The finishing touches were put on the Modular Offshore Grid (MOG) in the Belgian North Sea in April 2019. The platform is located 40 km from the coast, is anchored to the seabed with four posts at a depth of 60 m, and rises 45 m above sea level. Since going live in September 2019, the MOG has made a vital contribution to the expansion of offshore renewable energy.

elia
| Elia Group

High voltage off the Belgian coast

Elia's grid in the North Sea

elia
| Elia Group

Elia's grid off the coast

Modular Offshore Grid

— Switchyard platform 40 km off the coast
— Bundles cables from several offshore wind farms
— Directly connected to the STEVIN high-voltage substation in Zeebrugge
— Investment of around €400 million
— Operational since September 2019

p 2

NEMO LINK

— First interconnector with the UK
— Elia's first subsea electricity cable
— Belgium's first high-voltage direct-current (HVDC) project
— Collaboration with British system operator National Grid
— Investment of around €650 million (half covered by Elia)
— Operational since Q1 2019

p 8

STEVIN project

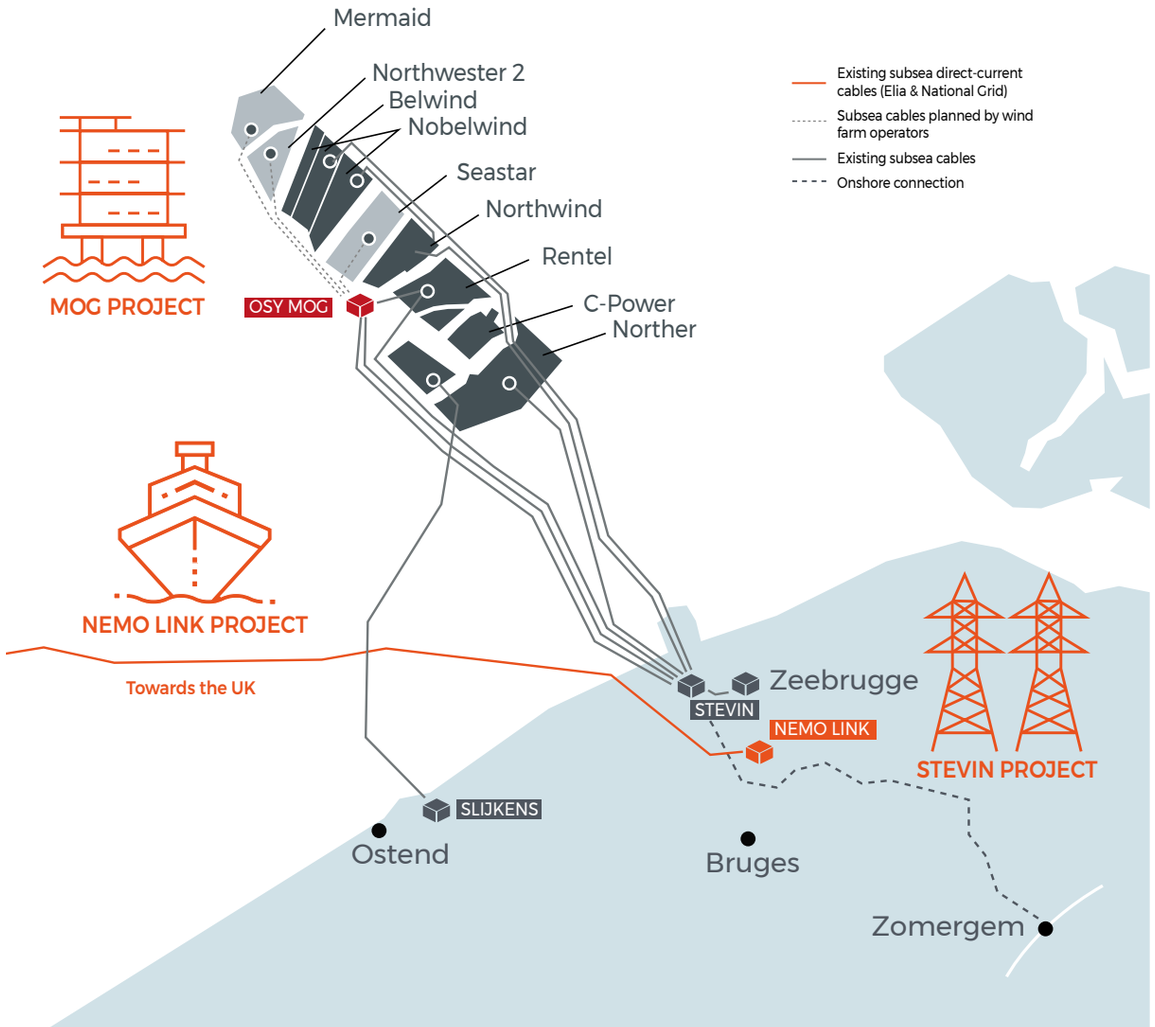
— New 380-kV line linking Zeebrugge and Zomergem
— 47 km long, including 10 km underground
— Integrates the power generated by offshore wind farms into the Belgian electricity grid
— Also transmits power from the Nemo Link project
— Capacity of 3,000 MW
— Investment of around €400 million
— Operational since 2017

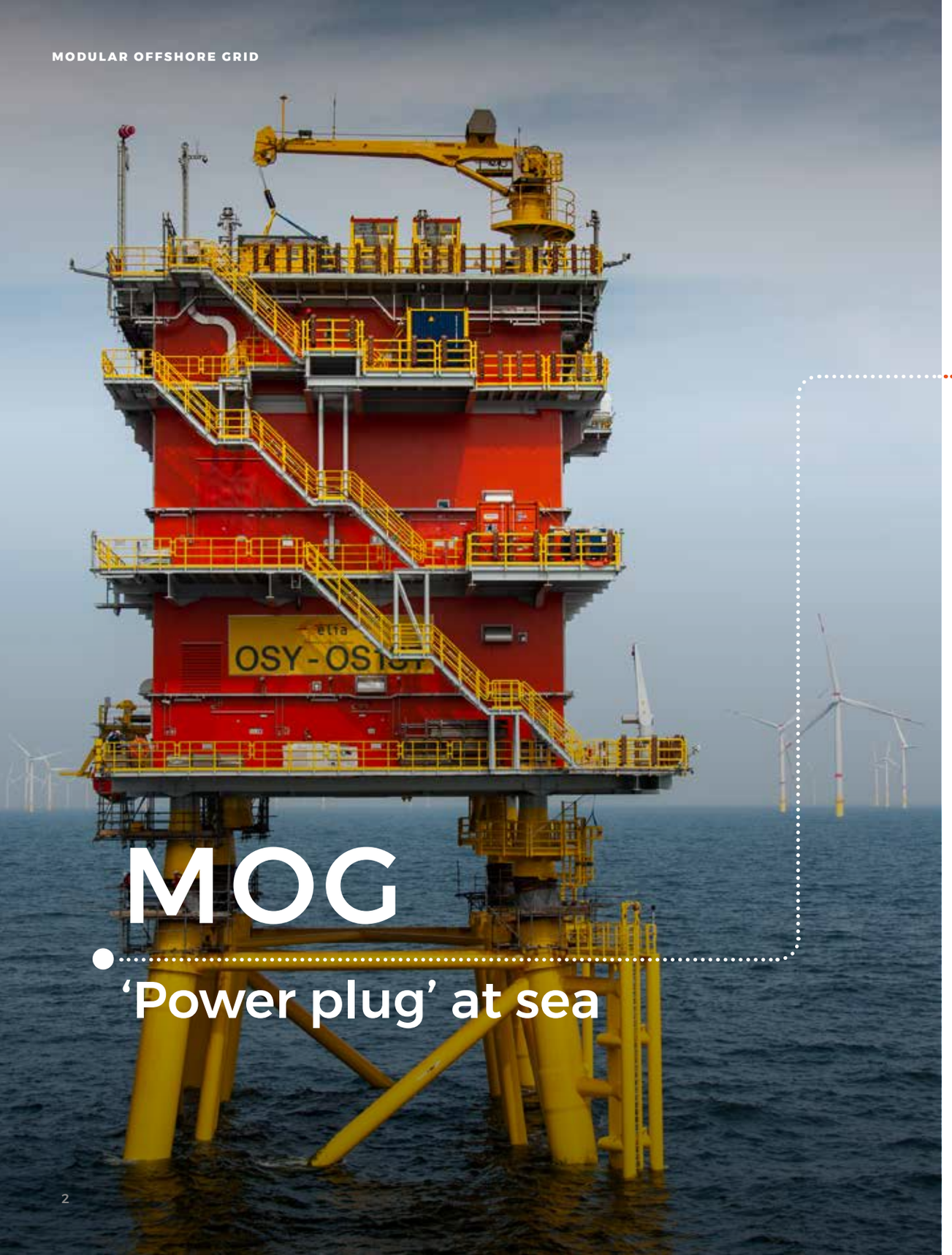
p 14

50Hertz offshore projects

— Ostwind 1 & 2
— Combined Grid Solution
— Hansa PowerBridge

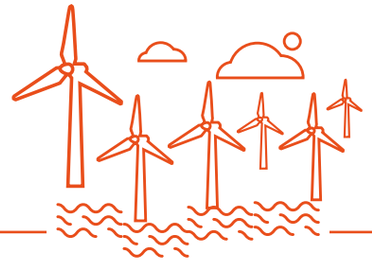
p 20



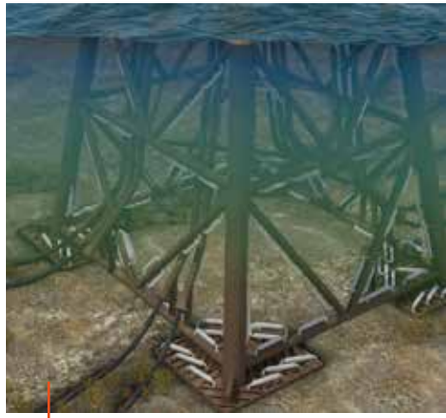


MOG

‘Power plug’ at sea



The Modular Offshore Grid (MOG) is the first Elia project to involve a switchyard platform at sea, officially known as the Offshore Switchyard (OSY). It will bundle the electricity generated by four offshore wind farms (Rentel, Seastar, Mermaid and Northwester 2) and transmit it to the mainland through joint subsea cables. The MOG makes it possible to efficiently integrate renewable power into the Belgian electricity grid.



130 km of 220-kV subsea cables connect the MOG to the Stevin high-voltage substation in Zeebrugge.

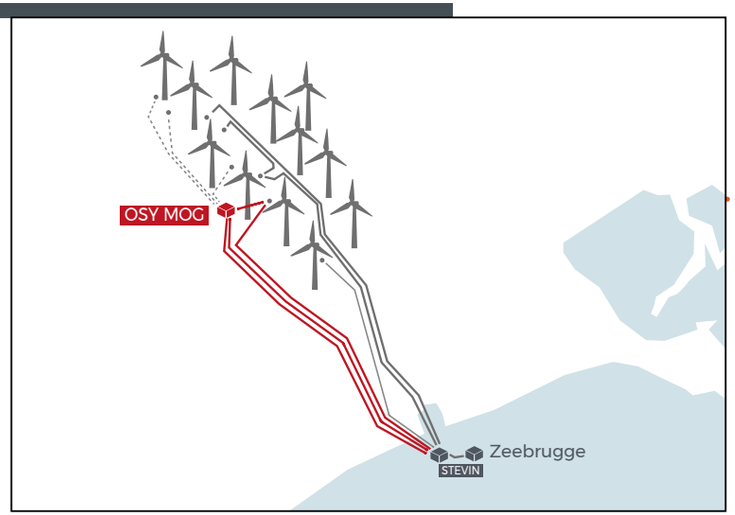
In detail

The OSY plug lies 40 km off the coast. The switchyard platform is connected to the Stevin high-voltage substation in Zeebrugge by 130 km of 220-kV cables. The combined cable infrastructure guarantees that the wind farms can always transmit the power they generate to the mainland, even if one of the cables is temporarily unavailable. Bundling the cables from several wind farms uses around 40 km less cable than building a separate cable connection for each wind farm, so the MOG project significantly reduces the impact on the seabed and the marine environment.

WARD MERTENS, OFFSHORE CABLE ENGINEER, MOG

“When Elia was working on Zeebrugge beach and along the MOG cable route at sea, we used a number of special methods to search the beach and seabed. Our investigations revealed a lot of unexploded ordnance (UXO) left behind by the two world wars. Under the watchful eye of a certified UXO expert, a specialised company (1) located and (2) identified potentially explosive objects. If they were found to be UXO, they were (3) dismantled by the Service for the Clearance and Disposal of Explosive Ordnance (SEDEE/DOVO). In all, more than 300 objects were detected, 13 of which turned out to be UXO. We also encountered a wrecked plane and ship and had to divert the cable route as a result.”

Why is the MOG so important?



We are making it possible to connect future wind farms to the grid

1

We are reducing the impact on the marine environment

2

We can connect new renewable energy sources (such as tidal and wave energy, or storage solutions) to the grid

3

In the long term, we will be able to build international offshore interconnectors

4

TOM TRAPPENIERS, INTERFACE & INTEGRATION MANAGER, MOG

"We proudly unveiled the MOG concept in 2015. We started work on it less than two years later, and the Modular Offshore Grid has been operational since September 2019. Meeting strict deadlines has been a core feature of this project, and was especially challenging given the complex interactions between contractors, subcontractors, suppliers, wind farms and internal and external stakeholders."

Work on the project

BUILDING THE SWITCHYARD PLATFORM

The platform consists of two parts: the top part where the electrical equipment will be housed (topside) and the support infrastructure that will rest on the seabed (jacket). Both parts have now been built.

INSTALLING THE OSY PLATFORM

We installed the jacket in the North Sea in late 2018. In April 2019, we successfully laid the topside on the jacket, completing the Modular Offshore Grid platform in the North Sea.

LAYING THE CABLES

The cables have all been manufactured and were laid in two stages. The last stage was completed in September 2019.

COMMISSIONING THE MOG

The first wind farm was connected to the Modular Offshore Grid in September 2019 and the MOG has been operational since then.

Building and installing the MOG: a challenging project

TOM PIETERCIL, MOG PROGRAMME MANAGER

Building and installing the MOG was no walk in the park. The platform is located 40 km from the coast, is anchored to the seabed with four posts at a depth of 60 m, and rises 45 m above sea level. The cables connecting the platform to Elia's grid onshore have a diameter of 28 cm, making them the thickest cables ever laid in the North Sea. Tom Pietercil, MOG Programme Manager, explains more about the challenges involved in a project he describes as a "real rollercoaster ride".

A COMPLEX PROJECT WITH AN AMBITIOUS SCHEDULE

"The Modular Offshore Grid is being built in stages, according to a very demanding schedule. In March 2016, we reached an agreement in principle with the various authorities and wind farms. The investment decision was made in April 2017. We installed the offshore jacket in August 2018, and the topside was laid on it in April 2019. Shortly after that, the subsea cables were installed and connected. The MOG project has been operational since late September 2019, allowing wind farms to connect their full capacity to the Belgian grid as per the federal government's climate targets. This tight turnaround time is truly unprecedented for a project of this scale and complexity."

28 CM ∅

DIAMETER OF ONE MOG CABLE

The MOG team visiting the site where the jacket for the Modular Offshore Grid is being built (Vlissingen, August 2018).

A MOTIVATED AND DEDICATED TEAM OF EXPERTS

"This ambitious project was completed on time and within budget, primarily due to the efforts of the project team: a group of driven, highly skilled employees. Together, they looked for ways to shorten the completion time without compromising on quality and safety. Elia looked beyond Belgium's borders to find the right people for the project. At its peak, the project team consisted of around 40 employees who worked round the clock to ensure that the project ran smoothly and safely."

60 M

DEPTH OF THE FOUNDATION POSTS IN THE SEABED

Scan the QR code with your smartphone camera to see a video about the different stages of the MOG project.

NEMO LINK

Subsea interconnector with the UK

140 KM

TOTAL LENGTH OF THE NEMO LINK CABLE CONNECTION

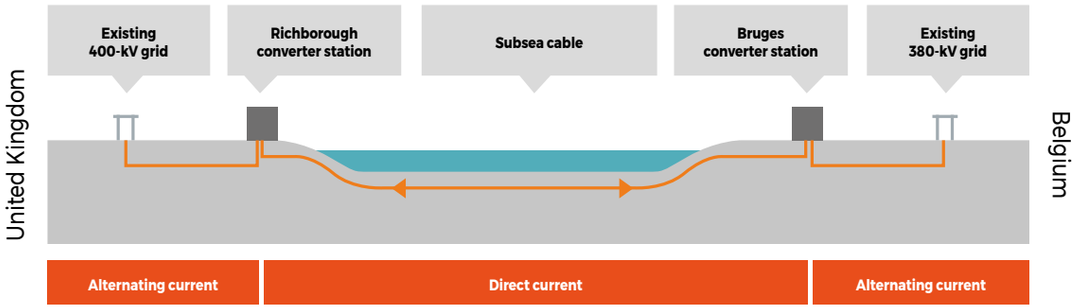
Nemo Link is Belgium's first electricity interconnector with the UK. Thanks to the subsea cables linking the two countries, Belgium and the UK have been able to exchange electricity since 2019. Nemo Link is a joint venture between Belgian system operator Elia and its British counterpart National Grid.

In detail

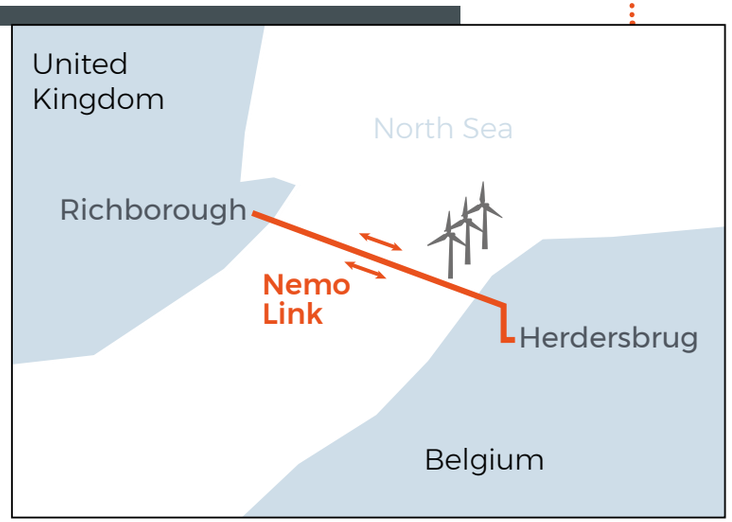
The Nemo Link project entailed laying a 140-km high-voltage cable (130 km of which runs under the North Sea) between Bruges and Richborough. The subsea and underground power cables are connected to a converter station and a high-voltage substation in each country, allowing electricity to flow in either direction. Nemo Link is Elia's first-ever high-voltage direct-current (HVDC) project. HVDC is the technology best suited to exchanging electricity over long distances, and is also easier to control.

BART GOETHALS, CHIEF COMMERCIAL OFFICER, NEMO LINK

"Interconnectors make it possible to trade electricity throughout Europe. They enable consumers to benefit from lower electricity prices abroad, make it easier to integrate renewable energy into the grid and are a cost-effective way to boost security of supply."



Why is Nemo Link so important?



MATHIEU DONCHE, BE PROJECT MANAGER, NEMO LINK

"Nemo Link is a highly international project: the cable is from Japan, the converter station was built by Germans, and the project itself is a collaboration between British and Belgian teams. Everyone has their own habits, procedures and traditions. Although we all do things differently, we were all working towards a common goal. It was a fantastic experience."

1 Nemo Link improves our security of supply by enabling energy exchanges between Belgium and the UK.

2 By importing and exporting energy to and from neighbouring countries, we have more scope to negotiate better electricity prices.

3 Nemo Link gives us access to renewable energy sources in the UK, and vice versa.

4 Given the variable nature of green power generation, Nemo Link allows for better coordination of supply and demand fluctuations in the two countries.

Work on the project

BUILDING THE CONVERTER STATIONS IN BRUGES AND RICHBOROUGH

Work on the converter stations wrapped up in August 2018.

PULLING THE SUBSEA CABLE

130 km of subsea cable was laid: 59 km in British waters and 71 km in Belgian waters.

PULLING THE UNDERGROUND CABLE

The underground cable runs for 2 km in the UK and 8 km in Belgium. The cable work was completed in June 2018.

COMMISSIONING NEMO LINK

Elia and National Grid inaugurated the first subsea electricity interconnector between Belgium and the United Kingdom on Wednesday, 5 December 2018. The first energy exchange using the cable took place on 31 January 2019.

Pioneering work in an international context

TIM SCHYVENS, ENGINEERING MANAGER, NEMO LINK

A joint venture of this magnitude requires a great deal of technical expertise and international teamwork. The interconnector's commissioning was the culmination of the efforts put in by everyone involved in the project: it could not have been done without their hard work. Tim Schyvens, Engineering Manager at Nemo Link, explains what makes the project so special.

Did you know?

A converter hall is 140 m long and 40 m wide – around four times the size of Elia's head office in Brussels!

MANY STAKEHOLDERS, DIFFERENT CULTURES

"Since the project was being carried out in a complex environment, we had to make sure there was a clear framework in place from the outset. Teamwork between people from different cultures was a key feature of the integrated structure we created for Nemo Link. At the end of the day, there is no real difference between the Belgians and the British when you are all working towards the same goal, as part of a team founded on dialogue and mutual respect."

A CHALLENGING PROJECT WITH A HOST OF 'SIDE PROJECTS'

"This really is an enormous project. The total surface area of the Herdersbrug site is equivalent to five football pitches – that should give you some idea of the project's scale. We had to do a lot of work on the beach and at sea too.

While we were carrying out preparatory work on the beach, we uncovered part of the German line of defence from WW2. We had to call in the SEDEE/DOVO demining team to defuse a number of bombs. We also came across thousands of objects as we worked on Nemo Link's subsea route: shipwrecks, plane wrecks, war munitions, and more besides. But what struck us the most was the huge amount of rubbish we found."

5 football pitches

THE TOTAL SURFACE AREA OF THE HERDERSBRUG SITE

Want to find out more about Nemo Link? Visit
www.nemo-link.com

STEVIN

Where offshore power meets the onshore grid

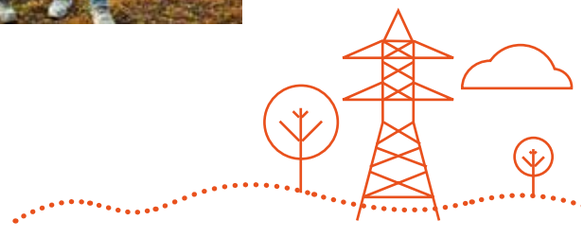
The Stevin substation in Zeebrugge is Belgium's biggest high-voltage substation. It is connected to the MOG and transforms the electricity generated by wind turbines to 380 kV for transmission further inland. The substation also boosts supply on the local high-voltage grid in West Flanders. The Nemo Link interconnector is connected to the Stevin route too. The Stevin substation is the only one of its kind in Belgium: nowhere else can the three highest voltage levels (150 kV, 220 kV and 380 kV) be found in a single location.

In detail

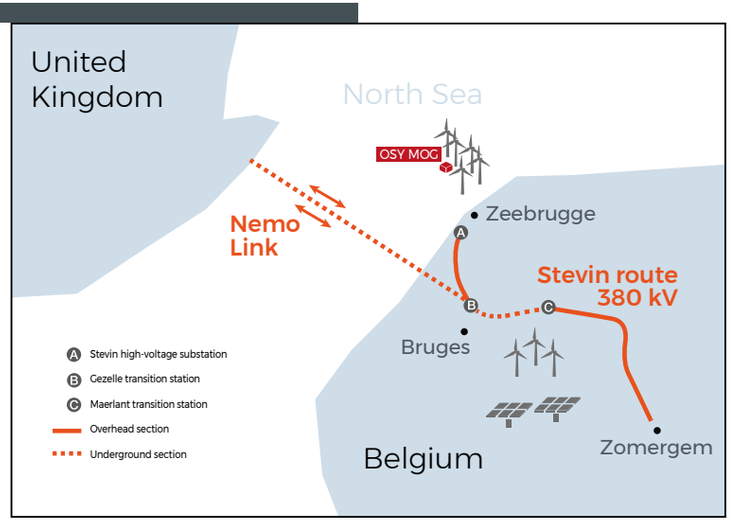
In addition to the high-voltage substation, the Stevin project includes a new 380-kV high-voltage line between Zeebrugge and Zomergem, covering a distance of 47 km. By extending the 380-kV grid, Elia is substantially improving the electricity supply in West Flanders. The project entails building new overhead and underground connections. As well as installing new connections, we are dismantling 53 km of old lines, of which 35 km are being replaced with underground cables.

WILLIAM STAS, PROJECT MANAGER FOR MAJOR INFRASTRUCTURE WORK, ELIA

"Stevin is Elia's biggest ever investment project. It is vital for adjusting our energy system to the major changes ahead. Renewable energy is becoming increasingly important, and Belgium will exchange ever greater volumes of electricity with neighbouring countries."



Why is Stevin so important?



16 km
EXISTING LINES RE-USED

+ 10 km
UNDERGROUND CABLE WITH TUNNEL UNDER THE BOUDEWIJNKANAAL

+ 21 km
NEW LINES

= 47 km
380-KV HIGH-VOLTAGE CONNECTION

1 Stevin enables the wind power generated offshore to be brought to the mainland via the MOG and transported throughout Belgium

2 Other sustainable generation units in the coastal region, such as wind power and CHP units, will be connected to Stevin

3 Since 2019, Stevin has enabled Belgium to exchange electricity with the UK through the Nemo Link interconnector

4 Stevin improves the electricity supply to West and East Flanders, and especially the Port of Zeebrugge

Work on the project

1 BUILDING HIGH-VOLTAGE SUBSTATIONS

We built new high-voltage substations in Zeebrugge, Vivenkappelle and De Spie, completing them in autumn 2017.

2 LAYING UNDERGROUND CABLES

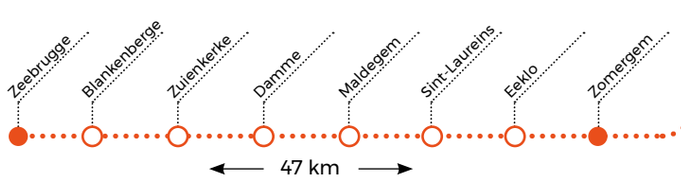
Elia built a tunnel under the Boudewijnkanaal at the Herdersbrug power plant. Tunnel shafts measuring 14 m across were dug at a depth of 32 m on either side of the canal.

3 BUILDING OVERHEAD LINES

Most of the work on the overhead lines is complete. Six pylons (located at Moerkerksesteenweg 5 in Damme and along the southern 150-kV high-voltage line between Brugge-Waggelwater and Eeklo-Pokmoer) are due to be demolished in spring 2020.

4 COMMISSIONING STEVIN

On 21 September 2017, Elia officially inaugurated the Stevin high-voltage connection with a ceremony in Zeebrugge, attended by Prime Minister Charles Michel and Energy Minister Marie Christine Marghem.



Public support essential for major projects

ARIANNE MERTENS, STEVIN PROGRAMME MANAGER

Stevin passes through eight towns and municipalities in West and East Flanders. Now that the Flemish government has approved the launch notice for the Ventilus project, work will soon begin on an additional high-voltage connection in West Flanders. Ventilus and Stevin will be connected to one another to boost the resilience and reliability of the Belgian power grid. Given the scale, complexity and impact of these projects, it is extremely important to ensure that they are broadly supported by the public. Stevin Programme Manager Arianne and Ventilus Community Relations Officer Steven tell us more.

BUILDING TRUST THROUGH OPEN DIALOGUE AND MAXIMUM INVOLVEMENT OF LOCAL PEOPLE

Arianne: "Stevin upgrades the existing high-voltage grid in West and East Flanders, which is good news for security of supply in the region. However, new overhead and underground high-voltage connections were built as part of the upgrade work. Although the Stevin connection mostly runs through farmland, there are also houses, watercourses, roads and nature reserves along the route. With that in mind, we communicated extensively with local residents and did everything we could to minimise disruption. We regularly organised site visits to keep local residents up to date with what we were doing, and even developed an information pack for schools and arranged educational tours for their pupils."

NEW PROJECT

In April 2019, the Flemish government and Elia unveiled plans for Ventilus, a new high-voltage project in West Flanders. Ventilus will be a 380-kV high-voltage line with a capacity of 6 GW, and will be linked to the Stevin route. Ventilus' route will be determined once the general public and interest groups have had their say.

Elia employees provide information about Ventilus at one of the ten information sessions.

STEVIN-AVELGEM CONNECTION (VENTILUS) FOR A MORE ROBUST, MORE RELIABLE AND GREENER POWER GRID

Arianne: "Wind energy is Belgium's biggest source of renewable generation and the province of West Flanders has the highest wind speeds in Flanders. The Stevin project is currently the only 380-kV high-voltage connection linking the coast to the mainland. Ventilus will ensure that even more green electricity can be transmitted from the North Sea to consumers onshore. Connecting Stevin and Ventilus to one another will make Belgium's power grid more robust and more reliable. In the long term, Ventilus may even make it possible to build a second subsea connection with neighbouring countries, alongside the Nemo Link project that became operational at the start of this year."

THE PUBLIC, LOCAL RESIDENTS AND INTEREST GROUPS GET A SAY IN VENTILUS' FUTURE ROUTE

Steven: "As with Stevin, we want to ensure that members of the public and stakeholders are as involved as possible at every stage of the project. That is why we and the Flemish government committed to using a participatory approach to determine Ventilus' route. In May and June, we organised 10 information sessions in the 10 affected municipalities, and anyone could share their thoughts about the route on the ventilus.be website until the end of June 2019. We will do our utmost to involve local people and stakeholders in subsequent stages of the project too, as this will give the project a broad support base."

STEVEN VAN MUYLDER, VENTILUS COMMUNITY RELATIONS OFFICER

Keen to find out more about Stevin and Ventilus? Visit
www.stevin.be
www.ventilus.be

50Hertz

Towards a greener, more interconnected European grid

50HERTZ

Elia's German subsidiary 50Hertz is also undertaking a number of major offshore projects. Offshore wind energy is growing exponentially in Germany, and 50Hertz is providing the grid connections required to transmit all this renewable power to consumers. 50Hertz is also taking advantage of its geographical location at the heart of the European energy system to boost security of supply and establish more interconnections with neighbouring countries.

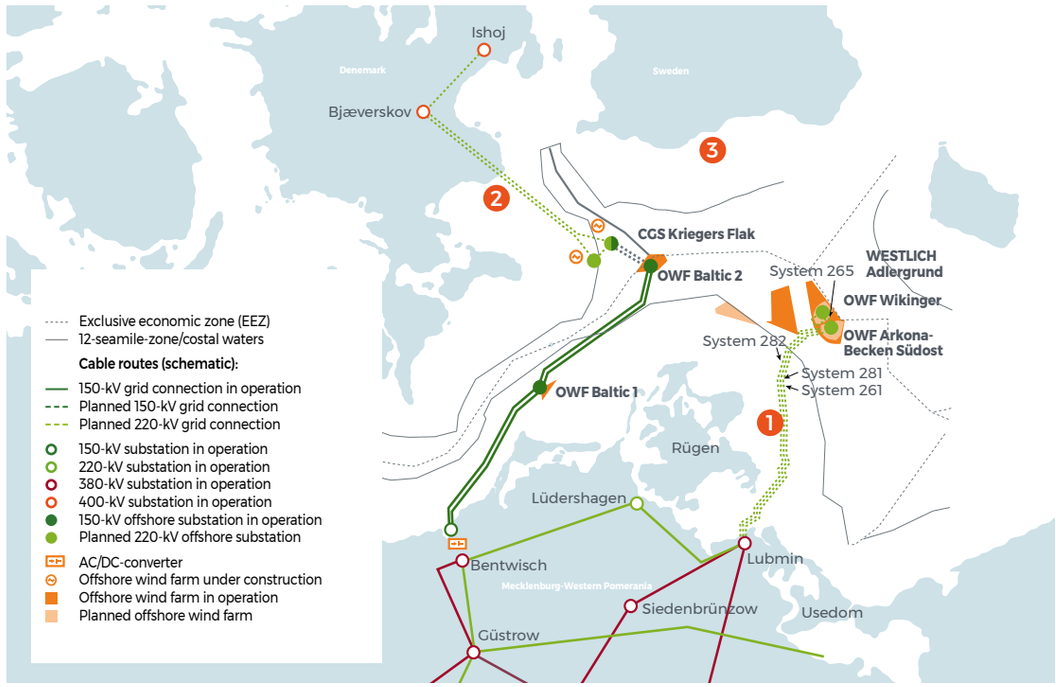
In detail

50Hertz is currently running three major offshore projects in the Baltic Sea:

1. **Ostwind 1:** three 220-kV subsea cables measuring 90 km each, connecting the Wikinger and Arkona wind farms in the Baltic Sea with the onshore electricity grid
2. **Combined Grid Solution:** an interconnector linking two wind farms between Denmark and Germany
3. **Hansa PowerBridge:** an extra connection between the German and Swedish transmission systems

HENRICH QUICK, HEAD OF PROJECTS OFFSHORE AT 50Hertz

"The Baltic Sea is an attractive region for the wind energy sector because of its excellent wind conditions, which are every bit as good as those in the North Sea. Germany held auctions for the next round of offshore projects in April, and concessions totalling 733 MW were awarded for projects in the Baltic Sea – far more than the anticipated 500 MW. 50Hertz has launched a programme to buy more cables and expand its project team with a view to connecting the new Baltic Sea wind farms, which are due to become operational in 2022-2023."



The Arkona offshore wind farm was officially inaugurated in April 2019 in a ceremony attended by German Chancellor Angela Merkel. Work on the project took three years and was completed within the €1.3-billion investment budget.

885 GWh

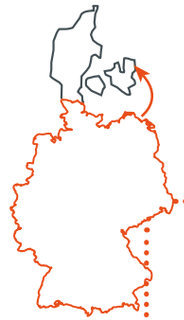
THE WIKINGER OFFSHORE WIND FARM INJECTED 885 GWH OF RENEWABLE ENERGY INTO THE 50HERTZ GRID IN 2018. THAT IS ENOUGH TO COVER THE ELECTRICITY CONSUMPTION OF 220,000 HOUSEHOLDS!

OSTWIND 1 & 2

Connecting offshore wind farms in the Baltic Sea

The Ostwind 1 project connects the Arkona and Wikinger wind farms with the onshore transmission grid. Its 220-kV subsea cables carry the power generated by the wind farms a distance of 90 km to the high-voltage substation in Lubmin, where it is converted to 380 kV and injected into the 50Hertz transmission grid. This makes it possible for renewable power from northern Germany to be transmitted to consumption centres further south. The Ostwind 1 project is the first project in Germany to use 220-kV AC (alternating current) technology, which provides a higher transmission capacity. The wind farms were inaugurated in autumn 2018 (Wikinger) and spring 2019 (Arkona), and renewable energy has been flowing to the Lubmin high-voltage substation since then. Work on the connection was completed in late 2019.

50Hertz is hard at work on Ostwind 2, which will connect another two Baltic Sea wind farms to the 50Hertz transmission grid on the mainland. Three 220-kV subsea cables will transmit the wind power generated by Arcadis Ost 1 and Baltic Eagle to the high-voltage substation in Lubmin. This cable connection spans a total distance of about 90 km. Ostwind 2 is due to go live in 2022/2023.

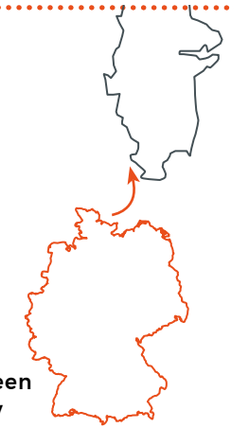


COMBINED GRID SOLUTION: A WORLD FIRST!

Interconnector between Denmark and Germany

Combined Grid Solution is a major offshore project that was carried out in partnership with Danish system operator Energinet. It is a hybrid system that connects the German region of Mecklenburg-Western Pomerania with the Danish region of Zealand. 50Hertz and Energinet achieved a world first by connecting German wind farm Baltic 2 and Danish wind farm Kriegers Flak. Combined Grid Solution is the first hybrid interconnector to use the infrastructure of existing offshore wind farms to link Germany and Denmark. The Renewables Grid Initiative crowned the project Good Practice of the Year for making maximum use of offshore infrastructure. The interconnector was commissioned in Q3 2019.

Want to learn more about 50Hertz's offshore projects? Visit www.50Hertz.com



HANSA POWERBRIDGE

Interconnector between Sweden and Germany

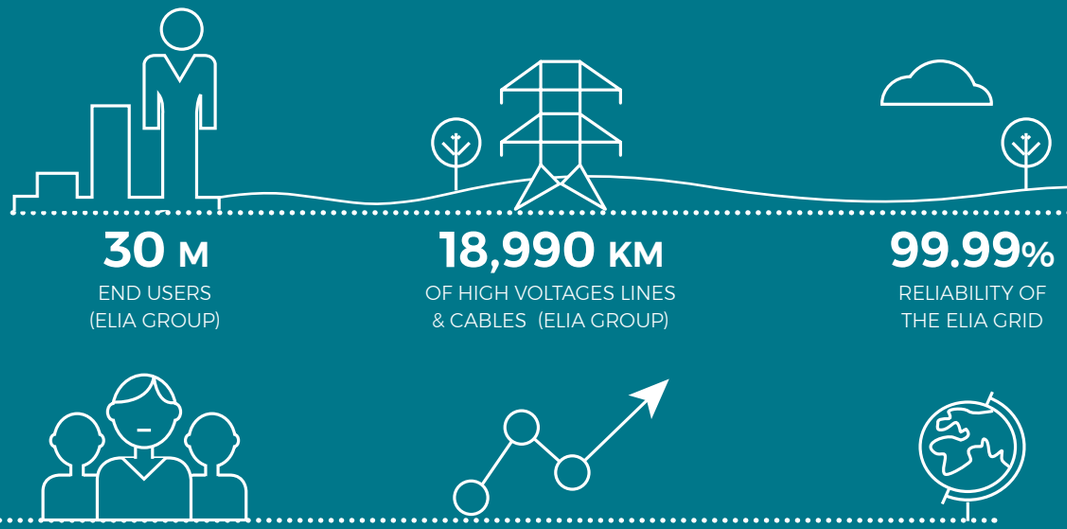
Hansa PowerBridge is an onshore/offshore interconnector that will run from the Guestrow high-voltage substation in Mecklenburg-Western Pomerania through the Baltic Sea to Sweden. The 300-km distance will be bridged by a high-voltage direct-current (HVDC) interconnector: the Hansa PowerBridge. The project is a collaboration between 50Hertz and Swedish system operator Svenska Kraftnät. Hansa PowerBridge is extremely important for security of supply and will allow the indirect storage of electricity from German renewable energy sources. Both countries will benefit from combining Swedish hydropower and German wind power. Hansa PowerBridge will have a capacity of around 700 MW and will become operational in 2026.

Scan the QR code to find out how Hansa PowerBridge will enhance interconnectivity.

One of Europe's top five players

The Elia Group is active in electricity transmission. With subsidiaries in Belgium (Elia) and north-east Germany (50Hertz), we operate 18,990 km of high-voltage connections that supply power to 30 million end users. As such, our group is one of Europe's top 5. With a reliability level of 99.99%, we give society a robust power grid.

Elia Group employs more than 2,400 people. In 2019, Elia in Belgium was awarded the Top Employer label for the second year running, recognising us as one of Belgium's 64 best employers.



30 M
END USERS
(ELIA GROUP)

18,990 KM
OF HIGH VOLTAGES LINES
& CABLES (ELIA GROUP)

99.99%
RELIABILITY OF
THE ELIA GRID

2,441
TOTAL NUMBER OF
EMPLOYEES (ELIA GROUP)

€280.8 M
NORMALISED NET PROFIT
(2018, ELIA GROUP)

24
NATIONALITIES
(ELIA GROUP)

In the interest of society

As a key player in the energy system, the Elia Group is committed to working in the interest of society. We respond to the rapidly changing energy mix, i.e. the increase in renewable energy, and constantly adapt our transmission grid. We also ensure that investments are made on time and within budget, with a maximum focus on safety. When we carry out our projects, we manage stakeholders proactively by establishing two-way communication with all affected parties very early on in the development process. We also offer our expertise to our sector and relevant authorities to build the energy system of the future.

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1000 Brussels – Belgium

50Hertz Transmission GmbH
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eliacorporate @eliacorporate Elia