Report 2021

France

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In 2021, over 1.2 GW of new onshore wind was built in France. This number lies slightly above the 2020 figure but well below the average of 1.5 GW over the 2016-2019 period. It should in the future increase to 2.6 GW per year to reach the newly set targets for 2023.

This brings the total wind power capacity to 18.9 GW. Wind and solar now jointly represent 53% of France's renewable installed power capacity, while wind alone represented one-third of the total renewable electricity production and 7.8% of the national electricity demand in 2021. Total annual electrical energy output from wind was 36.8 TWh, a significant decrease from 2020. This decrease results from an exceptional capacity factor of 26.5% reached in 2020.

During 2021, new measures have been put in place, including the start-up of the definition of specific areas suited to the development of onshore wind.

The four awarded offshore projects from the 2012 tender are now under construction, while two procedures of competitive dialogue are ongoing for bottom-fixed and floating offshore wind.

Table 1. Key National Statistics 2021: France

Total (net) installed wind power capacity*	18.9 GW
Total offshore capacity	GW
New wind power capacity installed	1.2 GW
Decommissioned capacity (in 2021)	GW
Total electrical energy output from wind	36.8 TWh
Wind-generated electricity as percent of national electricity demand	7.8%
Average national capacity factor**	23%
Target	24.1 GW in 2023
National wind energy R&D budget	15 M€ in 2020

Table 2

Award year	2019	2020	2021	2022	2023	2024
Bottom fixed (MW)	600 Dunkerque (45 €/MWh)	1000 Manche Est, Mer du Nord (60 €/MWh)	500-1000 MW Sud Atlantique (60€/MWh)		1000 (50 €/MWh)	1000 MW /year (bottom -fixed and/or floating)
Floating (MW)			250 Bretagne (120 €/MWh)	2 x 250 Med. (110 €/MWh)		

Highlight(s)

- New offshore wind tender processes ongoing for floating wind in the Mediterranean and bottom-fixed on the South Atlantic coast.
- Newly installed onshore wind capacity (1.2 GW) needs to increase 2-fold to reach targeted 24 GW total capacity in 2023.
- Four first offshore wind farm projects have reached construction phase.

Market Development

Targets and Policy

Along with the Paris Agreement during COP21, France defined new trajectories for renewables after adopting the Energy Transition for Green Growth Act in 2015. In 2021, objectives previously defined were confirmed, and set the following targets for energy:

- 23% renewable energy of electricity demand in 2020.
- 33% renewable energy share in 2030 (40% in electricity), with a decrease of 40% of GHG emission (with respect to 2012).
- A reduction for nuclear to 50% share of electricity.

To practically reach these targets, the Pluriannual Energy Program (Programmation Pluriannuelle de l'Energie, PPE) defines renewable energy target trajectories between 2018 and 2023. New trajectories for each renewable energy source are defined in the PPE.

The decree enacting the PPE was published on April 21st, 2020, with updated targets for 2023 and 2028.

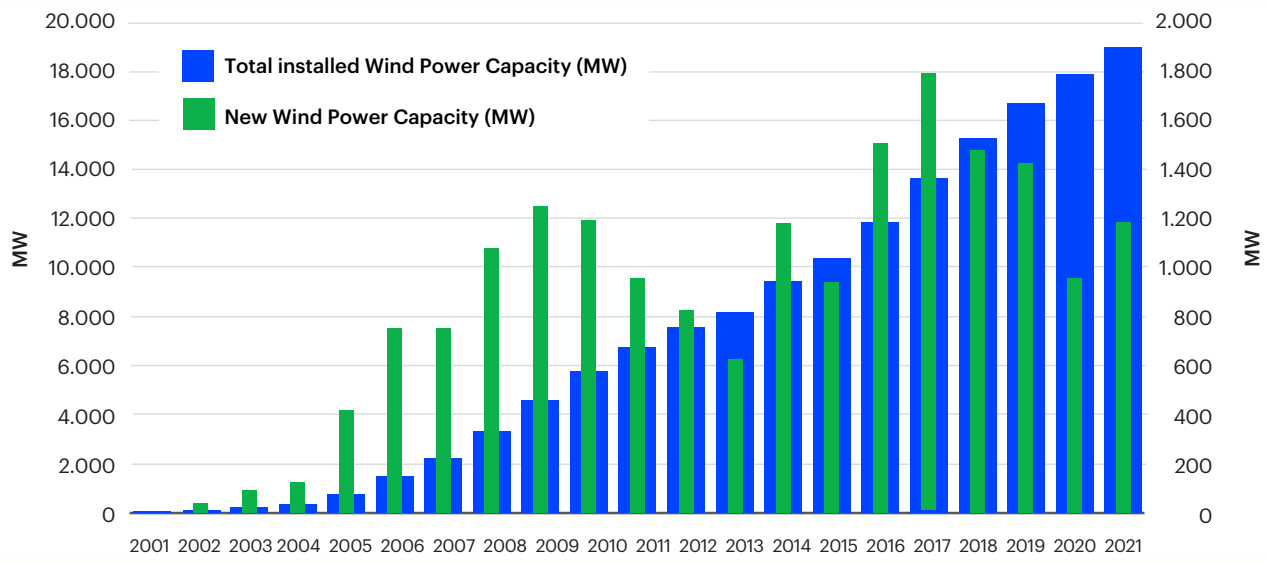

Figure 1: New and total installed wind power capacity.

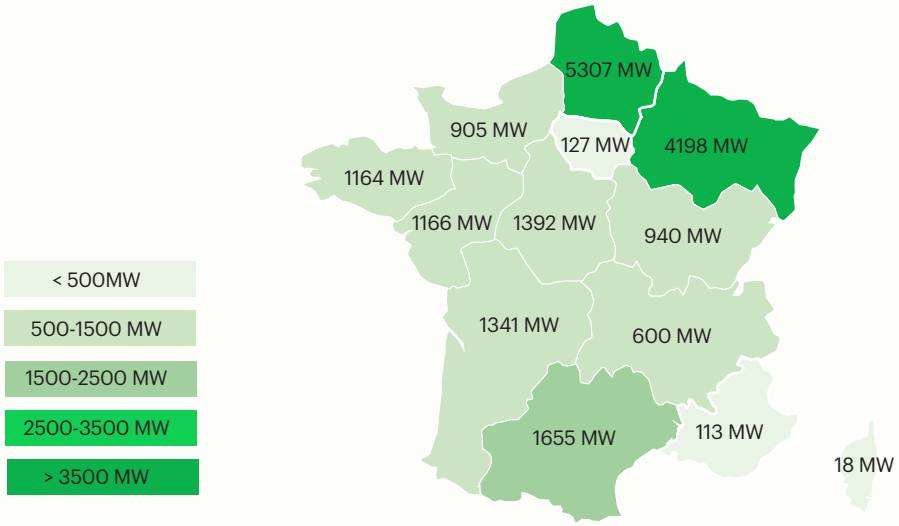

Figure 2: Total installed wind power capacity in the different administrative regions.

For 2023, the targets are:

- 24.1 GW land-based wind power capacity.
- 2.4 GW fixed bottom offshore wind.
- 20.1 GW solar energy.
- 25.7 GW hydro power.

The PPE sets also target for 2028 of between 33.2 and 34.7 GW of land-based wind power capacity and between 5.2 and 6.2 GW of offshore wind power capacity.

The PPE also includes a schedule for offshore bottom-fixed and floating wind tenders, as explained in Table 2 (see page 2).

In a longer term, RTE, the French TSO, published a report [1] describing several scenarios for 2050 and comparing different technology options to reach carbon neutrality. In all scenarios, renewables, and wind in particular, play a very significant role. Depending on cost and funding assumptions, the scenarios recommend, however different amounts of renewables and nuclear energy and study their robustness with respect to some parameters.

Progress and Operational Details

During 2021, over 1.2 GW [2,3] of new onshore wind power capacity was built in France. This number lies slightly above the 2020 figure (See figure 1) but well below the average of 1.5 GW over the 2016-2019 period. This deployment rate will require a step increase above 2.6 GW per year to reach the newly set targets of the PPE for 2023. End of year capacity has reached a total of 18.9 GW, with installed capacity concentrated in the North and East of the country (See figure 2).

Due to a poor capacity factor of 23% obtained in 2021, well below the record high of 26.5% reached in 2020, wind-generated electricity production totalled 36.8 TWh, a 7.2% decrease with respect to 2020. The percentage of electricity demand (excluding overseas territories) met by wind energy decreased to 7.8%.

In 2021, the last instance of onshore wind tenders resulted in an average price of 60.8€/MWh for the 6th period ending in April 2021 [4]. The average name plate capacity for this last period is 2.7 MW, below the European average value of 3.3 MW. In August 2021, new instances of the tendering process for onshore wind were launched, with ten periods covering up to 2026 for a total amount of 9 to 10 GW over the coming five years. The development of offshore wind progressed in 2021, with the four awarded wind parks for the 2012 tender (Saint-Nazaire, Fécamp, Saint-Brieuc, and Courseulles-sur-Mer) reaching the construction phase.

After the award of the Dunkerque project in 2019, the "AO 4 Centre Manche" bottom-fixed project of 1 GW in Normandy and first floating wind tender for 250 MW in South Brittany ("AO5") entered a phase of competitive dialogue in 2021. Public debates were also organised for subsequent call for tenders for floating wind in the Mediterranean and bottom-fixed on the South Atlantic coast.

Matters Affecting Growth and Work to Remove Barriers

Since 2017, several measures have been adopted to foster the development of wind in France and improve the consenting.

Following this trend, the Ministry of ecologic transition released a proposal of ten measures for a controlled and responsible development of wind energy [5], which rely on three principles:

- Instruct projects with the highest degree of exigence.
- Decrease the impact of wind farms on neighbours.
- Make wind energy a choice and a chance for the territories.

RD&D Activities

National RD&D Priorities and Budget

- The development of offshore wind and large wind turbine technology has been a priority in recent years. The French Environment and Energy Management Agency (ADEME) is the driving funding agency for applied RD&D projects in this area. ADEME funds and administers three kinds of projects: PhD theses; R&D projects for intermediate technology readiness levels (TRL); and the Programme des Investissements d'Avenir (PIA), which is dedicated to industrial projects and funded by subsidies, reimbursable aids, and possibly equity.
- After a call for proposals in 2009 on ocean energies, which included floating wind technologies, another call was launched in 2013, and four industrial demonstration projects were awarded by ADEME (see the IEA Wind TCP 2015 Annual Report).
- Among the selected topics, floating wind technology was identified as a strategic area. France has a favourable situation for floating wind, local harbour facilities, and a local naval and offshore oil and gas industry capable of addressing this market. A dedicated call for tender for floating wind farm pilot projects highlighted the focus on floating wind.
- Though several national public organisms perform R&D on their own budget, the dedicated R&D budget for 2020 is 15 M€ [6], which comes third after solar and biomass.
- It is worth mentioning that a new funding mechanism is relying on the Programme des Investissements d'Avenir fourth instance (PIA 4) will incorporate a funding mechanism for floating wind for new technologies and harbour infrastructures.

National Research Initiatives and Results

- The Momenta (farM rOtor ModEl accouNting aTmospheric wAke turbulence) project is ongoing after having been awarded funding by the ANR. Partners are the LA, LHEEA, PRISME labs, IFPEN, and VALEMO, which is a French O&M company. The objective is to study atmospheric and wakes turbulence effects that influence wind turbine loads. Lidar and drones will be used to measure in-situ wind conditions. Experimental work at a small scale and modeling tasks will also be performed.
- The ePARADISE (Evaluation des Perturbations AéRodynamiques sur les pales pour l'Amélioration de la Durabilité et de l'Impact Sonore des Eoliennes) aims at developing a sensor to measure the air flow near wind turbine blades, to optimise their operations and minimise acoustic emission. It os operated by ECN/LHEEA, CSTB, Mer Agitée and VALEMO.
- Several floating wind demonstration projects are ongoing, including the EOLFLOAT project led by Dietswell, the AFLOAT project led by SAIPEM, and the EFFICACE project led by Eolink.
- Within a call featuring the topic of Wind and Biodiversity, the projects SEMMACAP, OPRECH, ORNIT-EOF, ECOSYSM-EOF, EOLBIO, and MAPE have been selected by the ADEME and study the impact of wind turbines on mammals, bats, and birds, in different situations, including the specifics of floating wind.
- Finally, the H2-Ouest led by LHYFE was awarded funding by the ADEME to look at the production of Hydrogen from wind-generated electricity.

Test Facilities and Demonstration Projects

- The four pilot projects awarded in

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2016 for floating wind farms keep progressing on permitting and engineering work. As a reminder, the Groix and Belle-Ile project is located on the Atlantic coast, during the EoldMed project, Eoliennes Flottantes du Golfe du Lion project, and the Provence Grand Large project in the Mediterranean. Three of these projects have made a positive Final Investment Decisions and are free from legal recourses. These projects are now targeting installation in 2023.

- Along the SEMREV test site on the Atlantic Coast, the Mistral floating wind test site on the Mediterranean will be developed by Valeco/ EnBW in cooperation with France Energies Marines. It targets the first demonstrator with the HexaFloat technology from SAIPEM in 2023.

Collaborative Research

- Since joining IEA Wind TCP in 2014, nearly 15 French organisations, including private companies, Regional Transmission Organisations (RTOs), Small to Medium Enterprises (SMEs), and laboratories, have expressed interest in collaborative research. France has contributed to the following IEA Wind TCP Tasks with positive results:
- Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power
- Task 29 Analysis of Wind Tunnel Measurements and Improvement of Aerodynamic Models
- Task 30 Offshore Code Comparison Collaboration, Continued, with Correlation (OC6)
- Task 31 WAKEBENCH: Benchmarking of Wind Farm Flow Models
- Task 32 Lidar Systems for Wind Energy Deployment
- Task 33 Reliability Data: Standardising Data Collection for Wind Turbine Reliability, Operation, and Maintenance Analyses
- Task 34 Working Together to Resolve Environmental Effects of Wind Energy (WREN)

Other tasks, including Task 36 Forecasting for Wind Energy, Task 44 Farm flow control, and Task 45 Recycling of wind turbine blades, are also being considered.

Impact of Wind Energy

Environmental Impact

- Total renewable power capacity reached 59.8 GW at the end of 2021, of which wind energy contributed to providing approximately 31% of the overall installed renewable power capacity in France. Wind and solar now represent jointly 53% of the total capacity, the wind being the second largest source after hydroelectricity.
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- Renewable electricity produced 117 TWh which represented 24.9% of the total consumption in 2021. While solar-generated electricity increased, wind and hydro-generated electricity decreased from 2020 due to lower resource conditions. Wind contributed to 31% of the total renewable energy production, equalling to 7.8% of the total electricity consumption.

Economic Benefits and Industry Development

- According to [1], wind energy represented a total of 22600 full-time equivalent jobs at the end of 2020

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(a 12% increase from 2019), with steady growth over the last two years. Studies and development represented 7,600 employees, while manufacturing of wind turbines and components accounted for an estimated 4,700 employees. Engineering and construction represented 6,100 employees, while Operations and Maintenance provided 4,200 jobs.

- It is worth mentioning that several industrial players, including most international wind turbine manufacturers but also companies such as Vergnet and, more recently, Poma Leitwind, contribute to the French wind industry, along with facilities from several large wind turbine suppliers such as GE, Siemens- Gamesa, and an LM Windpower blade factory.

- A variety of suppliers already exist, such as Atlantique Offshore Energy (formerly STX) for offshore substations and foundations, Nexans for the electric cables, Leroy-Somer for generators, and Rollix for blade and yaw bearings. Several SMEs are also providing advanced technologies; for example, Epsiline as lidar provider, while METEODYN and METEOPOLE provide service and software for wind resource assessment. This situation is currently evolving quickly, along with the development of a local offshore industry.

- In addition, important infrastructures are pursued out in the Brest harbour for bottom-fixed and floating projects and the Port-la-nouvelle harbour for floating wind. These new infrastructures will foster the development of offshore wind in France.

Next Term

In 2022, the construction of the first offshore wind power plant in France will be completed. Others will follow in 2023, while offshore wind will keep gaining momentum through new tenders and thanks to newly defined targets of 50 offshore power plants by 2050.

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