Interreg
North Sea Region
Inn2POWER
European Regional Development Fund

EUROPEAN UNION

OFFSHORE wind energy

COUNTRY OVERVIEW

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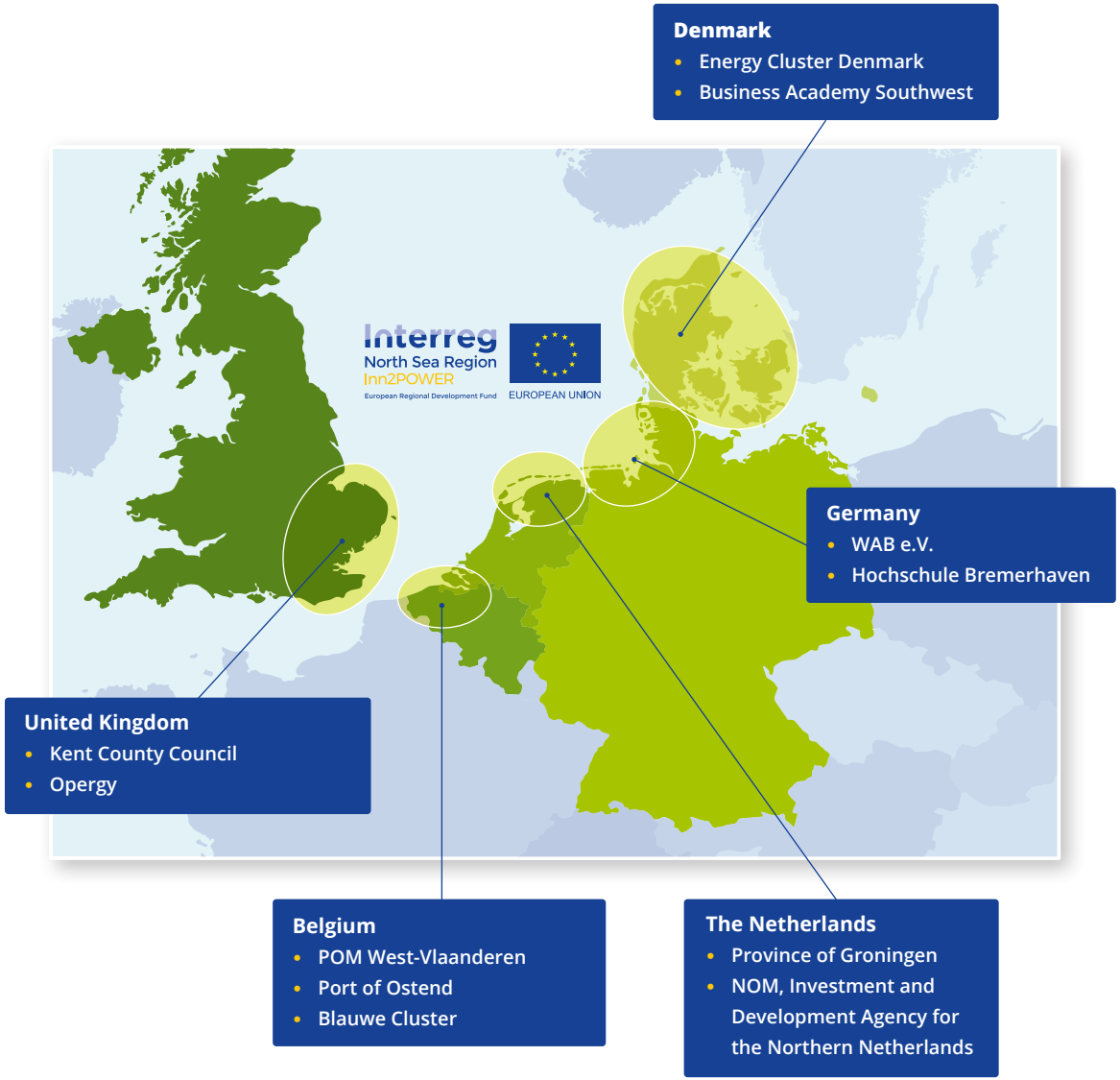


OFFSHORE wind energy

COUNTRY OVERVIEW

Inn2POWER is a four-year Interreg project of eleven partners from the five leading offshore wind clusters in the North Sea Region – Denmark, United Kingdom, Germany, Belgium and the Netherlands. The aim is to expand the capacity for innovation and to improve access to the offshore wind industry for small and medium enterprises (SMEs) by connecting offshore wind businesses in the North Sea Region.

In the context of Inn2POWER some high level key figures and trends related to offshore wind energy are listed per country that is part of the project.

The image alongside shows the partners of Inn2POWER.

Countries

- Belgium
- The Netherlands
- Germany
- Denmark
- United Kingdom

OFFSHORE WIND FARMS

Fully commissioned

Under construction

Development zone

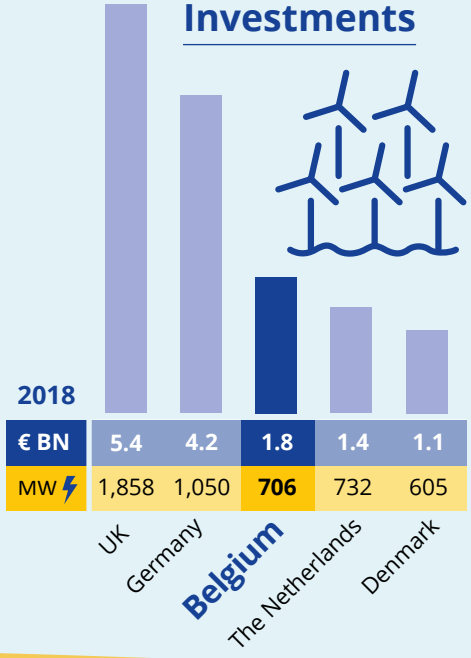
No.	Name	MW	Turbines
1	Seamade (Mermaid)	235	28
2	Northwester 2	219	23
3	Nobelwind	165	50
4	Belwind	165	55
5	Seamade (SeaStar)	252	30
6	Northwind	216	72
7	Rentel	309	42
8	Thornton Bank phase 2	184.5	30
9	Norther	369.6	44
10	Thornton Bank phase 3	110.7	18

OFFSHORE wind energy

Status

	2018	2021
Wind farms connected	7	10
Cumulative capacity (MW)	1,186	2,262
Turbines connected	274	399
Total investments (€ BN)	1.8	
New capacity financed (MW)	706	
Number of projects	2	

Investments



Capacity

2019	1,556 MW
2021	2,262 MW
2030	4,000 MW

Future

2030	Capacity installed	6,300 MW
2030	Electricity produced	17,976 GWh

Factor 2 increase expected between 2020 and 2030

Ecological impact

- **Gas 6 mln. ton/year**
- **Coal 12 mln. ton/year**

Saving

€ 200,000,000/year

(consumption € 40/ton CO_2)

Reduction CO_2 2018

Social Impact

2019
1.6 million households

2021
2.2 million households

2010 – 2030
16,000 jobs (direct)
34,000 jobs (indirect)

> The offshore wind industry is also creating a great deal of added value for the Belgian economy by improving our trade balance and creating employment: up to 16,000 jobs in the Belgian companies that are active within this sector.
>
> *Annemie Vermeylen, Secretary-General of the Belgian Offshore Platform*

Over the past decade of offshore wind energy production in Belgium, installed power has moved gradually from 30 MW in 2009 to 1,556 MW in 2019 with 7 windfarms installed. Offshore wind energy has developed particularly rapidly in recent years, through technological developments and a reduction in production costs. This is driven by large actors with their roots in Belgium and active around the globe building new windfarms.

By the end of 2020, two new wind farms will be commissioned. The first area dedicated to wind energy will be then fully operational and will allow to reach a total installed capacity of 2,262 MW. They will produce energy for approximately 2.2 million families, which is nearly half of Belgian households.

Further expansion with new areas in the Marine Spatial Planning 2020-2026, will allow the development of approximately 2,000 MW of additional offshore wind capacity. To make this possible within geographical constraints, the government considered dual or multi-use combining offshore wind installations with for example energy storage, aquaculture and passive fishing once the wind farms are fully operational.

If the developers are given a connection guarantee, the offshore wind industry could build new offshore power plants by 2024.

The port of Ostend developed an offshore wind hub and provides the service industry with tailored port facilities at proximity. In the slipstream of this development, the research centre 'Bluebridge' continues to attract innovation initiatives and university spin-offs, fuelling the economy of tomorrow in this predominantly tourism driven area.

Inn2POWER partners

- POM West-Vlaanderen
- Port of Ostend
- Blauwe Cluster

POM West-Vlaanderen · Port Oostende energy port · BLAUWE CLUSTER

Inn2POWER started in October 2016 and runs for 4 years. 50% of the budget is subsidized by the EU and the other half comes from public and private financing. More information about Inn2POWER: visit northsearegion.eu/inn2power

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Central scenario EWEA (Aug 2015)

THE NETHERLANDS

OFFSHORE WIND FARMS

Fully commissioned

Under construction

Concept/planning

Development zone

No.	Name	MW	Turbines
1	Borssele 1 and 2	752	94
2	Borssele 3 and 4	731.5	77
3	Borssele 5	19	2
4	Hollandse Kust Zuid Holland I and II	700	70
5	Hollandse Kust Zuid Holland III and IV	700	70
6	Eneco Luchterduinen	129	43
7	Hollandse Kust Noord	700	58-126
8	Egmond aan Zee	108	36
9	Prinses Amalia	120	60
10	Gemini	600	150

FACTS & FIGURES

Status

	2018
Wind farms connected	6
Cumulative capacity (MW)	1,118
Turbines connected	365
Net capacity connected in 2018 (MW)	0
Turbines connected in 2018	1
Total investments (€ BN)	1.4
New capacity financed (MW)	732
Number of projects	1

OFFSHORE wind energy

Future

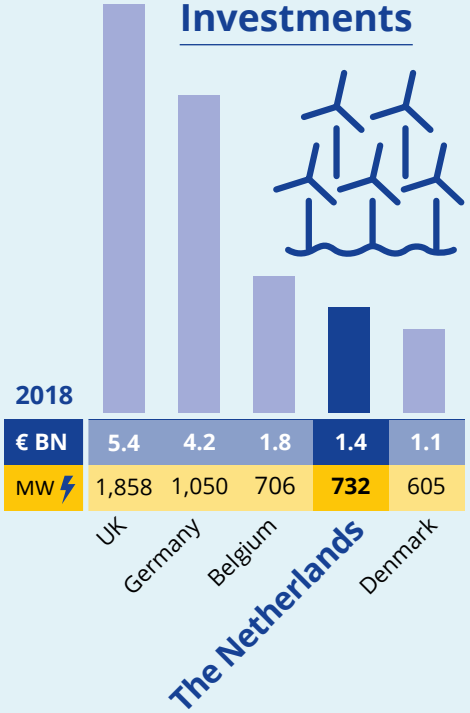
2030	Capacity installed	12,567 MW
2030	Electricity produced	36,670 GWh

Factor 5 increase expected between 2020 and 2030

Ecological impact

12%
compared with gas and coal

Investments



Capacity

2019 1,657 MW

2023 4,465 MW

2030 **11,500 MW**
= 8.5% of the total electricity demand (40% of the current electricity usage)

Social impact

2019
Electricity consumption generated
>1.9 million households

2020
>2.7 million households

2018 – 2030
Economic contribution **x5**

2020 – 2030
>12,500 jobs

> The Dutch North Sea offers opportunities for the energy transition due to its relatively low water depth, favorable wind climate and the proximity of good ports and (industrial) energy consumers.
>
> *Minister Wiebes (in Vervolgroutekaart wind op zee 2024-2030)*

Compared to local (domestic) demand, the Netherlands have a relatively vast area with potential for offshore wind development. The current installed capacity accounts for 1.7 GW, catering for approximately 1.9 million households' consumption.

Future development will be targeting export as well, for which further enhancement of the onshore grid will be necessary. To increase the pace of development over the coming years, some policy updates may be desirable, reducing the number of 'exclusion zones' that cover areas with a potential to produce at a very low Levelized Cost of Energy.

Over the past years, several Dutch coastal areas have developed strong activities in the offshore wind service industry, and dedicated port hubs are by now well established at Flushing, Den Helder, and Eemshaven, where offshore wind industry has become one of the primary drivers of the local economy. Years of experience and fully developed nautical facilities for storage, service and maintenance make these harbours play a pivotal role in the offshore wind operations and maintenance for the next few decades. These areas attract enterprises, leveraging local know-how to innovate processes and practices, and constitute a unique ecosystem.

Traditionally, some Dutch companies were strong in the dredging and marine contracting industries and have adapted well to the changing demand in sea-bed preparation and offshore wind farm construction, installation and servicing worldwide.

Inn2POWER partners

- Province of Groningen
- NOM, Investment and Development agency for the Northern Netherlands

provincie groningen

NOM

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Central scenario EWEA (Aug 2015)

OFFSHORE WIND FARMS

- Fully commissioned
- Under construction
- Concept/planning
- Development zone

No.	Name	MW	Turbines
1	Sandbank	288	72
2	DanTysk	288	80
3	Butendiek	288	80
4	Amrumbank West	302	80
5	Nordsee Oost	295.2	48
6	Meerwind Süd/Ost	288	80
7	Nordergründe	110.7	18
8	Gode Wind 3	241.75	22
9	Gode Wind 1 and 2	582	97
10	Nordsee One	332.1	54
11	Borkum Riffgrund 1	312	78
12	Riffgat	108	30
13	Borkum Riffgrund 2	450	56
14	Alpha Ventus	60	12
15	Merkur	396	66

No.	Name	MW	Turbines
16	Trianel Windpark Borkum 2	203	32
17	Trianel Windpark Borkum 1	200	40
18	OWP West	900	81
19	Deutsche Bucht	252	31
20	Veja Mate	402	67
21	Bard Offshore 1	400	80
22	EnBW He Dreiht	900	90
23	Albatros	112	16
24	Global Tech 1	400	80
25	Hohe See	497	71
26	EnBW Baltic 1	48.3	21
27	EnBW Baltic 2	288	80
28	Wikinger	350	70
29	Arkona	385	60

Status

	2018
Wind farms connected	25
Cumulative capacity (MW)	6,380
Turbines connected	1,305
Net capacity connected in 2018 (MW)	969
Turbines connected in 2018	136
Total investments (€ BN)	4.2
New capacity financed (MW)	1,050
Number of projects	2

OFFSHORE wind energy

Future

Even with energy requirements increasing, an optimal expansion of renewables will enable offshore wind to meet **30%** of the energy needs in Germany by 2050, according to the Fraunhofer IWES.

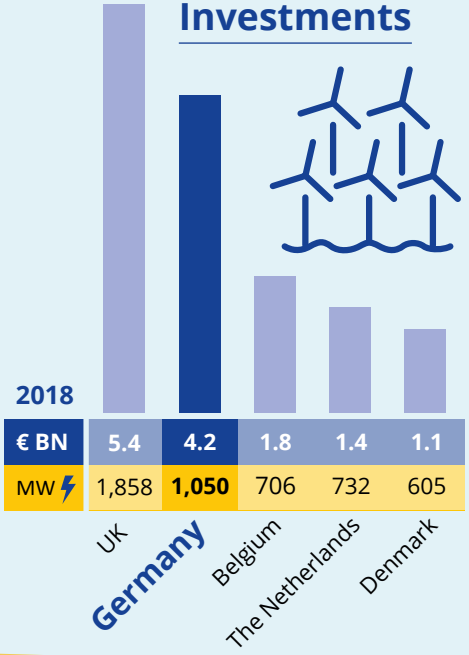
2030	Capacity installed	80,000 MW
2030	Electricity produced	195,786 GWh

Ecological impact

CO_2 saving

13.9 million tons in 2018

Investments



Capacity

2019 **6,380 MW**

2023 **7,700 MW**

2030 **15,000 MW**

Social impact

The industry currently employs **27,000** people directly

> We welcome the step of the federal government to increase the expansion target for offshore wind in Germany from 15 to 20 GW and believe that this is a significant step to meet the goal of 65% renewable energy in 2030.
>
> *Spokesperson for offshore wind association Bundesverband der Windpark-betreiber offshore e.V.*

By governmental decision in Germany the growth of offshore wind capacity has been capped and slowed down significantly during the last years, with tremendous impact on German wind industry and its entire supply chain. This industry is undergoing a severe economic phase (reduced workforce, closure of companies, etc.). It has proven to manage 2 GW of new installations per year and to achieve significant cost cutting through improvement programs.

WAB provided input for the Inn2POWER stakeholder analysis. The German Government and its policy were identified as most influential source, at the same a time 'negative' attitude baseline, although 'Friday's for Future' evolved and media favoured expansion of offshore wind. Consequently, WAB increased and improved its political and media work and activities.

WAB supported a survey with wind: research, which analysed in depth the regional distribution of offshore wind jobs, correlated with job creation, related turnover and the originating industrial branch, as basis for the ongoing German Inland Campaign (GIC), developed and initiated by WAB as part of the Inn2POWER project. GIC's main target is to present SME's as innovators, along German wind industry supply chains. It is interconnecting and elaborating the interests and competences of the relevant stakeholders, e.g. media, NGO's, cluster organizations, etc., to use their influence for the benefit of SMEs and aims to convince politics of economic benefits and future perspective of the wind industry branch in Germany. GIC obtained a lot of attention in relevant media and wind industry branch, especially in the south of Germany.

Inn2POWER partners

- WAB e.V.
- Hochschule Bremerhaven

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Central scenario EWEA (Aug 2015)

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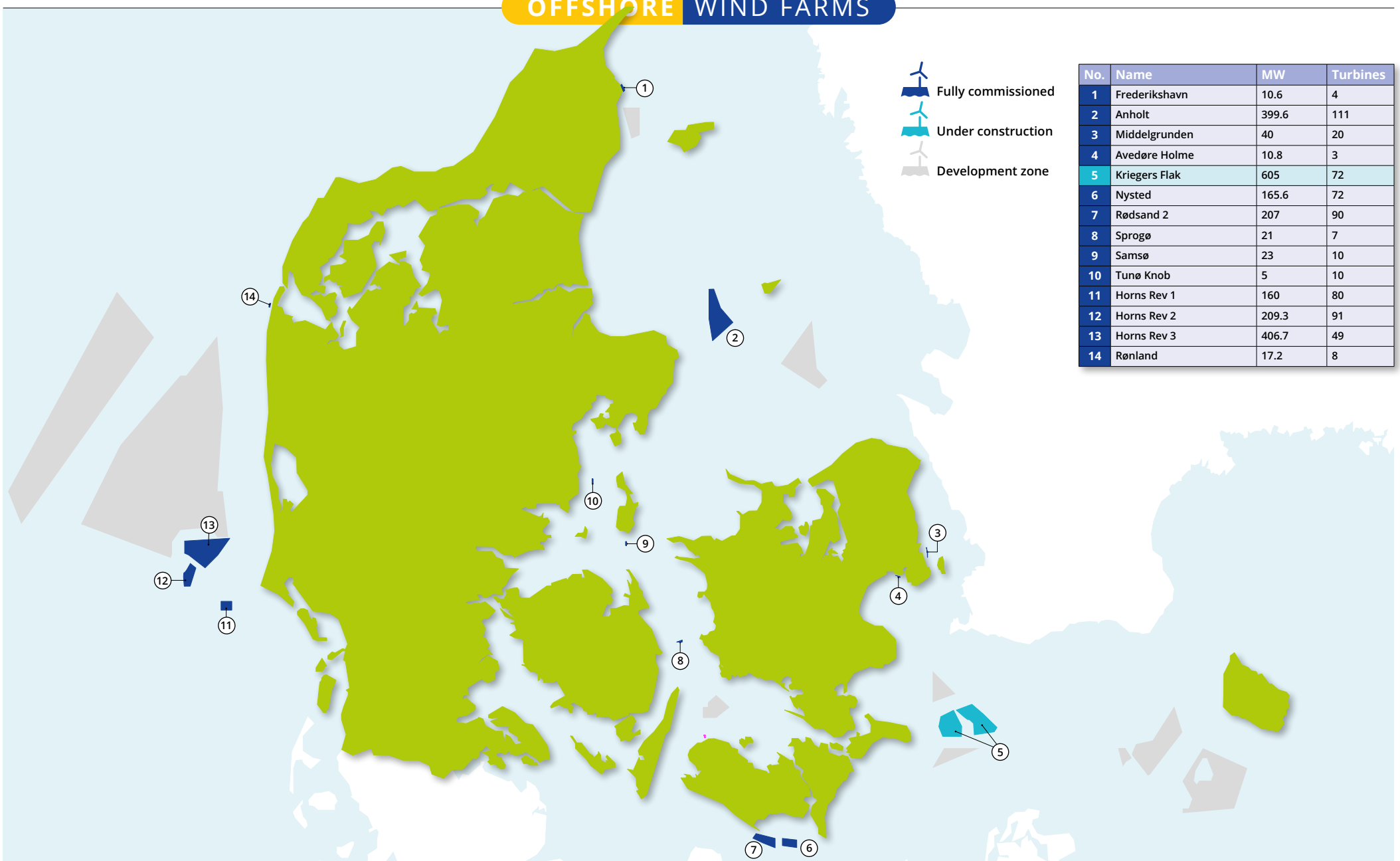
OFFSHORE WIND FARMS



No.	Name	MW	Turbines
1	Frederikshavn	10.6	4
2	Anholt	399.6	111
3	Middelgrunden	40	20
4	Avedøre Holme	10.8	3
5	Kriegers Flak	605	72
6	Nysted	165.6	72
7	Rødsand 2	207	90
8	Sprogø	21	7
9	Samsø	23	10
10	Tunø Knob	5	10
11	Horns Rev 1	160	80
12	Horns Rev 2	209.3	91
13	Horns Rev 3	406.7	49
14	Rønland	17.2	8

OFFSHORE wind energy

Status

	2018
Wind farms connected	14
Cumulative capacity (MW)	1,329
Turbines connected	514
Net capacity connected in 2018 (MW)	61
Turbines connected in 2018	42
Total investments (€ BN)	1.1
New capacity financed (MW)	605
Number of projects	1

Future

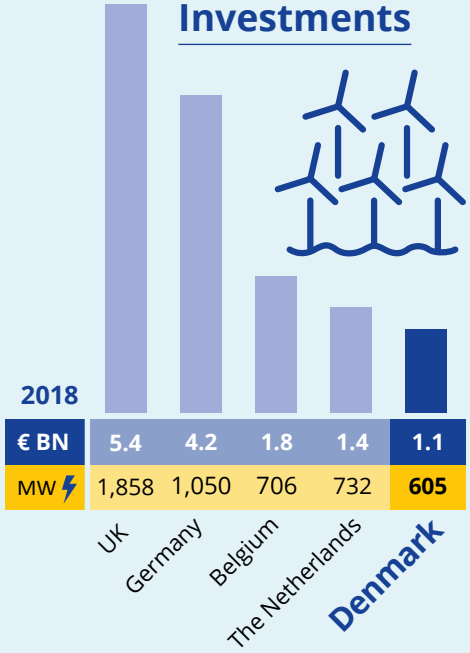
2030	Capacity installed	8,130 MW
2030	Electricity produced	22,659 GWh

(0.5 GW/yr in 2021 and 2022,
and 0.7 GW/yr from 2023-2025)

Ecological impact

- **Benthic fauna and flora:** Overall the wind farms increased habitat heterogeneity as well as the abundance and biomass of benthic communities.
- **Fish:** Overall studies showed that offshore wind farms did not have any negative impact on fish abundance. Some species appear to use the foundation and associated scour protection as refuge areas for hiding and forage. The positive effect may be enhanced by the exclusion of commercial fishing inside the wind farm area an thus function as a small marine protected area.
- **Birds:** Birds tend to avoid wind turbines and this was confirmed by a study.

Investments



Capacity

2013 1.27 GW

2020 2.24 GW

2030 15 GW

Social impact

The wind industry has a big impact on the Danish economy and employment. Today, the wind industry generates

85,500 jobs

direct and indirect (offshore and onshore combined)

> Denmark is already a great offshore wind location, and the survey shows that we have the potential for much more. We have such good conditions for offshore wind that we can contribute significantly to cover the need for green electricity, not just in Denmark, but also in many other countries.
>
> *Energy and climate minister Lars Christian Lilleholt*

Home to some of the leading manufacturing players of the offshore wind industry, the Danish industry leveraged the full potential of its first mover advantage to become the defacto world leader in offshore wind manufacturing and offshore wind farms' development.

In addition, the Port of Esbjerg is the leading port in Europe in terms of handling and shipping out wind power. Today, the Port of Esbjerg has specialized facilities and flexible areas for transporting, pre-assembling, shipping out and servicing offshore wind turbines. The companies at the Port of Esbjerg represent the entire supply chain for the wind industry, including several of the world's leading companies specialized in handling and servicing wind installations. 4/5 of the offshore wind capacity installed in Europe was shipped out from the Port of Esbjerg[1].

Denmark already has the largest penetration of wind in its power production portfolio worldwide, and wind farms seem to be widely adopted by the public. Obviously, the immense workforce active in this industry (85.000 direct and indirect jobs) contributes to the population's embracing this evolution.

In the Danish waters, there is still incredible potential for further expansion of offshore wind. According to the Danish TSO, Energinet[2], 'the Danish energy consumption in a fully electrified society will constitute approx. 13 GW in 2040, while the wind power potential in Danish waters alone is as much as 40 GW. The enormous Danish offshore wind resources can therefore not only be utilized for Danish energy consumption but can also become a significant contribution to the green transition of European energy supply.'

Inn2POWER partners

- Energy Cluster Denmark
- Business Academy SouthWest

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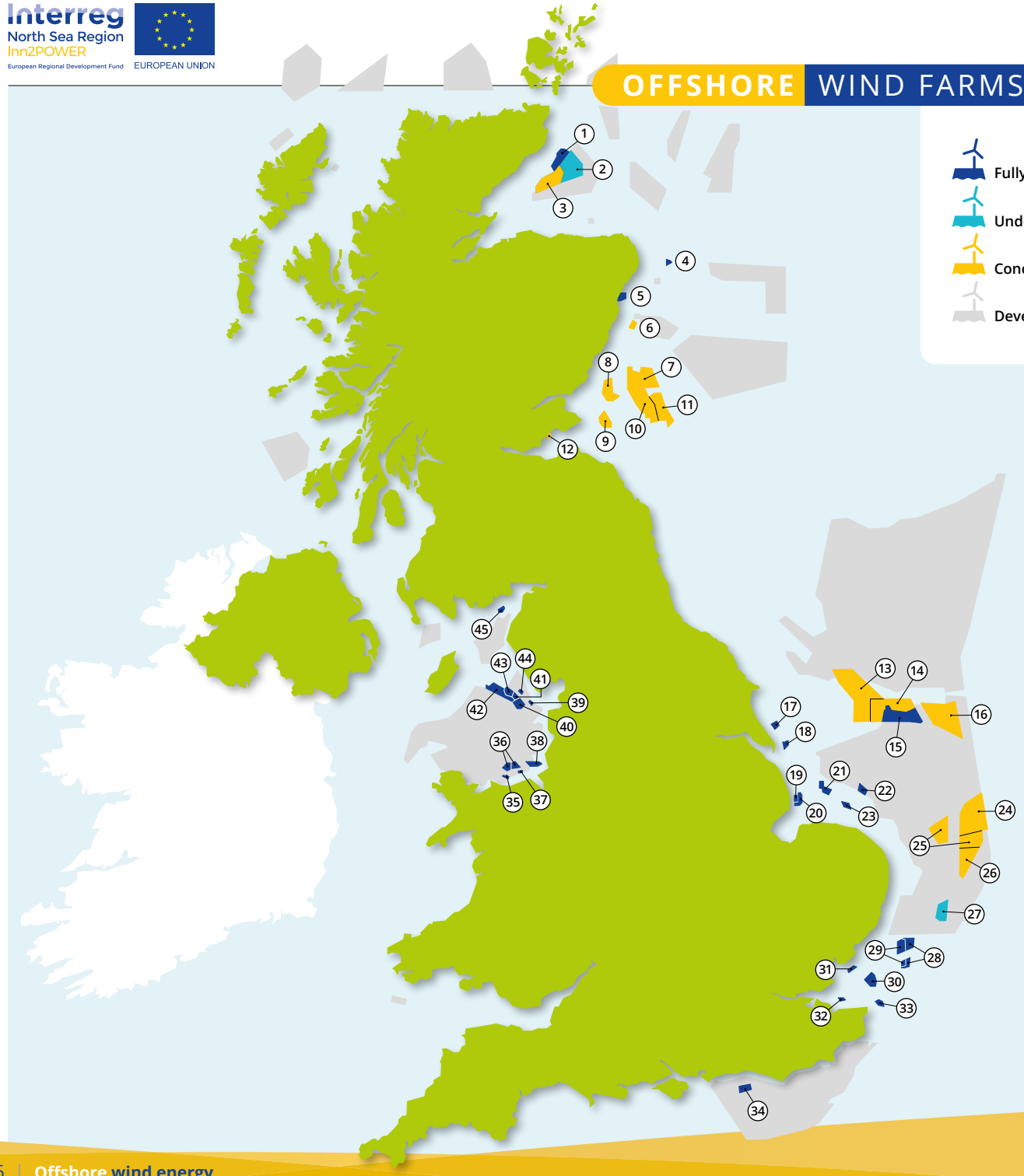
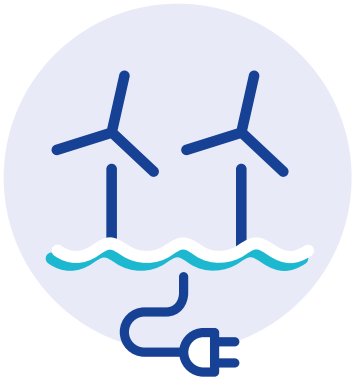
UNITED KINGDOM

OFFSHORE WIND FARMS



No.	Name	MW	Turbines
1	Beatrice	588	84
2	Moray East	950	100
3	Moray West	950	72 - 85
4	Hywind Scotland Pilot Park	30	5
5	Aberdeen Offshore Wind Farm	93.2	11
6	Kincardine - Phase 2	48	5
7	Seagreen - Phase One	1,075	114
8	Inch Cape	1,000	40-72
9	Neart na Gaoithe	448	54
10	Seagreen phase 2	1,400-2,300	
11	Seagreen phase 3	900-1,850	
12	ForthWind Demonstration Project Phase 1	12	2
13	Hornsea Project Four	1,000	180
14	Hornsea Project Two	1,386	165
15	Hornsea Project One	1,218	174
16	Hornsea Project Three	2,400	160-300
17	Westermost Rough	210	35
18	Humber Gateway	219	73
19	Inner Dowsing	97.2	27
20	Lincs	270	75
21	Race Bank	573.3	91
22	Dudgeon	402	67
23	Sheringham Shoal	316.8	88
24	Norfolk Boreas	1,800	90-200
25	Norfolk Vanguard	1,800	90-180
26	East Anglia Hub three	1,400	100-172
27	East Anglia one	714	102
28	Galloper	353	56
29	Greater Gabbard	504	140
30	London Array	630	175
31	Gunfleet Sands	184.8	50
32	Kentish Flats	139.5	45
33	Thanet	300	100
34	Rampion	400.2	116
35	Rhyl Flats	90	25
36	Gwynt y Môr	576	160
37	North Hoyle	60	30
38	Burbo Bank	344.2	57
39	Barrow	90	30
40	West of Duddon Sands	389	108
41	Walney phase 1	183.6	51
42	Walney extension	659	87
43	Walney phase 2	183.6	51
44	Ormonde	150	30
45	Robin Rigg	174	58

OFFSHORE wind energy



Status

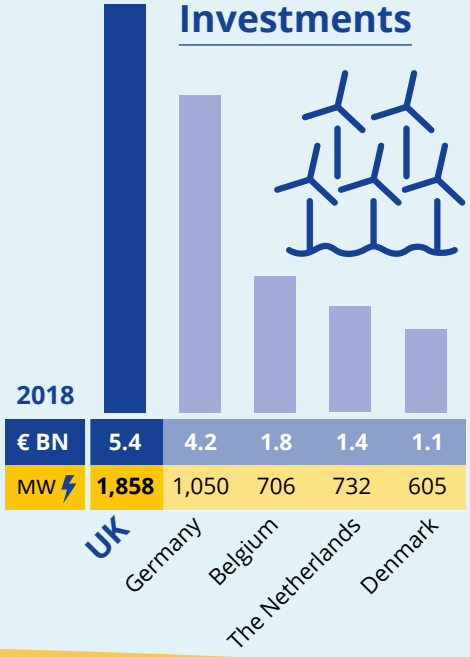
	2018
Wind farms connected	39
Cumulative capacity (MW)	8,183
Turbines connected	1,975
Net capacity connected in 2018 (MW)	1,312
Turbines connected in 2018	222
Total investments (€ BN)	5.4
New capacity financed (MW)	1,858
Number of projects	3

Future

48% of new investments, worth **€40 bn** Since 2010 the UK has attracted making it the biggest offshore wind market over the last nine years. Germany follows with **34%** or **€ 28 bn** invested over the same period.

2030	Capacity installed	40,000 MW
2030	Electricity produced	120,362 GWh

Investments



CO_2 emissions

Ecological impact

38% lower than they were in **1990**. The largest driver has been a cleaner electricity mix based on gas and renewables instead of coal. This was responsible for **36%** of the emissions reduction in **2017**.

Capacity

2018 7 GW

2019 8.18 GW = 10% of UK electricity

2030 30 GW

Social impact

2013 2.7 million homes
2016 4.1 million homes
2018 6.9 million homes

2016 42,000 jobs
2020 55,000 = growth with 13,000 jobs

> By 2030 a third of our electricity will come from offshore wind, generating thousands of high-quality jobs across the UK, a strong UK supply chain and a fivefold increase in exports. This is our modern Industrial Strategy in action.
>
> *Energy and Clean Growth Minister Claire Perry*

In absolute numbers, wind farm deployment in the UK's coastal waters represents by far the biggest capacity in the North Sea Region, both in terms of actual numbers as in development potential. With over 8.4 GW capacity deployed, a further 3.7 GW under construction, offshore wind production represents more than 14% of the domestic demand for electricity. At present, the offshore wind farms cater for the equivalent of 7 million homes.

The growth potential is still considerable and installed capacity will more than quadruple to 40 GW by 2030. In an ambition to meet its green energy targets, a fast deployment is needed. To keep up with this pace, tens of thousands of new jobs will be created in this sector over the next decade; many of them technical, service, or engineering related.

With an ambition to increase offshore wind capacity to provide 30% of domestic demand, policies are put into place to support further development.

Inn2POWER partners

- Kent County Council
- Opergy

Kent County Council kent.gov.uk

opergy

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Central scenario EWEA (Aug 2015)

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Partners

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Port Oostende energy port
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Region of Southern Denmark — AESV & OEDK

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