ANALYSIS OF THE FRENCH WIND POWER SECTOR: OVERVIEW, PROSPECTIVE ANALYSIS AND STRATEGY

Summary
FOREWORD

With installed capacity of approximately 12,000 MW at the end of December 2016, the French wind power sector today ranks, after 15 years of public support, 4th in Europe. Ambitions for wind power are high: the Programmation Pluriannuelle de l’Energie (PPE - a document that sets multi-annual national energy targets) published at the end of 2016 sets a low-end target of almost twice the current installed capacity by 2023, reinforcing the major role played by wind power in France’s energy transition strategy.

In this context, it appeared essential to conduct a detailed assessment of the sector and the policy implemented to support its deployment, prior to analysing future prospects to see what lessons are to be learned regarding the evolution of wind power policy. This study thus presents an assessment of the socio-economic, historical and future impact of the sector, in terms of economic activity and employment. It also provides a critical overview of the policy in place since 2000, in terms of effectiveness, usefulness and efficiency. Finally, it looks at development prospects for the sector and for its regulatory, technological and economic context; with achieving PPE targets in mind, the analysis draws lessons and provides recommendations concerning the wind power policy and the maximisation of the social and economic value of the deployment of wind power in France.

The production of this study implied a detailed review of current literature, two surveys (one targeted professionals in the sector and the other targeted local authorities), many bilateral discussions, as well as a co-elaborative workshop. Professionals in the sector, local authorities, central administrations, the Commission for Energy Regulation, network operators, the research community, environmental protection associations… all of wind power stakeholders were thus consulted in conducting this analysis.

By producing these data, the ADEME seeks to fuel the public debate on the strategic and technical questions surrounding the development of wind power in France. This work targets all wind power stakeholders involved, and is intended to help policymakers draft, oversee, and assess support policies for the sector.
EXECUTIVE SUMMARY

In 2000, there were only a few hundred wind turbines in France, with total capacity of about 50 MW. At the end of 2016, after 15 years of public policy supporting the technology, French wind farm capacity reached 11 800 MW, covering 3.9% of French electricity generation that year. In 2015, there were almost 18,000 direct and indirect full-time equivalents (FTE) in France in the sector, with 18 FTE/MW-installed-yearly, a performance below that of Germany, at 30 FTE/MW-installed-yearly in 2014. This difference mostly comes from the absence of leading French turbine manufacturers for onshore wind power. French companies active in the wind power sector still generate exports estimated at €663 million, from total French wind power turnover estimated at over €1.84 billion in 2015. Total added value is estimated at over €730 million.

From the year 2000, France has implemented various policy mechanisms to support the wind power sector: compulsory purchase of wind power by electricity suppliers followed by the introduction of feed-in tariffs and the launch of a series of calls for tender. In addition, wind power deployment objectives were established for 2000-2015. Retrospectively, it appears that, up until 2012, wind deployment targets and the regulatory framework did not sufficiently anticipate several barriers to the deployment of wind turbines: land-use conflict, local integration of projects, consideration of the environmental impact and network development issues. Taking these issues into account has led to an accumulation of regulatory changes, which were only belatedly understood to be inadequate for the ambitious wind capacity objectives. The administration since launched efforts to streamline regulations, and that continues today.

Even though the production capacity of major turbine manufacturers remains limited in France, a French wind power sector has developed, comprising nearly 600 companies in 2015. The initiatives taken since 2010, with the creation of Windustry France and the export clubs, and the inclusion of industrial criteria in calls for tender for offshore wind farm projects, are leading to an enhanced perception of high environmental, social and economic quality, local stakeholders, and the co-construction of projects. The development of wind power has also had significant environmental and health benefits, which, in monetary terms, represent an estimated gain for society of approximately €3.1 to 8.8 billion over the 2002-2013 period. These benefits greatly exceed the cost of the policy to support wind. Indeed, in 2015, wind feed-in tariffs represented about 2.9% of the average household’s electricity bill. Once added to the network development costs borne by network operators and to the research-development-innovation costs financed by public authorities, total wind power policy costs is estimated at €3.2 billion for the period 2002-2013.

Latest policy developments and PPE targets provided enhanced visibility over future volumes and levels of remuneration. To achieve renewable energy objectives set for 2023 and 2030, the annual rate of onshore installations must meet and even exceed that of 2016. Offshore installation process must, for its part, lead to concrete results and become stable. To do this, it is essential to make the deployment of wind power an opportunity for socio-economic development both nationally and at the local level. Projections show that employment in the sector could reach between 60,000 and 93,000 direct and indirect FTE (excluding exports) by 2050 (between 40,000 and 75,000 FTE by 2035). The players involved in the sector must, for their part, rise to the technological and logistical challenges in order to simultaneously increase load factors and decrease the cost per MWh, in particular in offshore wind power. They must also work more closely with local authorities. These cost reduction prospects make wind power one of the most competitive electricity generation sectors in France.

Despite the opportunities that the sector represents, 50% of wind farm projects were the target of legal disputes between 2012 and 2014, causing delays that could exceed 3 years. One of the reasons for the disputes is the unequal integration of projects at the local level, even though recent surveys have shown that the French have a very positive image of wind power. The increasing involvement of local stakeholders, and the co-construction of projects of high environmental, social and economic quality, are today considered major levers for a better local integration of projects.

1. Industrial consolidation tool, supervised by the SER (Syndicat des Energies Renouvelables, the Union of Renewable Energy), driven by industry players and supported by the State, with the objective of providing individual assistance to seventy companies, in order to develop their industrial processes, diversify their activity and generate business.
2. Significant greenhouse gas (GHG) emissions and other atmospheric pollutants emissions were avoided.
3. See section 2 below for a description of the analysis that leads to this conclusion.
4. Via the Contribution au Service Public de l’Electricité (CSPE - Contribution to Public Service Charges for Electricity)
5. OFATE. Panorama des principaux recours contentieux en matière de projets éoliens terrestres en France (Panorama of main sources of disputes for terrestrial wind farm projects in France). 2015.
TABLE OF CONTENTS

Foreword .................................................................................................................................................. 3
Executive summary ................................................................................................................................... 4

1. WHAT IS THE ECONOMIC WEIGHT OF THE WIND SECTOR IN FRANCE? ................................................................. 6
A global market which shows no sign of slowing down .................................................................................. 6
A sector with a significant number of industrial and service jobs ................................................................. 7
In France a sector that generates significant volumes of exports ................................................................. 7
A regional distribution of activities that reflects both resources and existing economic strength .................. 9

2. HOW SUCCESSFUL WAS THE POLICY TO SUPPORT WIND POWER? ........................................................................... 10
A progressive development of the support mechanism and regulatory framework ......................................... 10
A failure to achieve wind deployment targets over the period ......................................................................... 11
A policy framework that facilitated the emergence of a French wind power sector, without resulting in the creation of a leading national turbine manufacturer ......................................................... 12
A significant contribution to the renewable energy mix growth and to the reduction of GHG and other atmospheric pollutants emissions in France ............................................................................................................................ 13
A regulatory framework that accounts for safety, health and environmental issues, but still faces local integration issues ........................................................................................................................................ 13
A policy framework that provides economic stimulus at the local level ......................................................... 14
A policy that has a relatively limited impact on the cost of electricity to consumers ........................................ 14
Environmental benefits that are on par with wind power policy costs ............................................................ 15

3. WHAT ARE THE MID-TERM PROSPECTS FOR DEVELOPMENT? .............................................................................. 16
Encouraging worldwide prospects for wind energy sector growth ............................................................... 16
A set of technological challenges that wind sector players must meet in order to continue to lower costs ........ 17
Market strategies that must account for changes in the geographic structure of demand and overall growth in the wind power market .............................................................................................................. 17
Support mechanism, repowering operations, integration into the electricity market: a new generation of business models for wind power .............................................................................................................. 18
Beyond the technical objectives: challenges that relate to skills development, adapting the regulatory framework… ........................................................................................................................................ 18
…and promoting increased industrial capacities ............................................................................................ 19

4. WHAT ARE THE LONG TERM ECONOMIC BENEFITS? .............................................................................................. 20
Still a negligible effect on gross domestic product .......................................................................................... 20
Strong increase in local tax revenues and wind power sector employment .................................................... 21

5. WHAT IS THE ADEME’S ROLE IN A NATIONAL WIND POWER STRATEGY? ................................................................. 22
Actions supporting skills and knowledge development and projects’ local integration to accelerate the annual rates of wind turbines installations ................................................................................ 22
Actions supporting the development of a domestic sector and the appropriation of projects by local players to maximise wind power social and economic value ...................................................................... 22
1. WHAT IS THE ECONOMIC WEIGHT OF THE WIND SECTOR IN FRANCE?

Using publicly available data and a survey of the players involved in wind power in France, this chapter provides an overview of the economic activity, employment and costs of the onshore and offshore wind sectors, in France and other countries, in a favourable international context.

A GLOBAL MARKET WHICH SHOWS NO SIGN OF SLOWING DOWN

The wind power market has been growing rapidly for 10 years, and in 2015, the worldwide installed wind farm capacity reached 433 GW, equal to 7% of installed capacity, all sources included, and 3.7% of generated electricity. The global wind capacity has been growing by 17% per year since 2010 (see Figure 1) and should continue to grow at a steady pace. This growth is driven by emerging countries - China alone represented 50% of the new installed capacity in 2015. In 2016, wind power was the second biggest source of electricity in terms of investment in new production capacity, at $111 billion.

Onshore wind power is the technology that has been the most extensively developed, representing more than 97% of the installed power capacity, equal to 420 GW. In onshore wind power, low-power machines (less than 100 kW) are the minority, with a capacity of approximately 300 MW for 870 000 units. Offshore wind power has been growing at a constant pace since 2011, at approximately 28% per year between 2011 and 2014, which enabled it to reach 12 GW of cumulative installed capacity in 2015. 90% of this installed capacity is in Northern Europe: 5 GW in the United Kingdom and 3.3 GW in Germany.
The growth of wind power comes with considerable job creation in the sector: worldwide, it is the fourth renewable energy sector in terms of employment, with 1.1 million direct and indirect jobs, behind hydro-electricity, photovoltaic and biofuels. In 2015, investment was between 1 060 and 1 600 €/kW for onshore wind and between 3 300 and 5 000 €/kW for offshore wind. In total, investment in wind power represented a global market of about 100 billion euros that same year, with 65% to 80% of total investment in the manufacture and assembly of wind turbines, 15 to 30% for installation and commissioning, and 2 to 6% for detailed studies and development. The vast majority of wind power jobs are associated with investment, with a distribution by segment in the value chain approximately in line with the cost structure. Slightly more than 2% of the jobs worldwide are in operation and maintenance, and this is constantly increasing.

The number of jobs in the wind power market varies greatly from one country to another: from 30 FTE per MW-installed-yearly in Germany in 2014, to less than 15 in Brazil. In 2015, France had a ratio of approximately 18 FTE per MW-installed-yearly. This variation comes from the degree to which industrial activities are developed, as activities associated with development, installation and operations are "local" activities. Germany and China, which are the most labour-intensive countries, have been able to develop wind turbine industries that are very active in the domestic and international markets. Historically, some key factors have led to strong wind turbine industries in various countries: significant domestic opportunities, demand for local content in tendering processes, early support for research and development, mechanisms to foster export and policy targeting national industries' specific strengths.

In France, total onshore wind capacity stood at more than 11,800 MW at the end of 2016. French wind power production represented approximately 21 TWh in 2016, equal to 3.9% of national electricity consumption. In addition, the commissioning of the first installed offshore wind farms should take place in 2021.

In 2015, the domestic onshore wind power markets (excluding the value of generated electricity) was estimated at €1.8 billion, with investment in new wind farms estimated at €1.3 billion and operation-maintenance activities representing approximately €475 million. This market led to imports (mainly turbines and components) of approximately €685 million. Concerning the actual sale of electricity, this market was estimated at €1.87 billion. Furthermore, the players involved in the French wind power sector generated €663 million in turnover from exports, mainly in the manufacture of components. Finally, the added value created by the sector, whether domestic (offshore wind farms included) or exported, was estimated at €730 million.

In 2015, wind energy sector players in France represented almost 18,000 FTEs, including more than 10,000 direct FTEs and almost 8,000 indirect FTEs. Exports account for almost 40% of direct FTEs. Although French companies are present in most parts of the value chain, to date, there is still no major turbine manufacturer in the onshore large wind turbines segment. Nonetheless, there is a turbine manufacturing industry in France for certain markets (medium size turbines, offshore wind turbines) and for onshore wind turbines with specific technology (direct-drive machines) made by small companies.

8. IRENA Renewable Jobs, annual review. 2015.
10. Added value = value of the final products – value of rank 1 intermediate goods and services.
11. Employment linked to the direct effects of the deployment and operation of wind farms in France, in the different areas of the value chain considered specific to the wind power sector: project development and studies, component manufacturing, assembly, transportation of components, civil engineering, construction, operation and maintenance.
12. Employment linked to non-specific intermediate goods and services, in other words goods and services consumed by those parts of the chain involved in the direct effects.
In 2015, project development represented 3000 direct and indirect FTEs in France. In addition, French developers have established an international presence: more than 50% of their projects are abroad, which has led to a worldwide market share of approximately 4%. Nonetheless, this performance is due to local subsidiaries (only 12% of their turnover in France is from export). EDF EN and Engie make 85% of the turnover realized abroad and hold 3% of worldwide installed capacity.

In France, studies and inspection operations represented 1700 direct and indirect FTEs, with companies positioned across all of the relevant areas of expertise for the sector. Only a small number of French engineering companies are active on international markets: 20% of the wind power turnover for the companies in this segment is from exports, representing 0.9% of the worldwide market.

Turbine and component manufacturing represented approximately 6700 direct and indirect FTEs, in France (total number of jobs in components manufacturing and assembly in Figure 2 above). While no current major manufacturer of onshore wind turbines of more than 1 MW is French, some national companies are working in or developing markets that are more specific:
- Eolys and Okwind: small wind turbines;
- DDIS: manufactures 800 kW machines, with an innovative design;
- Poma Leitwind: manufactures 1- to 3-MW direct-drive turbines; and
- Vergnet: historically active in medium- and large-sized wind turbines for tropical regions.

In addition, a major foreign company – General Electric - is active in France, manufacturing turbines for offshore wind power. While turbine assembly and trade represented in 2015 1800 direct and indirect FTEs in France, component manufacturing represented 4900 direct and indirect FTEs.

French companies produce most types of components, including mechanical components (such as Rollix Defontaine's slewing ring), electronic components (Leroy Somer generators), structural components (Plastinov composite parts, for example). Some foreign turbine manufacturers also manufacture components in France: Enercon builds concrete towers, and GE builds blades. Exports can reach 80% of some manufacturers’ turnover, a sign of how dynamic French industry is.

Civil engineering and connection works represented 3200 direct and indirect FTEs in France. Companies specialised in large-scale worksites, in the construction and public works sector, do the civil engineering work. Specialist companies, such as Cegelec and Spie in France, subcontract for connection operations. Local companies do these operations: there is little export and the global market share is insignificant. French companies are active (or are already positioned) on future offshore wind power markets: foundations and floaters (IDEOL, DCNS, Eiffage Metal), offshore work and connection equipment (STX, Louis Dreyfus, Nexans).

Lastly, in 2015, operation-maintenance activities represented 3800 direct and indirect FTEs in France. While the operation business is mainly local (the export rate for French companies is 4%), some specialised maintenance operations, such as blade maintenance, can be exported (an export rate of up to 70% for some French companies).
A REGIONAL DISTRIBUTION OF ACTIVITIES THAT REFLECTS BOTH RESOURCES AND EXISTING ECONOMIC STRENGTH

Employment in the wind power sector is distributed across all regions, with Hauts-de-France, Île-de-France, Occitanie and Pays de la Loire reaping most of the benefits; the breakdown by segment of the value chain also varies from one region to the next (see Figure 3).

Unlike jobs in civil engineering, industrial employment including turbine and component manufacturers is concentrated in the historical industrial regions, not necessarily where the wind farms are located: Auvergne-Rhône-Alpes, Bourgogne-Franche-Comté, Hauts-de-France, Île-de-France and Pays de la Loire (in particular for offshore wind power).

Service jobs are mainly found in the Hauts-de-France, Île-de-France, Pays de la Loire, and Occitanie regions. Developers and developer-operators are concentrated in Île-de-France, Pays de la Loire, and Occitanie. Engineering and technical studies companies have a fairly strong presence in Hauts-de-France, Normandy, Pays de la Loire and Occitanie, and are located near the main wind farm sites.

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1. ALL SEGMENTS

2. TURBINE AND COMPONENT MANUFACTURERS

3. DEVELOPERS AND DEVELOPER-OPERATORS

4. TECHNICAL CONSULTANCIES

Figure 3 : Breakdown of wind power FTEs by region in 2015 in Metropolitan France

13. Map 1 represents employment with developers-operators, operation and maintenance companies, civil engineering companies, technical consultancies, turbine manufacturers and component manufacturers. Map 2 represents maintenance employment, when provided by turbine manufacturers to operators. Map 3 represents employment in operations, energy sales and maintenance when these activities are internal to developers.
2. HOW SUCCESSFUL WAS THE POLICY TO SUPPORT WIND POWER?

This chapter provides an overview, covering the past 15 years, of the policy framework to support wind power, prior to the enactment of the Loi de Transition Energétique pour la Croissance Verte (LTECV - the Law on Energy Transition for Green Growth). This Chapter examines the effectiveness of the policy framework with respect to the stated objectives, as well as its impact and benefits from the point of view of the French energy policy as well as policies for the protection of the environment, employment, industrial and economic development, and risk prevention.

A PROGRESSIVE DEVELOPMENT OF THE SUPPORT MECHANISM AND REGULATORY FRAMEWORK

The first support mechanism for wind power was implemented in France before the 2000s: an initial urbanistic framework for wind power was set up in 1986, the first procurement contracts were awarded in 1990 and an initial programme of calls for tender for wind turbines, called "Eole 2005", was launched in 1996.

The February 10th, 2000, law on the modernisation and development of the public electricity service gave birth to the current support mechanism which established compulsory purchase of wind power by electricity suppliers and set feed-in tariffs for wind power from 2001 on. Regulatory and fiscal measures, supply-side support measures and planning requirements and tools completed this mechanism that has been essential for growth in the sector:
- From 2003 on, wind farm projects have required a construction permit, an impact assessment and a public inquiry;
- In 2007, the Zones de Développement de l'Eolien (ZDE - Wind Power Development Zones), planned under the POPE law of 2005, came into effect, with the goal of involving local authorities in the planning and control of wind farm projects on their territory;
- In 2010 and 2011, the Grenelle II law and its decrees placed wind power installations under the regime of Installations Classées pour la Protection de l'Environnement (ICPE - Facilities Classified for the Protection of the Environment), introduced the "500 metre rule" (minimum distance to housings), the minimum distance from radars, the environmental monitoring requirements and new acoustic standards. The "5-towers rule" (which requires wind farms to be composed of a minimum of 5 wind turbines) was also introduced by the Grenelle II law; and
- In 2013, the Brottes law reversed some previous measures deemed incompatible with the development of wind power: withdrawal of the “5-towers rule” and of the ZDE, a revision of the rules applying to wind power coastal development. Furthermore, additional measures allowed the pre-signature of feed-in tariff contracts and an experimentation to test a “single permitting” procedure for wind power (to streamline the administrative approval process for wind farms).

In addition, the 2000-2015 period saw a succession of quantitative targets for the deployment of wind power, confirmed by the Programmations Pluriannuelles des Investissements (PPI - the Multi-Annual Investment Programmes prior to the PPE) in 2003, 2006 and 2009, and different calls for tenders. These calls for tenders were meant to initiate deployment: in 2003 for onshore and offshore (with disappointing results), then in 2011 and 2013 for offshore wind power alone.14

Analysis of these fifteen years of regulatory mechanisms and support for the wind power sector leads to a certain number of observations and lessons.

14. The legal and regulatory developments associated with the LTECV, as well as the planning tools which then arose, are discussed in section 3 below.
A FAILURE TO ACHIEVE WIND DEPLOYMENT TARGETS OVER THE PERIOD

The wind power objectives set by the PPI recognised the importance of wind power to renewable energy production. Nonetheless, the effective deployment did not achieve the different PPI objectives (actual installed capacity was 10% to 30% below targets). The offshore wind farm base did not achieve its established objectives either: as to date, no farm is in operation. For the 2004-2015 period, reaching the objectives (for onshore and offshore wind power) would have required the installation of 1580 MW/year (1140 MW/year for onshore alone). Yet the average effective annual rate was, for the same period, 840 MW/year, i.e. 740 MW/year short of necessary rate on average (300 MW/year for onshore alone).

This is explained, on the one hand, by the fact that a certain number of barriers were insufficiently anticipated while establishing national deployment targets and the regulatory framework: the duration of project development, development of the power network and associated costs, co-existence with radar and some aeronautic activities, planned regional development and difficulties with local integration. Throughout the period, the belated acknowledgement of these obstacles led to frequent regulatory changes and to an accumulation of constraints for wind farm development. Public authorities began, only at a later stage, to rationalise this complex landscape (this rationalisation has been continuing in 2016 and 2017; see next chapter).

On the other hand, the sector’s problems are also due, more indirectly, to an initial lack of industrial ambition: lack of support for the emergence of a national turbine manufacturer or absence of R&D coordination. Without this industrial ambition, greater mobilisation of the different stakeholders and the general public, to boost the sector, has not been possible (see below).

Figure 5 highlights the major regulatory and wind capacity developments for the 2002-2015 period.

Figure 4: Simplified history of policy support and of the regulatory framework (the grey shaded area represents the connected power each year)
A POLICY FRAMEWORK THAT FACILITATED THE EMERGENCE OF A FRENCH WIND POWER SECTOR, WITHOUT RESULTING IN THE CREATION OF A LEADING NATIONAL \textsuperscript{15} TURBINE MANUFACTURER

Virtually non-existent at the enactment of a policy to support wind energy, there were almost 600 companies across the entire value chain in the French wind power sector in 2015. In total, players based in France (whether they were held by French or foreign investors) held 56% of the domestic onshore wind power market in 2015 (in a market worth an estimated €1.8 billion)\textsuperscript{16}. Nonetheless, in the investment phase of the domestic onshore market (estimated at €1.3 billion), France’s share of the market is only of 43%. This is because French companies are not active enough in turbine manufacturing and assembly, which represent a large part of the added value in wind power. No major French manufacturer of turbines bigger than 1 MW has emerged at the international level, and there are still few foreign turbine manufacturers active in France. French companies rank better in activities that are hard to relocate, such as development, engineering studies, civil engineering and connection work, and operation and maintenance.

Because of the weakness of the French sector industrially, France has not been able to maximise the impact on employment of its wind power policy. Nonetheless, there are some encouraging signs: employment intensity of the sector increased from 7 direct FTEs / MW-installed-yearly in 2007 to 11 FTEs / MW-installed-yearly in 2015; some companies are involved in turbine manufacturing, developing a turbine on specific market segments; industrial sub-contractors have been particularly successful with exports. Furthermore, the growth of offshore wind power, via the calls for tenders of 2011, 2013 and 2016, is beginning to stimulate industry and employment in coastal regions, through the arrival of major foreign turbine and component manufacturers.

Finally, even if over the period, the volume of exports in the sector has progressively increased (whether in absolute volume or proportionally to imports); policy support for wind power has only had a limited impact on the emergence and promotion of French companies internationally. This is due, on the one hand, to toughening regulations, which have limited the benefits of the national long-term objectives, and on the other hand, to delayed implementation of research, development and innovation (RDI) programmes and tools to support exports. These different factors have not enabled French companies to make up ground lost to neighbouring countries in the development of wind power and have allowed German and Northern European manufacturers to dominate the European market. Only since 2010 has support for the positioning of French companies been implemented: major RDI projects, via the Programme des Investissements d’Avenir (Programme for Investments of the Future) launched in 2010, Windustry France, the Export clubs.

\textsuperscript{15} Understood as a turbine manufacturer controlled by French investors with its headquarters located in France.

\textsuperscript{16} Once imports of rank one and two goods’ and services’ suppliers have been deducted
A SIGNIFICANT CONTRIBUTION TO THE RENEWABLE ENERGY MIX GROWTH AND TO THE REDUCTION OF GHG AND OTHER ATMOSPHERIC POLLUTANTS EMISSIONS IN FRANCE

While France's objectives for installed wind power were not achieved, wind power has contributed significantly to the growth of the French renewable mix. In 2015, wind power represented 3.9% of total electricity production and more than 22% of French renewable electricity production (versus just 0.4% in 2002). An analysis of available historical data shows that wind-generated electricity is replacing nuclear, gas, coal and oil power production11. Thus, by reducing fossil fuel and fissile imports, wind power is contributing to France's energy independence.

One of the central objectives of wind power support is the decarbonisation of our economy. By avoiding the use of fossil fuels to produce electricity, wind power has led to the reduction of almost 63 million tonnes of CO₂ equivalent (MtCO₂eq) in total between 2002 and 2015 in France (including indirect emissions and embedded emissions in production facilities). In 2014, 9.6 MtCO₂eq emissions were avoided, representing approximately 9% of the national GHG reduction objective for 2014 as compared to 1990. This reduction also represented approximately 22% of electricity production and district heating emissions18. Furthermore, for the 2002-2015 period, wind power has significantly reduced emissions of atmospheric pollutants such as SO₂ (by approximately 127,000 tonnes cumulatively), NOₓ (by approximately 112,000 tonnes) and small particulates (by approximately 3,300 tonnes for PM₁₀ and 5,300 tonnes for PM₂.5). In 2013, the reduction of emissions (of SO₂ and NOₓ) represented approximately 22% to 37% of total emissions of SO₂ and NOₓ for the electricity production sector. Wind power development has also led to the reduction of a certain number of risks associated with electricity production (industrial risks, risks associated with radioactive waste management, financial risks related to price volatility for carbon allowances and fossil fuels).

17. Using historical data on the composition of the electricity mix as well as hourly production data and availability of the means of production [source: RTE], the merit-order shifting method was applied. By using this method, it was possible to determine, hour by hour, what means of production have in all likelihood been displaced by wind-generated electricity, resulting from the policy to support wind power. For more information on the method applied and the hypotheses used, refer to part 1.B of this study (available in French only).


19. These estimates for prevented emissions result from the production mix that wind-generated electricity has in all likelihood displaced (“business-as-usual mix”). Analysis conducted to determine the business-as-usual mix resulted, in terms of weight of the different means of production, in the following central values: 39% natural gas, 19% coal, 28% fuel, and 14% nuclear. A sensitivity analysis was conducted based on alternative electricity mixes that were more or less carbon intensive (refer to the part 1.B of this study). The volumes of prevented emissions were then calculated by applying emission factors specific to the identified means of production, for each of the pollutants analyzed. The emission factors used come from the ADEME’s emissions factor database (Base Carbone) and the 2017 OMINEA base of the CITEPA.
The regulations applied to the deployment of wind power also had to take into account land-use conflicts with a certain number of governmental and economic activities: radars, low-altitude flights and telecommunications. Operating requirements for radar and air navigation have required new rules and have led to the development of shared tools to assess interference. Other requirements have also been implemented, including technical (beacons) and design-related (reduction measures resulting from impact studies) requirements. In addition, research programmes aimed at developing lower-impact technologies have been financed.

The various measures implemented as part of the policy support for wind power have thus enabled these issues to be taken into account at each project development phase. Nonetheless, while remaining a marginal movement, local opposition remains an obstacle to increased installation rates in some regions. An international comparison shows that problems of local integration are relatively prominent in France, whereas in Germany there is less local opposition. This is due to a historical craze for energy transition and participatory wind farm projects in this country. This has led to a search for other, non-regulatory ways to facilitate local integration, including a better understanding by the general public of wind power and Energy-Environment constraints, and highlighting the decentralised nature of renewable energy: a policy tool for local authorities, an opportunity for citizens’ and other local stakeholders’ empowerment, and an opportunity for regional planning and economic activity.

A POLICY FRAMEWORK THAT PROVIDES ECONOMIC STIMULUS AT THE LOCAL LEVEL

The public policy to support wind power has provided an economic stimulus to some rural areas, through the establishment of specific wind power taxes (via the flat-rate taxation of network companies (IFER)), the provision of planning tools for local authorities (ZDE and regional wind power plans (SRE)) and the 2015 implementation of measures encouraging local participation in wind farm projects (via the LTECV law). Depending on a wind farm’s characteristics and the locally-voted taxation rates, the annual fiscal benefit from wind farms is generally between €10 k and €12 k/MW, divided among the municipality where it is located, the inter-municipality, the department and the region20. This tax revenue represents a non-negligible resource, which can help finance new local social and environmental projects. Furthermore, projects supported and/or financed by citizens and/or local authorities, frequent in some European countries, have been attracting growing interest in France21. Long-term employment expanded in regions with wind farms, in both operation and maintenance (13% of municipalities we surveyed and 27% of inter-municipalities stated that local companies are involved in wind farm maintenance).

A POLICY THAT HAS A RELATIVELY LIMITED IMPACT ON THE COST OF ELECTRICITY TO CONSUMERS

![Figure 6: Wind power CSPS cost as a percentage of the average household’s total electricity bill](image)

20. Figures from the “Simulateur de la fiscalité éolienne” (Wind power tax simulator) developed by AMORCE in partnership with ADEME and FEE.

21. ADEME. Quelle intégration territoriale des énergies renouvelables participatives ? (How do participatory renewable energy projects integrate locally ?) February 2016
At first negligible for the 2000-2010 period, wind power policy costs started growing after 2010. However, this impact has remained relatively limited up to now: in 2015, the share of the Contribution to the Public Service Charges for Electricity (CSPE) due to wind power reached almost €3.9\_2013/MWh for the final consumer, i.e. approximately 2.9% of the total average electricity bill, as shown in Figure 6.

**ENVIRONMENTAL BENEFITS THAT ARE ON PAR WITH WIND POWER POLICY COSTS**

The cost associated with the development of the French wind power sector was primarily borne by electricity consumers via the CSPE\textsuperscript{22}. Costs resulting from the extension and reinforcement of the networks, linked to the deployment of wind power, were also borne by consumers, via the Tarif d’Utilisation des Réseaux Publics d’Électricité (TURPE - Public Electricity Network User Rate). To a lesser extent, it has also been borne by taxpayers through public expenditure on associated RDI. Nonetheless, this development has brought benefits by reducing GHG emissions (including indirect emissions) and atmospheric pollutants from power generation facilities. The monetarisation of these benefits reveals that they are comparable to, if not greater than, wind power policy costs. For the 2002-2013 period, environmental benefits\textsuperscript{23} for society, of wind deployment, are estimated at €3.1 - 8.8 billion\_2013. Wind power policy costs, over the same period, are estimated at €3.2 billion\_2013, as shown in Figure 7.

The environmental benefits are estimated in two steps: (1) an estimate of emissions avoided thanks to the development of wind power and (2) monetarization of the avoided costs. (1): see page 13, for a discussion of emissions avoided and the methods used for the estimates. (2): the benefits of wind power are then monetarized by applying a unit cost to each unit of avoided emissions. For GHG, the shadow price of carbon [Quinet report] is used after linear interpolation between €30\_2008/t in 2002, €34\_2008/t (€32\_2010) in 2010, and €60\_2008 (€56\_2010) in 2020. For other pollutants, costs range per ton are taken from the report by the European Agency for the Environment “Costs of air pollution from European industrial facilities 2008–2012”\textsuperscript{24}. This estimated range of €5.7 billion reflects the uncertainties concerning on the one hand, the amount of emissions avoided and, on the other, the avoided costs per ton of avoided atmospheric pollutant emissions. It is this second factor of uncertainty, which has the most impact, at 75% of the total difference between the low end and high end of the range.

22. The CSPE was reformed. Since January 1st, 2016, a Compte d’Affectation Spéciale (CAS) Transition énergétique (Special Attribution Account - Energy Transition) has been compensating operators for cost overruns resulting from the renewable energy support mechanisms (in electricity and gas). The revenue from this CAS come from domestic taxes on energy consumption (electricity, gas, oil products, and coal).

23. The environmental benefits are estimated in two steps: (1) an estimate of emissions avoided thanks to the development of wind power and (2) monetarization of the avoided costs. (1): see page 13, for a discussion of emissions avoided and the methods used for the estimates. (2): the benefits of wind power are then monetarized by applying a unit cost to each unit of avoided emissions. For GHG, the shadow price of carbon [Quinet report] is used after linear interpolation between €30\_2008/t in 2002, €34\_2008/t (€32\_2010) in 2010, and €60\_2008 (€56\_2010) in 2020. For other pollutants, costs range per ton are taken from the report by the European Agency for the Environment “Costs of air pollution from European industrial facilities 2008–2012”. 24. This estimated range of €5.7 billion reflects the uncertainties concerning on the one hand, the amount of emissions avoided and, on the other, the avoided costs per ton of avoided atmospheric pollutant emissions. It is this second factor of uncertainty, which has the most impact, at 75% of the total difference between the low end and high end of the range.
3. WHAT ARE THE MID-TERM PROSPECTS FOR DEVELOPMENT?

This chapter examines present and future changes to market structure, regulatory context, technology and business models, and then analyses what these changes mean in terms of cost changes, deployment and structural objectives in the French wind power sector.

ENCOURAGING WORLDWIDE PROSPECTS FOR WIND ENERGY SECTOR GROWTH

Worldwide, wind power should undergo strong growth through 2030 with 40 to 50 GW of capacity added per year by 2030 according to the estimates of the International Energy Agency (IEA). By 2030, worldwide installed wind power could reach 1320 GW versus 433 GW today.

Emerging countries will increasingly drive growth: 8% annually on average in Asia, and 9% in Latin America, Africa and the Middle East, for the 2014-2035 period. These growth rates are supported by growing energy demand. Developed countries, forerunners in the development of wind power, should see strong growth too, although it will be more limited (5% annually on average for the period) in a context of stable or reduced energy demand. In 2035, 51% of wind capacity should be in Asia, 26% in Europe (versus 34% today) and 16% in North America. While onshore wind power should still represent the vast majority of facilities by 2035, offshore wind could increase from 2-3% of the total installed capacity today to 10% or more by 2035.

The growth of the French wind power market should accelerate in coming years, in order to achieve the PPE’s deployment objectives. For onshore wind power, this will require the net commissioning (after deducting repowering of capacities reaching the end of their lifespan) of 1,400 to 2,200 MW per year between 2017 and 2023, versus an average annual rate of 1,150 MW over the last three years. The PPE sets a target for onshore capacity of 15,000 MW in 2018 and 21,800 MW to 26,000 MW in 2023. With the perspective of achieving the upper 2023 PPE target, and assuming constant commissioning rates over the following period, France’s onshore capacity could well exceed 40 GW by 2030. The PPE plans to install 3 GW of offshore wind power by 2023. If the installation rate planned until 2023 is maintained over the 2023-2030 period, France’s offshore wind capacity could rise to 7 GW in 2030. At the end of December 2016, authorisation requests for 8 GW of onshore wind power and 3.2 GW of offshore wind power had been filed and were pending approval.

Four key factors lead countries to promote the development of offshore wind power: the prospect of decreasing offshore wind power costs, the existence of abundant, high-quality sites, supply-demand balancing issues, opportunities to structure a local industry, and space constraints that could limit the deployment of onshore wind farms. This is primarily the case in Europe, which should thus remain the market leader, with more than 60% of the installed offshore base to 2030.

25. IEA. World Energy Outlook 2016. Data based on the “New policies scenario”, the central scenario of the IEA.
The first set of challenges is to build and operate turbines that are both more reliable and more efficient, and to extend their lifespans, with the aim of simultaneously increasing turbine output and lowering production cost per MWh. First, it means designing and producing larger components (higher towers, longer blades, etc.) in order to increase turbines’ capacity and/or maximise the output on low-wind sites (high-productivity turbines28). The main innovations for turbines relate to materials, command-and-control systems, generators and offshore foundations or floaters. Further, real-time wear-monitoring must be developed to enable timely preventive maintenance and thus increase reliability and performance, extending the lifespan of the machines.

With regards to site development and operations, improving accuracy and mobility of measurement tools as well as increasing modelling tools’ reliability will enable innovation players to improve output predictability in the short, medium and long term. In the short term, improved predictability makes it easier for network operators to integrate wind turbines into the power network. In the long term, improving the evaluation of the wind energy potential reduces the uncertainty around the assessment of the production potential.

Finally, challenges specific to the problems of territorial integration must be addressed, with the goal of improving understanding of the impact on birds and bats and developing technical solutions to limit radar interference.

In addition to these technological innovations, process optimization (logistics, manufacturing) and product standardization should contribute to the expected reduction in wind power costs. The potential for cost reduction is higher for offshore wind power, which should benefit from lessons learned from the first wind farms, in France and other countries. This will in particular come from the standardization of project development, construction processes, components manufacturing, and from the optimization of operations and maintenance. If all technological innovations as well as logistical and financial levers for costs reductions are activated, the average total cost per MWh of wind power (connection included) should reach, in France and by 2030: €47/MWh for onshore wind, €54-€73/MWh for fixed offshore wind and €62-€102/MWh for floating offshore wind farms (for an extended lifespan of 30 years). At this horizon, wind power should therefore be one of the technologies with the lowest per-MWh cost.

**MARKET STRATEGIES THAT MUST ACCOUNT FOR CHANGES IN THE GEOGRAPHIC STRUCTURE OF DEMAND AND OVERALL GROWTH IN THE WIND POWER MARKET**

Several major trends in the development of the sector are expected to continue. Developers should continue their globalization in order to target more promising markets by acquiring local competitors or setting up subsidiaries. This globalization goes hand in hand with the consolidation of European companies, in particular in the offshore wind power market. It should also be noted that in Europe and France, more and more purely financial players (investment banks, investment funds) are investing in projects still under development or that have just started operations.

For turbine manufacturers, the trend towards market concentration could continue and generate more economies of scale, in a context where the size of wind farms is increasing and the switch to tendering mechanisms is becoming more widespread, requiring greater financial resources and risk-sharing among projects. Turbine manufacturers should continue to adapt in order to penetrate more promising markets, in particular in Asia, via the development of local plants. In France, however, this trend should not prevent the development of other players in new market segments, such as smaller-than-average turbine models (< 2 MW); adapted to specific operating conditions (tropical regions, faulty power networks, etc.).

Maintenance players restructuration should continue in order to respond optimally to demand by offering a one-stop-shop for a wider variety of technologies. Furthermore, independent developers and operators could progressively develop their maintenance service offering in the regions where they operate: some companies are starting to master level 2 maintenance operations, which were until now provided by turbine manufacturers.

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27. For a detailed presentation of the expected technological innovations in the short, medium and long term in the onshore and offshore wind power sectors, and a translation of these innovations in terms of reduction of investment, operating and maintenance costs, refer to the 2017 ADEME analysis Caractérisation des innovations technologiques du secteur de l'éolien et maturités des filières (Description of technological innovation in the wind power sector and sector maturity).

28.“High-productivity turbines” have a relatively high specific area (defined as the swept area relative to the turbine nominal power ; in France standard specific areas are in the range 2-3.5 m²/kW ; high-productivity turbines show a specific area larger than 4.5 m²/kW). These wind turbines demonstrate higher full load hours (with respect to standard turbine), and higher capacity factors (more TWhs per installed GWs). They facilitate wind energy grid integration and forecast, lower energy cost, and productive sites at low wind speeds.
SUPPORT MECHANISM, REPOWERING OPERATIONS, INTEGRATION INTO THE ELECTRICITY MARKET: A NEW GENERATION OF BUSINESS MODELS FOR WIND POWER

In 2016 and 2017, two new remuneration schemes were introduced for onshore wind turbines: the contract-for-difference (complément de rémunération) is replacing the regulated feed-in tariff system. The premium is provided on an open-ended basis for wind farms of 6 wind turbines or less; it is allocated through calls for tenders for wind farms of more than 7 wind turbines. For producers, this new model means revenue is first collected through the direct sales of electricity on the wholesale market, and then complemented by a variable premium meant to cover the full costs of the industry.

These changes will likely be accompanied by increased competition between players and improved efficiency of the wind power policy. The upcoming decommissioning of the first wind farms should also lead to new business models and activities. Intermediaries in the electricity market will grow in importance to carry out aggregation activities in response to the introduction of the contract-for-difference system. They will also provide balancing services on the capacity and reserve markets.

BEYOND THE TECHNICAL OBJECTIVES: CHALLENGES THAT RELATE TO SKILLS DEVELOPMENT, ADAPTING THE REGULATORY FRAMEWORK…

The LTECV adoption, the enactment of the PPE in October 2016, and the publication of the decree of May 6th, 2017 (which established the conditions for the contract for difference and the specifications for onshore calls for tenders) brought new visibility on volumes and remunerations. The 2018 and 2023 wind power targets are aligned with France’s energy and climate objectives and recognise the environmental, economic and social benefits of wind power. Achieving these objectives requires commissioning projects at a rate that exceeds historical trends, while ensuring projects’ high environmental and social qualities. With 1,419 MW connected, 2016 was a record year and it seems to indicate that simplification efforts undertaken by public authorities are beginning to bear fruit, even if it is far from certain that such a level can be maintained in the years to come.

The development of repowering activities should be the most jobs-generating segment for the sector, with an estimated market of around 7 GW per year in Europe between 2020 and 2030. The repowering market is expected to complement the new installations market in the coming years and to drive part of the growth in the wind power sector: in Europe, annual capacity subject to repowering could exceed 5 GW per year from 2025 on. Repowering should facilitate the achievement of national renewable electricity objectives. Furthermore, repowering activities open up opportunities for the creation of new waste processing activities (from dismantling to recycling), requiring the establishment of specific logistical approaches.

Self-consumption could develop in very targeted sectors such as the agricultural or industrial sectors. The same is true of the implementation of long-term bilateral contracts for the purchase of electricity, which could be signed directly between producers and large industrial or commercial consumers. Finally, new non-energy related services may benefit from wind farm infrastructure (installation of telecommunication equipment or weather observation stations on the wind turbines).

The LTECV also reflects public authorities’ will to support participatory investments in renewable energy and provides a more favourable framework. There is a growing awareness amongst elected officials and local authorities of the importance to build skills and to have the tools to take concrete action on energy transition, of which wind energy is a pillar. Public authorities, and in particular the ADEME assist various local organizations and provide local authorities with tools and methodological guides. At the request of the Ministry of Ecological and Solidarity Transition, the ADEME is also working with the Caisse des Dépôts et Consignations (a public investment bank in France) and other partners to establish an investment fund to co-finance so-called “citizen” projects in the early stages of development. The latest calls for tenders for renewable energy include a bonus for participatory projects. The AMORCE-FEE Charter for wind power development is also a tool for ensuring good practices which should help build trust among stakeholders.

As far as authorisation procedures are concerned, some simplifications measures adopted in recent years should have a positive impact on the sector in the short term.

29. Considering a lifespan of 20 years for wind farms and wind turbine development in Europe since 2000.
The Autorisation Environnementale (AE - Environmental Authorisation)\textsuperscript{30}, which came into effect on March 1st, 2017, simplifies the current regulatory framework and shortens the process for project approval (with a targeted approvals deadline of 10 months), without reducing the level of protection for local populations and the environment. The AE also makes it possible to group potential legal disputes over a single document and sets a time limit of 4 months for filing legal dispute. It should also be noted that the LTECV now limits the deadline for connecting facilities to 18 months from the signing of the connection agreement. Monitoring projects’ achievement will be necessary to assess the actual impact of this measure on wind farm development delays.

Public authorities have also begun to respond to the demand for more transparency in the assessment of radar interference: there is now a shared tool for weather radars. A similar initiative is underway for Defence radars. In addition, RDI efforts to develop “stealth” wind turbines must be continued. The Ministry of Defence has also undertaken to reduce the footprint of the military aviation manoeuvring and training zones.

As far as offshore wind power is concerned, the regulatory framework for connections as well as the procedure for calls for tenders have undergone major changes, with the objective of shortening the development phase and reducing project costs. Decree no.2017-628 of April 26th, 2017, sets out a compensation rates for delays in connection to the electricity transmission system of an offshore renewable energy installation. A legislative amendment is under consideration to extend compensation rates to the event of transmission service interruption during the operation phase. As part of the new tender procedure, public authorities have undertaken a “de-risking” of the sites by conducting studies in advance of the calls for tenders so as to provide more information to all applicants. A new procedure, known as the “competitive dialogue”, has also been established, to encourage discussion with the pre-selected applicants prior to publication of the definitive technical specifications.

Finally, in order to maintain the best environmental quality, feedback from currently-operating wind farms must be leveraged. Thus, the observation and environmental monitoring of wind farms must continue in order to objectively assess their impact on birds and chiropterans and improve cohabitation: the Museum National d’Histoire Naturelle (National Natural History Museum) is now in charge of centralising this. In addition, as the first wind farms are coming to the end of their lifespans, the technical, environmental and regulatory aspects of renewing them must be anticipated by taking into account the diverse set of configurations. This new segment represents an opportunity to optimise the technical and economic use of the existing sites and to ensure optimised integration with local populations and the surroundings.

\textbf{...AND PROMOTING INCREASED INDUSTRIAL CAPACITIES}

On both the main onshore market segment (3MW turbines) and the offshore market segment, conditions do not seem to be in place, within the French industry, for a national turbine manufacturer to position itself as a leader in the sector, or to become one of the top 10 turbine manufacturers worldwide. However, it seems more likely that new entrants will be able to position themselves in secondary segments abandoned by the biggest turbine manufacturers\textsuperscript{31}. The strategy of attracting foreign investments in local manufacturing capacities for offshore wind power in France has already been met with some success and should result in additional facilities in the future.

Given technological and strategic developments, the French industrial landscape could initially benefit from closer cooperation and business alliances to give greater importance to innovation demonstrators, enhance visibility of French know-how on the international stage and increase French players sales to international turbine manufacturers. French businesses could then take advantage of existing opportunities in new market segments and emerging activities. Firstly, this will involve developing a service offering for specific wind power models (onshore wind turbines more adapted to sites with constraints, floating offshore wind turbines). Secondly, it involves developing repowering activities, including dismantling and recycling of wind turbines.

\textsuperscript{30} The environmental authorization replaces up to 12 administrative authorizations for the renewable sectors. Regarding the wind power sector, the environmental authorization removes the obligation for a building permit and makes it possible to group legal disputes on a single document. It replaces the single authorization, which had been generalized with the LTECV.

\textsuperscript{31} C’est notamment le pari que fait un industriel comme POMA, qui vise le marché des turbines comprises entre 1 et 3 MW, plus adaptées aux sites sous contraintes. L’entreprise espère à terme se forger une place à l’international sur ce marché, notamment dans les pays en développement, et dans les pays connaisant des contraintes importantes sur la taille des éoliennes. La maîtrise de ces technologies (turbines de 1 et 3 MW) pourrait à long terme permettre la proposition d’offres pour le principal segment du marché terrestre.
4. WHAT ARE THE LONG-TERM ECONOMIC BENEFITS?

This chapter assesses the long-term macro-economic benefits associated with different wind power deployment scenarios. Different hypotheses are used regarding future industrial development of the wind power sector in France and the inclusion of offshore wind power in the mix. A reference scenario and three variants are modelled, using the multi-sector macro-economic model for assessing energy and environmental policies (ThreeME). Projections of future direct and indirect employment in the wind power sector as well as future local tax revenues are also produced based on these different scenarios.

<table>
<thead>
<tr>
<th>Low share of offshore wind</th>
<th>High share of offshore wind</th>
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<tbody>
<tr>
<td>No further development of the French industry</td>
<td>Reference scenario</td>
</tr>
<tr>
<td>• Share of offshore wind in total wind power at 12% and low weighted-average cost per MWh;</td>
<td>• Share of offshore wind in total wind power at 50% and high weighted average cost per MWh;</td>
</tr>
<tr>
<td>• Constant propensity to import by the wind power sector compared to the historical trend (50% for onshore and 35% for offshore).</td>
<td>• Constant propensity to import</td>
</tr>
<tr>
<td>Further development of the French industry</td>
<td>&quot;Low imports&quot; scenario</td>
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<tr>
<td>• &quot;Low imports&quot; scenario</td>
<td>• &quot;Offshore - low imports&quot; scenario</td>
</tr>
<tr>
<td>• Share of offshore wind power at 12%;</td>
<td>• Share of offshore wind power at 50%;</td>
</tr>
<tr>
<td>• Reduced propensity to import by the wind power sector (10% for onshore and 9% for offshore wind power).</td>
<td>• Reduced propensity to import</td>
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</tbody>
</table>

**Figure 8 : Description of the 4 wind power deployment scenarios to 2050**

STILL A NEGLIGIBLE EFFECT ON GROSS DOMESTIC PRODUCT

Comparison of the results associated with the different variants shows that the macroeconomic variables (employment, gross domestic product (GDP), available revenue, etc.) are generally insensitive to the shocks introduced on the propensity to import (reflecting increased development of domestic industrial capacity) and on average production costs (reflecting increased penetration of offshore wind power, which is more costly), due to the sector’s limited weight in the French economy. Nonetheless, the results confirm some trends.

32. The reference scenario (detailed in the report) is that of an 80% renewable electricity mix associated to the lower variant in the analysis "Mix électrique 100% renouvelable ? Analyses et optimisations" (100% renewable electricity mix? Analyses and optimisation) (ADEME, 2016).

33. Modelling tool developed by the Observatoire français des conjonctures économiques, in collaboration with the ADEME.
The reduction of the wind power sector import rate – and thus increased domestic production – has an expansionary impact on the French economy, via an improvement of the trade balance. Along with an increased development of the sector in France, the increased share of offshore wind power has a positive macro-economic impact. The recessive effect of higher electricity prices is then more than offset by the expansionary effect of an improved trade balance. The evolution of the trade balance explains almost all the impacts on GDP noted above. However, these estimated impacts have a very limited magnitude, below one hundredth of a GDP point. The location of the wind energy sector in France also has a positive impact on total employment.

**STRONG INCREASE IN LOCAL TAX REVENUES AND WIND POWER SECTOR EMPLOYMENT**

From a macro-economic point of view, analysis of the three variants shows that a lower propensity to import in the wind power sector could represent a net gain of 10,000 to 13,000 FTEs compared to the reference scenario, with the highest intensity of deployment between 2030 and 2035. Investment in offshore wind leads to higher employment only if it combines with a lower propensity to import in the wind power sector. These employment gains remain however negligible relative to total employment in the French economy.

On the other hand, an analysis of employment in the sector shows significant variations relative to the current level of employment in the sector. By 2050, the wind power sector could represent 60,000 direct and indirect FTEs in the reference scenario, including 29,000 FTEs in operations and maintenance and 31,000 FTEs in activities connected to the investment phase (excluding export-oriented activities) (Figure 10). This would represent five times the current level of employment in the sector (at 11,600 FTEs excluding exports). Employment in export-oriented component manufacturing, not accounted for in these projections, could constitute a non-negligible amount of additional jobs.

Furthermore, the increased development of the domestic sector, on the one hand, and the greater proportion of offshore wind power, on the other, both have a positive impact on direct and indirect employment in the sector. The observed increases nonetheless do not concern jobs of similar nature. In the first case, employment linked to the investments phase alone is favoured. In the second case, gains also come from operations and maintenance. At last, if a lower propensity to import in the sector and a greater development of offshore wind power combine, the sector could represent approximately 93,000 direct and indirect FTEs by 2050, i.e. eight times the 2015 level (excluding exports).

![Figure 10: Changes to direct and indirect FTEs linked to investment activities (above) and operation-maintenance activities (below) in the wind power sector, per scenario](image)

On the other hand, assuming that until 2050 local taxation on project companies, in line with current IFER and **Taxe sur les Eoliennes Maritimes** (TEM - Tax on Offshore Wind Turbines) stays in place, tax revenues for local authorities would increase sharply over the period. From more than €70 million in 2015, IFER and TEM could represent between €645 million (reference scenario) and €726 million (offshore scenario). Increased penetration of offshore wind power has a limited impact on the overall level of tax revenues, but leads to TEM’s share of the total increasing from 12% to 58%.

34. Les ETP associés aux renouvellement des parcs sont inclus dans les estimations des activités d’investissements.
5. WHAT IS THE ADEME’S ROLE IN A NATIONAL WIND POWER STRATEGY?

Beyond the objective of increasing wind power capacity and production, policy support for wind power has progressively developed additional objectives over the last 15 years, in accordance with the objectives of other public policies (defence, health, risk prevention and protection of the environment). These objectives for wind power support can be linked to two major challenges for the sector: aligning the annual installation rate with PPE objectives and maximising the social and economic value associated with wind power deployment.

![Figure 11: Public policy objectives and challenges for the sector](image)

**Central objective of the policy to support wind power:**
- Producing wind power and increasing its share in the French electricity market

**Additional objectives central to other public policies (employment, industry, environment, energy, etc.):**
- Limiting the impact of wind power on populations, economic or military activities and the environment
- Optimizing support costs
- Developing the French wind power industry to improve trade balance and create non-relocatable jobs
- Encourage transmission network integration
- Stimulate economic activity in rural areas

**Challenges facing the sector**
- Bringing annual installation rate in line with PPE
- Facilitating the rallying of stakeholders
- Maximizing the social and economic value associated with wind power deployment

**Actions supporting skills and knowledge development and projects’ local integration to accelerate the annual rates of wind turbines installations**

Bringing annual rates of wind MW installed in line with objectives set by public authorities (PPE and LTECV) requires a shortening of the projects’ development phase and an increase in the flow of projects entering development. From that standpoint, wind power sector players and public authorities will have to rely upon the continuation of efforts already undertaken to rationalize procedures and the facilitation of projects’ local integration.

To this end, it seems necessary to launch a series of studies regarding (i) the lessons learned from offshore wind farm projects developed in Northern Europe, (ii) an inventory of the legal disputes filed against wind projects in France, and (iii) alternative connection offers that can help connect wind farms at lower costs. These studies will provide lessons on changes that may lead to the shortening of onshore and offshore wind farm development delays.

In order to better reconcile wind power deployment and local planning, and thus facilitate the local integration of wind projects, the ADEME proposes to focus on raising citizens’ and local authorities’ awareness and skills. This could be achieved through the development of an information platform gathering objective data about all the issues associated with the sector, the dissemination of existing planning tools and the reinforcement of knowledge on the potential impacts of wind power (in particular on biodiversity and property prices). This could come with actions for a more widely-shared information on wind power.
ACTIONS SUPPORTING THE DEVELOPMENT OF A DOMESTIC SECTOR AND THE APPROPRIATION OF PROJECTS BY LOCAL PLAYERS TO MAXIMISE WIND POWER SOCIAL AND ECONOMIC VALUE

Public authorities now explicitly want to maximise the socio-economic benefits associated with wind power deployment. This maximisation requires, on a macro-economic level, the creation of jobs and added value and the improvement of the sector’s trade balance. It also involves, at the local or regional level, a greater appropriation of projects and their benefits (economic, fiscal, skills development) by the local ecosystem.

The further development of a domestic wind sector will not be possible without a strong involvement of the sector’s players and their representatives (in particular when renewing actions carried by clusters or initiatives such as Windustry France). Nonetheless, the ADEME can be a driving force in: (1) coordinating and reinforcing research into wind power, (2) supporting innovative companies, and (3) assessing the opportunities for integrating social and environmental criteria in the calls for tender in order to favour a local industry.

Greater appropriation of projects and their benefits by local stakeholders require close collaboration between developers and local authorities throughout a project lifespan and greater involvement by local citizens – from simply participating in the concertation process to contributing to project financing and/or development. In this context, the ADEME has a decisive role to play by encouraging the dissemination of existing charters of good practices (AMORCE-FEE charter) and by ensuring the implementation of actions to support the initiation and development of wind energy projects carried out by citizen groups and local authorities.

The implementation of these actions will require the mobilization of all the ADEME’s partners and their success will depend to a large extent upon the complementary actions that wind sector players (trade unions, clusters in particular), local and public authorities will implement. In order to rally all these stakeholders around the continuous monitoring and evaluation of the wind power policy, around actions mentioned above and the co-construction of additional actions, the set up and facilitation of a strategic committee at the national level seems critical.

<table>
<thead>
<tr>
<th>Challenges</th>
<th>ADEME’s strategic orientations for wind power</th>
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<tr>
<td>General governance</td>
<td>Development of governance committees and strategic dialogue for the sector</td>
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<tr>
<td>Bringing annual installation rates in line with PPE objectives</td>
<td>Procedures rationalization and needs anticipation</td>
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<tr>
<td></td>
<td>• Identify lessons learned from offshore wind farm projects in Northern Europe</td>
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<td></td>
<td>• Inventory legal disputes filed against wind farm projects in France</td>
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<td>• Study alternative connection offers</td>
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<td></td>
<td>Local planning and projects’ integration</td>
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<td></td>
<td>• Raise awareness and build skills (citizens and local authorities)</td>
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<td></td>
<td>• Reinforce our understanding of potential impacts</td>
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<tr>
<td>Maximizing the social and economic value of wind deployment</td>
<td>French wind power sector development</td>
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<tr>
<td></td>
<td>• Coordinate and reinforce RDI efforts for wind power</td>
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<td>• Support innovative companies</td>
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<td></td>
<td>• Assess opportunities to integrate social and environmental criteria in calls for tenders</td>
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<td></td>
<td>Projects’ local appropriation</td>
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<td></td>
<td>• Disseminate existing charters of good practice</td>
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<td>• Implement support at the initiation and throughout the development of citizen wind projects</td>
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Figure 12: Summary of ADEME’s strategic orientations
ABOUT ADEME

The French Environment and Energy Management Agency (ADEME) is active in the implementation of public policy in the areas of the environment, energy and sustainable development. The Agency provides expertise and advisory services to businesses, local authorities and communities, government bodies and the public at large, to enable them to establish and consolidate their environmental action. As part of this work ADEME helps finance projects, from research to implementation, in the areas of waste management, soil conservation, energy efficiency and renewable energy, raw materials savings, air quality, noise abatement, circular energy transition and food wastage abatement.

ADEME is a public agency under the joint authority of the Ministry for an Ecological and Solidary Transition and the Ministry for Higher Education, Research and Innovation.

www.ademe.fr
In a context of rapid development at the international level, the French wind power sector represents significant amounts of economic activity and employment for both the domestic market and export markets. The economic and industrial benefits extend throughout all regions of Metropolitan France.

The support mechanism, which has progressively been shaped since 2001, has enabled the development of wind power in France. Nonetheless, while establishing national deployment targets and the regulatory framework, a number of difficulties related to land-use conflict, local integration and environmental impacts were not sufficiently anticipated. As a result, none of the national deployment targets have been achieved to date.

And yet the sector has a very positive image in the public eye. Deployment provides significant health and environmental benefits due to the reduction of greenhouse gases, SO\textsubscript{2}, NO\textsubscript{x} and particulate matters emissions. The cost of the wind power support policy is thus largely offset by wind power’s benefits in terms of public health and mitigation of climate change. Furthermore, the ADEME has identified forthcoming technological innovations capable of turning wind power into one of the most competitive electricity generation sectors in France.

The prospects for the sector are thus encouraging, even more so as the ambitious deployment targets represent a major opportunity for economic development on a national level, and a local source of tax revenues capable of providing stimulus to rural areas.

Nonetheless, the major role expected for wind power within a strategy for national energy transition requires above-historical-trend rates of wind farm commissioning. To do so, increased involvement by all stakeholders, and the co-development of environmentally-friendly and socially- and economically-responsible projects must now become the major driving forces behind local integration of wind projects.