# BELGIUM

in 2004 created a 156-km² area in the Belgian Exclusive Economic Zone (EEZ) in international waters for wind farms. The first wind turbines were installed in this area in 2009. At the end of 2020, 399 offshore wind turbines were operational—producing 8 TWh/yr.

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Belgium is a frontrunner for installed capacity relative to the available space, the bathymetry, and the distance from shore. Prominent researchers and research institutions place Belgium as a leader in offshore wind power.

## Market development

### National targets and policies supporting development

In general, Belgium's renewable energy policy is aligned with the EU 2020 targets. Belgium's land-based and offshore wind energy developments are essential for both Belgian and European targets for energy development from renewable sources. For 2020,

TABLE 1. KEY NATIONAL STATISTICS 2020: BELGIUM

| | |
|---|---|
| Total (net) installed wind power capacity* | 4.7 GW |
| Total offshore capacity | 2,262 GW |
| New wind power capacity installed | 0.84 GW |
| Decommissioned capacity (in 2020) | / GW |
| Total electrical energy output from wind | 12, 871TWh |
| Wind-generated electricity as percent of national electricity demand | 16% |
| Average national capacity factor** | 34% (est. By avg capacity) |
| Target | |
| National wind energy R&D budget | |

*Installed wind power capacity: Use nameplate power ratings of the installed wind turbines. **Average national capacity calculation. Only include turbines in operation the whole year: (MWh production/8,760 hrs) / MW installed capacity MWh total electrical production from wind turbines operating January 1 through December 31 divided by 8,760 hrs divided by the total installed wind capacity (in MW) at the beginning of the year. [You can also use an estimate based on the average installed capacity during the year: (installed 1 Jan + installed 31 Dec)/2. But in that case, state that this is how the estimate is calculated.]

Belgium has a binding national target for renewable energy equal to 13% of the gross final consumption of energy (Figure 1).

By the end 2020, the total land-based installed capacity in Belgium had reached 3,000 MW, and an additional 2,292 MW are planned offshore for a possible total of 5,292 MW of wind power. Offshore wind alone accounts for 10% of the electricity demand and 7 TWh of electricity or almost 50% of the requirements of Belgian household consumers.

Regarding offshore wind power, the transmission system operator (TSO), Elia, is obligated to buy green certificates from generators at a minimum price set by federal legislation. This system was established in 2002 and amended in 2014 and 2016. Purchase agreements must be approved by the regulator, CREG. Purchase obligations apply for a period of 22 years but may not exceed the depreciation period.

Belgium introduced changes to the formula for the levelized cost of wind energy (LCOE) to address the risk of overcompensation. On 27 October 2017, the federal government took a decision regarding the LCOE for the remaining parks: Mermaid, Northwester 2, and Seastar. These three parks are built at an LCOE of 79 EUR/MWh (94.8 USD MWh). The period of support is fixed at 16 years, potentially extendable for one year in case of low-wind conditions.

## Progress and operational details

Offshore wind-generated electricity first began in 2009 and progressed rapidly to a total of 2,262 MW in 2020.

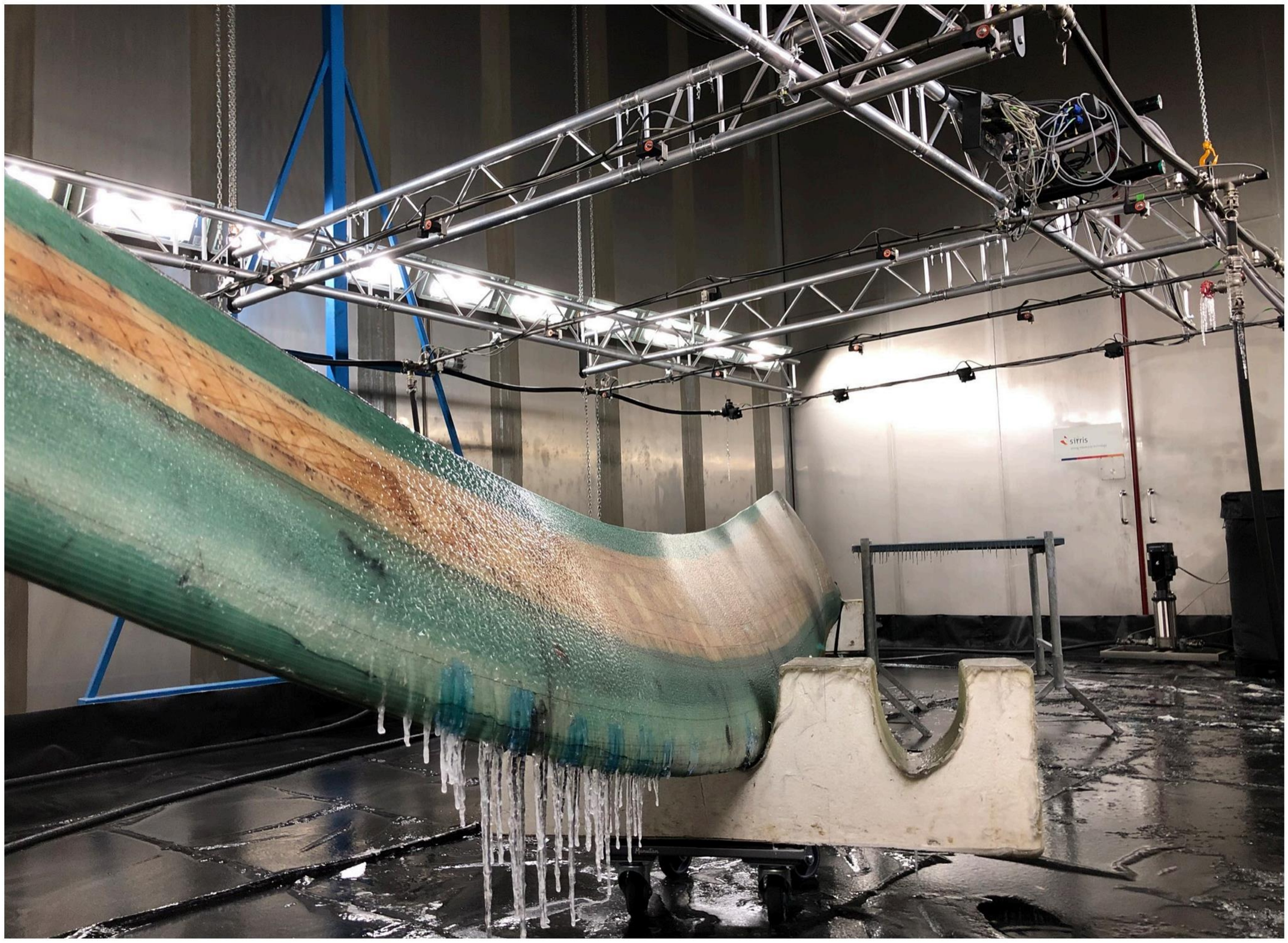
Land-based wind capacity remained low until 2004, when the installed capacity and production started to double year after year from 96 MW in 2004 to 2438 MW in 2020. Land-based wind is on track to reach its 2020 objectives after much progress during the last few years.

## Matters affecting growth and work to remove barriers

Work to remove barriers to new wind energy projects continues. Such barriers include spatial planning limitations (i.e., military, aeronautical, or traffic-related restrictions) and lengthy permitting procedures. The federal administration has created a 'one-stop-shop' aimed at simplifying and speeding up the license procedures.

Lengthy legal procedures also affect the sector. For example, cases where local communities appealed against the construction of wind energy facilities have taken years to resolve. Such legal cases could potentially be avoided by involving the local communities more closely at the project planning stage and by offering them the opportunity to take part in investments through cooperatives.

The main issue affecting growth for wind is the number of judicial appeals filed at the State Council, which has severely hindered the development of land-based wind farms both in the Flemish and Wallonia regions. Belgium has limited space for wind energy compared to many other countries. However, because of their relatively high availability, offshore wind resources provide the most potential according to an IEA in-depth review in 2015.




## R,D&D activities

### National R,D&D priorities and budget

Several key technologies that Belgium wants to invest in for the future have been put forward via the Steering Group of the SET-Plan.

With some research projects like GREDOR or SmartWater in the Walloon Region, Belgium is developing services that will ease the future integration of a larger share of wind energy by modernizing the electric grid and offering capacity for clearly tailored storage.

The Flemish Region supports R,D&D in offshore and land-based wind via several projects. In 2020, the cluster IBN Offshore Energy project (embedded in OWI-Lab, the Belgian RD&I expertise collaboration in onshore and offshore wind and set-up in 2017) has initiated, set-up and executed multiple RD&I projects in the field of offshore wind power.

The IBN-Offshore Energy (http://offshoreenergycluster.be/) is a network of Flemish companies innovating in the field of offshore energy (offshore wind, floating wind, wave & tidal). The activities of the IBN Offshore Energy are oriented towards facilitating innovation in this area, the mission of the support team is to support the process from back of the envelope idea towards a project plan for an innovative product or service ready to be executed.

The projects that have been set-up focus on 6 key topics in which industry-driven R&D is set up:

1. (Smart) structures and foundations (incl. new materials, structural integrity topics, etc...)

2. Innovative electro-mechanical equipment and connections (incl. new drivetrains, electrical power conversion, etc...

3. The usage of robots (UAVs ; drones; cobots, etc...)

4. Offshore energy in the grid (incl. storage, ancillary services, power quality, etc...)

5. Installation of offshore energy

6. Emerging offshore energy technologies (floating wind turbines, wave and tidal energy, etc...)


## National research initiatives and results

Results achieved by OWI-lab:

- Successful demonstration of structural health monitoring solutions for monitoring dynamic parameters, e.g. frequencies and damping, of offshore foundations and solutions for monitoring load/lifetime parameters e.g. bending moments, damage equivalent loads, damages, of offshore foundations.

- Successful use of optical fibres for subsoil strain measurements and back analysis of soil response curves of monopile foundations within the Nobelwind project.

- Successful validation of virtual sensing strategies on monopile foundations within the Nobelwind project.

- Successful windfarm wide load assessment using AI and machine learning algorithms demonstrated on C-power jacket foundations

- New 4G/5G IOT sensor set-ups and AI techniques set-up in Belgian offshore wind farms as part of ICON Supersized 4.0 project.

## Test facilities and demonstration projects

- Ongoing tests on the Belgium windfarms, Northwester, and Norther for the validation of advanced structural health monitoring strategies using IOT sensors and optical fibres in the framework of the DBC ICON Supersized project.

- Ongoing measurement campaigns for improving the soil-structure interaction models/digital twins within the Northwester 2 and Rentel windfarms in framework of the ETF project Windsoil and DBC SBO Soiltwin project.

- New large icing spray test array installed in Sirris/OWI-Lab large climatic test chamber as part of EU H2O20 Newskin project

- New humidity testing feature in Sirris/OWI-Lab large climatic test chamber

## New projects:

- H2020 platoon: digitizing the energy sector. Daar interessant is het uitbouwen van een ecosysteem van energy analytics app die kunnen werken via een data marketplace. Lead: Engie

- EU DOCC-OFF project Digitalization of Critical Components in OFFshore wind turbines

### Collaborative research

International collaboration is considered essential to accelerate the needed investments in research and development in renewable energy, such as in wind. To that end, the Federal Public Service of Economy became a member of the IEA Wind Technology Collaboration Program in 2015.

Belgium is active in several tasks of IEA Wind. (11, 31, 27, 41, 34, 46 and 48)

## Impact of wind energy

### Economic benefits

The wind energy sector creates excellent economic opportunities. Being active in this industry has also created opportunities for export. In addition to wind farm constructions, there is a need to build grid infrastructure, grid connections, and connections with neighboring countries.

The impact on employment is substantial, and jobs are created in the design, construction, maintenance, and replacement of wind farms, in addition to the permanent workforce, often in areas with few job opportunities. The offshore wind industry supports about 16,000 jobs in Belgium, including export activities, construction and operations, and maintenance. More specifically, the offshore wind industry will continue to provide significant direct and indirect contributions to the energy sector, which has about 50,000 direct jobs today.

### Environmental impact

In addition to adding sustainable energy capacity, offshore wind energy developments also increase biodiversity, specifically organisms such as sea corals and plants. Offshore wind turbine foundations form artificial reefs, where mussels and other sea life grow. The foundations also contribute to the growing fish population, providing many opportunities to further develop the marine culture in the Belgian North Sea. More than 2,200 MW are estimated to be installed in offshore areas by the end of 2020, representing more than 8.50 TWh without $CO_2$ emissions, and fulfilling 10% of the national electricity demand.

### Next term

Belgium is preparing for the tender for the second offshore zone. Normally, that tender will be launched in 2023