INSIDE

JUNE #33

TURNING THE TIDE

GustoMSC
an NOV company

THE PIONEERS OF OFFSHORE ENGINEERING

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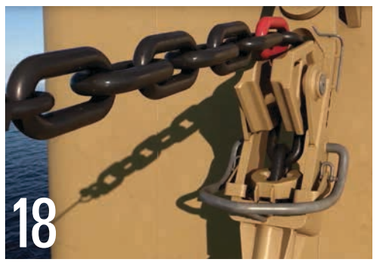
GUSTOMSC INSIDE OUT
THE STARTING POINT FOR A TIPPING POINT

This January GustoMSC invited NOV companies to take part in a discussion about the future of the energy supply. After this event, Assaad Mohanna, Director Business Strategy NOV and Nils van Nood, Managing Director GustoMSC and VP Business Development for NOV Marine & Construction, sat sown to philosophize about the future of the energy market.



INTERVIEW
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Geir Olav Hovde (APL) and Maël Gormand (GustoMSC) discuss the advantages and challenges of floating wind energy.

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CARBON FOOTPRINT ASSESMENT TOOL

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FACING THE FUTURE OF ENERGY

Lars Eirik Nicolaisen, Senior Partner & Deputy CEO of Rystad Energy, zooms in on the challenges that oil and gas markets will be facing beyond the COVID-19 situation. According to him it is technically possible to have carbon-free energy systems in the offshore industry.

COLOPHON

GustoMSC InSide
is a publication of GustoMSC B.V.
Total circulation: 3,000
Edition 33, June 2020
inside@gustomsc.com

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Printing
Mazeline

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PREFACE
TURNING THE TIDE

Dear readers,

The past couple of months have been exceptional in our lifetime. COVID-19 has caused profound changes that were hard to imagine beforehand. The virus has taken a grim global toll on lives, health services, jobs and energy demand. Economic activity has stalled and stock markets have tumbled. However, among all the negative consequences of the pandemic, there have been a few positive side effects such as falling carbon emissions.

Despite these exceptional circumstances, we have continued to serve our clients around the globe. In this case, it pays off to be part of a large global group, which enables us to bring in local NOV colleagues to serve clients locally, so we can avoid international travel bans.

The question that concerns all of us in the offshore industry is how profound and for how long oil and energy demand will be affected. It currently seems that oil & gas will be heavily impacted by the combination of the COVID-19 related demand drop and the ongoing oil price battle, despite the production reductions announced by OPEC+.

The travel bans appear to have the most impact on offshore wind. Therefore, this market could be able to recover more quickly once the travel bans are lifted.

When looking at the energy mix, we are in a transition period, which can rapidly develop regionally when there is strong government support. The EU has made it clear that not only does the Green Deal have to continue, but that the jobs and growth it offers are the best sources of economic recovery out of the current crisis. In light of this, we are committed to supporting the Sustainable Development Goals set by the United Nations in 2017.

We started 2020 in January by hosting a diverse team of NOV colleagues in an exchange about the future of the energy supply and how we can contribute to the energy transition. In the article 'Inside Out' you can read about what was discussed and what the highlights were.

It is too soon to tell whether the COVID-19 crisis will be a tipping point in our global carbon footprint. However, it has the potential to accelerate existing trends such as digitalization and increased efficiency, because these reduce the number of people required onboard offshore. Lars Eirik Nicolaisen, Senior Partner & Deputy CEO of Rystad Energy, elaborates in the main article of this issue on these trends and developments beyond the current situation.

As the COVID-19 situation has proven, we need smart technology more than ever. The article 'Pioneering in Technology' showcases a new CO_2 emissions assessment tool for rigs, which is currently being developed. This tool will help to quantify the impact of new technologies on the carbon footprint of offshore rigs.

It is probably safe to say that no one would have wanted emissions to be lowered in the way it is happening now. As economies will recover, the energy mix will rebalance and the energy transition will continue. At GustoMSC and NOV, we remain prepared and ready to contribute to this transition with our wide range of innovative and reliable technologies.

Enjoy reading this issue of InSide, take care of each other, and stay safe.

Nils van Nood
Managing Director GustoMSC

UP-TO-DATE

A SECOND WTI VESSEL FOR PENTA-OCEAN

Japan-based Penta-Ocean Construction Co., Ltd. has awarded GustoMSC an equipment package and design contract for their second offshore Wind Turbine Installation (WTI) jack-up. The jack-up enables the efficient construction of 10-12 MW class offshore wind power generation turbines, and will be the third unit in the region. All of which have been designed by GustoSMC.

The GJ-9800C jack-up design is a derivative of the well-established GustoMSC series of self-propelled WTI jack-ups. The jack-up will be outfitted with a proprietary 9800t capacity GustoMSC jacking system, designed specifically for the demands of the offshore wind market. By jacking up the hull above seawater, the vessel ensures safe, efficient, and precise crane operations even in the sea areas with severe meteorological and hydrographic conditions. The jack-up vessel will be operated jointly by Penta-Ocean Construction Co., Ltd., Kajima Corporation, and Yorigami Maritime Construction Co., Ltd. PaxOcean Engineering is responsible for the overall building of the vessel, which is scheduled to be completed and delivered in Q4 2022, and operational in Q1 2023.

SUPPORTING SHALLOW WATER OPERATIONS WITH OOS FRIDA I

In 2019, the Netherlands-based OOS Energy acquired OOS Frida I, the former ODN Delba III, for drilling operations in Mexico.

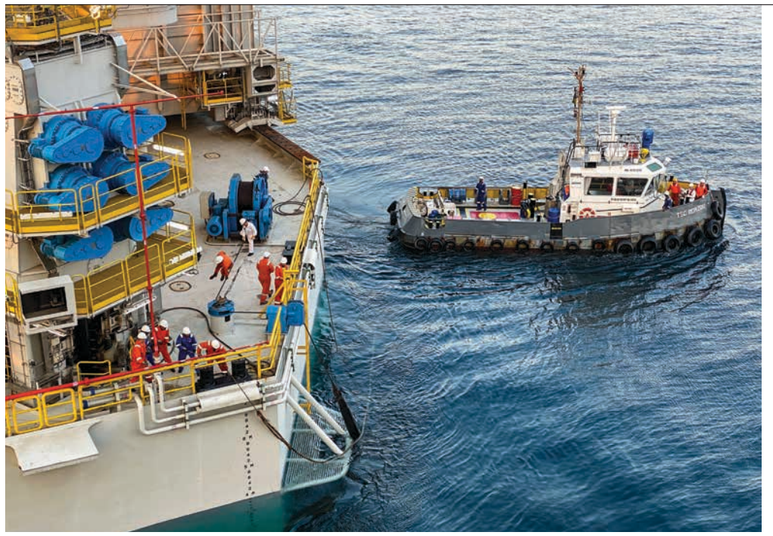
The rig, a GustoMSC TDS2500 semi-submersible design, was designed for deep-water drilling operations on its dynamic positioning system.

For the Mexico campaign, it will be working in shallow water in which dynamic positioning is not possible. Therefore, a mooring system had to be integrated on the rig.

OOS Energy awarded the engineering work to GustoMSC, the designer of the rig, to integrate the mooring system on the rig, including structural, stability, and station keeping analysis and engineering. With a tight schedule, the insights of GustoMSC as the original design company and close cooperation with the OOS team to make quick, joint decisions were vital in the process.

Together with the OOS team, a solution was devised, based on minimal impact on the existing structure and the possibility to do the construction work and integration on site in Mexico, causing minimum disruption and interference with the mobilization of the rig.

GustoMSC has further developed this solution into an engineering package, including class approval, and additionally supported OOS on several other projects related to the mobilization for the upcoming drilling campaign.



EXPANDING THE GUSTOMSC CJ FLEET IN THE MIDDLE EAST

Over the past months, several companies such as Northern Offshore, Shelf Drilling, and Saipem have been activating and preparing multiple GustoMSC CJ46 and CJ50 jack-ups for operations in Saudi Arabia, Qatar, and the United Arab Emirates. The further expanding fleet of the well-established CJ-jack-up series features field-proven sturdy X-bracing leg design, and also jacking systems and enhanced skidding capabilities via the X-Y cantilever systems.

GustoMSC is closely involved during the preparations with inspections, jacking assistance, spare parts delivery, training, and project support. The possibility of remote support and local presence as a result of further integration in the more extensive NOV service network has made it possible to deliver a fast response even in these uncertain times. We are keeping our focus on maximizing uptime and the return on assets of our clients' investments.

DATA INFRASTRUCTURE: THE FIRST STEP TOWARDS DATA BASED OPERATOR SUPPORT

GustoMSC is developing Operator Support Software (OSS) applications that provide real-time guidance to the operator based on real-time data generated by equipment on board. The Max NOV big data platform and analytics provides the infrastructure for these next generation OSS applications. We have finalized the first step: GustoMSC can now offer our clients a complete data infrastructure that has been designed using the latest security requirements, to be used in an industrial environment on offshore units.

The data platform consists of an Edge and Cloud environment. The Max edge devices are small industrial computers that connect equipment to the cloud. These edge devices read the data from the equipment, temporarily store the data for local access and intermittent internet connectivity, and process the data in real-time applications. The Max Cloud environment handles the long-term data storage and data science aspects. Via the AccessNOV web portal users can visualize the data that edge devices have collected over time. Custom dashboards can also be developed upon client request. Additionally, the data can be relayed to the clients' own cloud infrastructure.

Using the Max NOV big data platform enables our clients to focus on data analysis and decision-making without the headache of maintaining a complex data delivery infrastructure themselves.

AGENDA

Due to the recent developments concerning the COVID-19 virus many events are postponed or canceled. If you would like to stay up to date with the latest status where to meet us, please visit www.gustomsc.com/events

7 – 9 SEPTEMBER 2020
FOWT 2020
MARSEILLE
Participation in HHWE pavilion

12 – 16 OCTOBER 2020
ISOPE 2020
SHANGHAI
Paper: Using CFD to Assess the Wind Drag Force Acting on a Jack-up Truss Leg

(26), 27 & 28 OCTOBER 2020
OFFSHORE ENERGY
AMSTERDAM
Sponsorship

27 – 28 OCTOBER 2020
GLOBAL OFFSHORE WIND 2020
MANCHESTER
Stand 116

1 – 4 DECEMBER 2020
WINDENERGY HAMBURG
HAMBURG
Stand B7.517

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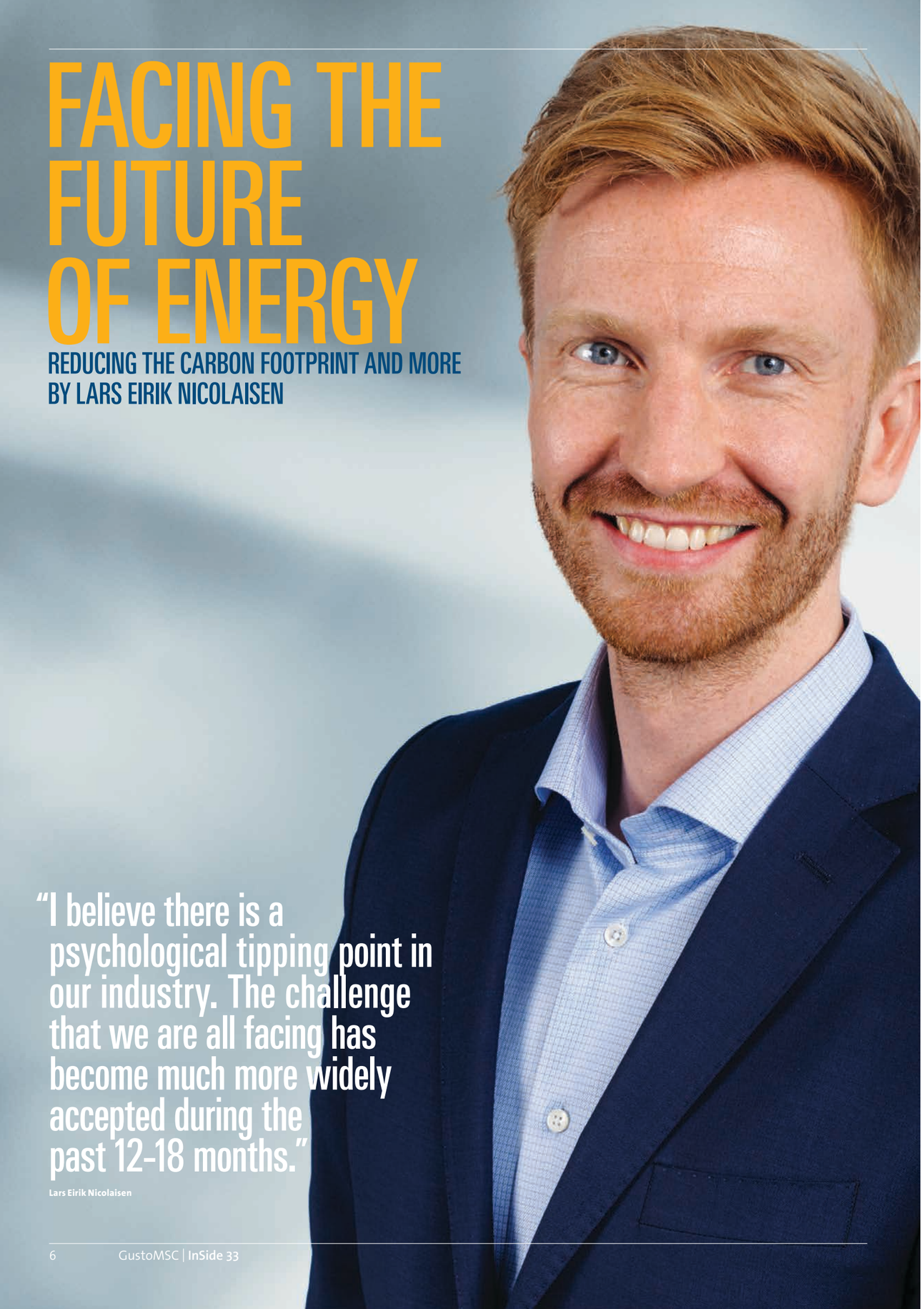
FACING THE FUTURE OF ENERGY

REDUCING THE CARBON FOOTPRINT AND MORE

BY LARS EIRIK NICOLAISEN



"I believe there is a psychological tipping point in our industry. The challenge that we are all facing has become much more widely accepted during the past 12-18 months."

Lars Eirik Nicolaisen

While energy markets have their hands full coping with an unparalleled, albeit temporary, demand destruction driven by our society's response to the COVID-19 virus, Lars Eirik Nicolaisen, Senior Partner & Deputy CEO of Rystad Energy picks up the thread of a more structural discussion – the energy transition. He believes that when coming out of the current COVID-19 turmoil, attention will once again turn to the future shape and form of energy markets. And who knows, the government stimuli packages in the wake of COVID-19 may even further accelerate the trend that we recognize as the energy transition.
In the next paragraphs Nicolaisen will discuss some of the challenges that oil and gas markets will be facing beyond the current COVID-19 situation.

The oil and gas industry has been through a lot of challenging times, many geopolitically driven, like the turbulence on the oil markets during the late 70s and mid-80s. This turbulence resulted in massive commodity price reductions and associated investment contraction. Some of these developments have been macro-related such as the economic contraction of the early 2000s and the 2008 financial crisis, which also resulted in a temporary setback for the energy industry. An industrially driven trend that has been extremely impactful is the economical exploitation of shale-resources.

First, it turned global gas markets upside-down by turning the US into a gas exporter. Secondly, it has shaken oil markets by lowering the price point for oil and making the US an energy independent nation. Arguably, this may be the most impactful trend witnessed to date, and it has had particularly dramatic consequences for the offshore industry as a competitor to shale. At the time of writing, we are also in a very challenging supply and demand imbalance driven by the COVID-19 virus (demand destruction) and a market share war (KSA and Russia choosing to increase production) unfolding at the same time.

"There is also an opportunity for GustoMSC to take part in increasing the competitiveness of offshore wind energy as a renewable power source."

The structural challenge we are facing today

Traditionally, Europe has been the leader in embracing the energy transition challenge, whereas the United States has been much more reluctant. A lot of the communication by European oil companies has been regarded as 'green rhetoric' more so than actionable strategy. However, the challenges of climate change have now been elevated from the communications department to the executive board levels at all major oil producers. One key reason for this is that Wall Street, as a representative of the financial institutions, has started to focus on the concept of climate risk and is challenging corporates on their strategy to address this. At the same time, in the East, China seems very committed to drive scale into the electrification agenda, partly due to the challenges that they are facing with heavy pollution in urban areas.

There are still large cultural and economic differences between regions. Several parts of the world are still without access to e.g. electricity and raising their living standards is much higher on the agenda than reducing emissions. This is one of the key challenges to overcome in mobilizing a large-scale movement towards a cleaner energy system.

Overall, I believe there is a psychological tipping point in our industry. The challenge that we are all facing has become much more widely accepted during the past 12-18 months, and additionally, real substitutes are challenging the traditional consumers of oil, most notably the penetration of electric vehicles.

Offshore regions differ

The offshore industry – alongside other sources for oil and gas – will have a challenge in maintaining its license to operate within society. In light of the emerging consciousness of climate change, societal and political pressure will be on, and the industry has to demonstrate that it takes this seriously. This includes challenges such as access to talent and access to capital.

There is also a rather substantial difference between the footprints of various offshore regions. The main differentiator is the practice of (gas) flaring. In certain regions, such practices are practically non-existent, such as in parts of the North Sea, whereas in other regions it is still common to flare gas that you cannot exploit given existing infrastructure. In addition to this, there are differences between how energy-efficient the upstream production is and also where this energy is sourced from. Certain operations have been 'electrified' and as such are often considered carbon neutral.

Working together
GustoMSC and NOV work together to increase their impact on the market. Not only to seize new business opportunities but also to create innovative sustainable solutions, for example, in the field of of Big Data and CO_2 reduction.

Also note that inherently in a tail-end offshore field, you would have a high emissions intensity, given that production levels have declined from a plateau, whereas emissions typically stay flat.

Reducing the carbon footprint through big data

Big data has a role to play in enhancing efficiencies in everything that we do, including the supply chain of the oil and gas industry. With increased efficiencies comes a lowered carbon footprint. And, more in relation to my own profession, big data can help identify and put the spotlight on poor and exceptional performers, which in turn can heighten the bar for operations of excellence. One example here is to start tapping into alternative data sources such as satellite imagery in order to identify methane emissions and then tie that back to the company of its origin.

Stimulating investments

One of the more efficient measures to reduce the industrial carbon footprint would be the introduction of carbon taxes or cap-and-trade schemes, ideally on a global basis. Although challenging politically, this would be a key lever in order to direct investments towards sustainable energy sources. The EU Emission Trading Scheme is the most comprehensive initiative to date. Secondly, putting subsidies into the production and R&D of emerging energy sources is an efficient way of stimulating the cost-competitiveness against traditional energy sources. The German incentive scheme for solar energy, put in place during the mid-2000s, is a good example of a political measure that helped accelerate the cost-reduction of solar energy. Offshore wind is another vertical that has seen costs being reduced by 2/3 over a 10-year period amid politically induced incentives to invest in such capacity.

Offshore energy still relevant in 30 years

Oil is very much about transportation; more than 60% of the current demand for oil is for the transportation of people and goods by road, sea and air. This is also one of the key sectors that is seeing competing substitutes winning their way into increased market share; electric vehicles (EVs) are penetrating the Light Duty Vehicle segment, currently accounting for 30% of oil demand. While the EV technology is also applicable to larger scale road freight further down the road, other alternatives – like hydrogen – are potentially even more likely to win that race in the medium term.

This trend – that the combustion engine in cars is losing ground to electric vehicles – is probably the single most important dynamic that is negatively impacting oil demand. Also – in the same sector – efficiencies of the traditional combustion engine are increasing by some 2% per year. This is where the most dynamic developments will take place in the next 30 years. That said, what still holds true is that population growth and increasing wealth are positive underlying drivers for oil demand, so these forces are working against each other.

Within the more traditional oil and gas industry, we believe that offshore resources will continue to play a vital role in the energy supply. The main challenge is probably to remain cost competitive in relation to other sources for oil, particularly unconventional shale oil resources in the US. This will demand continued innovation in order to improve and sustain efficiencies while at the same time ensuring profitable operations of the supply chain; currently, several segments are not earning a sustainable return to re-invest themselves.

However, society – and, in turn, project operators – will be calling for more sustainable operations. The entire

supply chain – including a design/engineering company like GustoMSC – will have to play a key part in making this happen. The question is: how can the carbon footprint of current drilling operations be minimized? There is also an opportunity for GustoMSC to take part in increasing the competitiveness of offshore wind energy as a renewable power source. This industry has gained a lot of momentum but can only benefit from even more cost reductions. Such cost reductions have so far come with the increased scale of the turbines which again calls for innovation of the equipment needed to handle (install, maintain, decommission) such systems.

CO_2 emissions as a key purchasing criterion

It has become widely accepted that CO_2 emissions are a key driver for climate change and therefore an immense focus to reduce such emissions has emerged. While opponents will always argue that this will come at the expense of economic growth, we believe that the next 30 years will see a further heightening of this focus. CO_2 emissions throughout the supply chain of the energy industry will likely turn into a key purchasing criterion for decision-makers in the procurement of goods and services. We see this already in certain sectors such as with Platform Supply Vessels in Norway.

A carbon-neutral energy system

The combustion of coal for electricity-generation purposes is still the single most important source of CO_2 emissions.
As such, large-scale buildout of renewable energy to substitute this combustion is therefore a key measure.

In addition to the challenge of achieving the necessary scale of the renewable investments, such a scenario comes with another challenge: how to cope with the intermittency of renewable power production. This is a key question that the industry will have to solve, probably calling for a combination of new storage systems, intelligent demand-regulation, etc.
It is technically possible: we have the solutions available to provide carbon-free energy systems. The challenge is to mobilize policies, capital and industry on a sufficient scale and speed to realize it – especially when the cost and benefits of reaching a carbon-free energy system are so unevenly distributed between economies.

About Rystad Energy
Rystad Energy is an independent energy consulting services and business intelligence data firm offering global databases, strategy advisory and research products for E&P (exploration and production) and oil service companies, investors, investment banks and governments. Rystad supports these organizations with insights and extensive analyses. The coverage ranges from global macro trends to detailed due diligence, transaction or court case projects.
By combining extensive industry expertise with full access to their huge inventory of data, Rystad delivers high-quality advice and reports.

Lars Eirik Nicolaisen
Senior Partner & Deputy CEO
"I joined Rystad Energy in 2008 as a young graduate on the lookout for analytically challenging tasks within the energy industry. At that time, Rystad Energy employed 14 individuals compared to the 260 people strong organization that we are today. One of the key features that my career has offered is to see the organization grow – accompanied by both challenges and rewards. An important challenge that we face today – which I think we share with many other stakeholders in the energy industry – is to remain relevant amid the energy transition. We have invested quite heavily in this during recent years."

TELESCOPIC LEG CRANE
THE RIGHT CAPACITY AT THE RIGHT HEIGHT

The offshore wind turbine installation market has matured significantly over the last decade. As an industry, we need to ensure that capable equipment is developed and engineered, in order to support this industry to install these next generation WTGs. In order to enable this, designers and equipment suppliers must continue to focus on purposeful innovation.

The Telescopic Leg Crane has been developed as one of GustoMSC's innovations to address the challenges imposed by the next generation of offshore wind turbines. The required extreme lifting heights in excess of 160 meters above deck with loads of over 1,000 tons and even heavier foundations require a new generation of special heavy lift cranes.

The Telescopic Leg Crane offers an innovative combination of high hoisting height when extended (up to 165 meters above deck) for wind turbine installation and higher capacity when retracted (up to 3,000 metric tons) for foundation installation. Key to these innovations is an integral approach to the design of the jack-up platform and its crane and combining them into an integrated heavy lift tool.

First crane under construction

In 2019, GustoMSC built a 1:20 scale model of the telescopic boom for demonstration and validation. Later in the year, Japan-based Shimizu Corporation ordered a first full-scale 2,500 / 1,250 t Telescopic Leg Crane (TLC) for the in-house developed 142-meter long, 50-meter wide, self-elevating SC-14000XL jack-up. This TLC is capable of lifting loads up to 2,500 tons in retracted mode for foundation installation and, in extended mode, the crane can lift loads up to 1,250 tons with a hook height of over 155 meters above deck.

Planning is underway in Japan for a total of 9GW of offshore wind generation capacity using a new generation of ultra-large-scale wind turbines of 9 to 12 MW in size. Delivery of this jack-up vessel, which will be the largest and most capable in the region, is expected in late 2022.

Gold Medal winner

The Telescopic Leg Crane was awarded Best Innovation 2019 by WindPower Monthly. The TLC was selected as a design for the speedy installation of the next generation of offshore turbines showing huge potential and combining ground-breaking ideas in a radical large-scale crane.

Scan the QR code for a video of the Shimizu project

1,250 T @ 48 M

The extended mode is for installing nacelles of up to 1,250 tons, requiring a total height for the lifting hook of around 165 meters above sea water level.

2,500 T @ 30 M

The retracted position is for hoisting foundations (monopiles and jackets) and other heavy loads up to 2,500 tons. The TLC integrated solution enables fast change between extended and retracted mode during operation.

TELESCOPIC SYSTEM

The technology for the locking and unlocking of the telescopic system is based on the proven concept of the GustoMSC positive engagement "Pin in Hole" jacking system, which is in operation for many years on a large number of units.

BOOM TYPE

Heavy Duty Lattice boom type structure, suitable for an offshore environment and largest telescoping mechanism in existence.

> "I think the future may offer a different picture that combines a more responsible use of hydrocarbons with a mix of renewable sources of energy."
>
> **Assaad Mohanna**

This is the sixth article in a series addressing developments around the theme of working safely and efficiently at sea. In this edition we zoom in on a special event that took place in January, in which NOV employees discussed what part we play in the ongoing energy transition.

> "It's all about creating purposeful innovations."
>
> **Nils van Nood**

THE STARTING POINT FOR A TIPPING POINT GUSTOMSC OFFICE, IN SCHIEDAM, THE NETHERLANDS

NOV employees from across the company met in 2020 at the GustoMSC office in Schiedam, the Netherlands, to take part in a discussion about the future of the energy supply and how we, as NOV, can make a positive contribution to the energy transition. Where do we stand nowadays, and how can the collaboration of the various NOV disciplines create new sustainable solutions?

Assaad Mohanna (NOV Director Business Strategy) and **Nils van Nood** (GustoMSC Managing Director and VP Business Development for NOV Marine & Construction) reflected together with Michael Gaines (NOV Interviewer) on the discussions held, and discussed the future of the energy market.

When the teams came together at the GustoMSC office, what did you find most interesting, insightful or inspiring during that time?
Assaad Mohanna: My most inspiring takeaway from the event we had at our GustoMSC office was how self-motivated participants in that meeting were. Everyone owned and acted as an ambassador of the energy transition for their business or segment. Participants volunteered and had chosen to take time away from their jobs to participate in this new heavy lifting effort. I am proud of the mentality of the people we have in this organization.

Nils van Nood: I arrived at a much better understanding of the depth and the volume of NOV's competency across all the topics we discussed. And, especially for me, the insight into the technology of geothermal hydrogen and carbon capture made me realize that there is a lot more to be gained in the NOV organization. I was quite encouraged by that.

As you talk to some of the customers that NOV has, what trends do they look to be experiencing in their businesses?
Assaad Mohanna: It's important to explore what our capabilities are in developing technology, but, more importantly, to address what our customers and energy developers in the broader energy perspective are doing and asking for. We've identified areas in which our customers are active and that are of interest to us, as well as areas where our existing technology can add value. We do see that our existing customers are active in a wide range

"I believe NOV can develop any solution that the market wants."

Nils van Nood

of areas. For example, some oil companies are already investing heavily in the broader field of clean energy through wind and solar farms.

Nils van Nood: It is key that there is alignment between NOV technology and the demands from new markets. When we really understand the demands in these markets, we can anticipate the developments. A lot can be gained this way. I'm a strong believer that NOV can develop any solution that the market wants. It's about finding the right problem to solve and the right topic to address. That is why we closely monitor the markets to see how they are developing and work in close cooperation with our clients.

When you look at what customers are talking about and what they're focused on, what themes are top of mind for them?
Nils van Nood: In offshore wind, we see that the main drivers are the upcoming larger wind turbines, and how to install these offshore. I think that's the main development that's going on now to drive the cost of offshore wind down. There are a lot of ideas about how to do that differently rather than in the traditional way, that's what I mean with market understanding. The wind turbine manufacturers, for example, are risk averse for the right reasons, so they are not as willing to step into any new technology. Then, it's easy to fall into the trap of developing all kinds of new technology that will not be accepted by the market. It's about making purposeful innovations.

Assaad Mohanna: The most common thing we're seeing is the need to reduce overall costs and make levelized costs of energy feasible without government subsidies and tax credits. We see our clients being faced with a big challenge ahead when it comes to energy storage. As for today, it's not clear yet how they can store energy from alternate sources. Maximizing the use of existing storage technics is a good example of a combination of lower costs and long-term storage, like the potential of empty pore spaces in depleted reservoirs when it comes to storing CO_2 for non-enhanced oil recovery (EOR) purposes. On the business innovation side, I feel that there are large areas of improvement in business model structure and formulation. There is an opportunity today for everyone to create a true alignment between the various players involved in resource development that surpasses limitations in existing business models used today.

If you're looking ahead to 2050, do you believe that oil and gas are still the primary energy source, or do you think that there are other energy sources that complement the conventional solutions?
Nils van Nood: Obviously, the recent developments in connection with COVID-19 and the imbalance in oil supply and demand have changed many things. Before these kicked in and looking at all the scenarios that are being drafted by the International Energy Agency and oil and gas companies, it looked like that there was some consensus. We would most likely be peaking oil and gas consumption between 2020 and 2030. That, of course, doesn't mean that oil and gas are totally unimportant after the peak. A lot of replacement still has to take place, and renewable energy cannot keep up the pace and replace traditional energy sources at that fast pace. The question now is how deep and for how long the recent developments will impact energy and oil demand. If societies change their fundamental behavior with regard to energy consumption there may be a long-lasting impact. But there will certainly be oil and gas demand in 2050, in my estimate, both for energy as well as a component for materials. With regard to energy it's a transition that we are in, and that can go very quickly if there is enough government support. We have seen in Norway how quickly electric cars can be implemented with government support. But we don't see the same government support everywhere.

Assaad Mohanna: After the Paris agreement on climate change that was signed in 2016, the world decided to opt for a more energy responsible future. Since then, the attention for the reduction of emissions and clean energy generation grew and both governments and organizations took it upon themselves to make a difference. While the world today depends heavily on hydrocarbons for transportation, petrochemicals and power, I think the future may offer a different picture that combines a more responsible use of hydro-carbons with a mix of renewable sources of energy.

Which opportunities can NOV develop in the field of the energy transition?
Assaad Mohanna: NOV has always been a large player in oil and gas, but that is not because we're an oil and gas company, but because our expertise lies in building large and complex machines that can move with very high precision and consistency while delivering high-quality performance. This requires a unique set of skills that is transportable from the oil and gas industry into clean energy harvesting. However, the oil and gas industry is where our focus has traditionally been. Capital intensity is one parallel that can be drawn in the renewable industry with oil and gas, and that is precisely where NOV offers added value.

Nils van Nood: The energy transition is heavily supported by smart technology and equipment. A challenge where NOV can make a positive impact. We aim to create the ideas and innovations that our clients need to move forward as the global energy transition takes hold. We need to create solutions to produce energy as efficiently as possible while minimizing the impact on the environment. The key piece there is the alignment between NOV technology and the demands from the, let's say, new or new-ish markets. We are experienced in offshore wind; we know what we are doing in this sector and we see more potential. We are here to extend our offshore efforts, together with our NOV colleagues and our clients, to a global scale.

What really stood out for you from bringing teams together to collaborate, talking about the future and the horizon for NOV, and from this renewable discussion?
Assaad Mohanna: As an enabler in the oil and gas industry, NOV evolved over the years, and that has shaped and reshaped effective ways to develop an oil field. I think what also makes NOV effective in the clean energy world is the permeability of the boundaries between disciplines at NOV. The ability of businesses to tap into the company-wide resources and develop technology jointly, no matter how far disciplines are apart. We have people that believe in the ability of cross developing technology and innovating at the company level as opposed to restricting innovation at the common stream level, like many large companies operate.

Nils van Nood: The one topic that comes to mind is that we found it challenging to really develop the right business model for floating wind for NOV: how we can develop a business model for NOV, as a whole, to benefit most. And what I found really interesting is that participants enthusiastically took on that challenge and offered their help and assistance. My takeaway there, is that there's so much competency, quality and insight in the organization, and it's really encouraging to see those people joining forces and trying to see and to determine the best way to support new markets. For the energy transition, we all agree, it's not so much completely replacing oil and gas, it's really a transition. It's not a question of whether we must change, it's the great opportunity for us to capitalize on and apply our advanced technologies in supporting the energy transition to everybody's benefit.

Please visit the online version for a video of this discussion:

STRIVING FOR A SUSTAINABLE FUTURE

At GustoMSC, we believe by conducting our operations in a responsible way, we can contribute to a sustainable future. With the introduction of the 17 Sustainable Development Goals (SDGs) in 2015, the members of the United Nations introduced a framework that defines a collective goal balancing the three dimensions of sustainable development: economic, social and environmental. As pioneering engineers, we contribute to several goals and intend to increase our positive impact.

GustoMSC sponsors several educational programs, we enable the offshore wind energy market since the beginning, we seek partnerships and are consistently investing in innovative solutions that reduce the carbon footprint in the offshore oil & gas markets and make sure all of our employees work in the safest way possible.

We also realize we have a responsibility to mitigate negative impact. Our goal is to limit our impact on the environment and the ocean and help our partners to find solutions to mitigate environmental risks.

Potentially big impact
Through our products and services and the way we operate in our market we can have a positive impact on the following goals
4 Quality Education
7 Affordable & Clean Energy
8 Decent Work & Economic Growth
9 Industry, Innovation and Infrastructure
17 Partnerships for the Goals

Mitigate risk
Working at sea comes with hazards and risks. GustoMSC is committed to mitigate potential negative effects on people and/or the environment.

13 Climate Action
14 Life Below Water
16 Peace, Justice and strong institutions

Please visit the online version for more information:

PIONEERING TECHNOLOGY

CARBON FOOTPRINT ASSESSMENT TOOL

As a reputable designer of mobile offshore units, GustoMSC has the ambition to assist rig owners in meeting today's demand for lowering their carbon footprint. In order to help quantify the impact of new technologies on the carbon footprint of offshore rigs, a CO_2 emissions assessment tool is being developed.

The increased focus on carbon footprint reduction has sparked the development of a host of new products claiming to reduce fuel consumption. Judging these claims for a particular application in a larger system (e.g. a complete drilling rig) is usually difficult. What may work well for a supply vessel or ferry does not necessarily translate into the same benefits when applied on a drilling rig, as this has a completely different power profile. Therefore, at GustoMSC, we have started to develop a simulation model in order to measure the effect of new technologies on fuel consumption, and consequently the CO_2 footprint.

Approach

Power generation and distribution systems on a modern drilling rig are fairly complex and can involve various sources of power like diesel generator sets, batteries, capacitors, flywheels, and shore power. In order to model the behavior of these systems, a time domain simulation model has been created to gain insight into the power balance at each time step.

The most important input for the simulation model is the required (electrical) power and its fluctuations over time. Many of the current floating rigs are configured with a Dynamic Positioning (DP) system for station keeping and Active Heave Drawworks as a heave compensation system. Both these systems require a lot of power with a highly fluctuating nature. In order to model these loads accurately, the required power is derived from fully coupled time domain simulations of a drilling rig in wind, waves and current.

The operations on a drilling rig do not only consist of drilling with the drill bit on the bottom. Typically, this only constitutes about 45% of the time spent on a well. Therefore, the simulations are divided over several operations such as drilling, running casing, tripping in and out of the well, with a time percentage attached. The other part of the equation that is never constant is the weather. Simulations are run for a set of different weather conditions, again with a distribution attached to describe the amount of time the rig will encounter this weather condition.

The fuel consumption is calculated for every combination of operation and weather condition and afterwards, the results are weighed and summed up to calculate an average daily fuel consumption. The fuel consumption can easily be translated into CO_2 emissions for a given type of fuel.

Preliminary results

Several configurations of a floating drilling rig have been tested using the assessment tool. Both variations in station keeping systems as well as variations in power generation set-ups are tested to see how they affect the fuel consumption and CO_2 emissions. The figure below provides a summary of the results for two designs with two different station keeping configurations, both with Active Heave Drawworks.

Future

To increase the value of the assessment tool, GustoMSC plans to carry out a benchmark study with an existing drilling rig to further validate the tool. In the future, we also intend to include other harmful emissions like NOX, methane and particulates in an equivalent CO_2 emission (CO_2e). We will thus be able to include the potential effect of alternative fuels on the carbon footprint.

For GustoMSC as a designer, the assessment tool is expected to become part of the collection of tools used in the design of new mobile offshore units. The tool will help in weighing design choices not only based on operational performance, weight and/or cost, but also on the impact on the environment.

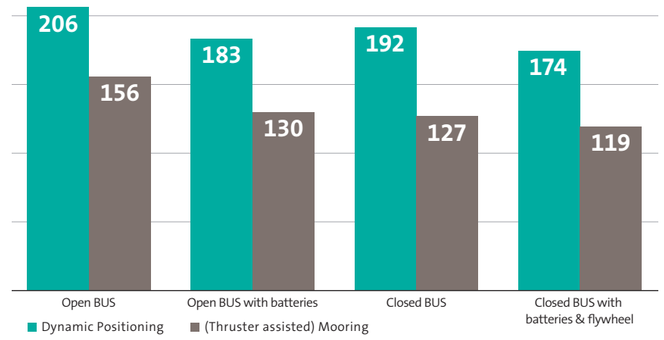
Four different set-ups

Thruster assisted mooring means that the rig is moored with the DP system used only for assistance in heavy weather (about 10% of the time).

The study shows that a reduction of CO_2 emissions of about 87 tons per day (about 40%) can be achieved, going from a traditional DP setup to a thruster assisted mooring setup with a modern power generation and distribution network.

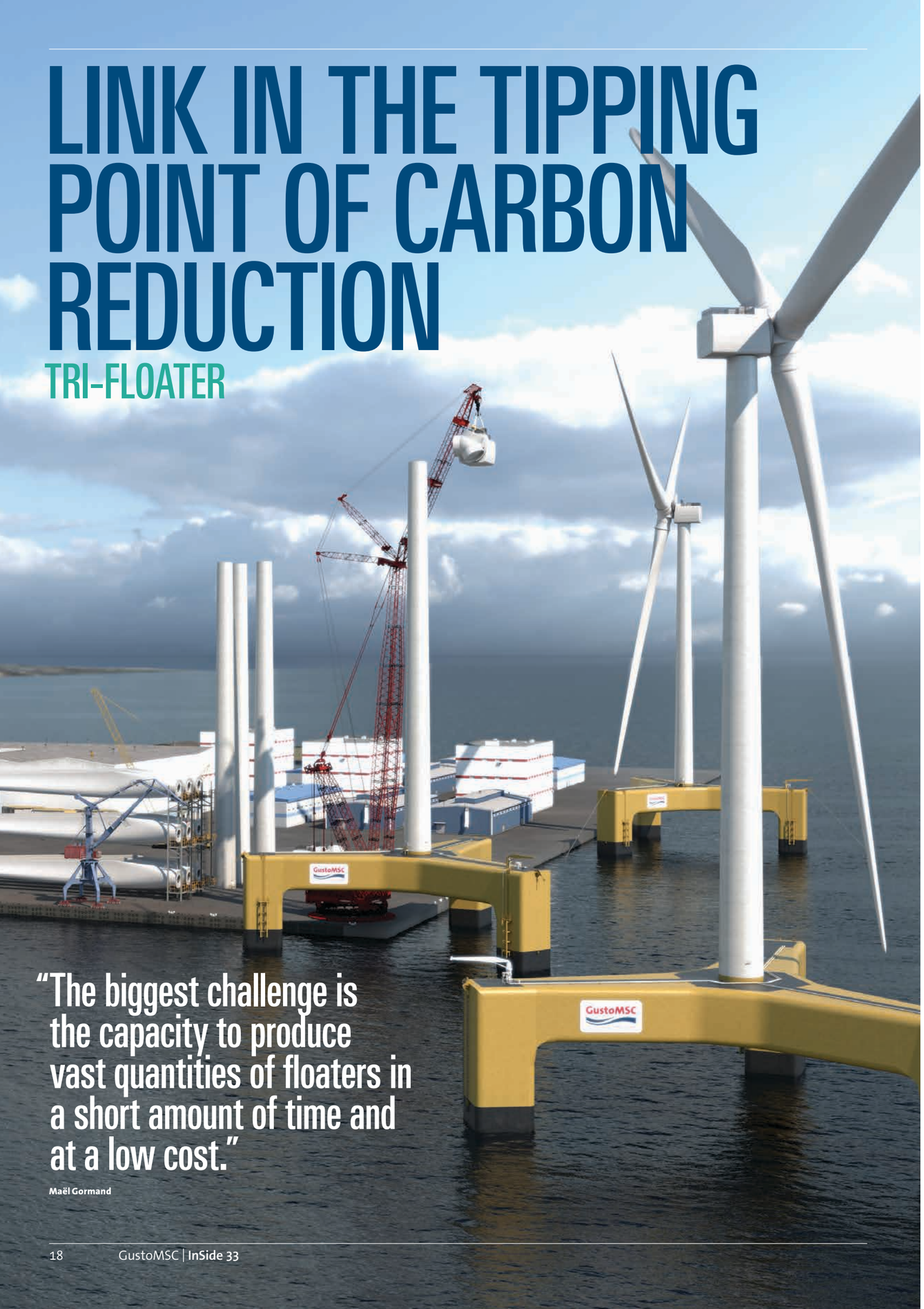
For this purpose, a Key Performance Indicator (KPI) approach is being developed with which cost, safety and sustainability can be quantified. This allows comparison of design alternatives on all these aspects, reflecting an industry that is increasingly balancing costs and the impact on the environment.

Average CO_2 Emissions in Ton per Day



LINK IN THE TIPPING POINT OF CARBON REDUCTION

TRI-FLOATER



"The biggest challenge is the capacity to produce vast quantities of floaters in a short amount of time and at a low cost."

Maël Gormand

Well-established research companies tell us we will be relying on oil and gas for 85% of our energy requirement in 2040. At GustoMSC, we firmly believe that we contribute to a sustainable future by conducting our operations in a safe and responsible manner. For example, by designing floating offshore wind turbines. However, in order to make floating offshore wind turbines economically feasible, the costs will have to be reduced significantly.

The GustoMSC Tri-Floater is a robust and cost-effective wind turbine support structure. The advantage is that this solution avoids having any fatigue sensitive details located below the still water line, where access for inspection and maintenance would be expensive. In this article, **Geir Olav Hovde** (APL) and **Maël Gormand** (GustoMSC) shed light on the pros and cons and the future of floating wind energy.

How do you see the future of floating wind with regard to reducing CO_2 emissions?
Geir Olav Hovde: Floating wind is one piece of the big puzzle of reducing CO_2 emissions around the world. There are many accessible offshore areas with good wind resources. Moreover, offshore wind does not occupy important land areas for other uses, and will also be out-of-sight and out-of-noise for people, and out-of-harm for birds. However, there are potential conflicts with aquaculture, military operations and the fishing industry, but the further offshore and the deeper the water, the easier it will be to find compromises with other interests. In addition, many coastal areas do not have shallow water where fixed offshore wind is possible. In that case, floating wind turbines like the Tri-Floater will offer an attractive alternative.

Maël Gormand: To reduce our CO_2 emissions, we have to drastically push the electrification of our economies (cars, trains, heating homes, industries, etc.). Today, offshore wind offers the high capacity factors necessary to produce large amounts of renewable base power at a competitive price. But with bottom fixed wind turbines, this is only possible in Europe and a few other places. Floating wind is expected to remain more expensive than bottom fixed wind turbines. But it's our ability to provide competitive renewable electricity prices to the areas that would otherwise not have access to it that matters. And the high potential for industrialization of floating wind makes it a perfect contender.

What kind of changes can the Tri-Floater, an innovative design, realize in the offshore wind market?
Maël Gormand: The biggest challenge is the capacity to produce vast quantities of floaters in a short amount of time and at a low cost. The structure of the Tri-Floater is made almost entirely of flat stiffened plates. There are many companies and shipyards that can supply the steel panels that we need in large quantities and at competitive prices. To me, this is the most important innovation of the Tri-Floater. With the Tri-Floater, we can facilitate the high level of throughput necessary to make floating wind a major electricity provider in the world of tomorrow.

Geir Olav Hovde: The Tri-Floater is simple in its design and manufacturing. Inspection and potential maintenance of mechanical components such as mooring line connection hinges and bearings are easy due to dry access. Additionally, the power cable hang-off structure may be located above the water line. Dry access is in general also advantageous for offshore installation work. We therefore believe that the Tri-Floater is a competitive alternative to other floating solutions.

APL, FOCUS ON MOORING

APL, founded in 1993, is one of the world's leading providers of innovative technologies for offshore oil and gas production and transfer. Its foundation was based on the need for a reliable mooring and fluid transfer system in harsh environments offshore Norway and the UK. Today, APL technology, as part of NOV, offers solutions for harsh environments, benign waters, and shallow and deep water, with more than 90 loading systems and 80 turret mooring systems delivered worldwide. APL designs and manufactures cost-efficient and innovative technology with a focus on products in the interface between the seabed and the floating units.

“The big question is whether we can build a supply chain where we combine the best production possibilities, while bringing final assembly close to the installation sites.”

Maël Gormand

What will be the most important innovative drivers for floating wind to become a reality in the world of energy production and energy transition?
Geir Olav Hovde: It’s all about cost, cost and cost. The floater design must be simple and cost efficient in all phases from the drawing board through manufacturing, installation, commissioning, logistics, operation and maintenance. A key challenge is to find a cost-efficient solution that is also robust, because failure of one component may result in a very expensive experience during operation. All relevant experience from industries such as offshore oil & gas should therefore be considered in addition to having a good design process to minimize the risk of fabrication and manufacturing errors.

Maël Gormand: Currently, the size of the floaters and the large quantity of steel that is required are still hurdles for investors. In my opinion, those hurdles will be lifted when the rated power of offshore wind turbines will go beyond 15 MW. With higher and larger rotors, the wind turbine capacity factor will increase, which will make the wind turbines more economical.

What do you see today as the technology and industry challenges to using floating wind?
Geir Olav Hovde: Today, it is the logistics related to the fabrication of the floaters and the installation of the wind turbines on the floater, especially if this needs to be done in open sea where the floater will move due to exposure to wind, waves and currents. Another challenge is to find optimized mooring systems which are low in cost, easy to install and with the lowest possible footprint. With regard to the mooring components, we already see that the connection to the floater will experience more motions than we see for floaters in oil & gas. Building up the knowledge on the wind modeling and the loads from the turbine to the floater is therefore our highest priority, but we are well underway with this and have already gained experience from various studies and we are also involved in joint industry projects.

Maël Gormand: Floating wind needs to start upscaling and to learn by doing in order to gain reliability and reduce its costs. Many technologies exist, and most of the physical phenomena are now well understood by the stakeholders. What we don’t know is how to produce and install in large quantities and what will be the effect of time on the floaters. Luckily, a lot of information has already been collected in the construction of bottom-fixed turbines and many lessons have been learned, knowledge that is applied in floating wind too. On the floater side, it is mainly an industrial challenge. The big question is whether we can build a supply chain where we combine the best production possibilities, while bringing final assembly close to the installation sites.

Will floating wind as a new market play a role in reaching a tipping point concerning the CO_2 footprint?
Maël Gormand: Floating wind is important for reaching the tipping point. It can bring large scale renewable electricity production to the 50% of the world population who have no other choice. If, as an industry, we succeed in lowering our costs and increasing our throughput massively, then we will bring the economical renewable energy surge that the world needs to switch to wide-spread electrification.

Geir Olav Hovde: Floating wind, and then hopefully the Tri-Floater, will play an important role in this aspect. Fixed offshore wind will still be a large market, but many countries do not have access to shallow water suitable for fixed offshore wind and other countries are already

filling up their available shallow water sites. We therefore believe floating wind will be the next big development in the wind industry.

How important is synergy between APL, GustoMSC and other NOV subsidiaries in ensuring that the Tri-Floater is a success?
Maël Gormand: Synergy is essential. What we have noticed during our many years of development is that floating wind is a highly integrated market. All systems need to be integrated into the engineering analysis, because they all influence each other. That’s why our integration into NOV and its family of companies is so important. Together with APL, GustoMSC and other NOV companies, we will ensure that the designs of the mooring system, the mooring connector and the Tri-Floater are fully integrated for the best performance and we will simplify the hook-up to the maximum.

Geir Olav Hovde: GustoMSC, APL and other NOV subsidiaries all have years of experience in design, procurement, manufacturing and installation of components and structures, fixed and floating, exposed to wind, waves and currents. We are very complementary in what we do and deliver, which means that NOV can fulfill most of the client’s wishes when it comes to scope of supply and services. Within the NOV family, we know each other well and co-operate efficiently, which is important for interface management and responsibility.

“Floating wind can bring large scale renewable electricity production to the 50% of humanity that has no other choice.”

Maël Gormand

Please visit the online version for more information:

Geir Olav Hovde
“APL is a relatively small company, but with many years of experience in EPC and EPCI of complete mooring systems, especially turret systems and spread-moored systems. I am positioned in the Technology department of APL where I work on R&D and new concepts.
My background and main field of experience since I joined APL 25 years ago is related to mooring and riser systems, everything from supporting the sales department, conceptual design, FEED studies, detail engineering as well as managing procurement and manufacturing follow-up of mooring components.”

Maël Gormand
“I have been working for GustoMSC for 12 years. I started as a structural engineer. This is how I got involved with the Tri-Floater development 10 years ago. I have been working almost exclusively on floating wind since 2015. I support the commercial and project managers from the technical side and also handle industrialization and supply chain questions. In connection with the latter, I advise shipyards on how to fabricate, assemble and launch the Tri-Floater in order to optimize production as much as possible.”

BOLD TERN INVOLVED IN THE COMPLETION OF THE WORLD'S BIGGEST OFFSHORE WIND FARM

In February, it was one year ago that Bold Tern left the port of Hull in the United Kingdom with the first load of turbines for the world's largest offshore wind farm installed to date: Hornsea One. Approximately one year later, the wind farm became fully operational.

In September 2019, Fred. Olsen Windcarrier's jack-up installation vessel Bold Tern successfully installed its last turbine on Hornsea One. Bold Tern installed 91 out of the 174 turbines at a distance of 120 km from shore, making Hornsea One the furthest offshore wind farm that has ever been built.

The Bold Tern had been installing turbines in tandem with DEME's Sea Challenger. Whereas the Sea Installer participated in the transition piece installation campaign. All three vessels are GustoMSC NG-9000C design jack-ups. A fourth jack-up, GMS Endeavour, a GustoMSC NG-2500X design, has been functioning as a modern offshore hotel to support the commissioning activities from an in-field location.

Hornsea One

Hornsea One is an offshore wind farm located off the Yorkshire coast within the Hornsea Zone in the southern North Sea. At 1.2GW, the project will be the world's biggest offshore wind farm commissioned to date and the first offshore wind farm to have more than 1GW of capacity. The wind farm will have a lifespan of approximately 25 years and will power approximately one million UK homes.

Scan the QR code to see Fred. Olsen Windcarrier's Hornsea One project film

THE PIONEERS OF OFFSHORE ENGINEERING

Please visit the online version for more inspiring content:

GustoMSC
an NOV company

GustoMSC, a subsidairy of National Oilwell Varco, is a reputable design & engineering company of mobile offshore units and equipment. In close cooperation with our clients, we translate experience, science and technical knowledge into realistic & innovative ideas. In this way, GustoMSC enables and supports safe and efficient operations at sea, contributing to a sustainable future.

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