FAYARD

NAVIGATING A ROUTE TO NET ZERO
Energy efficiency first - then new zero-carbon fuels

#energy #efficiency #projects

#EEXI #CII #action

#2022 #modern #shipyard #realaction

Climate change is one of the biggest sustainability challenges of our time.

At FAYARD we have a strong focus on supporting customers regarding the CII and the EEXI improvements, and in optimizing the ships in operations by incremental retrofits.
We are thrilled to work together and to help our customers become more efficient while reducing the vessels' environmental footprint.

QUALITY
ON-TIME
ALWAYS

The BIG Picture

EEDI, EEXI, CII, SEEMP III is Now!

Continuously lowering of the Emissions - on the road towards Zero Emissions.

Energy **E**fficiency e**X**isting ship **I**ndex (**EEXI**).

$$\textbf{EEXI} = \frac{\text{Carbon factor} * \text{SFOC} * \text{Engine Power}}{\text{Vessel Capacity (DWT)} * \text{Reference Speed (Vref)}}$$

Carbon **I**ntensity **I**ndicator (**CII**) **2023 -> 2030** (IMO)

From 2023, the **CII** requirements will take effect for **all** Cargo, RoPax and Cruise vessels above 5,000 GT and trading internationally.

$$\textbf{CII} = \frac{\text{Annual Fuel Consumption} * \text{CO2 Factor} * \text{Correction Factors}}{\text{Annual Distance Travelled} * \text{DWT or GT}}$$

While the EEXI is a one-time certification targeting design parameters, the **CII** addresses the actual emissions in operation.

IMO's target for **2026** is a **11% reduction** of vessels' CO2 emission

Actions in vessels:

- Shaft Limitations
- Engine Power Limitations
- Install Energy Saving Devices
- Convert to Low Carbon Fuel
- Increase vessel capacity
- …

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Energy Saving Devices (ESD)

Innovative Solutions & Incrementally Improvements

for reducing emission to air by less consumption

Find the right solution to stay compliant and efficient.

Our examples on the following pages are

- available to all
- have low OPEX
- fast to implement

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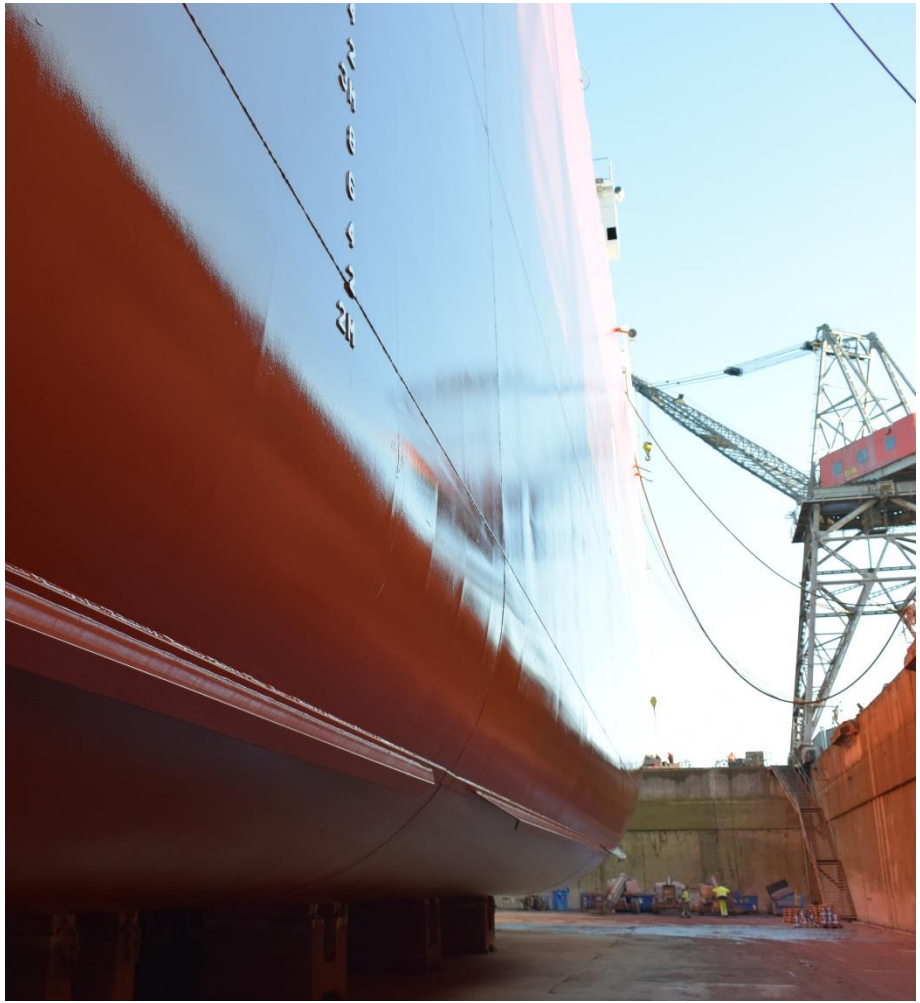
REDUCE EMISSIONS OPTIMIZING THE HULL FRICTION AND THE HYDRODYNAMICS



Silicone Antifouling

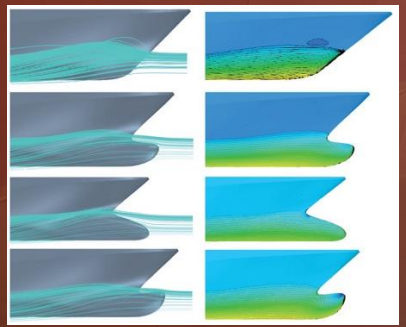
- Reducing resistance on the hull creates significant savings of fuel
- FAYARD meets the higher applying demands this paint system requires:
  - Special equipment needed, including heated sprayers
  - Special processes needed with high level of documentation and accuracy
- Latests projects are made with Hempadur X7

A study - by I-tech, Sweden - reveals vessel idling, coupled with warming waters means vessels are at increased risk from biofouling. The study shows over 40% of the vessels surveyed had a barnacle fouling coverage on the hull of more than 10%.
This level of biofouling could be responsible for at least 110m tonnes of excess carbon emissions.

With the industry still facing its looming IMO greenhouse gas reduction targets and the impending introduction of EEXI and CII for existing ships, these findings should serve as a reminder that a clean hull to be high on the agenda of a fleet's decarbonisation strategy

FACILITIES AVAILABLE FOR APPLYING SILICONE-ANTIFOULING THROUGHOUT THE YEAR

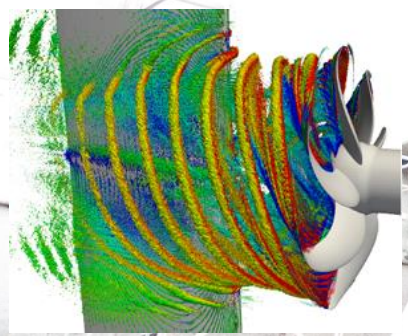
REDUCE EMISSIONS BY HYDRO-DYNAMIC OPTIMIZATION



REDUCE EMISSIONS BY HYDRO-DYNAMIC OPTIMIZATION: *ELOGRIDS*

Reduces fuel consumption about 2 %, which leads to about 500 kilos of fuel saved per day equal to app. 1 500 kilos less CO_2 emissions per day per ferry.
Viking Line / ELOMATIC

REDUCE EMISSIONS BY HYDRO-DYNAMIC OPTIMIZATION



REDUCE EMISSIONS BY RECOVERY OF HEAT IN THE EXHAUST

From waste heat to added value
Retrofitting the onboard boiler solution with boiler technology that recovers waste heat from the main and auxiliary engines offers an emission reduction potential.
Potential is reductions up to 14% on energy use and carbon emissions
(Source: Alfa Laval)

REDUCE EMISSIONS BY AIR LUBRICATION SYSTEM

REDUCE EMISSIONS BY

CHANGING THE PROPELLERS. THESE SHINY BLADES WILL LOWER THE FUEL CONSUMPTION AND EMISSIONS.

JUMBOIZATION: IMPROVING THE PROFIT-ABILITY, EEXI & CII BY LENGTHENING

Control of rotating equipment

- Controlling of e.g. cooling pumps / ventilation fans' speed etc. using e.g. actual monitored temperatures, pressure, torque, volume or ...
- Actual demand operation versus on/off approach
- Less Fuel consumption causes less GHG.
- Less Wear and tear.
- Less noise onboard.
- FAYARD has installed several solutions for this purpose, all having a short return on investment for the Owner, and
  at FAYARD, we use flow control ourselves in our Dry Docks for filling and emptying.
- Saving potential is related to specific vessel and its major operational area.
- Roughly the average saving potential is app. 300t CO_2 per vessel per year.

LED Lights

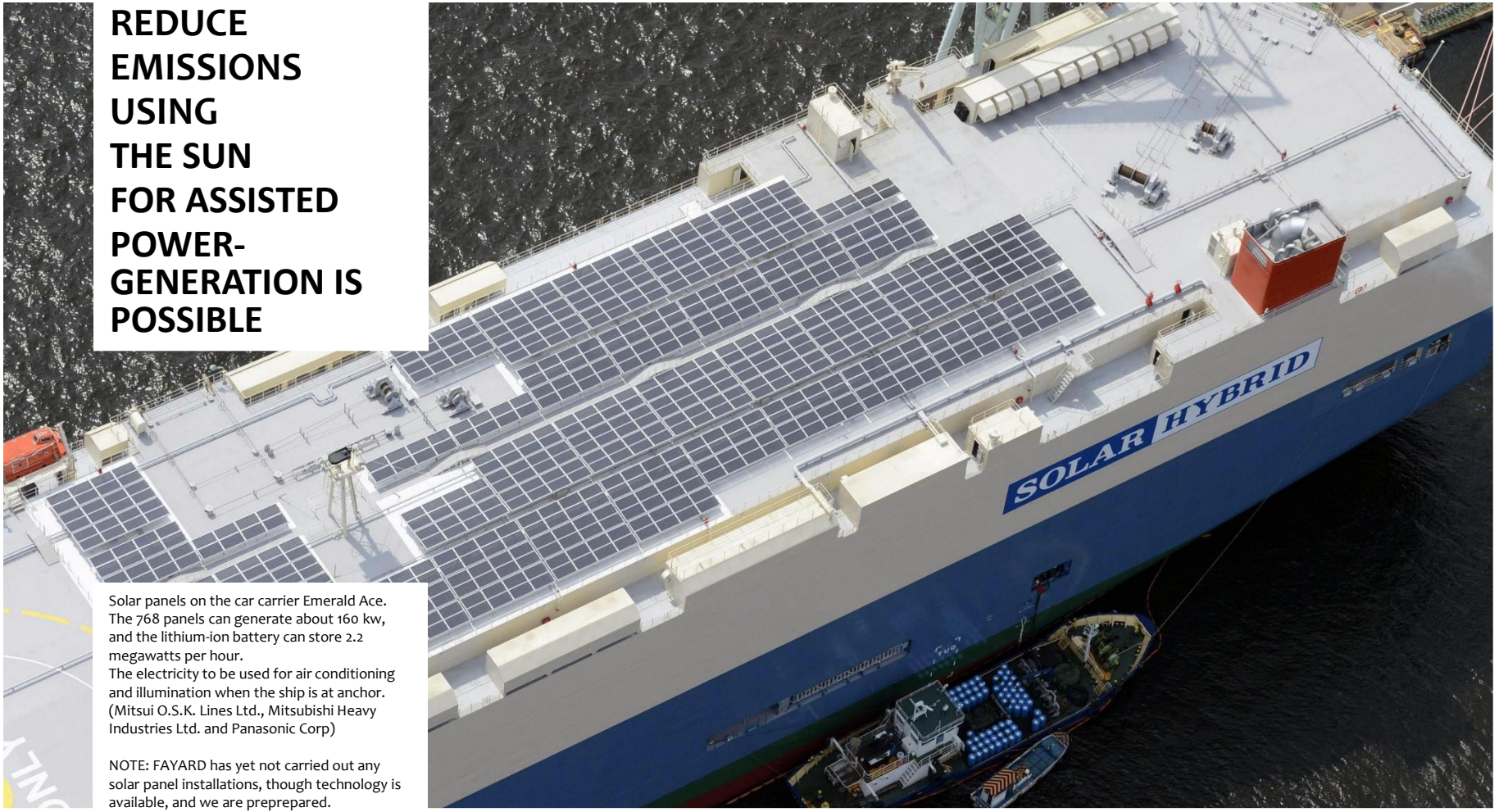
- Replacing the lights onboard with low energy consumers as e.g., LED lamps not reduces the power consumption reflecting lower GHG emissions
- LED lamps also reflect lower heat generation and by such reduces the HVAC requirement.
- Relevant for especially Cruise, Ferries, PCTC vehichles carriers, RoRo vessels etc.

WIND ASSISTED SHIP PROPULSION

AS A DECARBONIZATION STRATEGY

Photo: Juha Hietikko / www.laivakuvat.com

REDUCE EMISSIONS USING THE SUN FOR ASSISTED POWER-GENERATION IS POSSIBLE



Solar panels on the car carrier Emerald Ace. The 768 panels can generate about 160 kw, and the lithium-ion battery can store 2.2 megawatts per hour.
The electricity to be used for air conditioning and illumination when the ship is at anchor. (Mitsui O.S.K. Lines Ltd., Mitsubishi Heavy Industries Ltd. and Panasonic Corp)

NOTE: FAYARD has yet not carried out any solar panel installations, though technology is available, and we are preprepared.

FUEL

FUEL SAVING

COOL4SEA'S COOLING TECHNOLOGY IS DRIVEN BY WASTE HEAT FROM THE SHIP'S MAIN AND AUXILIARY ENGINES. THERE IS NO NEED FOR EXPENSIVE, FUEL-GENERATED ELECTRICITY FOR COOLING.

CO_2

LESS EMISSIONS

A REDUCED ENERGY REQUIREMENT THROUGH ENERGY OPTIMIZATION PROVIDES A LOWER FUEL CONSUMPTION, WHICH RESULTS IN REDUCED EMISSIONS OF CO_2 AND HAZARDOUS PARTICLES.

HFC

NO HFC GASES

THE COOLING TECHNOLOGY DOES NOT NEED ENVIRONMENTALLY DAMAGING COOLANT GASES, USING ONLY WATER AS A REFRIGERANT, WHICH IS BOTH AN ECONOMIC AND ENVIRONMENTAL BENEFIT.

24/7

OPTIMAL OPERATION

THE COOLING ARISES AS A RESULT OF A SERIES OF KEY PROCESSES. TO ENSURE HIGH EFFICIENCY, THE PROCESS CHAIN MUST BE OPTIONAL. THEREFORE, OPERATION OF THE COOLING TECHNOLOGY IS REMOTELY MONITORED 24/7.

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NEW MARITIME COOLING TECHNOLOGY

Patented Cooling Technology, driven by waste heat from the ship's main and auxiliary engines, reduces onboard electricity production, consumption and related emissions.

Technology:	Absorption Cooling
Refrigerant:	WATER
Savings Potential:	90%+
Reduces:	Fuel consumption and CO2/NOx emissions

Scandlines' *Prinsesse Benedicte* has the COOL4SEA cooling solution in use since 2017.

COOL4SEA's patented cooling technology utilizes the ship's waste heat for cooling e.g., the crew quarters, service areas, batteries (ESS) etc.
The cooling system is based on absorption cooling and developed specifically for use on ships.
By recycling the ship's thermal waste energy and utilizing it for heat-driven cooling, the ship's amount of fuel-generated electricity used for cooling can be reduced by over 90%.

The design has high adaptability, with a flexible construction that can be adapted to the conditions of the individual ship. The system is modular and can be carried on board the ship, through the ship's hatches, and installed while the vessel is in operation or at during a yard stay.
The only essential requirement is simply that the technology's key processes can be connected to three external process circuits.

The choice of materials and the minimal use of moving parts give the system high operating reliability and long operational life.

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HYBRID
Energy Storage Systems

for reducing emission to air

Selected Case Stories

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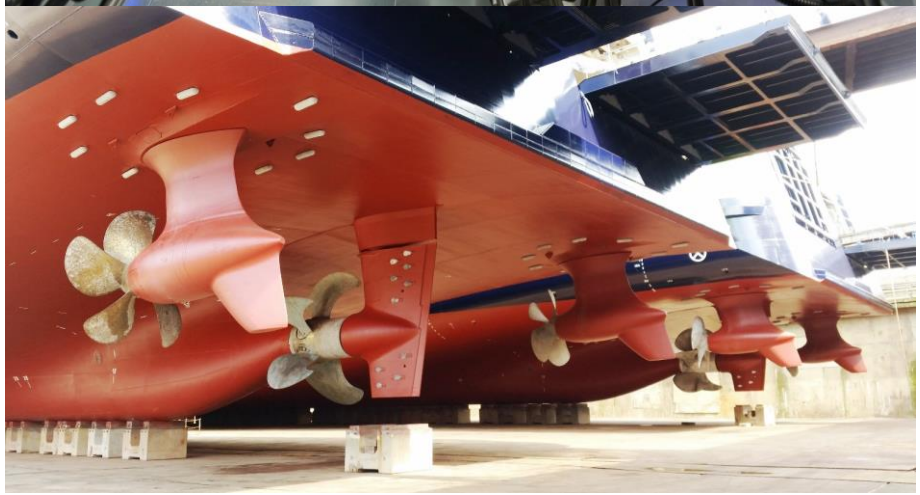
ON-TIME
ALWAYS

Hybrid Energy systems

- Vessels are dependent on always having enough power for vessel operation in all terms
- When one single solution is not the right approach, the securing of the propulsion can be achieved combining more state-of-the-art solutions into one Hybrid Energy system
- At FAYARD we have teamed up with Owners in a wide range of system combinations to achieve the most suitable Hybrid Energy systems for specific vessels:
    - Emission hybrids
    - Fuel system hybrids
    - Power generation hybrids
    - Energy Storage Systems
    - And more to come



Electrical – Electrical Propulsion

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HYBRID Options

- Diesel - Emission controlled by closed loop Scrubbers
- Diesel – Electrical - Emission controlled by closed loop Scrubbers
- Electrical – Electrical - Zero Emission from the propulsion

Scandlines is the first ferry operator in the world introducing a large scale hybrid system, which can store excess energy in batteries on board.

Scandlines' visions of sustainable ferry services go even further. The ambition of the green strategy is ultimately **zero emission**; that is, a propulsion system for the ferries without any emissions.

A key goal is to optimize the fuel consumption of the two new ships for Rostock-Gedser – and to comply with applicable environmental requirements.

This is done by Scandlines' award-winning hybrid propulsion system and by exhaust gas cleaning solutions (closed loop scrubbers), which reduce the Sulphur emissions by at least 90 percent and thereby comply with the 2020 standards for Sulphur limits.

Hybrid Energy systems

- The Northern Offshore Service Vessels are dependent on always having enough power for vessel operation in all terms
- Also, the vessels are required to be compliant to various port restrictions for emission
- At FAYARD we have assisted Northern Offshore Services for upgrading the vessels to HYBRID operation, Diesel and/or Electrical propulsion made possible.
- 4 x Volvo Penta D13-700 DST (Tier 3) engines
- 4 x Volvo Penta IPS900 Q2 props
- ESS made ready for to allow charging by shore power for emission free sailing

Battery power a condition for vessel contracts

DOF CARRIED OUT THE HYBRID CONVERSION OF SKANDI MONGSTAD AT FAYARD

DOF's Skandi Mongstad went to FAYARD for conversion early 2018.

The conversion for battery hybrid operation is now required under contracts awarded by Equinor: All vessels to be equipped with hybrid battery operation, and the possibility of shore power connection. This will allow the vessel to reduce fuel consumption while working in dynamic positioning mode.

Equinor says, that with an ambition of being a leader in carbon-efficient oil and gas production, it is focusing on reducing emissions from its logistics activities. The contract requirement will allow to focus on optimizing our operations to continuously improve operation, safety and energy efficiency.

Hybrid propulsion that combines electric drives, diesel generators and batteries can make offshore vessels more fuel efficient, reducing fuel consumption, CO_2 emissions and enhancing the level of redundancy onboard.

Batteries also smooth the load by compensating for peaks and troughs, as well as enhancing safety and reliability by providing back-up in the event of blackouts.

The ability of battery-based Energy Storage Systems to provide peak shaving, power smoothing and power for dynamic positioning operations, features are especially applicable to OSVs.

Plug-in Hybrid

Color Line's "Color Hybrid"
– World Largest plug-in Hybrid Ship in operation from 2019

The ship has full battery operation in and out of the fjord to Sandefjord inner harbor. The ship therefore does not emit emissions to air from harmful environmental gases and
the noise is significantly reduced. At 100 m distance to the ship, the noise corresponds to a normal conversation between two people.

Passengers	2000
Crew	100
Cars	500
Batteries (ESS)	5MW equal to app 60min maneuvering at 0-12 knots
Power generation	4 diesel electrical engines & Waste Heat Recovery System
Drives	2 CP propellers (16.8MW Mcr)

Onshore power plants for Shore Connections

The company has been a driving force in the establishment of onshore power plants in Norwegian ports. Oslo in October 2011. Kristiansand in 2014, Larvik in 2016, Sandefjord in 2017 and Kiel 2019

Total annual CO_2 emissions are reduced by about 8 000 tons CO_2. In addition, the local environment is saved for large point emissions of NOx, SOx and particulate matter, as well as a significant reduction in noise when the ships are docked.

SHORE TO SHIP POWER

FAYARD's SHORE CONNECTIONs

Reducing emissions to air when in Port, at lay-up and when at FAYARD.

"COLD IRONING" made possible by FAYARD's solution

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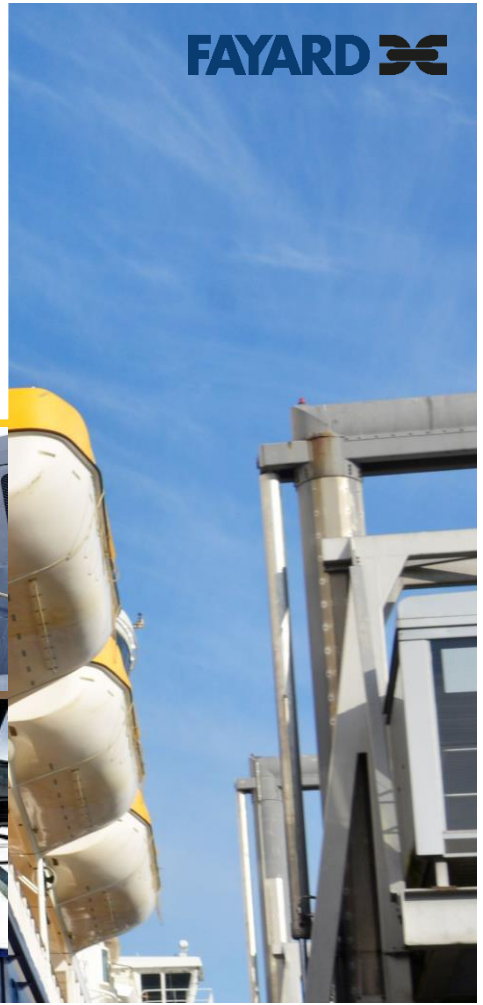
ON-TIME
ALWAYS

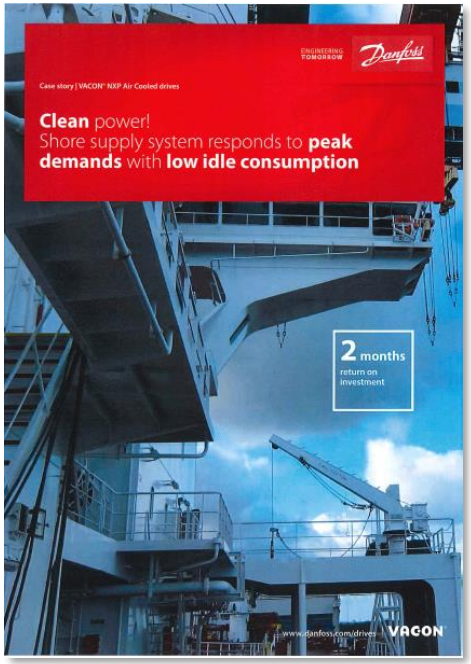
COLD IRONING: LOWER THE EMISSIONS USING SHORE TO SHIP POWER WHEN IN PORT

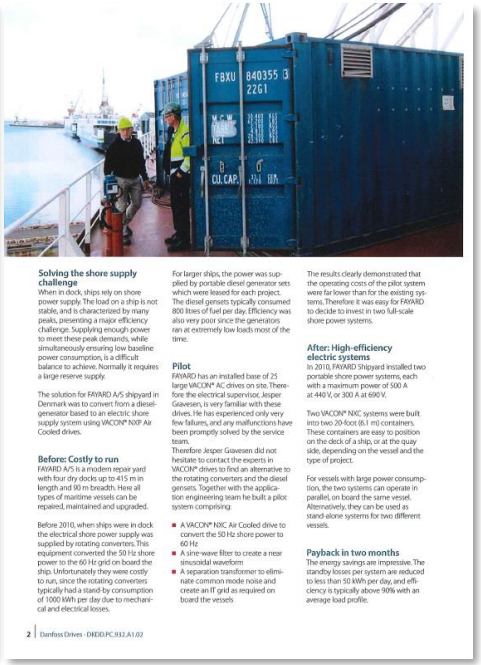


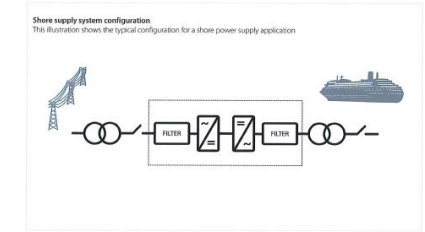
Innovative SHORE TO SHIP POWER – Cold Ironing

Most vessels have shore connecting equipment allowing power supply from ashore when in port or yard.
For the onshore supply of power to the vessel, FAYARD and Danfoss have developed the **"Clean Power"** shore supply system.
At FAYARD we naturally use the solution having 10 systems in use
2019 & 2020: 50% of Provided electricity was from the Wind and the Sun.

We sell, rent, lease the solution to Ports and Owners in need for the right Shore to Ship interface between the domestic onshore power grit and the vessel.







The payback period was calculated to be less than two months, based on:

- Reduced energy cost. The fuel cost for each diesel generator was approximately 43k € for a 40-day project
- Elimination of leasing cost for diesel generators
- Maintenance of the generators no longer being required

Due to the good experience with the first two shore power systems, FAYARD built another system in 2013. The total shore power capacity is now 1500 A at 440 V.
In spite of the turbulent business conditions in the marine and offshore industry, FAYARD has been operating at 75–80% capacity over recent years. The shore power systems run for 180 days per year on average.

Reduced emissions and acoustic noise
As an extra benefit, the working environment at the shipyard has improved, with better air quality and reduced noise. FAYARD is in the process of implementing an ISO 14001 environmental certificate and it is very important for the yard to validate the green company profile. These documented reductions in emissions and acoustic noise provide the much-needed proof.

Innovative SHORE to SHIP POWER

- **Green Energy solution at FAYARD**
  FAYARD has 10 mobile shore connecting power supply systems 300A/690V, 500A/440V & 1500A/440V with Vacon AC drives to provide electricity from the national grid to the app 130 vessels and platforms, yearly in dock or alongside at FAYARD.
- The Shore to Ship solution can supply the required voltage and the required frequency.

The green solution has many advantages:

- Proven Technology – has been in operation since 2009.
- Low exhaust emissions, great flexibility.
- Power, voltage and frequency,
- Lower costs of operation, noise and GHG-emissions.

- The Green Energy Shore Connections are incorporated in FAYARD's ISO14001:2015 certification.

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THE ESTABLIHING OF FUTURE FOSSILFREE POWER REQUIRES SIGNIFICANT MARITME INVOLMENT

QUALITY
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Servicing the full range of Vessels of the offshore windsegment

FAYARD

Emission to Air reductions
NEXT is NOx-Limitation

#NOx
#SCR Catalysator
#DPF Particle filters

Selected Case Stories

QUALITY
ON-TIME
ALWAYS

LOWERING GHG NOX-EMISSIONS BY

SELECTIVE
CATALYTIC
REDUCTION
SYSTEM

Urea tank with dosing unit and control system

Injector spools

SCR Unit no. 3 of 3


LOWERING GHG
NOX-EMISSIONS
BY
SELECTIVE
CATALYTIC
REDUCTION
SYSTEM
gard
FAYARD
2
BASTØ FOSEN

FAYARD

FUTURE FUELS

for reducing emission to air

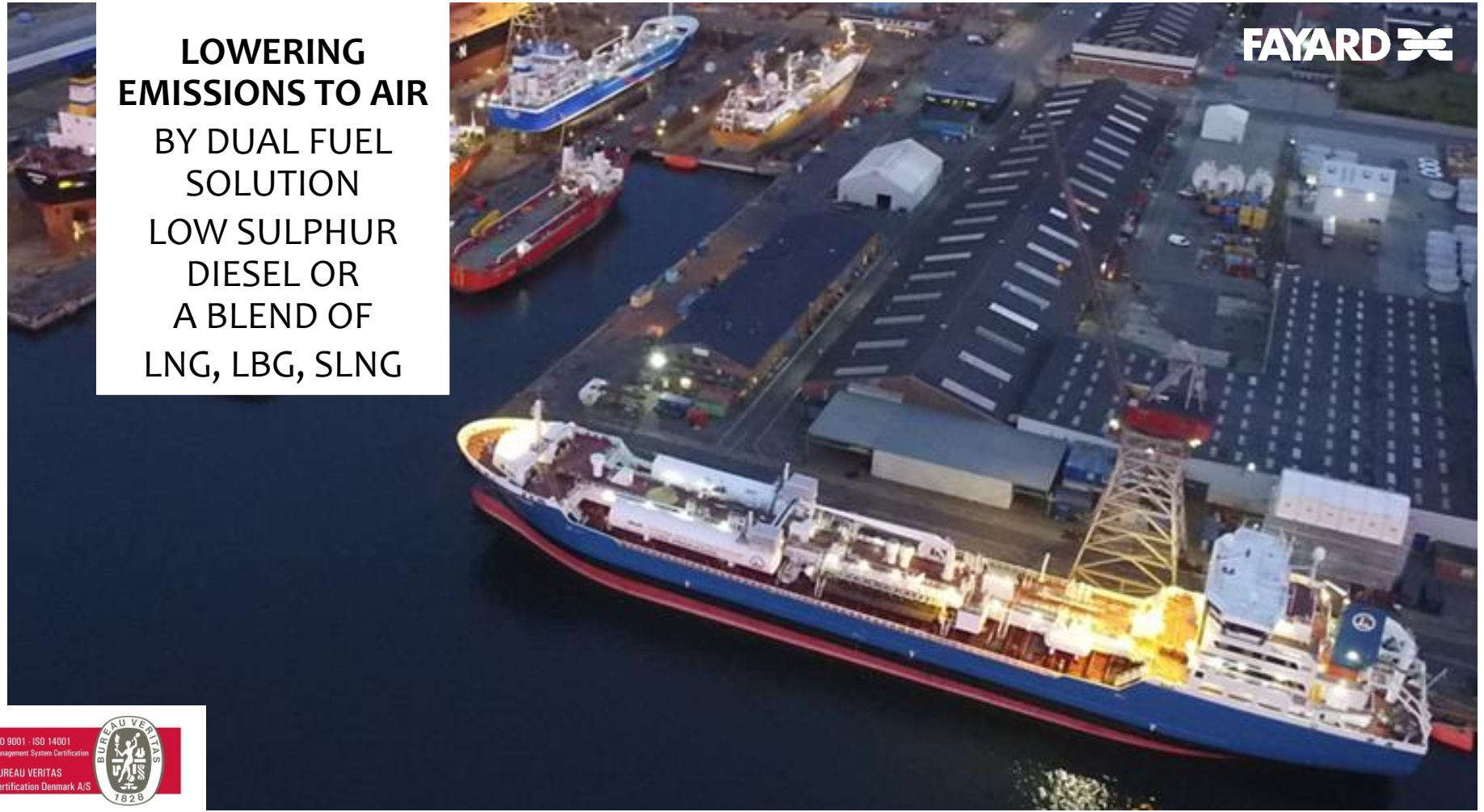
Selected Case Stories

QUALITY
ON-TIME
ALWAYS

LOWER EMISSION PROJECTS

UPGRADING TO DUAL FUEL PROPULSION

QUALITY ON-TIME ALWAYS

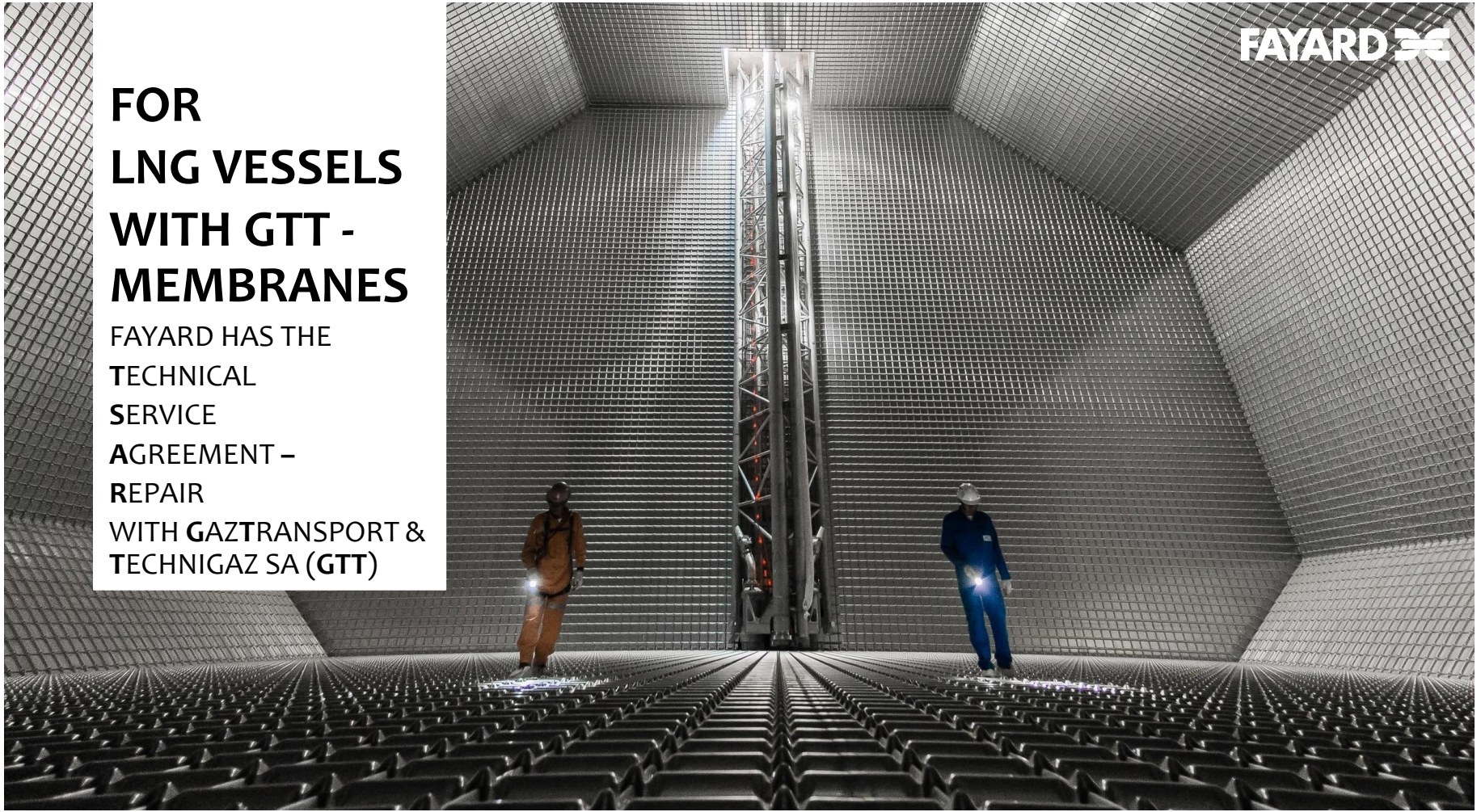


LOWERING EMISSIONS TO AIR

BY DUAL FUEL SOLUTION

LOW SULPHUR DIESEL OR A BLEND OF LNG, LBG, SLNG

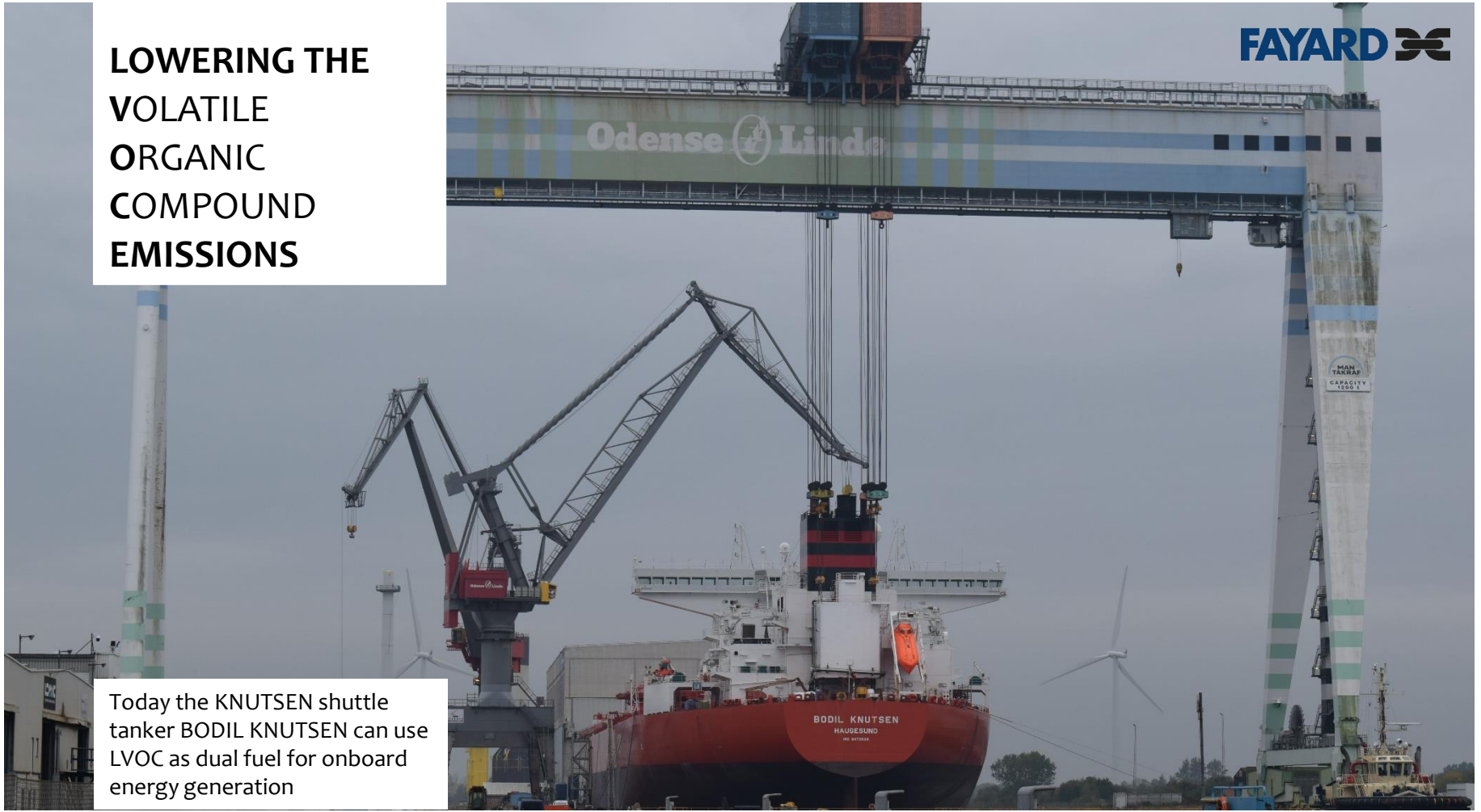
LNG CARRIERS, SECURING THE GLOBAL LNG-INFRASTRUCTURE, ARE ALSO SERVICED AT FAYARD



FOR LNG VESSELS WITH GTT - MEMBRANES

FAYARD HAS THE **T**ECHNICAL **S**ERVICE **A**GREEMENT – **R**EPAIR WITH **G**AZ**T**RANSPORT & **T**ECHNIGAZ SA (**GTT**)

LOWERING THE VOLATILE **O**RGANIC **C**OMPOUND **EMISSIONS**



Today the KNUTSEN shuttle tanker BODIL KNUTSEN can use LVOC as dual fuel for onboard energy generation

How FAYARD handles other Energy Efficiency projects

… efficiently!

QUALITY
ON-TIME
ALWAYS

Making Global Goals Local Business

Improvements Implemented

- We are fully committed to conducting our activities in an environ-mentally responsible manner. In our attempt to run a yard that is as environmentally friendly as possible we have amongst others
- Dry Docks are environmentally Closed Loop systems
- Hull Cleaning by Water Jetting as standard
- Shore Power availability reduces vessel emissions
- Tank Washing Water Receive System (Slop)
- Vessels in Inerted condition allowed
- Lower VOC Emission to air than allowed quota
- Waste Management System in operation
- All Chemicals are stores in Secured areas
- Recycling of scrap materials availability
- LED-bulbs where applicable
- EU-approved Ship-recycling facilities

SDG ACCELERATOR

FAYARD’s special focus on adapting to your requirements means that we are able to take on any roles that you would like us to.

We co-operate very efficiently with makers and owners in Energy Efficiency projects in order to make a clear split of the work in the project in advance, including the following scopes:

- **E**ngineering
- **P**rocurement
- **C**onstruction
- **I**nstallation
- **C**ommissioning

In doing so, we make sure that you will see your vessel handled effectively and that the project progress is fast, and your assets spends the least possible time in yard.

Naturally, quality, safety, and compliance are warranted by our various systems and work ethics.

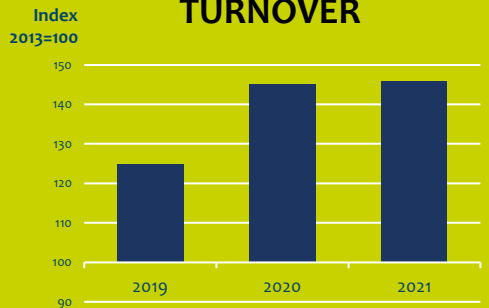
FAYARD – Trusted to Perform

FAYARD

QUALITY ON-TIME ALWAYS

THE NUMBERS

TURNOVER

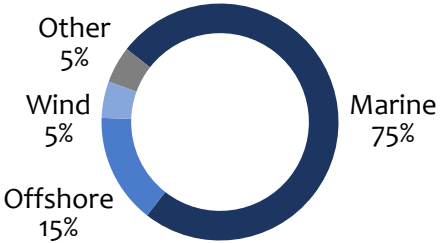


AVG. UNITS PER YEAR

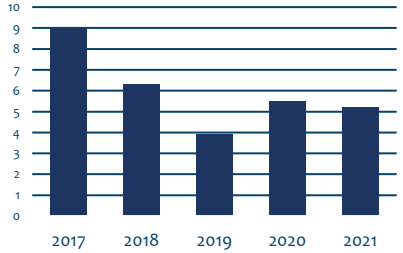
130

AVG. DOCK UTILIZATION

SEGMENTS



OSHA TRIR
(the 200,000 hrs benchmark)



DELIVERED ON-TIME

100%

AVERAGE WORKING HOURS PER YEAR

PART OF TURNOVER FROM RETURNING CUSTOMERS

86%

DOCK AVAILABILITY

100%

Quality - On time - Always

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