

# OFFSHORE CHARGING SOLUTIONS

- FULLY HANDSFREE CHARGE PROCESS
- AQUARIUS PLUS: 2 TO 8 MW CHARGING
- AQUARIUS ECO: 0.5 TO 2 MW CHARGING
- MODULAR & FAST INSTALLATION
- TURNKEY INTERFACE W/ ASSET & VESSEL POWER & CONTROL SYSTEMS
- FIELD PROVEN TECHNOLOGY @ TRL8
- LOW MAINTENANCE & OPEX
- LOW CAPEX
- CLASS APPROVAL



# 01

## WHY CHARGING OFFSHORE

Decarbonisation of O&M fleets operating in wind farms is being gradually implemented because of increasing regulatory constraints forcing reduction in fuel oil usage, coupled with incentives through Contracts for Difference (CfD), grants, subsidies, and the rapid downward trend in technology costs.

The decarbonisation goal is achievable by either burning of alternative and expensive "green" fuels and/or through vessel electrification and the use of batteries charged at regular intervals.

Electrical solutions are particularly suitable for wind farm O&M fleets specific operational profiles, due to the possibility of regular charges directly at offshore energy production sites and at shore-based quay sides.

Electrification is now considered a highly viable solution because of the constant improvement in battery technology and energy density coupled with rapid downward trending of CAPEX costs, as well as because of the gradual availability in the market of economical and reliable onshore and offshore charging solutions.

Additionally, the operational safety track record in marine industry applications, in particular for ferry fleets, are a driver for vessel designers and owners shifting to battery ready O&M assets.

Fast-growing fleets of fully electrical/ hybridised CTVs and e-ready SOVs are now coming to market through Bibby, Damen, Rieber, Edison Chouest, Tidal Transit, NSS & others.

By allowing fast & safe CTV & SOV battery charging at any time while in operation at offshore wind farms, the offshore charging infrastructure, installed on either sub stations, turbines, or other dedicated structures, is deemed to be the technology key enabler in decarbonisation of O&M activities. Battery capacity & CAPEX constraints, as well as vessel's payload limitations will, in most cases, not allow for a full base to base cycle of operation on a single harbour charge, without charging offshore or extensive alternative fuel consumption.



# 02

## CHARGER INSTALLATION

Planning the installation of charging units on new build wind farms is relatively straightforward and economical, if a few simple engineered add-ons are considered early at the offshore asset design stage.

Mechanical modifications required to a typical wind turbine transition piece or substation designs are minimal.

The charging unit can also be easily fitted on a small dedicated monopile if access to turbines or substation are not practical.

Offshore Assets fitted with "Ready for Charging" add-ons, remain fully operational, with no access and workability limitation for maintenance Vessel operations.

The charger modular design approach allows rapid mobilisation/removal at any stage during the life of the wind farm, without any disruption or risk to field production.

If not installed at initial field set up, the "ready for charging" add-ons permit charger installation at a later stage, possibly combined with maintenance campaign for optimum cost control. Allowing ½ day for lifts in position and 1 to 2 days of a small team transported by CTV for hook up of each charger unit.

# MET-OCEAN LIMITS

# 03

The MJR Charging System is designed to service both CTVs or SOVs through simple, safe and **fully hands-free** charging processes.

With a wide 0.5MW to 8MW range of power transfer options, the charger can operate from any offshore asset rated for the purpose: WTG fixed or floating, OSS, Dedicated Mono Pile, or Mothership

## MET-OCEAN CHARGING LIMITS:

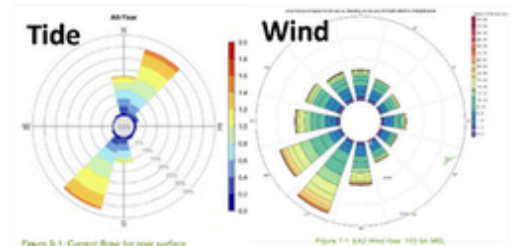
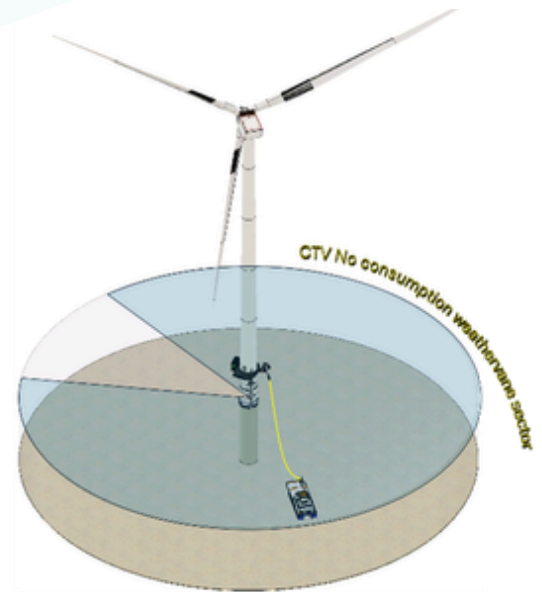
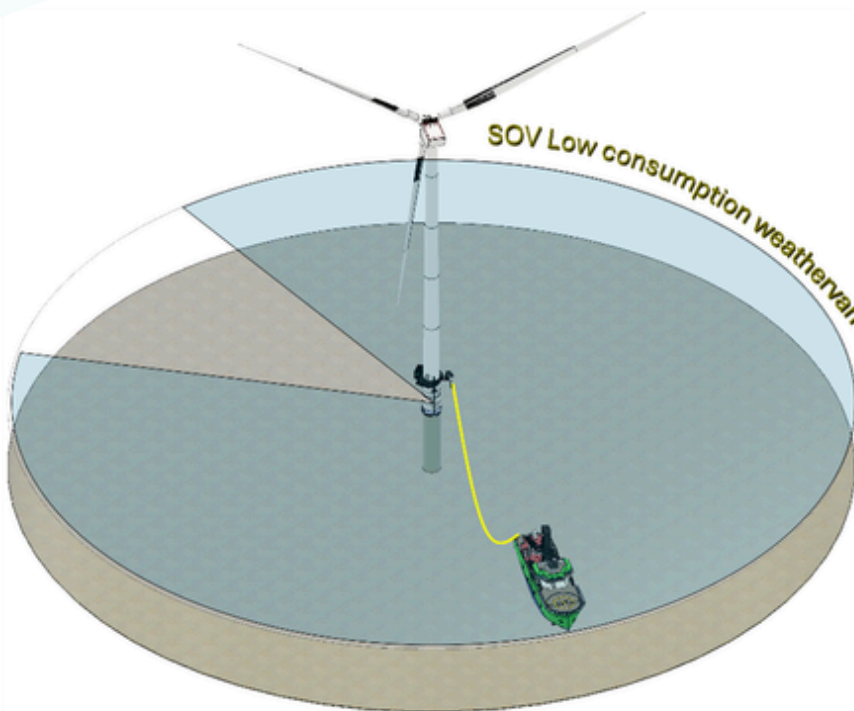
- Connection of the charger to the vessel is designed to be possible in conditions far worse than the limits for personnel and cargo transfer. Typically, 1.5 to 2m Significant Wave Height (Hs) for CTVs and 3 to 3.5m Hs for SOVs.
- Power transfer and disconnection stages have higher Met-Ocean thresholds with the limit driven mostly by extended footprint station keeping ability for the SOVs.
- The charger's wide sector slew function allows Vessels to safely connect in "blow away from asset" weather vaning **in all tidal and wind conditions** (graphic below).

Through connection to the Inter Array network, power to the charger remains available at all times, even if the turbine is shut down or in the rare cases where the field does not produce because of lack of wind.

For electrical in-field operations, CTVs typically require chargers in the 1 to 2MW range.

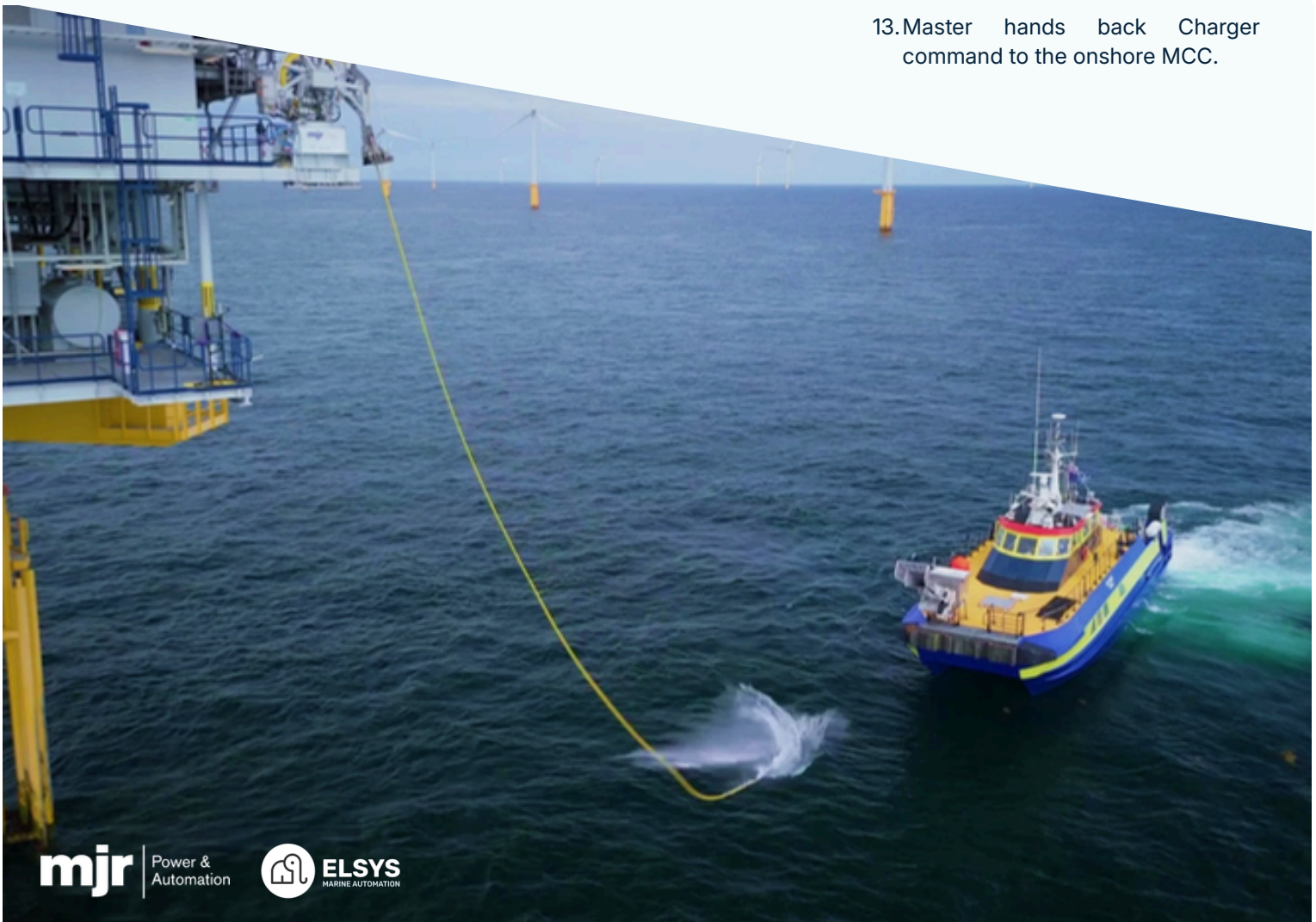
Larger CTVs and SOVs will require 2 to 8MW chargers, depending on Vessel specific consumption and operational profiles required to cover daily tasks.

If the field is intended to be served by an electrified O&M fleet for the medium or long term, the recommendation is to prepare 2 to 4 "Charger ready" locations on WTGs or OSSs in order to guarantee redundancy as well as flexibility in case of future field extension.



# 04 CHARGE OPERATION

1. The vessel books a charging slot and requests Charger access from the onshore Marine Control Centre (MCC).
2. Charger in built compensation and safety functions **allow by design for connection in Met-ocean conditions above personnel & cargo transfer limitation**.
3. Vessel positions within safe distance from asset.
4. Vessel connects. No personnel are required on deck at any stage. The process is fully controlled remotely with a high degree of automation to minimise human errors & risk level.
5. Vessel moves to safe downwind charge position.
6. Vessel is now on minimal economical thrust, and Master/DP Operator powers up umbilical remotely to initiate the charge process.
7. Reeler **automatically** maintains charge cable tension below maximum pre-set threshold to guarantee system is never mechanically stressed and adjusts the catenary dynamically.
8. Reeler function permits vessel weather vaning, **allowing for charging operations in any prevailing weather directions** and guaranteeing vessel drifts in safe blow away from asset in case of any blackout or other failure.
9. The Master can at any time release the connector to free the vessel. Subsea rated connector is ejected in water and reeled back to asset. Charge process can be immediately re-initiated without any maintenance.
10. In the event of a blackout or malfunction on either the vessel or asset, charge power is instantly shut down and the connector is released by either Master's command on the console, or passively on overload above pre-set safe threshold.
11. At end of charge cycle, the Master/DP operator de-energises system and moves towards asset.
12. Connector is released and reeled back clear of splash zone.
13. Master hands back Charger command to the onshore MCC.



# 05

## CAPEX & OPEX INDICATORS

Bibby Marine operational assessment for their new 90m e-SOV currently under construction, indicates 25 MWh of battery capacity combined with a 6MW offshore charger allows for nominal full electrical zero emission in-field operations, with a single charge during the night-time idle period.

Current e-SOV CAPEX is 10-15% higher than its MGO equivalent, but OPEX (day rate + energy rate) is already competitive through the significant vessel energy costs savings, in the range of £1M/ year, offsetting the CAPEX delta well within the usual long term charter period & making e-SOVs competitive from 2027 as soon as ETS is enforced.

Noting that e-SOV CAPEX (as for CTV) is on a downward price equalisation trend with MGO units.

Tables below, from Bibby Marine's Feb. 25 energy costs comparative review, is illustrative of the current status. It is based on average emission taxation of \$100/ T of Co2 (whether ETS, IMO or FuelEU generated).

STANDARD SOV Operating on Marine Diesel	
Daily Fuel Consumption	5 Ton
Avg bunker price	\$ 750 / Ton
Fuel Cost / Day	\$ 3,750 / Day
CO2 emission equivalent	15 Ton / Day
Carbon tax cost / Day	\$ 1,500 / Day
TOTAL ENERGY COSTS	\$ 5,250 / DAY
	\$1,575,000 / YEAR
	\$ 39,375,000 / LIFE SPAN

e- SOV 100% Electrical operations	
Daily Electrical consumption	16.6 MWh
Avg charge power pricing	\$ 70 /MWh ( Base case strike rate)
Energy price / Day	\$ 1,162 / Day
Carbon tax costs/ Day	Nil
TOTAL ENERGY COST	\$ 1,162 / DAY
	\$ 348,600 / YEAR
	\$ 8,715,000 / LIFE SPAN



<b>Energy Costs savings</b> <b>&gt; 75%</b>
<b>\$ 4,088 / Day</b>
<b>\$ 1,226,400 / Year</b>
<b>\$ 30,660,000 / Life span</b>



- Assumptions:**
- \$100 carbon tax per Te of CO2
  - 3 Te CO2 / Te marine diesel oil burnt
  - Average MDO Bunker Price – Rott. 2024
  - Electric cost Jan 2025
  - SOV Operation days: 300 /year
  - SOV life span: 25 years

OPEX minimisation and guaranteeing a charger durability equivalent to the field life cycle are key parameters for the on-asset charge equipment. This is achieved through:

- Ensuring all equipment is asset mounted and remains easily accessible to maintenance technicians.
- Mechanical components are well clear of splash zones and protected from UV radiations, birds and weather.
- Sensitive electrical and electronic components are in enclosed climate-controlled areas.
- Selection of marine grade proven standard components .
- Design based on standard, simple & proven offshore equipment technology.
- Extensive qualification process for main components exposed to high duty cycles.

Several preventive maintenances strategies & means of controlling wear are implemented to anticipate potential failures before they actually happen.

## SYSTEM LIFECYCLE

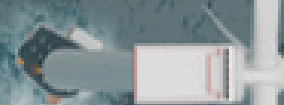
Although it is anticipated that technology changes during the lifetime of the field may call for upgrade of the charging equipment after a certain period, the system is originally designed (with adherence to a maintenance program) to match the windfarm's 25 to 30 year lifetime.

Noting that the Reeler and Step-Down unit modular mobilisation designs allow for easy removal/change out at any stage if required.

## MAINTENANCE CYCLES

All Inspection, maintenance and overhaul operations can be managed by standard marine spread (CTV or SOV° and a small team of technicians.





## WEBS

<https://www.mjrpower.com>  
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