Belgium

Table 1. Key Statistics 2017, Belgium	
Total (net) installed wind power capacity	2,843 MW
Total offshore capacity	877 MW
New wind power capacity installed	165 MW
Decommissioned capacity (in 2017)	0 MW
Total electrical energy output from wind	6.346 TWh
Wind-generated electricity as percent of national electricity demand	7.58%
Average national capacity factor	25.48%
National wind energy R&D budget	2.73 mil EUR; 3.27 mil USD
Target	13% of renewables by 2020 in final gross energy consumption

OVERVIEW

The federal government began the first Belgian offshore wind park in the North Sea in 2003, and in 2004 created a 156-km2 area in the Belgian exclusive economic zone in international waters for wind parks. The first wind turbines were installed in this area in 2009. At the end of 2017, 232 offshore wind turbines were operational—producing 2,867 TWh/yr and providing electricity for approximately 8,000,000 families.

Belgium is a frontrunner when installed capacity is considered in relation to the available space, the bathymetry, and the distance from shore. Excellent researchers and research institutions place Belgium as a leader in offshore wind power. For example, the test zone for the Alstom-Haliade 150-6 MW offshore turbine demonstrates how Belgium's offshore zones are perfect for research purposes.

MARKET DEVELOPMENT

National Targets & 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 the Belgian and European targets for energy development from renewable sources. For 2020, Belgium has a binding national target for renewable energy equal to 13% of the gross final consumption of energy (Figure 1).

By 2020, the total land-based installed capacity in Belgium should reach 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 will account for 10% of the electricity demand and 8.5 TWh of electricity by 2020.

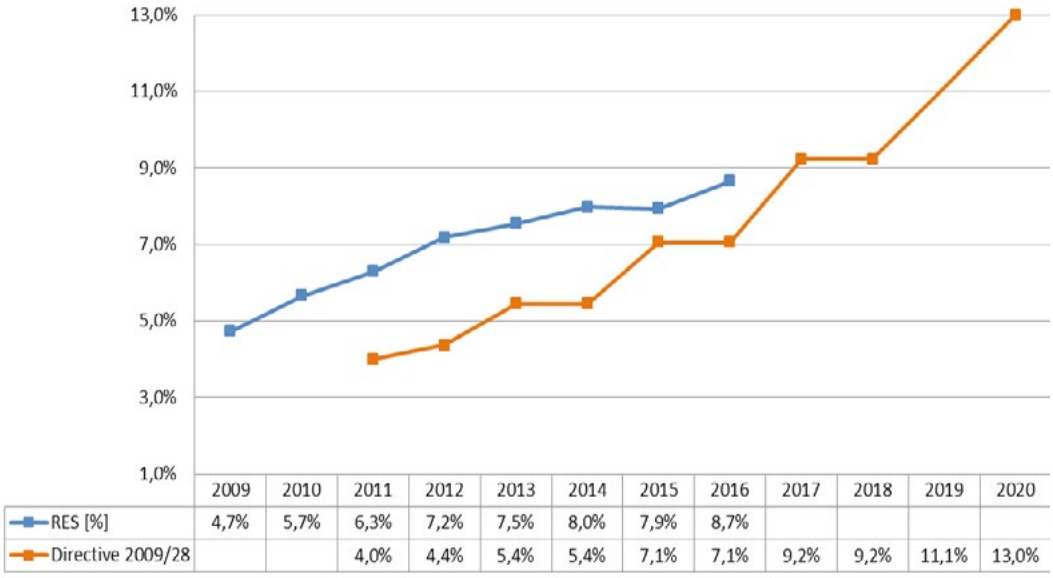
Regarding offshore wind power, the transmission system operator (TSO), Elia, is obligated to buy green certificates from generators at a minimum price set by federal legislation. This system was established in 2002 and amended in 2014 and 2016. Purchase agreements must be approved by the regulator, CREG. 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 shall be 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 circumstances.

Progress & Operational Details

Offshore wind-generated electricity first began in 2009 and progressed rapidly to a total of 877 MW in 2017. The Belgian government is working quickly to reach the 2020 targets, although some social acceptance problems with a land-based connection caused delays in 2015 and 2016 (Table 2). This matter was resolved, and offshore installation is expected to increase in 2017.

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 1,966 MW in 2017. Land-based wind is on track to reach its 2020 objectives after much progress during the last few years (Table 2).



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
RES [%]	4,7%	5,7%	6,3%	7,2%	7,5%	8,0%	7,9%	8,7%				
Directive 2009/28			4,0%	4,4%	5,4%	5,4%	7,1%	7,1%	9,2%	9,2%	11,1%	13,0%

Figure 1. Percent of renewable energy share in Belgium's gross final consumption [1]

The rated capacity of installed turbines has increased sharply for offshore and land-based wind. Table 4 shows the operational status of all the offshore wind parks in Belgium; the same data are unavailable for land-based wind parks.

Matters Affecting Growth & 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 parks 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 & 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. An important one is the co-financing of the state-of-the art project OWI-lab (www.owi-lab.be). The OWI-Lab was initiated by several leading companies in the Belgian wind energy sector: 3E, CG Power Systems, GeoSea-DEME, and ZF Wind Power (formerly Hansen Transmissions).

These companies worked in close collaboration with the Agoria Renewable Energy Club and GENERATIES, the

Table 2. Wind Power Capacity and Production [1]

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Offshore Wind Capacity and Production									
Offshore power capacity (MW)	32	197	197	381	708	708	712	712	877
Offshore electricity production (GW)	0.082	0.190	0.709	0.854	1.540	2.216	2.613	2.390	2.876
Capacity factor (%)	29.7%	11.0%	41.2%	25.6%	24.8%	35.8%	41.9%	38.3%	37.4%
Total Electricity Production									
Total electricity production (GW)	91.235	95.189	90.241	82.923	83.526	72.687	70.648	83.133	83.722
Wind-generated electricity (GW)	0.996	1.292	2.312	2.751	3.687	4.614	5.574	5.191	6.346
Electricity demand met by wind energy (%)	1.09%	1.36%	2.56%	3.32%	4.41%	6.35%	7.89%	6.24%	7.58%

industrial innovation platform for renewable energy technologies in the Flemish Region. Vrije Universiteit Brussel (VUB) is responsible for the project's academic research, in close collaboration with the other local universities.

The Belgian government invested 2.728 million EUR (3.273 million USD) in offshore and land-based wind in 2017. This is less than the 4.299 million EUR (5.158 million USD) in 2015, mainly due to the reduction of the budget for unallocated wind energy (from 3.503 million EUR in 2015 to 0.068 million EUR in 2016; 4.20 million USD in 2015 to 0.081 million USD in 2016). On the other hand, the budget for wind energy systems and other technologies increased from 0.543 million EUR (0.652 million USD to 2.453 million EUR (2.943 million USD).

National Research Initiatives & Results

Belgium's wind industry includes:

- Manufacturing companies such as Xant, which produces small- and medium-sized wind turbines
- Component suppliers such as ZF Wind Power, CG Power, Sky Man, Monitoring Solutions
- Operators such as OWI-lab, VJI, Laborelec

In the public sector, we have a large wind-energy research community, including Universiteit Gent, Katholieke Universiteit Leuven, ULB, Universite Mons, Universite de Liege, Sirris, BMM, and Laborelec.

Test Facilities & Demonstration Projects

OWI-lab's climatic test facility focuses on offshore wind R&D [3]. This lab invested 5.5 million EUR (6.6million USD) in state-of-the art testing and monitoring tools, including:

- Large climatic test chamber (-60°C to +60°C; humidity)
- Floating lidar (FLIDAR)
- Offshore measurement systems
- R&D and innovative projects
- SMART operations and maintenance research

The cold climate wind tunnel test facility (CWT-1 facility) at the Von Karman Institute (VKI) is a low-speed, closed-circuit wind tunnel capable of operating at subfreezing temperatures [4].

Figure 2. Nobelwind wind farm located in the Belwind concession area in the North Sea approximately 47 km from shore (Source: Nobelwind, http://nobelwind.eu/)

The OCAS test facility has a unique fatigue testing technique. This testing ensures the improved fatigue life of welded jacket connections, which can help decrease the cost of offshore wind by optimizing the design of jacket foundations [5].

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.

In 2016 and 2017, on behalf of Belgium, Sirris participated in Task 19 Wind Energy in Cold Climates. As part of the cooperative research Task, Sirris and OWI-lab co-authored two studies last year. Task 19 is also collaborating on a European level with the creation of the EERA Joint Program 'Cold Climate', led by Belgium with BERA.

Table 3. Operational Status of Belgian Offshore Wind Parks [1]

Project (Location)	No. of Turbines	Capacity (MW)	Area (km²)[a]	Water Depth (m)	From Shore (km)
C-Power (Thorntonbank)	54	325	13.7-18.1	12-27.5	27
Belwind (Bligh Bank)	56	171	15.8	25-50	46
Nobelwind (Bligh Bank)	50	165	19.8	26-38	47
Northwind (Eldepasco) (Lodewijk-bank)	72	216	16.9	16-29	37
Norther (S. of Thorntonbank)	44	369.6	38	20-35	21
Rentel (N. of Thorntonbank)	48	312	23.16-27.3	22-36	31
Seastar (S. of Bligh Bank)	30	246	18.4	20-25	41
Mermaid (N. of Bligh Bank)	27-41	232-266[b]	28.4[c]	25-50	54
NorthWester (Bligh Bank)	22-32	217-224	28.4[c]	25-40	51
Totals	**414-459**	**2,254-2,295**	**238.5**		

Note: [a] Total Area (without security zone); [b] +20 MW wave energy; [c] Mermaid and Northwester

Another international collaboration program is the North Seas Energy Cooperation. This is an initiative for the development of offshore wind energy to ensure a sustainable, secure, and affordable energy supply in the North Seas countries. This will facilitate the building of missing electricity links, allow more trading of energy, and further integrate energy markets. Reinforcing regional cooperation will help reduce greenhouse gas emissions and enhance security of supply in the region.

Nine Ministers signed the initiative (Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway, and Sweden), as well as Vice-President for Energy Union Maros Sefcovic, and Commissioner for Climate Action and Energy Miguel Arias Canete. Belgium was president of the initiative until September 2017, followed by a Dutch presidency who handed over to Denmark in June 2018. During the DG meeting in December all DG's agreed to monitor progress, get an overview of the work, a 'roadmap' per Support Group, including deliverables and timetables till mid-2019.

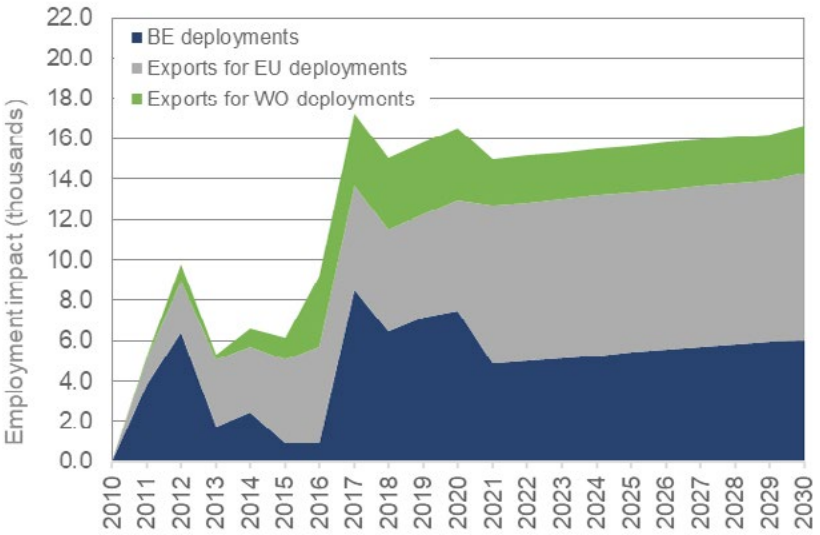


Figure 3. Total employment impacts from deployment in Belgium (BE), in Europe (EU), and in the rest of the world (WO), including construction and operations, both direct and indirect impacts [2]

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 park 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 parks, in addition to the permanent workforce, often in areas with few job opportunities. The offshore wind industry supports about 15,000 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 (Figure 2) [1].

Environmental Impact

In addition to adding sustainable energy capacity, offshore wind energy developments also increase biodiversity, specifically organisms such as corals and plants in the sea. 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 2020, representing more than 8.50 TWh without CO_2 emissions, and fulfilling 10% of the national electricity demand.

NEXT TERM

The offshore wind parks Rentel, Norther, Seastar, Mermaid, and Northwester 2 are fully approved by all planning bodies and will account for another 1,283 to 1,428 MW offshore capacity by the end of 2019.

References

Opening photo: Offshore wind turbine in Belgium

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