Green vessels for a green industry: the offshore wind sector’s race to decarbonise its assets

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Presentation & sponsor documents

Page 2: Carolina Escudero, Vattenfall Network Solutions
Page 11: Arnstein Eknes, DNV GL
Page 23: Andy Newman, Global Marine Group
Page 29: John Olav Lindtjorn, ABB Marine & Ports
Page 37: ABB corporate literature
Page 38: Global Marine Group corporate literature
Enabling Green vessels: Shore to Ship Charging in Ports

Vattenfall Network Solutions

June 10th 2020, Carolina Escudero
Vattenfall at a glance

1909
Founded
One of Europe’s largest producers of electricity and heat. Owned by Swedish State

20,000+
Employees
Main products: electricity, distribution, heat, gas, energy services & solutions

7
Countries
Main markets: Sweden, Germany, Netherlands, UK, Denmark, France & Finland.

£ 13.4 bn
Net sales in 2019

Underlying operating profit in 2019: £2.09 bn

Vattenfall’s Organisation

- CEO
- Heat
- Customers and Solutions
- Wind
- Power Generation
- Distribution
Agenda

1. New capacity requirements in ports
2. How can we enable this future?
3. Key reflections
Quantify the challenge: New capacity requirements in Ports

- Propulsion technologies are responding to the drive to decarbonise marine transport

- Hydrogen and hybrid solutions are increasingly dominating the narrative

- Vessels from other sectors are following suit, due to port emission regulations changes
  - Including an increase in shore-to-ship power requirements

<table>
<thead>
<tr>
<th>Vessel type</th>
<th>Peak capacity required (MW)</th>
</tr>
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<tbody>
<tr>
<td>CTV**</td>
<td>0.5</td>
</tr>
<tr>
<td>Ferry</td>
<td>1.5</td>
</tr>
<tr>
<td>Cruise *</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
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</table>

An example port (without diversity):

*From Shore Side Electricity T&D Europe – Task Force Harbours 2015
** Internal calculations

Is there enough capacity for this?
Port capacity estimates

Offshore wind farms

Nearby ports for transportation

Distribution capacity in nearest substation*

(extract of projects operating and under construction)

*Compared to 10MW capacity according to DNO heat maps

*Desktop study only. Not to be used to planning purposes
How can we have an all-electric future?

• We have to address the following challenges and unknowns:
  • Multiple stakeholders need to be engaged
  • Capacity available doesn’t translate to cheap connections
  • Ports might not want to upgrade their electrical infrastructure without support
  • Who pays for the new onshore infrastructure required?

Vessel operators can progress hybrid/electric projects only to find out that they can’t charge at port, or run on-board loads
Partnerships will get us there

- Funding mechanisms
- Propulsion and Battery technology providers
- Electric Infrastructure Owners
- Naval Architects and Shipyards
- Port Owners/Operators
- Vessel Owner/Operators
Key reflections

• You and your competitors will be required to go zero/low carbon
• Most zero/low carbon propulsion tech will need ship-to-shore power when in the port
• Others will be after connection capacity in the ports
• Acting early and securing capacity, gets you in a better position
• Vattenfall Network Solutions can help you:
  • Securing capacity where you need
  • Providing a funding/ownership mechanism for all the required infrastructure
Thank you
Arnstein Eknes, Segment director Offshore Service Vessels and Special ships, DNV GL

Green vessels for a green industry: the offshore wind sector’s race to decarbonise its assets
2020-06-10, Webinar by Riviera
World electricity generation
Renewable energy trigger new investments
(from 20/80 to 80/20)

World electricity generation by power station type

Units: PWh/yr

The pathway to decarbonisation contain several elements: Carbon-neutral fuels need to supply 30%–40% of the total energy in 2050.
Multiple ship types needed to support offshore wind field operations! Operational profile and key capabilities decisive for each ship.

Which fuel to use?

Crew Transport / Windfarm Service

Service Operation Vessels

Wind Turbine Installation Vessels
Example of operation at Windpark 2 – Arkona (RWE Renewables)
Vessel operations during construction vary a lot

Building phase - 2018

- VOS Stone, offshore support vessel
- Voyages in 2018

Percentage of time in navigational status
- At Anchor: 4%
- Under Way Using Engine: 20%
- Restricted Maneuvrability: 41%
- Moored: 35%

Percentage of time at various speed [sailing only]
Example of operation at Dudgeon windfarm
Movement of a Service Operation Vessel

Source: DNV GL internal, Clarksons, 2020-01-16
Currently 246 ships are in operation with battery installations and 202 are being converted or under construction. 67 are offshore vessels.

By installing battery systems in hybrid configuration; offshore wind vessels can reduce fuel, emissions & operational cost.

Shore power should become industry standard.

Showing delivery year of existing orders only. Future additional contracts will increase the number of battery installations in 2020 and onwards.
The renewable industry can move faster to zero emission technology. Concepts have been launched – qualification of technology is the next step.
A shift in power source – transition is for real

UK renewables generated more electricity than fossil fuels for the first time
The third quarter of 2019 was the ever to see this switch

Fuel flexibility and bridging technologies - the three pillars

**Bridging** technologies can facilitate the transition from traditional fuels, via fuels with lower-carbon footprints, to carbon-neutral fuels.
One possible pathway; Fuel mix towards 2050 in the ‘Design requirements’ pathway

In all three pathways modelled, liquefied methane (both fossil and non-fossil) ends up dominating the fuel mix.
Green Vessels for a Green Industry

CWind CTVs in the Post Carbon Future

Andy Newman – June 2020
Emissions and Safety

1. What does a typical 24 PAX CTV emit?

*In 24 hrs...*

A. 2700L of diesel (average car uses ≈950L / year)
B. Emits 27kg No$_x$
C. Emits 7te of CO$_2$

We are committed to reducing our impact.
Other Reasons to Not Like the Status Quo

1. Fuel price fluctuates. Difficult to contract and include fuel.

2. Diesel is difficult to transport to site and dangerous to store.

3. Vessel trim and weight changes as fuel is consumed.

4. ICE involve lots of moving parts. Failures.
The Future

From this...

The linear economy

To this...

CIRCULAR ECONOMY
Example

Hybrid SES CTV

Net Result:
1) Fuel savings of >12%
2) Transfer height improved by 20-30%
3) Shore-Site voyage time reduced by 30%
We are answering the chicken and the egg question!

By having a viable hybrid option now we:

1. Are developing an all-electric propulsion system
2. Open up offshore charging opportunities.
3. Make ourselves H2 ready. Fuel cells can replace *some* of the diesels to test without adopting an “all or nothing” approach.
4. Are encouraging a long term, benefits led approach.
Electric. Digital. Connected. Green vessels for a green industry

Supporting the offshore wind sector’s race to decarbonise its assets

John O. Lindtjørn
Our Vision

The Future of Shipping will be...

**Electric.**

**Digital.**

**Connected.**

Simpler. Greener. Safer.

Simplicity

Mechanical power train

Electric power train

Electric is more efficient, simpler, flexible, more digital & better integration
Electric. Pathway to carbon-free shipping

Transitions in fuel and technology

Energy carriers
- Ammonia
- Methanol
- Onboard reforming

Technology
- ICE + energy storage
- Fuel cell demonstrator
- Zero-emission port call or port stay
- Shore charging
- Shore connection
- Battery systems
- Fuel cell modules (PEM)
- MW scale fuel cell system (ABB and Ballard)

Carbon free shipping 2040
Current State of the Art: hybrid DC based Propulsion systems

Currently 400 ships with batteries in operation or in constructions globally *

* Source: Maritime Battery Forum
On the Horizon: fuel cell projects in shipping

Hydrogen fuel cell technology demonstrators

A 100 kW pilot container for U.S Coast Guard
A prototype of 165 kW fuel cell system onboard a research vessel

100 kW fuel cell installation for Royal Caribbean Cruise Lines

400 kW fuel cell installation on a fully hydrogen powered vessel for Compagnie Fluviale de Transport (CFT)

Maritime fuel cell project by Hydrogenics (2017)

MARANDA (EU H2020) arctic research vessel

FLAGSHIPS (EU H2020) river pusher vessel
Fuel cell technology demonstrator (2017)
Pathway to carbon free shipping: Fuel Cell

- Small river vessels: 100...200 kW fuel cell modules
- Ferry & River cruise: 1-3 MW generating units
- Harbor operation of large ships: 3-5 MW generating units

ABB & SINTEF
Ocean hybrid laboratory

MW-scale marine fuel cell unit by ABB and Ballard
Offshore Wind Farm Vessels

With rising demand for wind power, there is an increased need for wind turbine installation vessels, service operation vessels and cable laying vessels. ABB’s electric, digital and connected solutions help these ships enhance safety, efficiency and sustainability of operations.

Highlights

- Pacific Orca - a Wind Turbine Installation Vessel (WTIV)
- Wind of Change - a Service Operation Vessel (SOV)
- NKT Victoria - a Cable Laying Vessel (CLV)
- The floating filling station: bunkering zero-emission fuel at sea

Solutions for newbuildings

- 800xA - an integration platform for vessels
- ABB Ability™ Marine Pilot Control
- Advanced Power Systems
- Azipod® D
- Energy storage
- Fuel cells
- OCTOPUS - a real time vessel advisory tool
- Onboard DC Grid™
- Service agreements
- Spares and consumables
- Training
- VFD Jacking Control System

Solutions for existing vessels

- Containerized energy storage
- Extensions, upgrades and retrofits
- Maintenance
- Remote troubleshooting and on-call repair
- Service agreements
- Spares and consumables

new.abb.com/marine
HYBRID SES

OVERVIEW
The Hybrid SES offers a step change in operational capability, performance and efficiency for a CTV operating in support of offshore wind farm O&M and construction activities. With a high crew transfer wave height capability, it presents a significant increase in operational days offshore, whilst the hybrid propulsion system results in significant reductions in fuel consumption and the associated CO₂ emissions. The highly innovative surface effect hull form and associated heave compensation, ensures a high degree of comfort for all passengers and crew.

KEY CAPABILITIES

<table>
<thead>
<tr>
<th>Class</th>
<th>BV</th>
<th>HULL</th>
<th>MACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Farms Service Ship - S0, sea area 2 (2.5m Hs) ELECTRIC HYBRID (PM, ZE) MCA HS-OSC, Cat. 1</td>
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</tbody>
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| Hull material | Aluminium |
| Deckhouse material | Composite |
| Passengers | 24 |
| Crew | 3 |

DIMENSIONS

| Length overall | 22m | Fwd deck space | 30m² max |
| Beam | 8.9m |
| Draft | 0.5m on cushion/1.6m off cushion |

TANK CAPACITIES

| Fuel | 14,000L |
| Fresh water | 400L |
| Black water | 400L |

MACHINERY

| Main engines | 2 x Scania DI 16076M @809kW |
| Propulsion | 2 x RR Kamewa S50-3/CA |
| Gearbox manufacturer | ZF or Twin Disc |
| Electric generator/motors | 2 x 130kW |
| Electrical power bank | 75kWh |
| Centrifugal lift fan | 1 x 200kW |

PERFORMANCE DATA

| Max speed | 33kts/38 kts (with 30min battery boost) |
| Service speed | 27kts | Deck strength | 1,500kg/m² |
| Fuel consumption per hour @ full speed | 330L/hr | Max deck cargo | 5Te |
| Fuel consumption per hour @ service speed | 180L/hr |
| Motion damping | Active pressure/airflow control of air cushion for heave damping Active transom interceptors for rolling damping and trim control |

PART OF THE GLOBAL MARINE GROUP
**INTERNAL EQUIPMENT**

**Accommodation**  
Fully air-conditioned, personalized seating for passengers and crew. Galley area with microwave, fridge, hot water, and separate seating area. Changing area with lockers and shelving for technician bags.

**DECK EQUIPMENT**

**Fuel transfer**  
Yes, up to 12m³

**HP washer**  
Yes

**Crane**  
Foundation and services to power the unit shall be prepared for later installation of a specific crane.

**NAVIGATION/COMMUNICATION EQUIPMENT**

**Radar**  
Two high speed radars one X-Band, 9Ghz and one broadband 4G radar

**Electronic chart**  
ECDIS

**AIS**  
Class A

**Compass**  
1 x type approved magnetic compass  
1 x gyro compass

**Depth sounder**  
Integrated with navigation system

**Crew finder**  
Rothena

**VHF**  
2 x VHF radio telephones, fixed with DSC and DSC Watch Receiver

Figures are indicative at time of publishing and are subject to change.

For further information on CWind please visit: [CWIND.GLOBAL](https://www.cwind.global) or contact our sales team.  
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