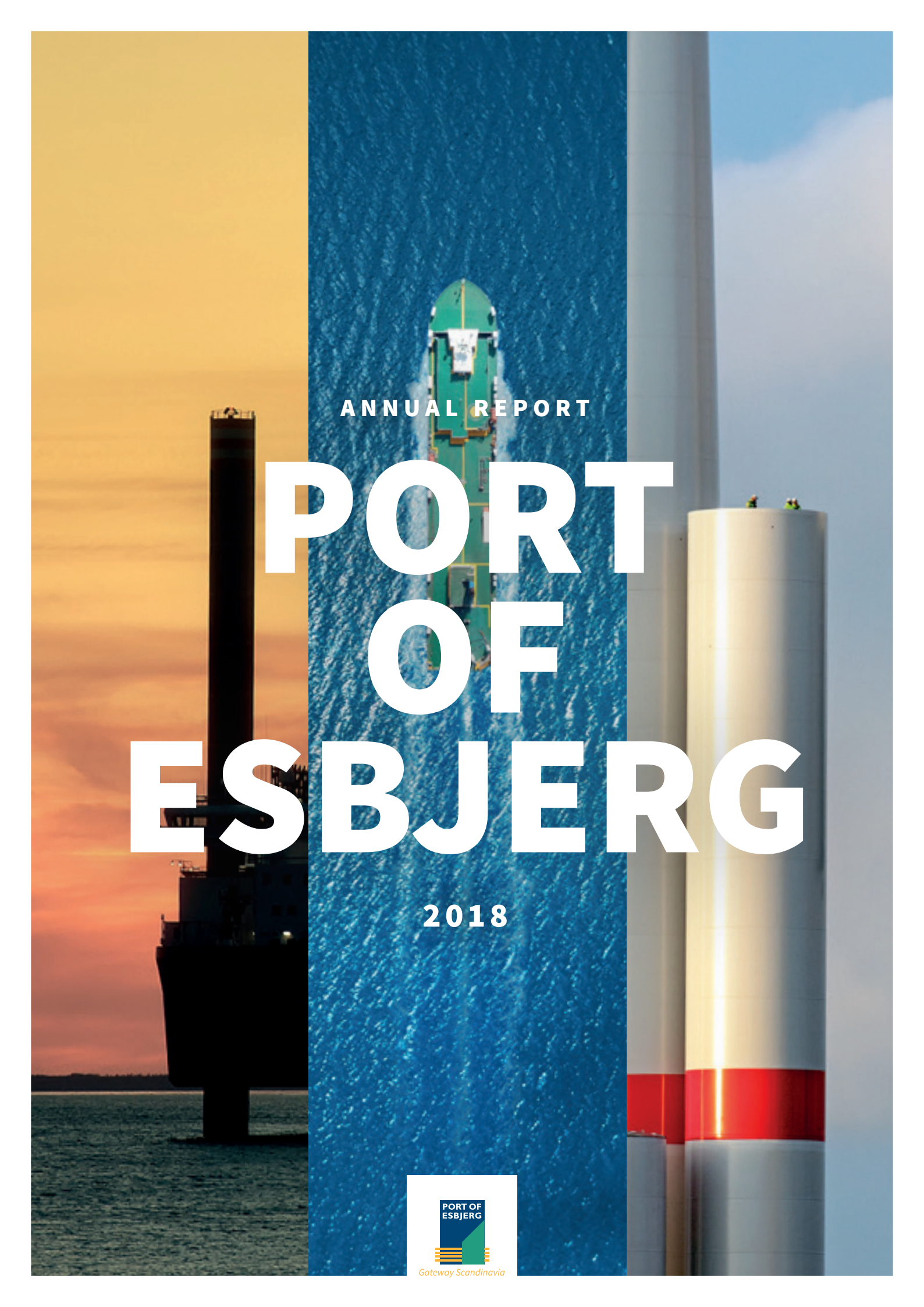




ANNUAL REPORT

PORT OF ESBJERG

2018



TURNOVER

30.83

MILLION EUR



NET PROFIT

9.56

MILLION EUR

PREFACE

The Port of Esbjerg's anniversary year in 2018 joins the list of financial years with a satisfactory net profit. The turnover of EUR 30.83 million was more or less the same as in 2017, while the net profit decreased slightly to EUR 9.56 million.

The net profit for the year confirms that the Port of Esbjerg is a healthy and robust business. This provides the port's new CEO, Dennis Jul Pedersen, who on March 1 replaced Ole Ingrisch after 16 successful years at the helm of the port, with a good basis for ensuring continued development and progress within our three main business areas: wind, oil and gas, and RoRo.

It has been a good year for our wind business. A total of 1.2 GW was shipped from the Port of Esbjerg, cementing the port's position as the world's largest offshore wind port. Looking ahead, we expect an even higher activity level. The development is driven partly by the decision to establish one of the world's largest offshore wind farms off the west coast of Jutland, close to Esbjerg. Wind energy also has a generally strong momentum in both Europe and the rest of the world, and the pipeline of new projects is large. Thanks to its unique infrastructure, location and experience, as well as Denmark's global leadership position within wind, the Port of Esbjerg is well-equipped to play a significant role in many of these projects.

We are also seeing positive tendencies within RoRo. In fact, in 2018, RoRo cargo volumes reached the highest level in five years, and trailer cargo rose by 5.2 per cent. This reflects a

clear trend of cargo being moved from road to sea. The congestion crisis on European roads is a contributing factor. Although the road network is being expanded and improved, congestion is likely to remain a serious problem. The enormous pressure on the narrow Dover-Calais corridor between Europe and the UK, which Brexit risks exacerbating, underlines the severity of the problem. There is an acute need for alternative routes and the European level of interaction between the various forms of transport must be strengthened. The Port of Esbjerg has the space, facilities and location to be part of the solution.

Unfortunately, the oil market failed to stabilise in 2018 as otherwise predicted at the beginning of the year. In October, the price reached USD 81 per barrel, but fell to USD 51 by Christmas. And the market remains unstable. This makes the situation difficult for the oil industry, also in Esbjerg. However, the redevelopment of the Tyra field in the coming years, which is already in full swing, is raising spirits in the conventional offshore industry. We can take pleasure in the fact that the project will bring many jobs and tasks for local companies. And the EUR 2.8 billion project, which is the largest investment in gas in Denmark's history will futureproof Danish gas production. Far-sighted regulation and the industry's determination to invest in Denmark have made a world of difference. That is worth acknowledging.

2019 is off to an excellent start for the Port of Esbjerg, which continues to focus on developing and delivering the solutions necessary to support our customers' operations and businesses while creating new growth opportunities. We are therefore, among other things, conducting an environmental impact assessment in order to be able to quickly expand the port, if required. And all else being equal, this will become necessary as the green transition is rolled out in Denmark and abroad.

Finally, on behalf of the Port of Esbjerg's management and Board of Directors, I would like to thank our partners, owners and, not least, our customers for their cooperation in 2018.

*Flemming N. Enevoldsen
Chairman of the Board, Port of Esbjerg*



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2018

FINANCIAL

AND KEY FIGURES

EUR million	2016	2017	2018
Turnover	30.94	31.61	30.83
Other operating income	0.0	0.953	0.18
Other external expenses	-6.15	-5.73	-5.36
Gross profit	24.79	26.83	25.64
Staff costs	-4.44	-4.66	-4.49
Depreciation	-7.41	-7.95	-8.68
Other operating expenses	0.0	-1.07	0.00
Operating profit	12.95	13.15	12.48
Net financials	-2.27	-2.32	-2.92
Net profit	10.68	10.83	9.56
Total assets	190.87	195.72	198.56
Tangible fixed assets	146.70	170.86	171.16
Equity	108.23	119.06	128.61
Capital expenditure	7.13	32.11	8.98
Key figures (%)			
Return on equity	10.4%	9.5%	7.7%
ROAIC	8.9%	8.4%	7.4%
Solvency ratio	57.4%	60.8%	64.8%

FINANCIAL STATEMENT

The Port of Esbjerg came out of 2018 with a net profit of EUR 9.56 million. Compared to 2017, this meant a decline in earnings of EUR 1.27 million.

This is due to a minor decrease in turnover, increased depreciations and the reimbursement of the lease increase for 2018. In terms of extraordinary costs, we should mention the expenses in relation to celebrating the port's 150th anniversary and Tall Ships Races.

The rise in depreciations stems from the major investments in the East Port made in recent years, in addition to new multi-terminals for the port's customers.

The cargo volume for trailers and containers rose by 6.5 per cent compared to the previous year. However, the cargo volume for 2018 saw an overall decline of 2 percent, which is explained by the unstable oil and gas market. In addition, the number of projects involving the handling of offshore and onshore wind turbines remained slightly below the record level in 2017, which resulted in less income from leased areas.

Group turnover for 2018 ended at EUR 30.83 million against EUR 31.61 million in 2017.

The net profit for the year of EUR 9.56 million is considered satisfactory.

BALANCE SHEET AND CASH FLOW STATEMENT

The Port of Esbjerg's total assets at the end of 2018 amounted to EUR 198.56 million against EUR 195.72 million at the end of 2017.

The net cash flow was EUR -980,000.

Equity ended at EUR 128.61 million against EUR 119.06 million in 2017. The solvency ratio thus rose from 60.8 per cent to 64.8 per cent and underlines the robustness of the business.

Return on average invested capital (ROAIC) totalled 7.4 per cent in 2018 against 8.4 per cent in 2017.

Staff costs fell in 2018 to EUR 4.49 million from EUR 4.66 million in 2017. Turnover per employee was EUR 590,600.

During 2018, EUR 8.98 million was invested, and repayments on long-term debt amounted to EUR 4.19 million. The investment level for the Port of Esbjerg remains high. Since 2000, approximately EUR 228 million has been invested in expanding and modernising the port.

The main part of capital expenditure in 2018 was spent on the construction of new multi-terminals, further expansion of the new East Port, construction of Zodiakvej and an upgrade of the port's main road.

CARGO TRANSPORT

Total cargo volumes fell slightly to 4,428 million tonnes from 4,519 million tonnes in 2017. RoRo amounted to 39 per cent of the total cargo volume, which is an increase of 2 per cent from the previous year. Bulk (coal, gravel, and liquid bulk in the form of fish oil etc.) accounted for 40 per cent and containers 6 per cent.

A total of 1,210 MW of offshore wind was shipped in 2018 against 1,300 MW the previous year. Although this represents a decrease, it is still the second-highest level achieved in the past five years. At the same time, the level in 2019 seems likely to increase towards 1,500 MW.

The number of cars crossing the wharf, which has been increasing for many years, dropped to 62,938 from the record-high level of 73,893 in 2017. However, it is worth noting that four times more cars drove across the wharf than in 2013.

MORE SHIP CALLS AND PASSENGERS

In 2018, 5,974 ships called at the port (excluding the Fanø Ferry), which is a marginal increase from the previous year, when 5,867 ships called at the Port of Esbjerg. The level is now a good 20 per cent above the level in 2013.

Meanwhile, the number of passengers rose to 1,834,000. That is 71,000 more than in 2017 and the highest level over the past five years.

ENVIRONMENTAL FACTORS

The Port of Esbjerg has previously entered into a climate partnership with Ørsted A/S. The agreement means that the parties work in a goal-oriented and responsible manner to implement energy-efficient solutions, stimulate demand for renewable energy and contribute towards sustainable development.

DEVELOPMENT ACTIVITIES

An environmental impact assessment (EIA) for a future port expansion of up to 1 million square metres was launched in 2017. The EIA process is expected to be completed by the end of 2019, after which an expansion could be initiated.

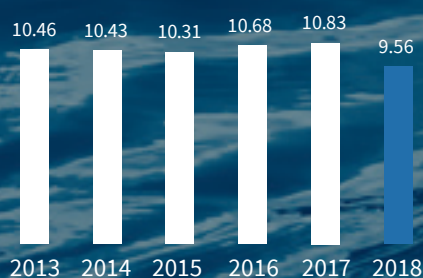
EXPECTATIONS FOR 2019

A rise in net turnover is budgeted in 2019 due to expectations of a continued increase in activity at the Port of Esbjerg, but with a drop in the ordinary operating profit. This is due to increased depreciations on investments and expenditure on major renovations.

FACTS AND KEY FIGURES 2018

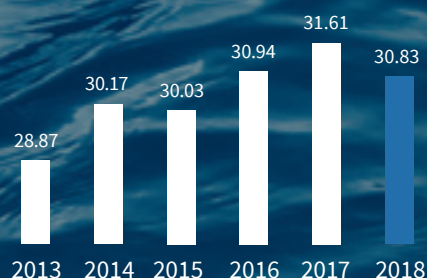
NET PROFIT

 **9.56** million EUR



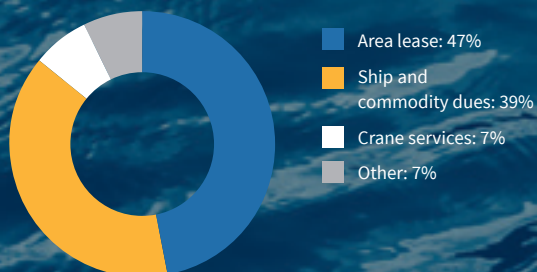
TURNOVER

 **30.83** million EUR



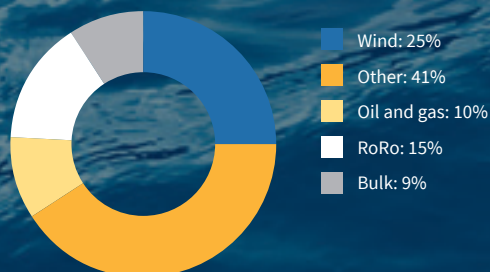
TURNOVER

 by type



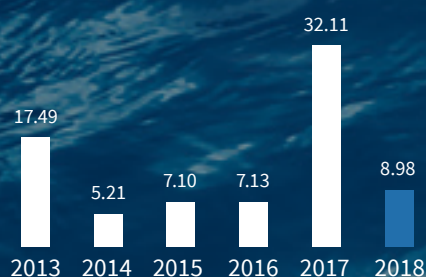
TURNOVER

 by business area



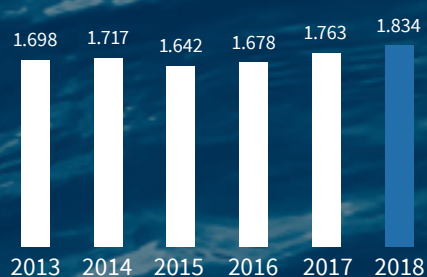
INVESTMENTS

 **8.98** million EUR



PASSENGERS

 **1.834** million persons



CONTRACTED AREAS



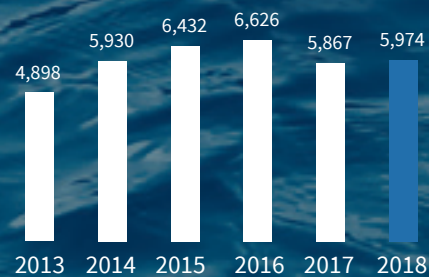
by type



SHIP CALLS



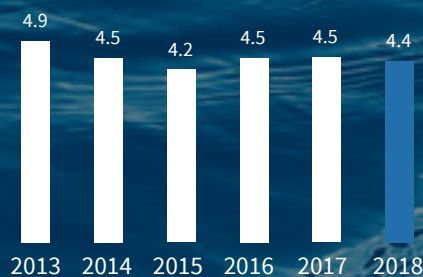
5,974



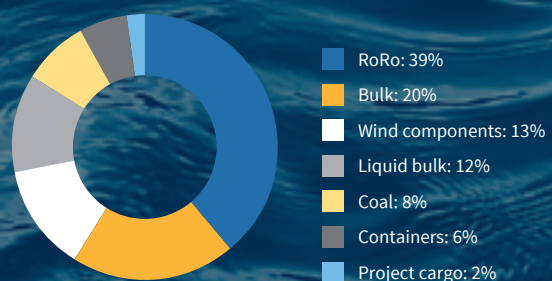
CARGO VOLUME



4.4 million tonnes



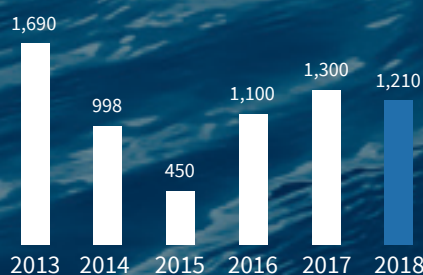
CARGO BY TYPE



OFFSHORE WIND SHIPPED



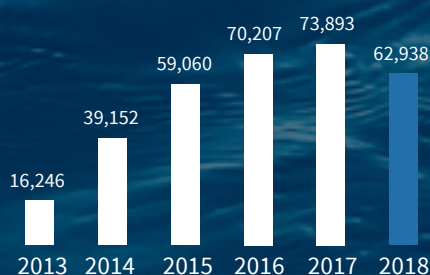
1,210 MW



CARS



62,938



WIND TURBINE GROWTH CONTINUES

The size and capacity of wind turbines are constantly increasing, and the upcoming turbines are as tall as the Eiffel Tower. This poses special logistical challenges when transporting the rotor blades and towers measuring more than 100 metres to and around the port. However, this challenge can be solved, according to one expert, whereas another believes in more coastal manufacturing plants.

The Port of Esbjerg recently welcomed wind turbine blades with a length of 88.4 metres. They were transported by lorry all the way from Lunderskov.

Meanwhile, nacelles weighing 390 tonnes are being sailed to the port. Other smaller nacelle components are driven to the port and assembled.

The wind turbine towers of 100 metres are lined up on the quayside after being assembled from the tower sections of 30 metres or so, which arrived to the port by motorway.

In other words, the port has adapted to accommodate the huge growth in wind turbines over the past couple of years. A growth that has been rapid.

THREE-METRE TALL TURBINES

In 1976, a 19-year-old man spent his spare time building a wind turbine on his parents' farm in Jutland. The name of this enterprising young man was Henrik Stiesdal, and he went on to become a pioneer of the wind turbine industry. However, no one knew that back when he was mounting his wind turbine on a tractor trailer.

That wind turbine was about three metres tall. 42 years later, the wind turbine industry has exploded in size as have the turbines.

Blade manufacturer LM Wind Power is currently producing blades for turbines that measure 260 metres from top to bottom, with a rotor diameter of 220 metres and blades of 107 metres each. On drawings of the turbine, it is compared to the Eiffel Tower. Put one of the blades on a football pitch and it would extend over the goal line.

CONSTANTLY PUSHING THE LIMIT

"We have often been surprised by the size after pushing the limits," says Jesper Månsson.

He is Chief Technology Advisor at the rotor blade manufacturer LM Wind Power, which is the world's largest producer of wind turbine blades. Jesper Månsson has worked with rotor blades since 1990, and he does not see the growth in size and capacity stopping any time soon.

"I had actually thought we would see a pause after we launched our 88-metre rotor blades but that didn't happen," he explains.

Jesper Månsson has helped push the limits of what is possible a number of times.

"When we launched our 61.5-metre blades for a 126-metre-diameter offshore turbine back in 2004, people thought – wow, they're big. How much bigger can they get? But it just continued," says Jesper Månsson.

The new turbines will supply 12 MW. By comparison, Henrik Stiesdal's first turbine produced 2-3 KW when the wind was blowing hard. The new turbines supply a good 4 million times more electricity than Henrik Stiesdal's homemade turbine on the tractor trailer.

YOUNG INDUSTRY

There was no wind turbine industry in 1976, but Vestas displayed interest in Henrik Stiesdal's wind turbine, and after some years of collaborating with Vestas, Henrik Stiesdal joined Bonus Energy, which was subsequently acquired by Siemens. He spent a total of 28 years leading the wind turbine company.

According to Henrik Stiesdal, the industry accelerated from the mid-1980s. The turbines did the same. From 1989-2001, Bonus was growing at a rate of 40 per cent every year, and the turbines were doubling their capacity every four years. An exponential growth.

In 1991, the world's first offshore wind farm was built on Lolland. It was so far-sighted that it was nine years until the



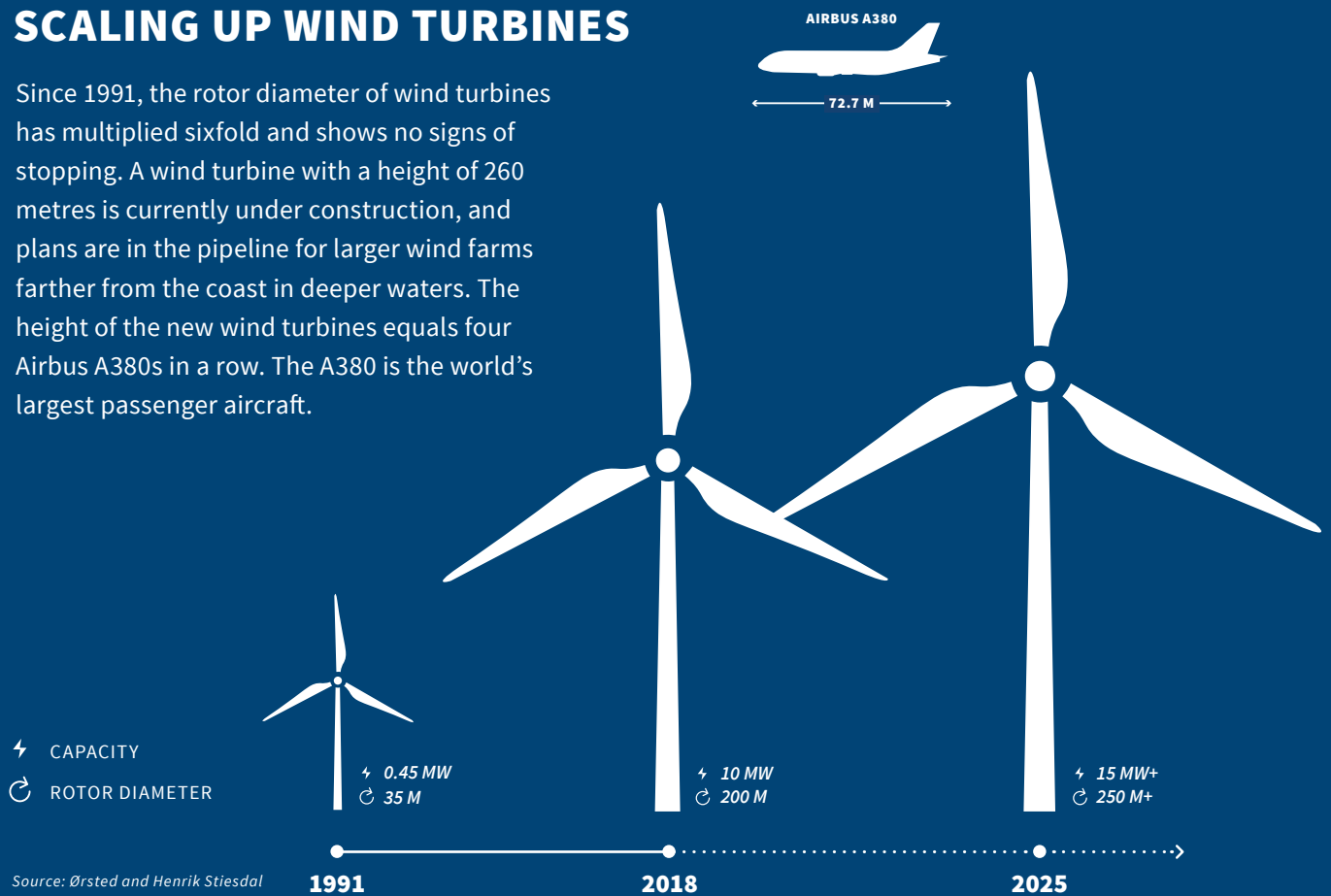
Henrik Stiesdal built his first wind turbine in 1976 on his parents' farm in West Jutland. Since then, he has spent 28 years at the top of first Bonus Energy and, later Siemens Wind Power. He believes that the Port of Esbjerg has the logistics surrounding offshore wind power under control.



Jesper Månsson from LM Wind Power believes that the rotor blades can easily be larger. "Could the rotor reach a diameter of 250 metres? Yes, it could," he says.

SCALING UP WIND TURBINES

Since 1991, the rotor diameter of wind turbines has multiplied sixfold and shows no signs of stopping. A wind turbine with a height of 260 metres is currently under construction, and plans are in the pipeline for larger wind farms farther from the coast in deeper waters. The height of the new wind turbines equals four Airbus A380s in a row. The A380 is the world's largest passenger aircraft.



next was built near Middelgrunden close to Copenhagen, which has 2 MW turbines with a hub height of 64 metres and a blade length of 37 metres.

But from then on, the pace picked up. Construction work continued in the UK and Sweden, and by about 2004, activity levels abroad matched those in Denmark.

"However, looking back, that means the offshore turbine industry's track record with large volumes actually only spans about 15 years," says Henrik Stiesdal. That is why the industry is still developing significantly. And consequently, there is still a wide spectrum of challenges.

ROUGH WATERS AHEAD

As a supplier, competition is fierce and the pace of developments is high, accompanied by the constant need to match other companies. At the same time, there are technical risks associated with erecting relatively new offshore turbines. It entails the risk of so-called serial damages.

Meanwhile, over the past 15 years, foundations and transport vessels have had to be developed because the ships were typically previously used for oil and gas.

"They are not always geared for serial production. There is huge potential in industrialisation," says Henrik Stiesdal, citing the Port of Esbjerg as an example of what can be gained by systematising the category.

"The Port of Esbjerg has it under control. But working 50 kilometres out in the North Sea is still difficult," he says.

WHERE WILL IT END?

In recent years, there have been discussions in the sector about how big the turbines will become, and how they will be built and transported.

According to Henrik Stiesdal, two contradicting trends are taking place. The turbines become more expensive in terms of the amount they produce when they are larger. According to the Square-Cube Law, which describes the ratio between volume and surface area, the weight increases significantly when the size of the shape is increased.

If you double everything on a turbine with a rotor diameter of 164 to 324 in diameter, the wingspan of the turbine will be four times larger. However, it will be eight times heavier. This makes the turbine much heavier per kilowatt than before.

"It is also this law that means birds cannot grow bigger than 20 kilos because they'll be too heavy to fly," says Henrik Stiesdal. Therefore large turbines are generally less competitive than small ones.

On the other hand, large turbines make the infrastructure cheaper. A foundation for a 3 MW turbine costs largely the same as a larger foundation, and means that there are fewer foundations to service.

Meanwhile, the blade design has become refined and the material improved, explains Jesper Månsson from LM Wind Power.

"Through a combination of technological improvements, we have succeeded in reducing the scaling factors," says Jesper Månsson.

To date, the improvements have compensated for the more expensive and heavier turbines.

"But at some point the party will stop," says Henrik Stiesdal. Because the ships are large and expensive, and the number of turbines is low, it means that the production will not be industrialised.

But is there an upper limit for when the turbines will be too large?

Based on current trends, the limit is at least higher than where we are today. Today, there are 10 MW turbines. GE is launching a 12 MW turbine. And the national test centre for wind turbines in Østerild is prepared for turbines of up to 330 metres in height.

"It's very likely that 15 MW turbines will be available in the first half of the 20's. But will they be competitive? We don't know yet," says Henrik Stiesdal.

Jesper Månsson believes that the blades can be considerably larger.

"Could we see a rotor diameter of 250 metres? Yes, we could," he says.

"But at some point, some lines will begin to cross each other. We just don't know when," says Jesper Månsson.

WILL PRODUCTION BE BASED AT THE PORT?

According to Henrik Stiesdal, the industry is debating whether the growth in turbine size will also mean that they will have to be produced at the ports.

Siemens Gamesa has built a manufacturing facility in Cuxhaven, Germany. However, at the same time, a good half of the world's offshore turbine towers are made by Welcon in Give, Denmark.

"The town of Give is 70 km from the coast. You can hardly get further away from the sea at any point in Denmark," says Henrik Stiesdal.

He highlights that today, towers with a diameter of 6-7 metres are driven from Give to Esbjerg and there are plans over the next few years to transport sections measuring 8-10 metres.

"It is possible. Some suppliers might be located at the ports, but it is not a problem transporting towers by road. 25 years ago, there was a big fuss about a tower measuring 32 metres being transported by road, but today a 75-metre long blade is transported to Lolland for a paint job without any problem," says Henrik Stiesdal.

Jesper Månsson from LM Wind Power has a different view and does not entirely agree.

According to him, the offshore elements, at least the rotor blades, with both large rod diameters and lengths, are now so big that it is difficult to transport them over land.

"It seems as if being based near the coast may be necessary in the future. Blades of 107 metres have a rod diameter that can't fit under a motorway bridge. So when we reach that scale, we need to be at the coast," he says.

For that reason, blades of 107 metres are produced in Cherbourg, France, at a factory near the coast. Although LM Wind Power has also exported a number of onshore rotor blades from its manufacturing facilities in China, Jesper Månsson thinks it will be necessary to produce the very large blades near their markets, which would require a constant and stable market, however, if the investment is to pay off.

"Blades will also be moved around the world, but many will be produced in close proximity," he says.

USA's only functioning offshore wind farm, Block Island, has rotor blades that were produced in Spain.

"However, it brings down the logistics costs if you are near the port," he says, mentioning a range of challenges like those posed by the large blades.

"Transport permits are becoming harder to obtain. Trees have to be cut down. Roundabouts must be expanded and that kind of thing."

However, he is not completely uninclined to agree with Henrik Stiesdal.

"During all the years, when we've been concerned about size, we've been asking ourselves how we will manage to move the components around. And we've always managed. So Henrik Stiesdal has a point," says Jesper Månsson.

CHANGING ROLE FOR THE PORT?

According to Henrik Stiesdal, the port's role in the future will not change significantly even though the turbines are changing. The same applies, even though the market is slowly moving to other locations than the North Sea. There will be plenty of wind power activity in Esbjerg, even if towers are perhaps built locally.

"Things are happening in the Mediterranean, USA, China and throughout the rest of Asia. The total volume will increase. That's why the pressure will not decrease," he says.

Henrik Stiesdal believes conditions in the North Sea are good enough for the offshore wind power projects to continue.

"After all, the North Sea is an anomaly. There are very large areas with shallow water close to densely populated centres with many hundreds of millions of people living a realistic distance from the production, and where there is plenty of wind. So regardless of the size of the turbines, the North Sea is central for offshore wind power worldwide, and there will be many projects in the future and lots to do at the ports," he says.

The Port of Esbjerg is also ready for the further developments.

"We are adapting access roads and roundabouts. We can handle the large turbines," says CCO Jesper Bank. But Jesper Bank also points out that preparations are being made for manufacturing facilities coming to the ports.





TOTAL: ESBJERG IS DENMARK'S ENERGY METROPOLIS

With its purchase of Maersk Oil, Total is now the largest operator in the Danish part of the North Sea and the second-largest in the entire North Sea. Now, Total explains why the acquisition is a 'perfect match', and how the French energy giant sees the Port of Esbjerg's role and future for the oil and gas industry.

It's a fantastic deal for Total that builds on our core business. It gives us a presence in Denmark that we have not had before, where we become the second-largest oil and gas producer in

the North Sea and, at the same time, create growth." That is what Total said back in March 2018 when the sale of Maersk Oil to Total was finalised with a purchase price of DKK 47 billion.

That was a year ago. Now, Martin Rune Pedersen, Vice President for Total's exploration and production activities in Denmark, Norway and Netherlands, explains the background for the investment, the first year, plans for the future, and Total's approach to the green transition.



What is the background for Total's purchase of Maersk Oil and the billion-kroner investment in the Danish fields in the North Sea?

The purpose is to exploit the overall strength of both Total and Maersk Oil and create a strong energy base built on North Sea oil and gas resources. The North Sea has been a core area for Total for decades and still offers growth opportunities. So the purchase of Maersk Oil was in many ways a perfect match for Total. It has given us the chance to expand our production, improve efficiency and increase our competitiveness.

At Total, we have faith in the potential and future of the North Sea. We have increased our presence in order to use both the expertise and opportunities available here. For example, we have made Copenhagen the centre of our regional business management and investigations for the North Sea and Russia. We have also established an offshore technology centre in Copenhagen. It is actually the first of its kind outside France, which is the heart of Total. Our office in Copenhagen has also become the home of both support

functions and Total Marketing & Services activities throughout the Nordic region.

Today, we are the largest oil and gas operator in Denmark's part of the North Sea and the second-largest operator in the whole of the North Sea after Equinor, so our investment makes a great deal of sense in many ways.

Now a year has passed since the purchase of Maersk Oil was formally completed. How would you describe the first year?



Martin Rune Pedersen from Total believes Esbjerg is the city with the greatest expertise in the oil and gas sector.

It has been a busy and very exciting time. Merging companies, cultures and employees is rarely a smooth process. We have put a lot of work into integrating Maersk Oil in Total, and the majority of that extensive work has now been carried out. One of our most important priorities has been to retain many of the employees who came from Maersk Oil. Maersk Oil employees' skills were one of the main reasons for the acquisition, and we have really made a great effort to offer our employees interesting jobs and integrate them in the Total family.

And you have already expanded your Danish presence?

Yes, in September 2018, we announced our plan to buy Chevron's share of Dansk Undergrunds Consortium (DUC). That gives us a total share of 43.1 per cent of DUC and is another tangible signal of Total's faith in the activities in Denmark. Another top-priority project for us is the Tyra redevelopment. As many people probably know, it's an investment worth DKK 21 billion. The redevelopment of the Tyra field is in full swing and will last for the next two to three years. It's a gigantic infrastructure project that will be the nerve centre of Danish gas production. More than 90 per cent of Denmark's natural gas flows through Tyra, so this is absolutely vital for Denmark's future supply reliability. We are redeveloping an important piece of the Danish North Sea infrastructure, and this will also be the centre of possible future discoveries in the northern part of the North Sea. The project is highly prioritised and is going very well.

What would you say is Esbjerg's greatest strength as a metropolis for Denmark's oil and gas production?

Esbjerg is in general an energy metropol. Oil and gas make a considerable contribution to Denmark's economy, and in Esbjerg alone, 14,500 people are employed in the energy sector. Out of these, about 9,500 are employed in the oil and gas industry. This has made Esbjerg Denmark's primary energy hub.

The city has the ideal location for the offshore activities in the North Sea. There is also strong, close and good cooperation between the many companies supporting and working in

our field. Esbjerg also has the country's highest level of skills in terms of expertise and experience in oil and gas. So, there are many good things to say about Esbjerg.

What is your own relationship with Esbjerg?

I have lived in Esbjerg with my family for some years. Close to the sea and surrounded by beautiful countryside. With a modern city life and good job opportunities, in many ways it's the idea setting for a family. I think Esbjerg has a lot to offer and is an attractive location on the world map. Not least if you are interested in a career in the energy business.

How do you expect the companies in the port to contribute to your commitment?

Work at the port is important to everyone with interests in the North Sea. It is an innovative environment with many synergies where companies work together - also on developing many new technologies.

We view the energy cluster as an important front runner for positioning the Danish part of the North Sea as an innovative and technology-driven environment across industries. Total's ambition regarding further developing the Danish part of the North Sea into the *best in class* within the areas of exploration and production requires us to have partners that can inspire and help drive the use of new technology. And we find that in Esbjerg.

How would you describe the future of Danish oil and natural gas as an energy source?

The redevelopment of Tyra is a new chapter for Denmark's upstream industry that will ensure commitment in the Danish part of the North Sea for many years to come. When the Tyra field resumes production in 2022, Denmark will once again be self-sufficient in terms of natural gas. Natural gas is a crucial factor in Denmark's energy transition as a 'transition fuel' as our energy consumption remains high and cannot be covered by green energy alone. Natural gas emits less CO₂ and will continue to be an important part of Denmark's energy mix in the years ahead. In fact, Denmark is the country that produces oil with the lowest CO₂ footprint in the world.

One day, the Danish energy system will have transitioned to green and renewable energy. Even then, we will continue to produce natural gas in the North Sea, as we export to other countries that still need oil and gas for manufacturing industries, heating and transport. We will therefore remain active in the North Sea in the most responsible, secure and sustainable way. That is one part of Denmark's oil and gas strategy that will benefit the Danish economy in the future. It will also benefit the broader geopolitical situation that part of the natural gas, which Europe needs, is produced within the EU. Total is active in the entire gas supply chain and we expect the share of natural gas in the oil and gas mix to increase from 50 to 60 per cent towards 2035.

TOTAL

Total is the world's fourth-largest oil and gas company, with about 100,000 employees worldwide, and serves eight million customers a day.

Total is also one of the largest and most international workplaces in Esbjerg. The company employs about 1,450 employees who represent up to 45 nationalities. Half of them work offshore 225 kilometres out in the North Sea. From Esbjerg, a mix of oil and gas is produced from 16 offshore fields with 50 offshore installations and five main platforms.

How is Total addressing climate change and the global energy transition?

Our climate strategy includes clear goals for combatting climate change. Total was the first large company in our industry to fully integrate the Paris Agreement and 2-degree scenario into its strategy.

Our mission is to produce and deliver responsible energy at an economically feasible price and to make it accessible to as many people as possible. We aim to reduce our so-called 'carbon intensity' by 15 per cent by 2030 and 25-30 per cent by 2040. We will achieve these goals via various solutions that focus on optimising operations, growth in the gas market, strengthening our role in electricity production with low greenhouse gas emissions, and increased our use of bio fuel and CO₂ storage.

Natural gas is one of the best solutions we have when it comes to combatting global warming and securing the world access to the energy it requires.

What framework conditions are critical for Total's future activities and investments in the North Sea?

Stability and support for the industry are crucial. Naturally, we also wish to work together with the government and the rest of the industry to ensure optimal tax framework conditions that enable us to invest our money profitably here in Denmark.

Total believes that Tyra will be an anchor point for potential future discoveries in the northern part of the North Sea.





EXPERT: THE PRODUCT OF THE FUTURE IS A SOLUTION

If maritime companies want to survive in the digital economy, they must build digital service solutions on top of their products, says DTU professor Tim McAloone. But they are up against a conservative maritime business where new services are often met with scepticism, according to Danish Shipping's digitisation manager.

About 10 years ago, the management of VIKING Life-Saving Equipment made a crucial decision. Rather than primarily

selling life-saving equipment, the world-leading Danish producer of maritime life-saving equipment created a business plan based on offering fixed service agreements for the equipment already sold.

"Back then, things were very traditional. Customers had some parts replaced and paid for them plus an hourly rate for the service station. However, it made management realise there was a market for selling service based on agreements and at a fixed price. And that became the concept behind *Shipowner Agreements*," explains Henrik Balslev, IT Director at VIKING.

'Shipowner Agreements' mean that the company services and maintains their customers' life-saving equipment for



VIKING Life-Saving Equipment made a crucial decision approximately ten years ago. Rather than primarily selling life-saving equipment, the company devised a business plan based on offering fixed service agreements for the life-saving equipment already sold. That has been a great success, explains Henrik Balslev, IT Director at VIKING. "It's no secret that we now earn more on servicing than selling products," he says.

a fixed price The special aspect about maritime life-saving equipment is the mandatory inspection once a year. While shipowners previously owned life rafts, more than half of the customers now lease the equipment and leave all the service and controls to VIKING, explains Henrik Balslev.

"The concept has been a great success, and has helped change our business model. It's no secret that we now earn more on servicing than selling products," he says.

PROFESSOR: NO AVOIDING SERVICISATION

This transformation, which is the precise reason that VIKING today sells 'security on vessels', is something that many production companies can learn from. This is the opinion of Tim McAloone, professor at the Department of Mechanical Engineering at the Technical University of Denmark (DTU) and expert in product/service systems, also called *servitisation*.

"If a company focuses exclusively on producing a physical product that everyone in principle can copy, it won't last long," says Tim McAloone.

In essence, servitisation involves a company adding new services to its physical products in order to offer a more complete solution while bringing customers closer. As new digital technologies spread and just about all equipment, machines

and systems today are linked via chips, sensors and other technology, the model has wind in its sails.

In the digital economy, the companies' own big data is a cornerstone, and the more and better data, the company has about its customers, and the better the data is coordinated, the more value-adding service solutions the company can deliver on top of its physical products.

"It is about finding out where you can differentiate and stand out from competitors in relation to understanding and interpreting needs based on the customer's behavior and activities, and then developing solutions based on this. Companies must ask themselves how their exact product can open doors to selling more services. Digitisation and use of data is a crucial means to success here," says Tim McAloone.

OPTIMISATION FROM TOP TO BOTTOM

Digitisation also provides good opportunities for Danish companies, which typically cannot compete on price, to still compete for market share. Optimisation can occur both at the bottom of the business in the form of technology that can improve the efficiency and automate the operation of systems and equipment, and it can happen at the top of the business, as is the case with VIKING.



In its planning system, VIKING has all the data on the customers' life-saving equipment, where it is located, and when it was last inspected. This means that VIKING can easily take care of all administration and notifications of upcoming service inspections on behalf of their customers.

VIKING's development has evolved in stages and been constantly steered by the vision of selling 'safety on vessels'. According to Henrik Balslev, the overall IT investment, which also includes a new financial system, will run into 'the low tens of millions of Danish kroner'.

In its planning system, VIKING has all the data on the customers' life-saving equipment, where it is located, and when it was last inspected. This means that VIKING can easily take care of all administration and notifications of upcoming service inspections on behalf of their customers.

"This saves shipowners a lot of trouble, and the captains can simply sail to the nearest one of our almost 300 service stations worldwide when it's time for a service," says Henrik Balslev.



IT Director at VIKING, Henrik Balslev, says that their digital solutions save shipping companies a lot of trouble. "The captains can simply sail to the nearest one of our almost 300 service stations worldwide when it's time for a service," he says.

CONSERVATIVE SHIPOWNERS

In January last year, the Liberal-Conservative government in Denmark presented its growth plan for the Danish maritime sector, where part of the vision is that by 2025, the Danish maritime sector will be 'a powerhouse for digitisation'. For that to happen, shipowners must see the value of the new service solutions, but that is not always the case, even though the shipowners vary a great deal, explains Asbjørn Overgaard Christiansen, Head of Innovation and Digitalisation at Danish Shipping.

"Maersk, for instance, is unique simply due to its size. They do a lot in terms of development - also at the top of their business. And they do more and more with partners. Others also have a strong digital strategy. Many small shipowners work with digitisation and development, but this typically concerns fuel efficiency, which is reflected directly on the bottom line," he says.

Although the Head of Digitisation believes it is important that shipowners 'throw themselves into the digitisation battle', because the development is moving fast, he also encounters widespread scepticism in the business when it, for instance, comes to *servitisation*.

"When speaking to people in the shipping companies, the attitude I meet is very much that 'new smart business models are not really for us'. So entering into agreements, which entail a high level of operating costs, are met with resistance. The competition is tough, the margins small, and therefore it is all about ensuring low operational costs," says Asbjørn Overgaard Christiansen.

CHIPS IMPROVE EFFICIENCY AT MAERSK

One of the companies, which continuously invests in optimising operating process efficiency at the bottom of the business, is Maersk Drilling. Here too, digitisation brings a wide range of benefits linked to a smarter and more cost-efficient management of equipment and systems on the 23 drilling rigs in the North Sea, like those run by Maersk Drilling. Thousands of RFID chips are currently being replaced with a new generation based on open standards.

"We have discovered some very good uses, and we are now expanding our portfolios to find where else we can use the new chips to our advantage," explains Kristian Mortensen, mechanical engineer and project manager at Maersk Drilling's department for Maintenance, Processes & Solutions, who is leading the comprehensive replacement of the many chips.

The benefit of having RFID chips in all the hydraulic hoses, drill pipes, electrical installations etc. is you by scanning bar codes easily can identify every single piece of equipment. All the RFID barcode has to do is link the equipment out in the North Sea with Maersk Drilling's ERP system in Lyngby.

"All the data of interest in relation to maintenance are fed into our ERP system, and then we can adapt our maintenance requirements in relation to the counters that are now relevant for this piece of equipment or maintenance work," says Kristian Mortensen.

A NEVER-ENDING JOURNEY

As well as making work easier for the technicians out on the rigs, who instead of filling in physical papers, now can type

data directly into an ERP system via a tablet, the chips also make the technicians' everyday lives safer. According to Kristian Mortensen, it is hard to put a price on the value that the new RFID chips create.

"But it means we are delivering a better, more efficient and stable product. In principle, this isn't something that will end. We are still finding new uses for the chips," he says.

And that is precisely one of the points of digitisation, Professor Tim McAloone points out: it will never stop. New opportunities are always opening up for collecting and combining data to deliver even better service solutions.

"Many companies will be forced to make some brave decisions if they want to remain relevant. And if they don't, a competitor is likely to offer digital service solutions in the same area at some point in the future," says Tim McAloone.

At VIKING, IT Director Henrik Balslev describes the company's transformation as a journey where the end destination has not been reached yet. Along the way, for example, VIKING expanded its portfolio through acquisition, and today it can also offer equipment for fire fighting and lifeboats with hard hulls, naturally including service agreements. The vision also entails viewing yourself as a future one-stop-shop for everything associated with safety on vessels.

"We have now come so far that our service turnover has overtaken our product sales. We have also grown and conquered market share so that today we are clearly number two in the world market," says Henrik Balslev, who expects the next stop on the journey to be the introduction of *robotics* and *chatbots* to further automate service.

Maersk Drilling is currently replacing thousands of RFID chips. This brings a wide range of benefits in relation to smarter, secure and more cost-efficient management of equipment and systems on the 23 drilling rigs in the North Sea, like those run by Maersk Drilling. The benefit of having RFID chips in all the hydraulic hoses, drill pipes, electrical installations etc. is that you by scanning bar codes easily can identify every single piece of equipment.



A portrait of Kristian Jensen, a man with short brown hair and a light beard, wearing a dark blue suit, white shirt, and orange tie. He is standing with his arms crossed, looking off to the side. The background is a dark green wall with gold-colored vertical stripes.

KRISTIAN JENSEN: NEW FREE TRADE AGREEMENTS SET THE COURSE FOR THE FUTURE

2018 was a turbulent year for international free trade with intense negotiations about the UK's exit from the EU and the trade conflict between the USA and China. Europe's trade agreements with the USA have also had a bumpy ride. "Businesses must know that both Denmark and the EU are working hard to de-escalate the current trade conflicts and limit the consequences for Danish and European companies," says Danish Minister for Finance Kristian Jensen, who, together with the government and the EU, is working towards increasing international free trade.

Where do you see international free trade moving in 2019, not least in the light of Brexit and the accelerating trade war between China and the USA?

International free trade is under pressure, and there is a risk that the current trade conflicts will escalate to the detriment of all parties. At the same time, the insecurity concerning the UK's future links with the EU constitute a significant economic and trade risk. Danish companies depend on selling their goods internationally, also to the UK, and increased trade barriers will clearly damage us all. I am consequently very satisfied that the EU recently entered into new ambitious free trade agreements with important trading partners such as Canada and Japan, and that more agreements are on their way. This strengthens trade, promotes growth and employment in Denmark and is an important European commitment to increased international free trade.

The Port of Esbjerg has about 200 companies, many in offshore wind and oil and gas, and there are about 10,000 jobs at the port and in related value chains. In an environment like this, how should you address the uncertainly currently dominating international trade relations?

Businesses must know that both Denmark and the EU must work hard to de-escalate the existing trade conflicts and limit the consequences for Danish and European companies. Regardless of whether some companies can win market share when other suppliers are excluded, trade conflicts are not in Denmark's interests. It is equally important to remember that the nearby markets in Europe still constitute the majority of Danish companies' exports, and the government is working to ensure a well-functioning internal market in the EU.

Should we – and can we – perceive the EU's internal market as a safe harbour?

The internal market is of vital importance to Danish and European growth and job creation. Surveys indicate that since its establishment 25 years ago, the internal market has brought both higher Danish welfare and employment. Denmark's GNP is estimated to be approximately 5 per cent higher (approximately DKK 100 billion a year) as a result of the internal market, and the real wage for an average middle-class married couple is 10 per cent higher (DKK 65,000 annually). The importance of Danish companies' access to a single market of over 500 million consumers will be more important still when international trade barriers are increased outside Europe. However, it is vital that the internal market continues to develop. This applies in particular to the digital area, so Europe can harvest the full potential from technology and innovative business models to benefit our competitiveness.

"Denmark is highlighted in international contexts as one of the most competitive countries in the world. We wish to maintain that position and must therefore ensure good framework conditions for Danish companies," says Minister for Finance Kristian Jensen in this interview.

USA is an important new market for the offshore wind power industry. What can politicians do to help Danish players in the American markets?

USA is Denmark's third-largest export market, and the most important market outside Europe, and Danish companies are strongly represented in the USA, which promotes growth and employment in both the USA and Denmark. The government is therefore naturally very conscious of ensuring the best possible trade relations with the USA, and we are supporting the ongoing EU negotiations with the USA regarding a mutually improved trade relationship. Finally, Denmark's Trade Council has a strong presence in the USA to assist and advise Danish export companies on becoming established in the American market.

What do you think about sustainability as a strength in relation to our international trade and Denmark's future prospects?

Sustainability and CSR are important competitive parameters and also the basis for new markets for those, who can deliver the relevant transition, and I expect this trend to increase in the future. It is vital that both citizens and companies assume responsibility and contribute daily to a sustainable development. Fortunately, many companies already appreciate the opportunities and are making a tidy profit from them. Last year, the government launched a new council for CSR and global goals, which will promote good framework conditions for the companies' strategic work in the area.

What do you think are Danish companies' future strengths in terms of international trade?

Denmark has a strong position in the intensifying international competition, and Danish companies have strong positions in a range of areas. As one of the world's leading maritime nations, shipping is a clear example, but also within medicine, energy, food, the climate and water, Danish companies' products and solutions are in high and increasing international demand. Meanwhile, in Denmark we have a relatively highly educated workforce that is ready for change, which is another strength in relation to handling and embracing greater technological change. Denmark is highlighted in international contexts as one of the most competitive countries in the world. We wish to keep that position and must therefore ensure good framework conditions for Danish companies. The government wants it to be easier and cheaper to run a business in Denmark.



GREENER SHIPS AHOY!

In 2018, the world's largest electric ferries saw the light of day when they were introduced in Oresund, and in 2019, the shipping company Grimaldi is building new RoRo ships that are expected to reduce emissions by 30-40 per cent. "Now, the trend is accelerating," according to the industry.

23,000 tonnes of CO₂. That is how much less CO₂ the new battery-driven ferries in Oresund emit a year. In fact, they emit zero. They are the world's first high-frequency ferry routes fuelled exclusively by electricity.

Onboard, there are 640 batteries weighing 90 kilos each. On the Danish side, they recharge for 6 minutes and on the Swedish side for 9 minutes. That is all it takes. Each crossing requires about 1,175 kWh. That corresponds to the consumption of an average household for one month.

The ferries are the result of a targeted strategy to be fossil free, and without compromising on operations, mind you, explains Jens Ole Hansen, COO at ForSea.

"Basically, the green ferries must continue with the same close-packed schedule as when the ferries were fuelled by diesel. We make 50,000 trips a year, and the ferries are in port for ten minutes at a time. With that in mind, we asked ourselves: How will we replace diesel with electricity?"

Developing the ferries has taken some years, and there have

been bumps along the way. Among other things with ensuring the connection to the charging station.

"But that's how it is when you're innovative. You must be ready for unexpected challenges when pushing the limits of what is possible," says Jens Ole Hansen.

BEING GREEN MAKES GOOD BUSINESS SENSE

Global shipping constitutes about 2.2 per cent of total CO₂ emissions worldwide, and the environment and climate are high on the agenda of both the EU and UN's International Maritime Organisation, IMO, which passed a historic Climate Agreement last spring. It obligates the industry to halve its CO₂ emissions by 2050 as a step towards a complete phase-out.

The agreement also aims to strengthen design requirements for all ship types.

In Helsingør, Finn Wollesen can feel that demand for green technologies is growing. He is CEO of the design house Knud E. Hansen, which specialises in designing ships such as those for the RoRo industry.

"The development has gained momentum over the past 10 years but right now it is accelerating," he says, explaining:

"To begin with, it involved living up to rules and regulations but now it is also useful for marketing. Having a green image is worth money because customers are focusing on it. There's no doubt that being green will become an increasingly important competitive parameter."

Knud E. Hansen designs ships for both DFDS and Grimaldi

Lines. Recently, they were involved in designing Grimaldi's new Green 5th Generation, which is well under way and expected to be ready in 2020. The series consists of 12 new hybrid ships that can each transport about 7,800 metres of rolling goods, equivalent to about 500 trailers. The ships use a range of new technologies that when combined reduce their CO₂ emissions by 30-40 per cent.

Three of the new ships will join Grimaldi's fleet in the Mediterranean. These are the ships that call weekly at Esbjerg and carry cargo such as food and cars.

NOT JUST FOR THE SAKE OF IT

Jens Ole Hansen at ForSea is sure the green focus is good business. Because even though the IMO has passed legislation that emissions must be reduced by 50 per cent by 2050, there are plenty of reasons to start straightaway.

"We believe there will be a competitive advantage in being first movers because the climate agenda has gained momentum right now," says Jens Ole Hansen.

And he also points out that it makes financial sense because the batteries are far more energy efficient.

"Oil is not cheap at the moment and even if the price falls, a lot of waste heating is linked to sailing on diesel. That isn't the case with electricity," he says.

He also points out that electricity-driven ferries were not really interesting until the battery technology took off. In recent years, the development of batteries of the calibre that ferries require has accelerated.

"We have made this investment because we feel it makes good economic sense," says Jens Ole Hansen.

AN OCEAN OF TECHNOLOGIES

The battery technology is not the only technology currently progressing in leaps and bounds. An ocean of new technologies is seeing the light of day. Technologies that together contribute to considerably greener ships.

For Finn Wollesen and his 94 employees at Knud E. Hansen,

THE NEW ELECTRIC FERRIES IN ORESUND

The two sister ships Tycho Brahe and Aurora shuttle across Oresund between Helsingør in Denmark, and Helsingborg in Sweden. Each ship has room for 1,150 passengers and 240 cars.

- There are 640 batteries onboard weighing 90 kilos each. The total weight of the vessel is increased by 280 tonnes.
- On the Danish side, they are recharged for 6 minutes and on the Swedish side for 9 minutes.
- Each crossing uses about 1,175 kWh.
- The conversion to electric operation has cost almost DKK 240 million, of which the EU has contributed almost DKK 100 million.

Source: ForSea

it is always a question of the ship type and needs when developing the right green ship design. For cruise ships, ventilation plays a crucial role. And for RoRo vessels, optimising the logistics flow is in focus.

"If we optimise the flow so that containers and cars roll on and off quickly, it reduces the time spent in the port. This means the ship can reduce its speed when sailing, and that helps reduce fuel consumption significantly," explains Finn Wollesen.

In addition to optimisation of this kind, Knud E. Hansen and Grimaldi have together implemented a number of new technologies on the new generation of RoRo vessels. This, for instance, involves a battery pack that enables running exclusively on electricity when the ships are in port. There are also various systems onboard that reuse energy. For example, heating is converted into electricity, and a special technology

"We believe there will be a competitive advantage in being first movers because the climate agenda has momentum right now," says Jens Ole Hansen, COO at ForSea about their electric ferries that are crossing Oresund.



can convert sulphur emissions into gypsum, which can be reused in port. Finally, the hull has a special air lubrication that adds a thin coating of air around the hull and reduces water resistance.

Together, the technologies help reduce the ships' CO₂ emissions by 30-40 per cent compared with today. Similarly, the size and the optimised flow mean they are twice as effective as the existing ships. This significantly reduces energy consumption per transported tonne.

Finn Wollesen explains that the green solutions must make sense from a business perspective otherwise they are not included in the design.

"Our task is to design vessels that are as efficient as possible to ensure *value for money* for our customers. We screen and choose equipment that works and contributes to both CAPEX and OPEX," he says, adding:

"Here, green solutions are more and more interesting because they contribute to efficiency and thereby also the financials."

REGULATION MUST FOLLOW SUIT

At the Danish Maritime Authority, the development of the new technologies prompts new ways of regulating the sector, explains Per Sønderstrup, Head of Centre of maritime regulation and law. The speed presents challenges when developing regulation.

"We risk regulating something that will be replaced by something else in a year's time."

Therefore future regulation is more about setting goals than micro-management.

"Put simply, we today require ships to have two lifeboats and six life jackets, but in the future we might to a greater extent make it clear that ships must have life-saving equipment to save everyone on board. It is about creating room for innovation," explains Per Sønderstrup.

The trend is global, he says and he predicts that we will see more target-based rules in the future, so the industry will to

a larger extent compete more based on goals rather than on defined standards. One example is the IMO's latest climate agreement where the ambition to reduce emissions by 50 per cent works as an overarching goal.

"Now, the industry and authorities must team up to achieve this goal," says Per Sønderstrup.

COLLABORATION ON BATTERY POTENTIAL

One example of the kind of collaboration necessary is in the field of batteries. Here, the Danish Maritime Authority has recently entered into collaboration with the industry and classification societies to explore the options and challenges presented by the battery technology together.

Per Sønderstrup's colleague Martin John, Director, Ship Survey, Certification and Manning at the office for maritime safety, explains that the collaboration is symptomatic of what the development demands.

"Regulation must not limit development, however there are also important safety concerns to bear in mind when dealing with batteries," he says.

The new collaboration will explore the opportunities of battery technology and reveal the challenges. That is the only way Martin John and his colleagues can develop relevant regulation. And knowledge sharing is precisely what is needed, he feels.

"The technology is so untested that we must learn from each other's experience. We are experiencing great demand for knowledge and networking from the industry, where we together explore the opportunities presented by the new technology."

The collaboration in the field of batteries will result in standards for certification that can apply to the industry in general. They are currently not available.

At ForSea, Jens Ole Hansen welcomes common certification standards. In connection with the new electrical ferries on Oresund, obtaining approval from authorities has been complicated because there are no rules in force.

Grimaldi's new Green 5th Generation ships are expected to be ready in 2020 and comprise 12 hybrid vessels. Three of them will join Grimaldi's fleet in the Mediterranean. Ships from there are those that call at Esbjerg once a week.



"We included the authorities in the development from the outset, and that was vital," he says.

PORTS MUST KEEP UP

Another important player, when it comes to development, is the port. This applies e.g. to the establishment of onshore power, which makes it possible for the large RoRo vessels to switch to electricity when in port.

For electric ferries on Oresund, the opportunity to quickly connect to onshore electricity is vital. In fact, connecting must take no more than one minute. Then the ferry must charge approximately 1,175 KWh in 6-9 minutes.

"We have developed a robot that connects the charging cables to the vessel in under a minute. It must do this 96 times a day for the two ferries, with tip top regularity," explains Jens Ole Hansen, pointing out that this creates demands on the power available in the port. The ferry battery packs need a 10 MW connection to optimise charging during the minutes available.

The infrastructure in the ports is also a focal point at the Danish Maritime Authority. Martin John explains that many of the new technologies make demands on the onshore facilities. This does not mean the ports must be able to cover all these bases at once, but they will have some choices to make.

"I believe that more and more ports must make some strategic choices about how they will support the green development and new technologies. Should we pursue supplying ships with electricity from shore or LNG, for example? Taking the right course of action will require major investments, so the individual ports must consider the matter carefully," he says, adding:

"In the future, ports such as Esbjerg must increase their scope for experimenting with the new technologies. The port will be a development partner that can contribute to the development via intelligent infrastructure."

AN EVEN GREENER FUTURE

Neither Finn Wollesen nor Jens Ole Hansen have any doubts that green technologies are here to stay. ForSea has, in fact, set its sights on becoming completely fossil-free, so the shipping company's other vessels must also be fossil-free in the long term.

"Ten years ago, I honestly didn't think this would be possible," says Jens Ole Hansen. However, the development of the battery technology has progressed rapidly, with the batteries becoming both better and cheaper.

Jens Ole Hansen will therefore not exclude that the development will ultimately enable the use of batteries for longer crossings.

"For large vessels and long crossings, a combination would be interesting. For example, can battery packs be implemented so the ships sail on battery power in coastal areas?"

Finn Wollesen also points out that combining the technologies does the trick on the large vessels. Grimaldi's new ships are an example of how a range of different technologies can be integrated to optimise the potential benefits.

This also means that some of the technologies will disappear again. But that is the nature of innovation, according to Per Sønderstrup at the Danish Maritime Authority.

"Right now, progress is being made within automation,

FACTS ABOUT GRIMALDI'S GREEN 5TH GENERATION

- Comprises 12 new hybrid vessels that are 238 metres long and have a gross tonnage of 64,000 tonnes.
- The ships use fuel while sailing but electricity when docked.
- While sailing, they obtain electricity from large lithium batteries that are recharged during the crossings by generators running on solar power.
- The ships have a special air lubrication system comprising a special type of lubrication on their keel, which via small bubbles on the surface, reduces friction and thereby fuel consumption. The ships are also covered by a special silicone paint that reduces friction.
- The ship has a technology on board that exploits the chemical reaction between the sulphur and salt in seawater to produce gypsum, which can be recycled or disposed of onshore.

Source: Grimaldi Lines

batteries and scrubbers, while experiments on natural gas, hydrogen and ammonia as fuels are also being conducted," he says. He thinks there are many good new initiatives at the moment.

"But it takes many drops to make an ocean, and perhaps that's how it should be. Who knows, perhaps the development of a new, clean energy source is right around the corner."

Martin John also points out that Denmark has a good basis for pioneering the development due to our extensive maritime knowhow.

"We are good at both thinking up ideas and testing them in practice, partly because we have clusters like the ones in Esbjerg, where new ideas can evolve in practice. It could certainly be an important competitive parameter for the Danish maritime sector, if we work hard and don't rest on our laurels," he says.



Jens Ole Hansen, COO at ForSea



Finn Wollesen, CEO at Knud E. Hansen



ELECTRIFICATION TO DRIVE THE GREEN TRANSITION

In November, the European Commission presented a new climate initiative that paves the road for a carbon-free Europe by 2050. The Commission clearly specifies in the initiative that one element stands out as being of primary importance for reducing Europe's CO₂ footprint - electrification. Kristian Ruby, Eurelectric, Thomas Egebo, Energinet, and Morten Helveg Petersen, EP, share with us their perspectives on the announcement.

This is the ambition of the EU Commission's climate initiative from November 2018. The last time the Commission announ-

ced such a long-term goal was in 2011. Back then, the aim was to reduce emissions by 80 per cent by midway through this century. But now the bar has been raised.

The vital ingredient of this recipe for success is electrification. That means an increasing amount of our energy consumption must come from electricity. And even more of this electricity must be produced by renewable energy. Today, renewable energy comprises 30 per cent of our electricity production. The Commission's ambition is for this to reach 80 per cent by 2050, with offshore wind power comprising half of that figure.

Here, Kristian Ruby, Secretary General of Eurelectric, Thomas Egebo, CEO at Energinet, and Morten Helveg Petersen, Member of the European Parliament, share their perspectives on the announcement and not least what it will take to achieve the ambitions.

“WE NEED A GIGANTIC EXPANSION WITHIN RENEWABLE ENERGY”

Kristian Ruby, Secretary General of the Union of the Electricity Industry - Eurelectric



Kristian Ruby

What changes in our society will be required for us to realise the potential of electrification?

"Looking ahead towards the middle of the century, half of all the energy used must be carbon-neutral electricity. It is therefore vital that we work on strengthening demand for electricity in other sectors. It's a matter of electrifying more sectors but also ensuring flexibility so we can store electricity, for example,

in the batteries in electric cars when it's blowing a gale in the North Sea. As renewable energy is a more variable energy form, we must make sure that the demand side is flexible so that society doesn't stop in its tracks."

Is this ambition even realistic?

"We must approach this like a Tour de France – can you complete that in one day? No. But if we are a determined team and focus on our strengths, we can do it.

Here, Denmark has the track record to lead the pack. There is plenty of Danish experience of expanding the offshore wind sector and integrating renewable energy in the electricity grid that can inspire the development that Europe is facing.

The countries in Europe have diverse starting points for seizing opportunities. Also, some countries face greater investments than others. This is where the Danish case can provide inspiration, and I am already experiencing great interest in the systematic Danish approach to energy efficiency and renewable energy."

Today, renewable energy accounts for 30 per cent of our electricity production. The Commission's ambition is for this to reach 80 per cent by 2050. How will we achieve that goal?

"Offshore wind power is a crucial part of the answer. If we want this transition and a climate-neutral society, it will require an expansion that is unfeasible on shore. There are not the same limitations offshore as there are onshore. This is one of the reasons the North Sea contains such huge potential. It also means we must hit the ground running and start expanding in the field of renewable energy. The expansion we need is gigantic, and it must happen now."

“THE ENERGY GRID OF THE FUTURE IS GREEN, DIGITAL AND CROSS-BORDER”

Thomas Egebo, CEO of Energinet



Thomas Egebo

What changes in our society will be required for us to realise the potential of electrification?

"If we are to exploit the potential of electrification, we must succeed in using electricity for far more things than we do today. This could involve transport, or electricity for heating e.g. via heat pumps. The benefit of the new applications for green power is that the technologies are energy efficient.

So if electricity consumption increases, it does not mean more energy is consumed.

It is also important that we develop new technology that can help us to convert electricity into alternative forms of energy. Electricity can be converted into a wide range of different materials and energy forms, such as hydrogen, synthetic plastics etc. I hope that in the future we will see energy plants that ensure energy in various forms flows freely between different sectors to a much larger extent than today. We call the latter 'cross-sectoral connections', and I think we should do far more to strengthen them."

Today, renewable energy comprises 30 per cent of our electricity production. The Commission's ambition is for this to reach 80 per cent by 2050. How will we achieve that goal?

"The Commission's initiative is ambitious, so our initiatives must match that. At Energinet, we are currently working with Dutch TenneT on exploring the opportunities for energy

islands in the North Sea. It's a matter of combining power from offshore wind farms with interconnectors (cables, ed), so the power can flow where it is needed. Today, there is 11 GW of offshore wind power in the North Sea countries. With energy islands in the North Sea, reaching up to 75-200 GW is possible. In the future, nationwide power production will be a thing of the past as production will be on a European scale. Here in Denmark, we have fantastic opportunities for producing energy in the North Sea. In fact, the very best areas are off the west coast of Jutland. The potential is great and much more greater than our own requirements here in Denmark. Consequently, a strong internal market for energy in Europe is another important precondition."

What demands will this development make on our electricity grid?

"I am not concerned about whether the large amount of new green power can be integrated in the electricity grid in the short term. However, if we scale up our exploitation of the wind in the North Sea, we will face some challenges in terms of our infrastructure. At this point, we must consider whether there are any smarter solutions than those we have been using up to now. For example, when transporting energy a long way, it is easier to use gas pipelines rather than powerlines.

Another focal point for the infrastructure of the future is to create intelligent demand and consumption. Demand must be linked to flexibility so we automate our consumption depending on the level of pressure on the system. This will, for example, mean that electric cars recharge during peak capacity when the power is cheapest. If we can make the consumption intelligent in this way, we will be much more flexible and efficient. Digitisation is crucial for this to be possible. We have a wide range of data that we must make an effort to bring into play to make solutions smarter."



I hope that in the future we will see energy plants that ensure energy in various forms flows freely between different sectors to a much larger extent than today. We call the latter 'cross-sectoral connections', and I think we should do far more to strengthen them.



“THE BATTLE AGAINST CLIMATE CHANGE IS A QUESTION OF LIFE OR DEATH”

Morten Helveg Petersen, Member of the European Parliament



Morten Helveg Petersen

Do you agree with the core ingredient of the Commission's initiative – that electrification will play a major role?

"Yes! Because renewable energy is the key to completely carbon-free electricity as early as the coming decade. And as we are increasing the share of renewable energy, of course we must electrify the heating, cooling and transport sectors. On all three parameters, we currently depend far too much on fossil

fuels. In Denmark, particularly within transport, we unfortunately have a long way to go in relation to rolling out electric cars."

What will it take to succeed?

"We must understand that battling climate change is a question of life or death. A new kind of commitment is therefore essential – we need action and investments, both politically and economically. In other words, an extensive political task that involves creating a well-functioning internal market for

trade with the energy that long term will be produced in the North Sea. It must be possible to sell the energy freely on the continent. Before Christmas, I negotiated a reform of the EU's electricity market that will force national authorities to open up a minimum of 70 per cent to electricity from the neighbouring country. It was a large step forward even though of course I was pushing for 100 per cent.

And it also involves raising our green ambitions while tightening up in relation to governments in EU countries that do not meet their obligations. If it was up to me, countries would not get EU support unless they take action in the climate area. This would apply in particular to fulfilling the goals for renewable energy, which require an offensive agenda at both national and European levels."

What role does the European collaboration play in this area?

"European and international collaboration in particular is the key to solving future climate challenges and realising the potential of electrification. It is so important that we prioritise the climate and energy negotiations at EU level. Denmark only accounts for 2 per cent of the EU's total economy. It is therefore useless to focus on national initiatives like the energy settlement from the summer of 2018. We must work on European energy and climate policies if we are to make serious progress and solve the climate crisis."



Chief Commercial Officer at the Port of Esbjerg Jesper Bank is one of the hosts for the many tours of the port. He is shown here with New Yorkers Joshua Nelson and Ed Backlund from the consulting company Hatch. The visitors are typically from other ports, organisations, politicians or companies. "On an annual basis, we give about 1,000 commercial guests tours of the port. Add to this schools, universities, political organisations and EU officials. And then we have the official open tours for neighbours and citizens," says Jesper Bank.

GUESTS FLOODING IN TO ESBJERG

The number of foreign guests at the Port of Esbjerg has multiplied many times in recent years, and guests are now more often from countries such as the USA, China and Korea rather than from Europe. Last year alone there were 150 visits.

Joshua Nelson and Ed Backlund sit in a port car gazing out of the window. They have come all the way from New York just to visit the Port of Esbjerg and are having a tour. Silence fills the car and Joshua takes a photo with his phone out of the window. "Wow," he says. A second later, Ed says the same.

"Wow." They say they have never seen anything like it.

They are both consultants from the global consulting company Hatch, which provides advice in fields such as energy, infrastructure and ports. The two men carefully researched ports all over the world and decided to visit Esbjerg because "no other ports have a more diverse profile than Esbjerg," as Joshua Nelson says.

"And then there's no choice but to 'get your boots on the ground'," he says. He studied the Port of Esbjerg thoroughly on Google Maps but knew very well that this would not suffice.

In the USA, offshore wind power is exploding. Although the guests at the Port of Esbjerg on this January day come from a country where everything is normally bigger, that does not apply to offshore wind. In the USA, to date there is only one

active offshore wind farm but 16 others are on the drawing board. In December 2018, three areas were allocated in Eastern USA, each covering 130,000 acres, which corresponds with the area of Falster.

Joshua Nelson and Ed Backlund also feel the rising interest for offshore wind power in the USA. That is why they are sitting in the port vehicle looking out at 80 rotor blades from Siemens Gamesa lined up on the quay.

American states and companies and even the Port of New York are interested in offshore projects and contact Hatch.

"And that's why we base our advice on seeing the best there is," says Ed Backlund without the hint of a smile.

When the tour is over, the two Americans are treated to traditional Danish open sandwiches. "We certainly got what we came for," says Joshua Nelson, nodding goodbye. The 40 hours in Denmark were a good investment.

MORE FROM DISTANT DESTINATIONS

Foreign visits to the Port of Esbjerg began booming a good five years ago. According to CCO Jesper Bank, it began with delegations from the North Sea countries, Germany, the UK, Netherlands and Belgium. Then three or four years ago, visitors from more distant destinations began showing up.

"After that came China, Korea, Taiwan and Japan, which are kind of 'emerging markets' within offshore wind power," he explains. Over the past couple of years, visitors from the USA have been arriving. Mainly visitors from the East Coast states.

VISITORS TO THE PORT IN 2018

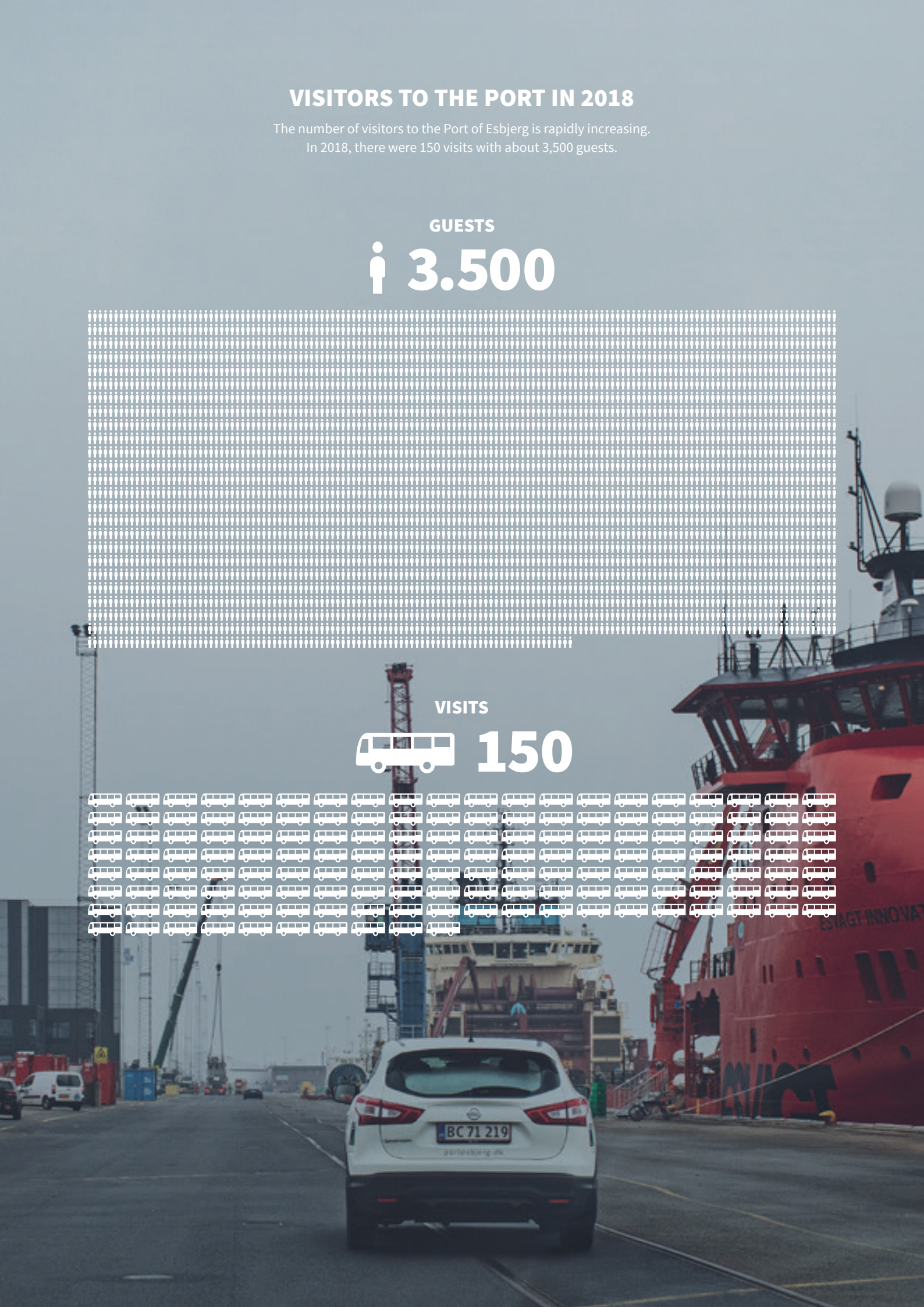
The number of visitors to the Port of Esbjerg is rapidly increasing.
In 2018, there were 150 visits with about 3,500 guests.

GUESTS

 **3.500**

VISITS

 **150**



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