Operations and Vessel Tracking for a Tow-to-Port Maintenance Strategy at the Kincardine Offshore Windfarm

Kaiser Saeed & Laura De Melo Corgosinho

Academic Supervisors – David McMillan, Maurizio Collu, Stephanie Ordonez Sanchez (EEE, NAOME, MAE)

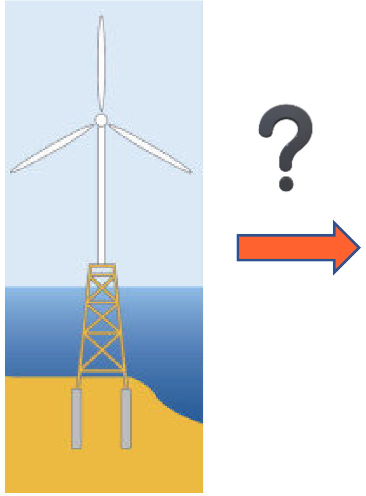
Industry Supervisors – Nassif Berrabah & Tom McCombes (EDF R&D UK, First Marine Solutions)

EERA DeepWind Conference 2023

Outline

- Motivation
- The first major component failure of a FOWT
- Maintenance operation timeline
- Turbine disconnection & reconnection
- Turbine tow-out and tow-in
- Vessel costs and fuel consumption

Motivation



- Deployment in deep waters of up to ~300m
- Availability of an unlimited & constant wind resource
- Allow the use of low-cost, readily available vessels
- Less-invasive activity on the seabed during installation

O&M

Float technology

Vessels

Weather

OpEx costs

The first major component failure of a FOWT

Kincardine floating wind farm facing turbine repair job

Wednesday, May 4 2022

WIND ENERGY – FLOATING WIND

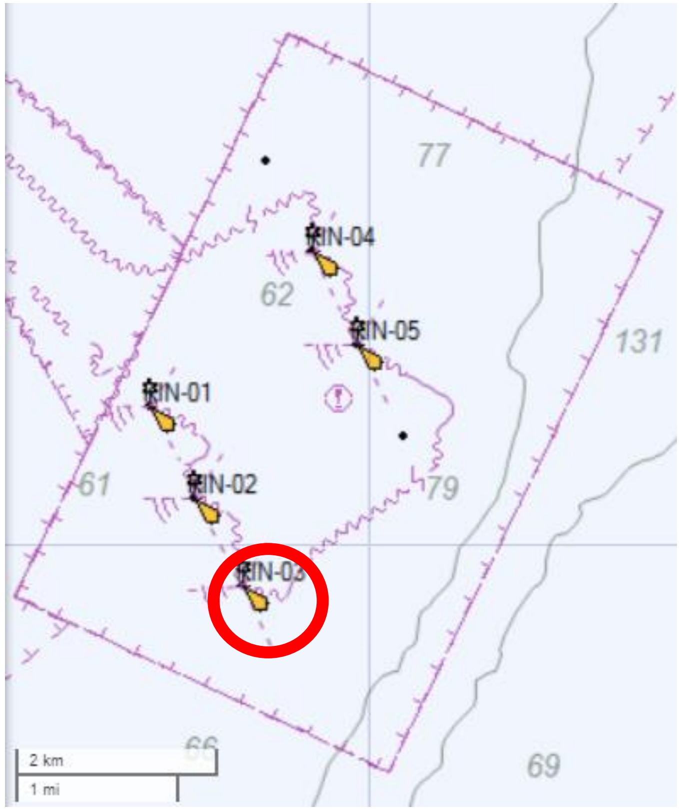
The pioneering 50MW Kincardine floating wind farm off the coast of Aberdeen, Scotland, has suffered a significant technical set back just months after it became fully operational.

- ✓ Tow to port O&M strategy
- ✓ Port of Rotterdam, Netherlands
- ✓ Available weather window

- ? *Duration of entire operation*
- ? *Disconnection / Reconnection*
- ? *Towing*
- ? *Costs*

MarineTraffic

Publicly available AIS data sourced from MarineTraffic.



Map of the project with five 9.5MW turbines 50MW. Source: Marine Traffic

University of Strathclyde Engineering

Repair operation timeline

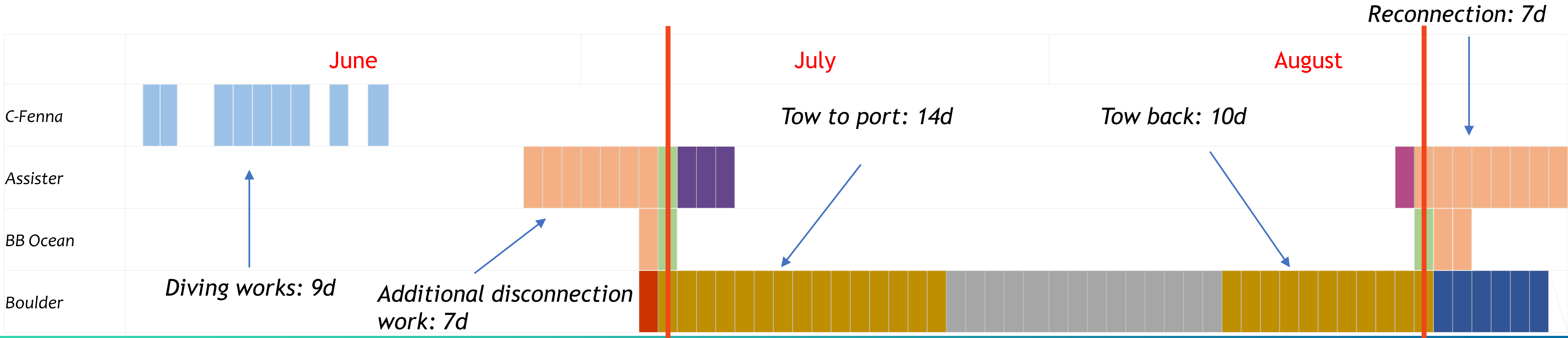
- Mooring disconnection (Diving works)
- Cables & mooring DC / RC
- Attaching WT for tow operation
- Assiting WT departure / arrival
- On-site work after WT departure
- WT tow to port / tow back
- Waiting on repair
- Preparing for WT arrival
- Tensioned to WT

C Fenna
IMO 9675963
Tug/Utility vessel

Assister
IMO 9193783
Tug/Supply Vessel

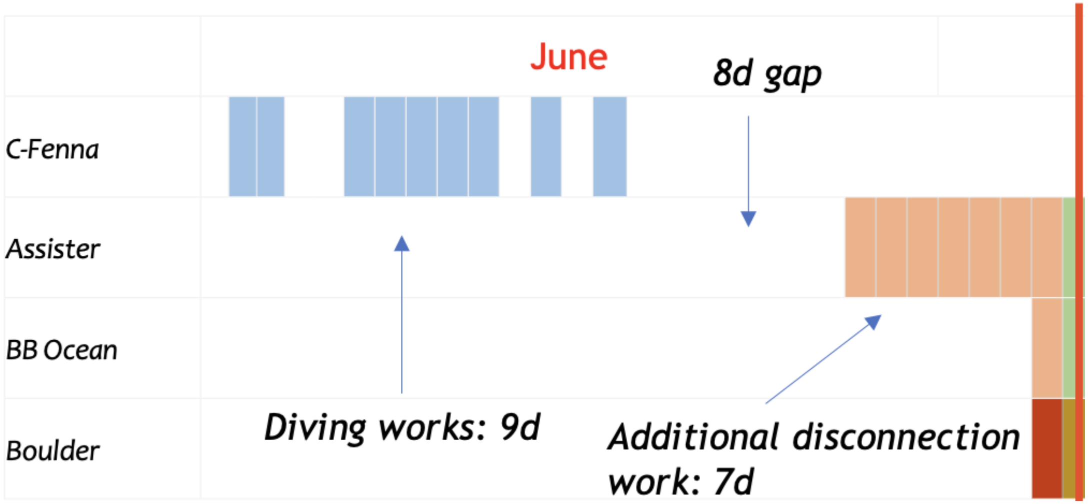
BB Ocean
IMO 9196503
Anchor Handling Vessel

Boulder
IMO 9151577
Tug/Supply Vessel



University of Strathclyde Engineering

Turbine disconnection



Activities:

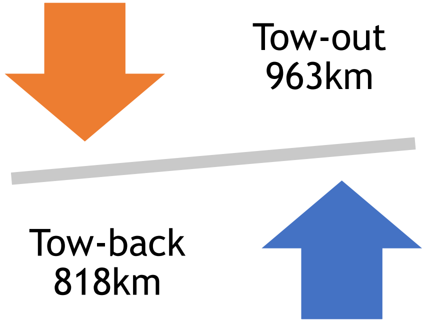
- Disconnection of mooring system and electrical cabling
  - -Diving works (4-8hrs)
  - -Total working time 51hrs
- Personnel transfers (between vessels and floater)
- Deployment and recovery of an ROV

- 8 days gap between diving works & disconnection
- Assister waited at Aberdeen port

→ **Possibly for an available weather window**

Towing operation

Boulder
IMO 9151577
Tug/Supply Vessel



$\bar{v}_{out} = 1.6$ knots $t_{out} = 13$d 13hrs

$\bar{v}_{back} = 1.8$ knots $t_{back} = 9$d 19hrs

$\Delta d = 145km$

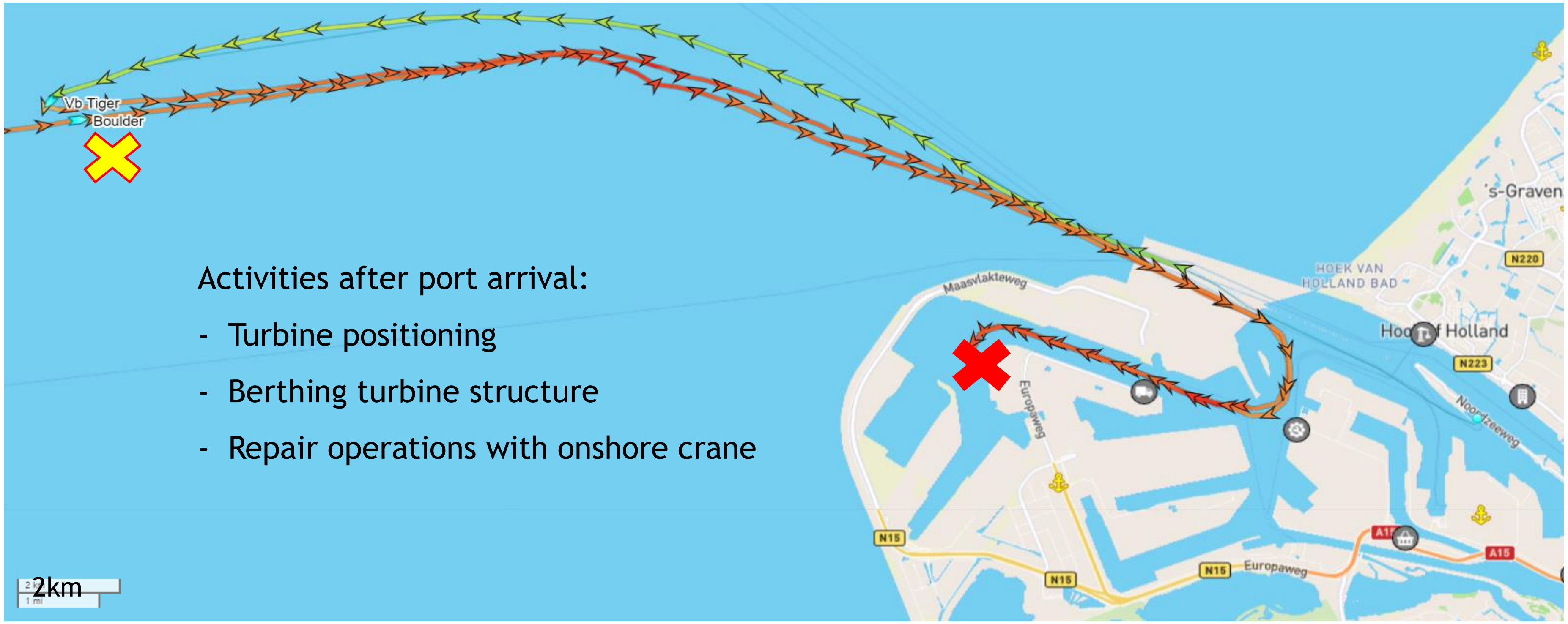
Factors affecting towing speed:

- Wind
- Waves
- Currents

University of Strathclyde Engineering

Assisted towing at Port of Rotterdam

From To



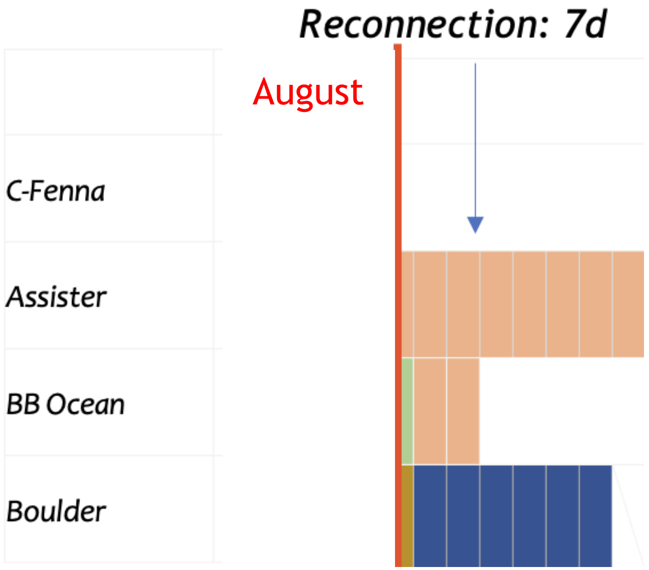
Activities after port arrival:

- Turbine positioning
- Berthing turbine structure
- Repair operations with onshore crane

- 31km arrival and departure assist by VB Tiger (small tug)
- Met by two fire fighting vessels upon entry to port
- Arrival duration **12h**
- Departure duration **7h**

Note: These vessels are not considered in the cost or fuel calculation

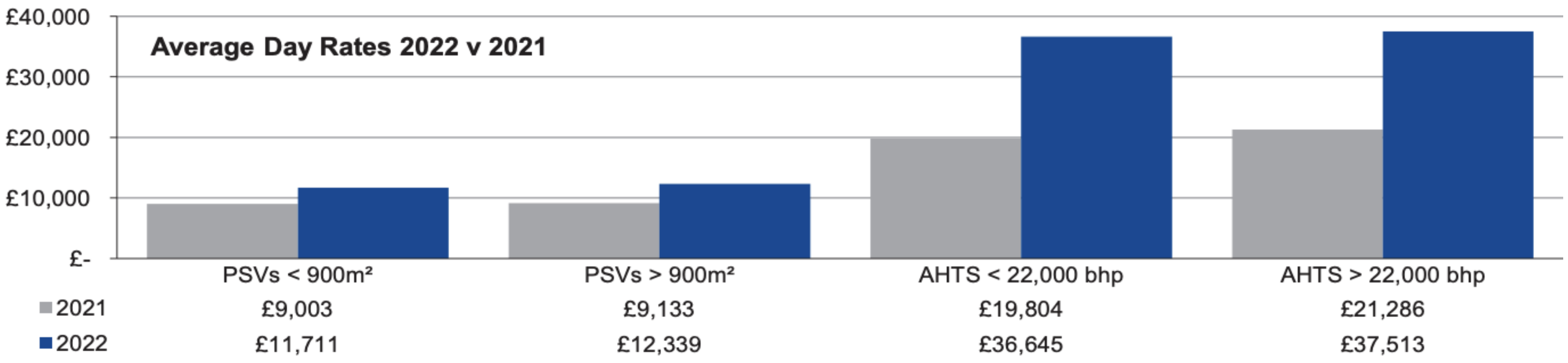
Turbine reconnection



Activities:

- Reconnection of mooring system and electrical cabling
- WT connected boulder for entire operation
- Mooring system tensioning
- ROV deployed for inspections

Vessel costs of operation



AHTS = £36,645

TUG/OSV = £11, 711

Day rate X **No. of days deployed** = **Charter cost for each vessel**

Vessel	No. of days deployed	Total cost (£)
BB Ocean	5	£183,225.00
Boulder	47	£550,417.00
Assister	20	£234,220.00
Cfenna	12	£140,532.00

Total cost:
£1,108, 394

University of Strathclyde Engineering

Vessel costs – floating wind vs fixed bottom wind

Fixed bottom wind MCR

Assuming MCR of a gearbox ≈ *6 days*

£174,980 /day x *6 days* ≈ *£1,049,880*

Floating wind MCR




Previously calculated vessel costs = **£1,108, 394**

- Long waiting times]

- High mobilisation costs

- Day rates peak during summer months

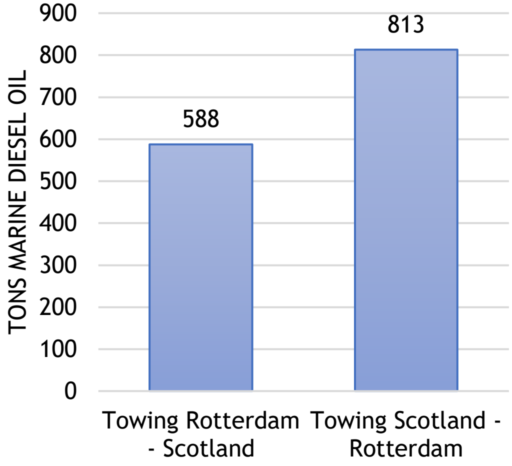
+ Lessons learnt will reduce disconnection / reconnection times

+ For the same scenario a nearby port has the potential to reduce costs by up to 30%

University of Strathclyde Engineering

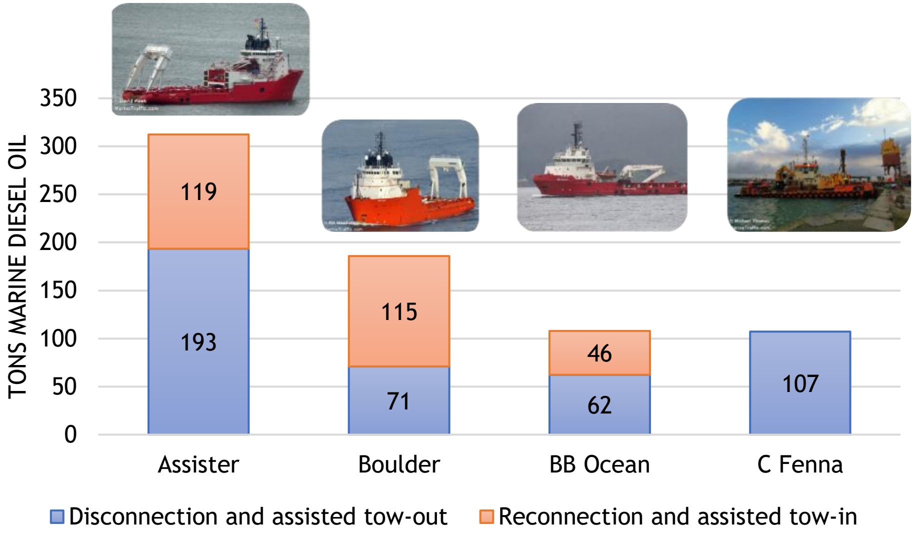
Fuel consumption of operation

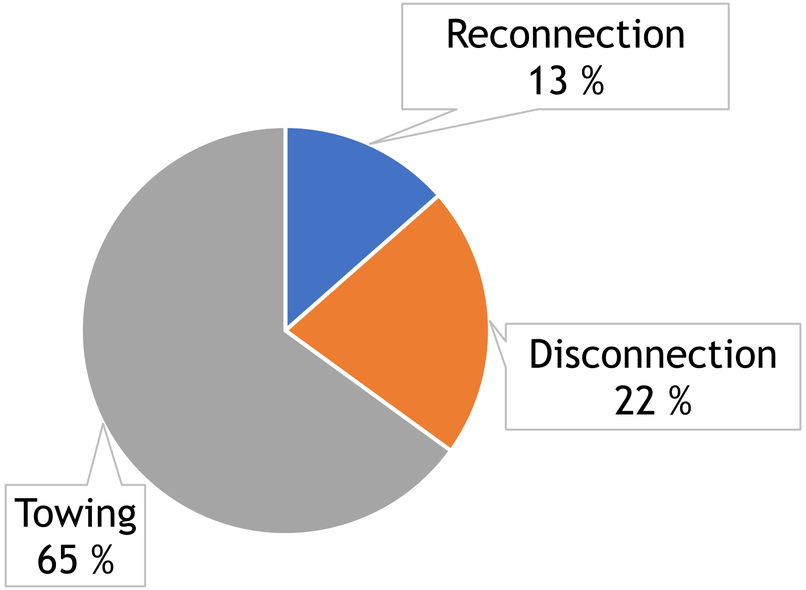
Towing journey



Boulder (AHTV)

Disconnection and Reconnection phases





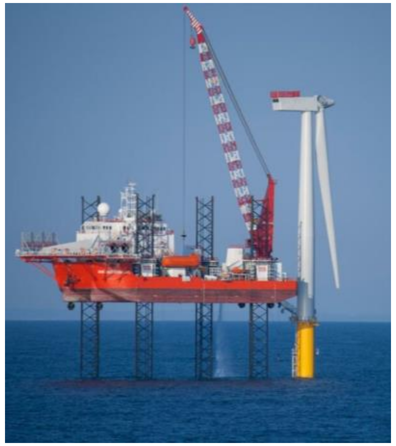
Time offshore	*	Fuel consumption rate @vessel operational mode	=	Metric tons Marine Diesel Oil (MDO)

In transit **Towing** **Dynamic positioning**

Total: 2131t MDO

Fuel consumption – floating wind vs. fixed bottom wind

Fixed bottom wind MCR



Jack-up vessel

~10t MDO/day

Floating wind MCR

Calculated total fuel consumption = 2131 tonnes MDO

Duration of Kincardine operation = 74 days

$$\frac{2131\text{t}}{74\text{d}} \approx \boldsymbol{29t\ MDO/day}$$

∴ 3x fuel consumption /day for the tow-to-shore O&M strategy

Conclusions

- ✓ Fully tracked the first successful tow-to-port operation
- ✓ Investigated unknowns for the disconnection / reconnection process such as resources and time required
- ✓ Calculated average towing speeds for tow-in and tow-out
- ✓ Presented a vessel cost and fuel consumption comparison for fixed bottom wind and floating wind O&M cases

Thank you!

Follow the Strathclyde University Floating Wind Research Group!

linkedin.com/company/strathclyde-floating-wind-research-group