facilitate the integration of developers in co-shareholding projects with participatory and/or citizen financing?
- What role do ADEME and their partnerships play in the development of wind projects?
- How could project developers better incorporate ADEME partnerships into their projects to promote the integration of local actors into their projects?
- What are three regime changes you would recommend to promote onshore wind energy in the future?

Answers:

- More energy education is needed to improve the greater population's knowledge and information about the energy sector so voters can make informed decisions of their own, and not be so susceptible to misinformation.

- Mediators have a big role to play. Ademe's mediator network 'Les Générateurs' is only just starting up and will be present in all regions and in most departments. There will five representatives per region, but if they are effective at increasing wind projects, their budget will increase.
- The energy transition must become the government's biggest priority. This should translate to interministerial collaboration between MTE and Ministers of Education, Finance and Defense (*for opening up low-fly areas to developers*)
- Options for decentralising energy decisions to local territories should be considered. For example, requiring EPCIs to achieve certain climate and environmental indicators and a deadline. However, allowing local decision-makers the freedom to plan and which goals to prioritise according to the local situation.
- Sensitivity to changes in landscape is difficult because it is not scientific but rather representative of shifts in the cultural perception of society at a given moment. More care and research must be taken to tackle this issue more effectively.
- Broadening energy education will be critical for the energy transitions to succeed. People need to understand the energy system's challenges to make informed decisions when they vote in municipal, regional and national elections.
- Desired changes: simplify exchanges, regionalised PPE objectives, add environmental footprint criterion, remedy misinformation with an unbiased information source

Interview with Camille Charpiat, Head of Onshore wind energy at SER

Questions included:

- How could we improve the distribution of wind farms throughout the country?
- If the SER wants to support a Public Communication Campaign to raise public awareness, who would be responsible for it and by what means is it envisaged?
- How to encourage a better 'symbiosis' between wind developers and citizen projects in the future?
- How to facilitate citizen participation in wind energy projects?
- What are three regime changes you would recommend to promote onshore wind energy in the future?

Answers:

- In the current system, wind energy project profitability is dependent on wind resources (often high up) and local geographical constraints (aviation height limits, residents' preference for smaller turbines and biodiversity). However, some areas are not feasible for building wind parks because of scattered inhabitants, reducing the size of open areas to developers. These are some of the causes of the 'chaotic' wind farm clusters in France. A new market strategy is needed to keep wind energy competitive, not just in windy areas. The Open Window mechanism is a good start but needs more fine-tuning. Adapting the wind turbines to height constraints and noise restrictions damages their efficiency and reputation.
- Community energy projects may not be the only solution to social acceptance. Other strategies exist in other countries, like collective-prosumerism, which is unavailable in France. The main issue is that the benefits of hosting a wind turbine are not visible to communities. The tax returns (known as IFER) alone are 20 000 euros per year for every 3 MW installed, which is a noticeable source of income for most rural communities. If the community has invested in shares in the project, then returns would be more. A new approach being considered by the industry's work group is to introduce a 'heritage fund'. All returns from the wind turbine would go directly into the community fund dedicated to restoring community property and making the returns more visible to the public.
- There needs to better media management on wind energy and a reliable and unbiased information base, ADEME, for example. It is absolutely necessary that the media treat the subject better, despite their economic constraints (to attract as many readers as possible), because they have too much influence. Find opinion relays, a figurehead to defend wind energy relatable to the general public and those more specialized on the subject. A good communicator, pedagogue

and scientifically solid who would be prepared to defend an unpopular opinion. A media campaign promoting RES would be helpful, but it is not obvious if it should be funded by the State or members of the RES industry.

- Desired changes: accelerate and simplify, find space and better communication and media management 5.4.3

Useful Websites:

French Energy System:

Comapgnie Nationale du Rhône (CNR) : https://www.cnr.tm.fr/en/

Commission de Régulation de l'Energie (CRE) : https://www.cre.fr/

Enedis : https://www.enedis.fr/

Réseau de Transport d'Electricité (RTE) : https://www.rte-france.com/

French Wind Industry:

Agence de la Transition Ecologique (ADEME) : https://www.ademe.fr/en/frontpage/

France Energie Eolienne (FEE): https://fee.asso.fr/

Syndicat des énergies renouvelables (SER) : https://www.syndicat-energies-renouvelables.fr/

National and International energy policies:

European Commission : https://energy.ec.europa.eu/

Ministère de la Transition Ecologique (MTE) : https://www.ecologie.gouv.fr/

Vie-Publique : https://www.vie-publique.fr/