Sound Source Characterization for the World's Largest Floating Offshore Wind Farm

Hywind Tampen

Havvind- og miljøseminar 2025

06.11.2025

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Hywind sound study history

Hywind Demo - 2011

Dimensions	Equipment and results
• 1 turbine, 2.3 MW • 8.3 m substructure	Two omnidirectional hydrophones • Broadband and impulsive • Mooring

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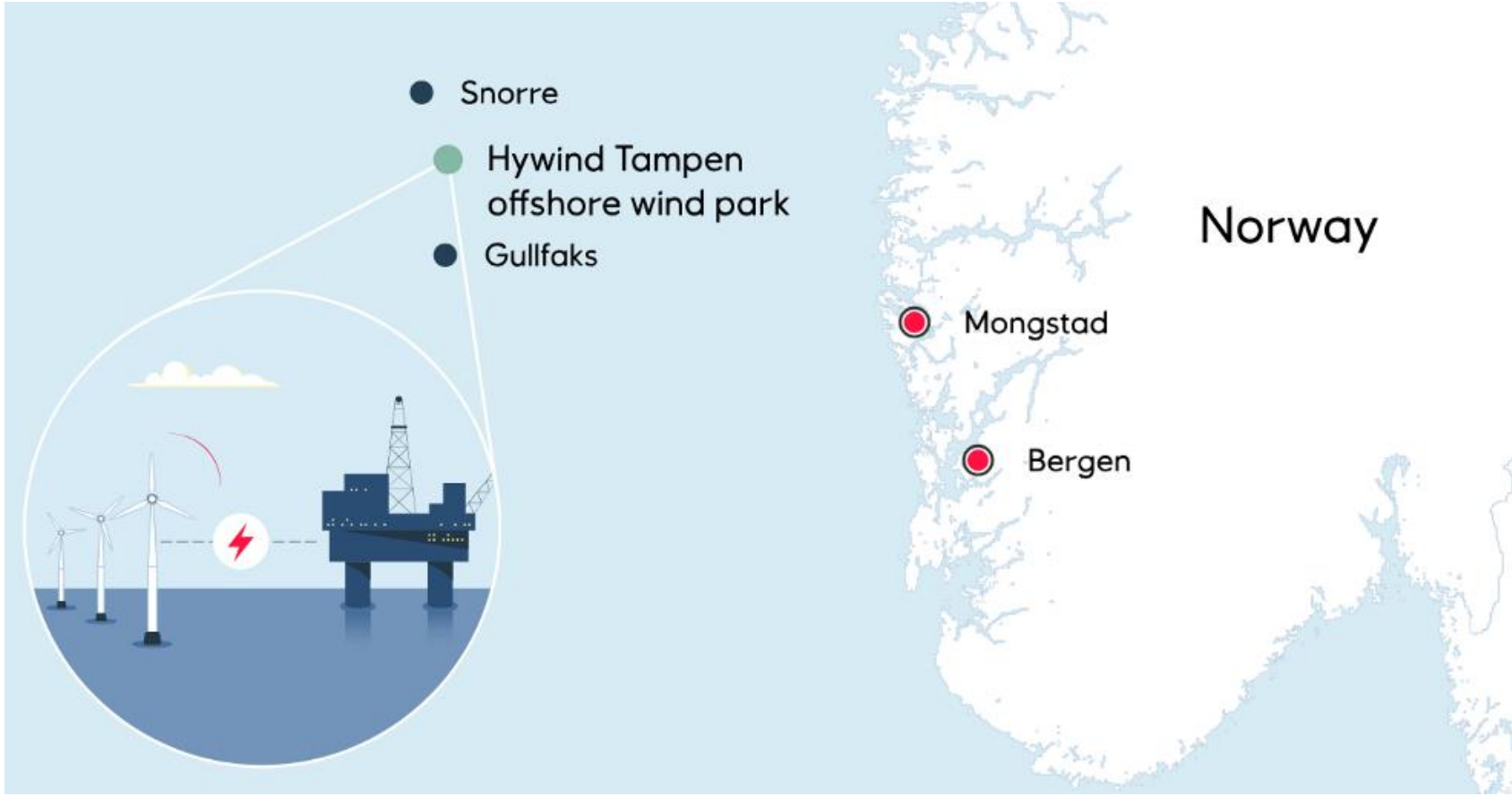
• 11 turbines, 8.6 MW • 18.3 m substructure	Two 4-channel array (in park & outside) + two omnidirectional outside • **?**

Hywind Tampen

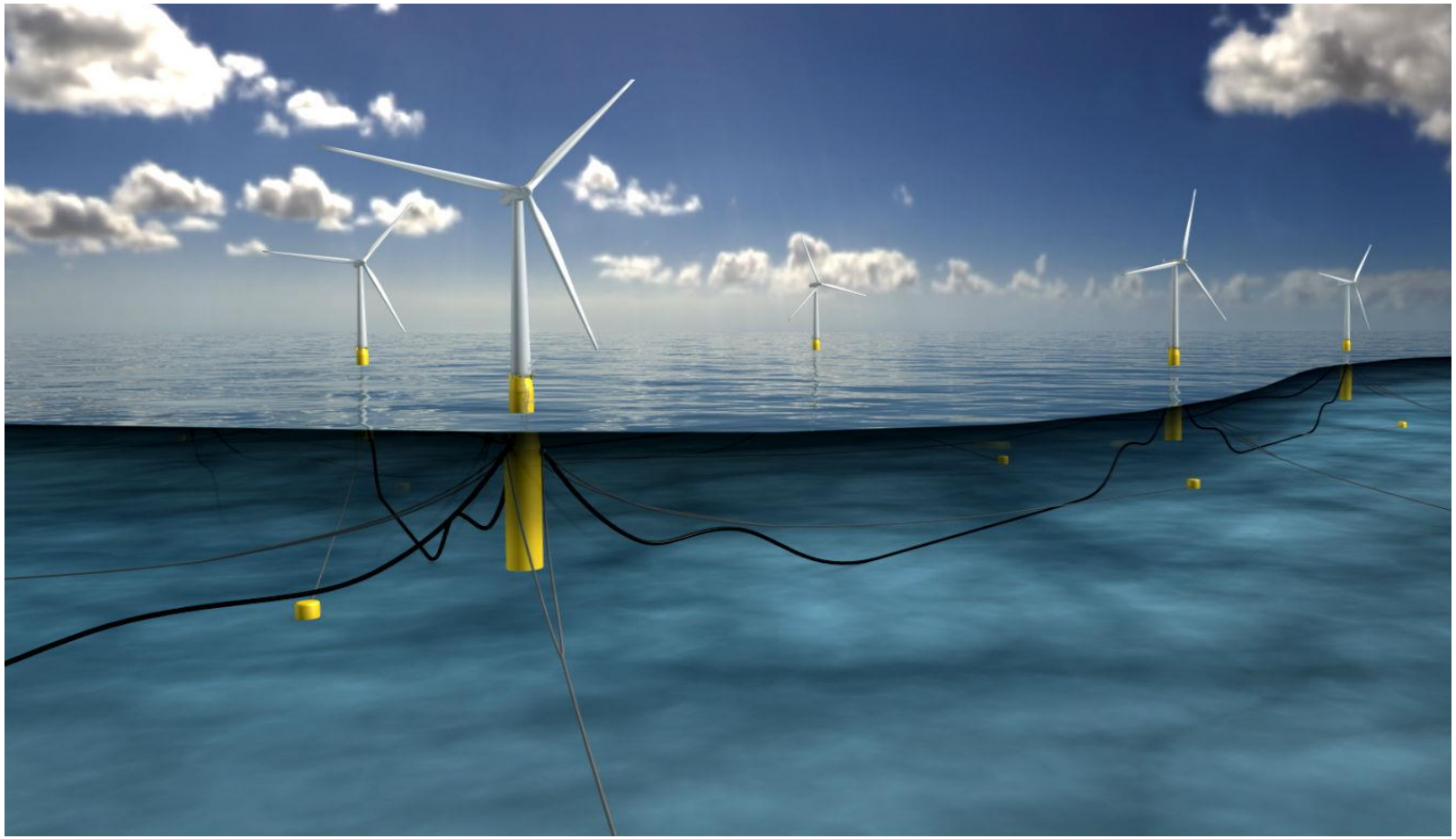
11 Turbines, total system capacity 94.6 MW



Hywind Tampen

11 Turbines, total system capacity 94.6 MW

Floating concrete spar structures with a shared anchoring system



Hywind Tampen

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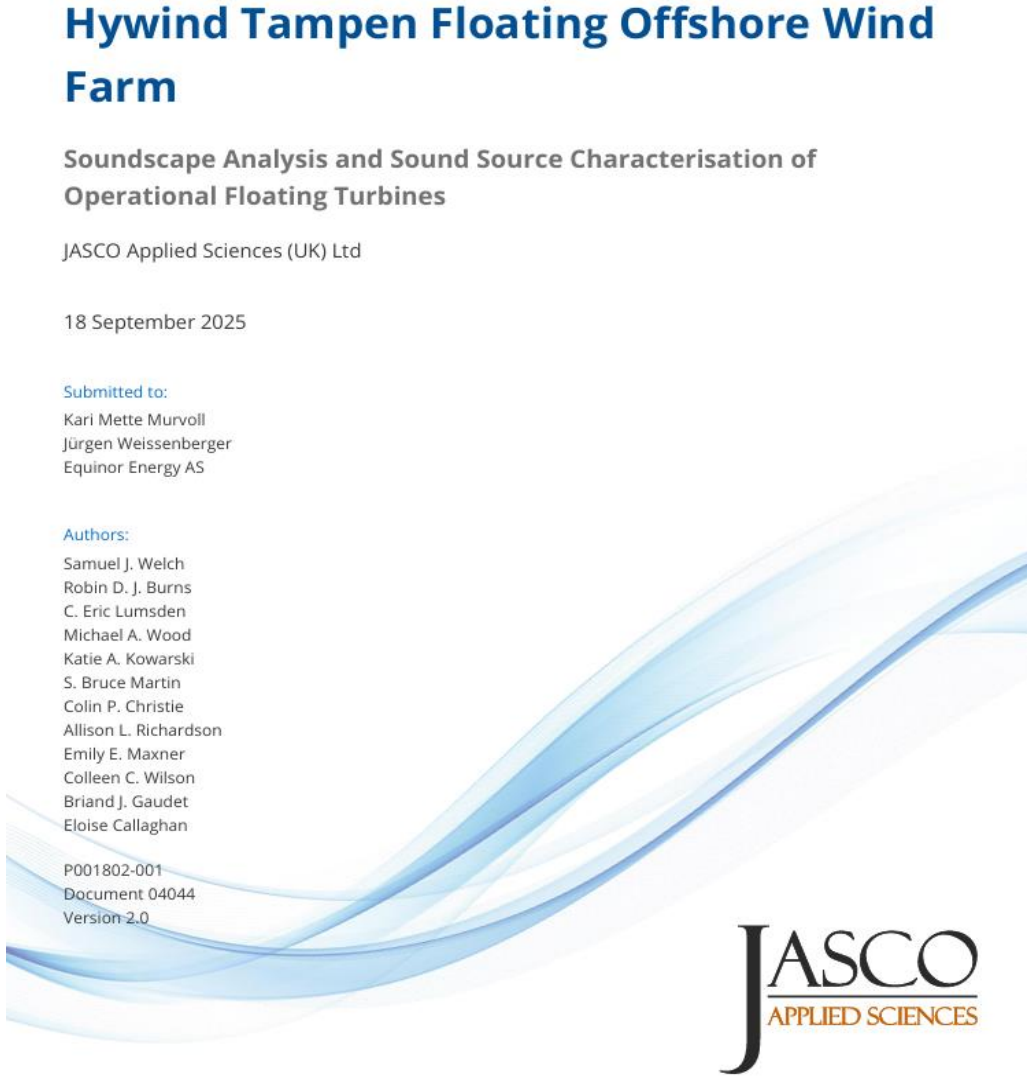
Floating concrete spar structures with a shared anchoring system

Research activities: e.g. eDNA, bird monitoring, fish behaviour, **sound characterisation**



Hywind Tampen Floating Offshore Wind Farm

Soundscape Analysis and Sound Source Characterisation of Operational Floating Turbines

JASCO Applied Sciences (UK) Ltd

18 September 2025

Submitted to:
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P001802-001
Document 04044
Version 2.0

JASCO APPLIED SCIENCES

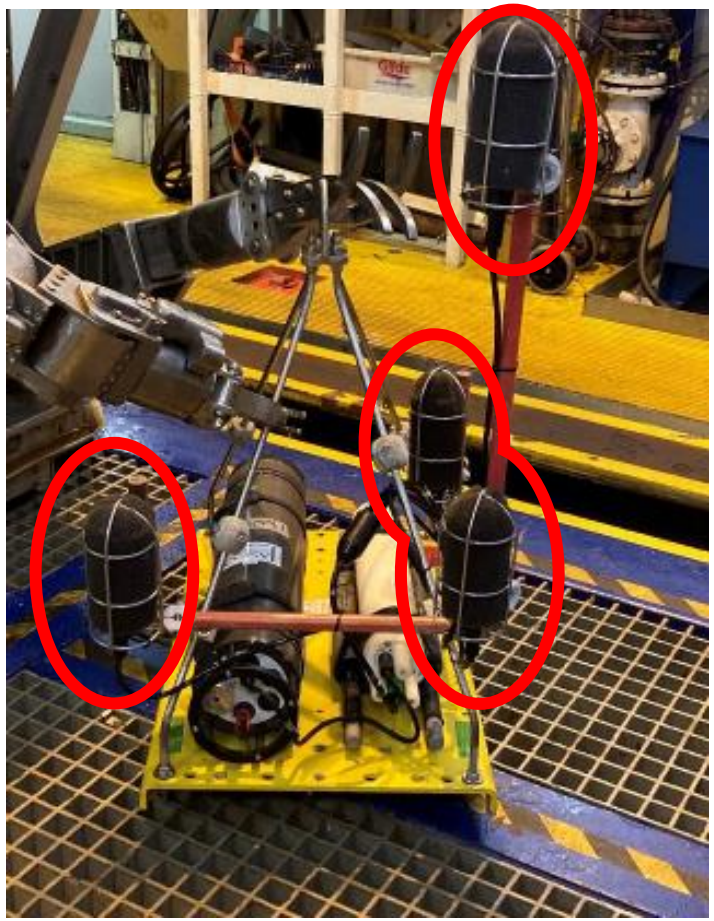
Aims:

- Operational noise profile
- Mooring noise
- Source levels

Hywind Tampen

Recording equipment

Four hydrophone directional array

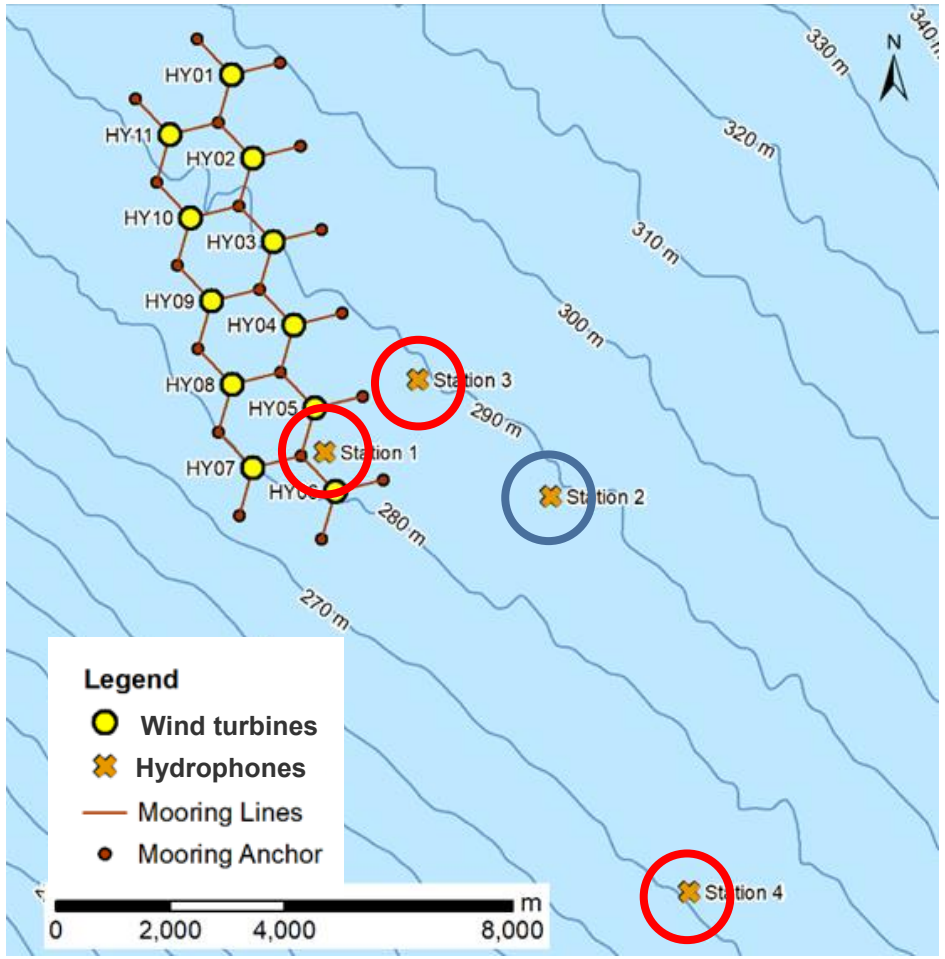


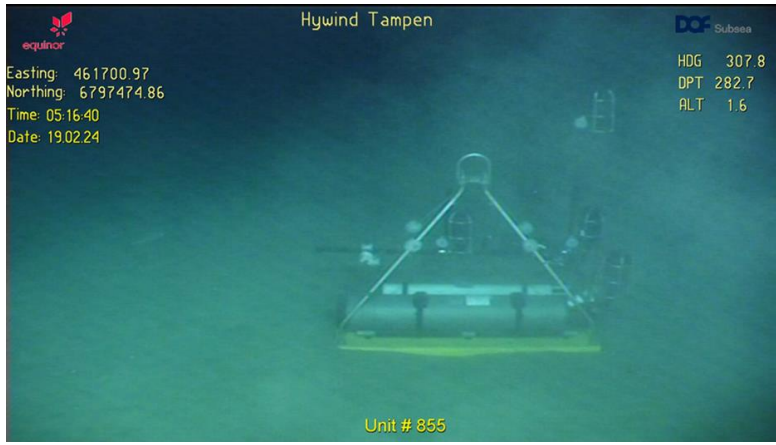
Single omnidirectional hydrophone

Hywind Tampen

Recording equipment

Recording locations



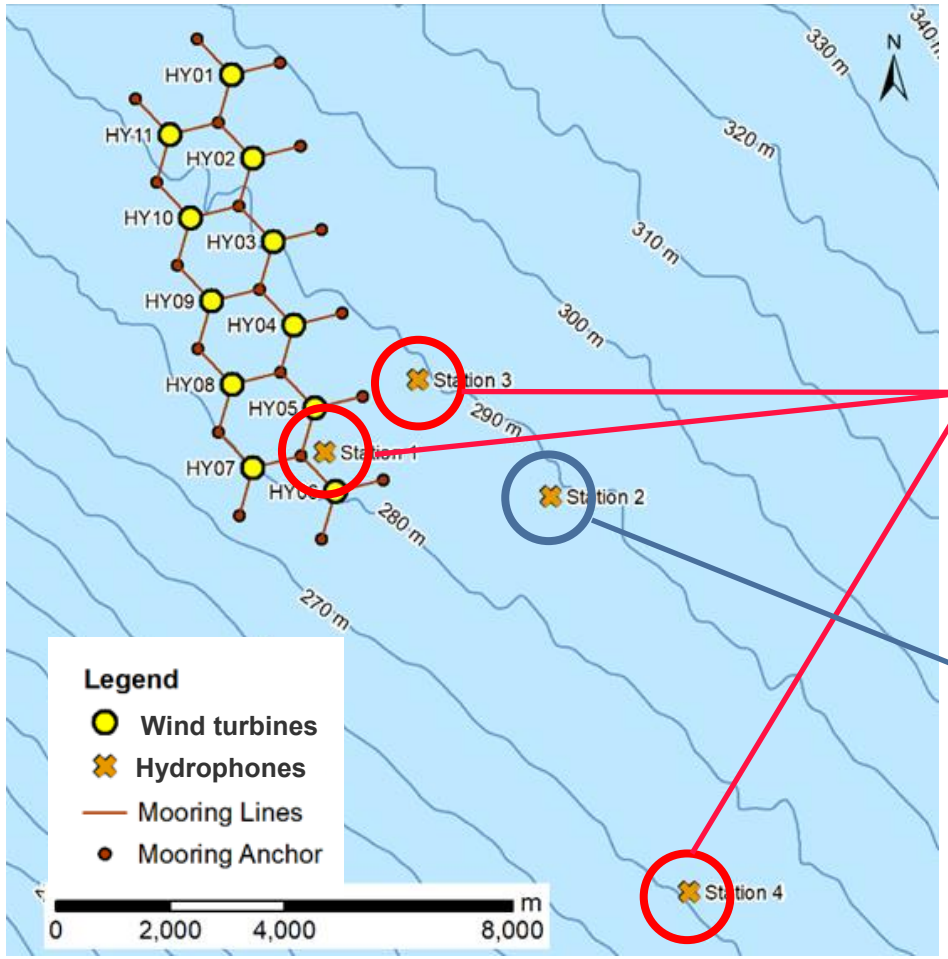


Hywind Tampen

Recording equipment

Recording locations

Recording duration

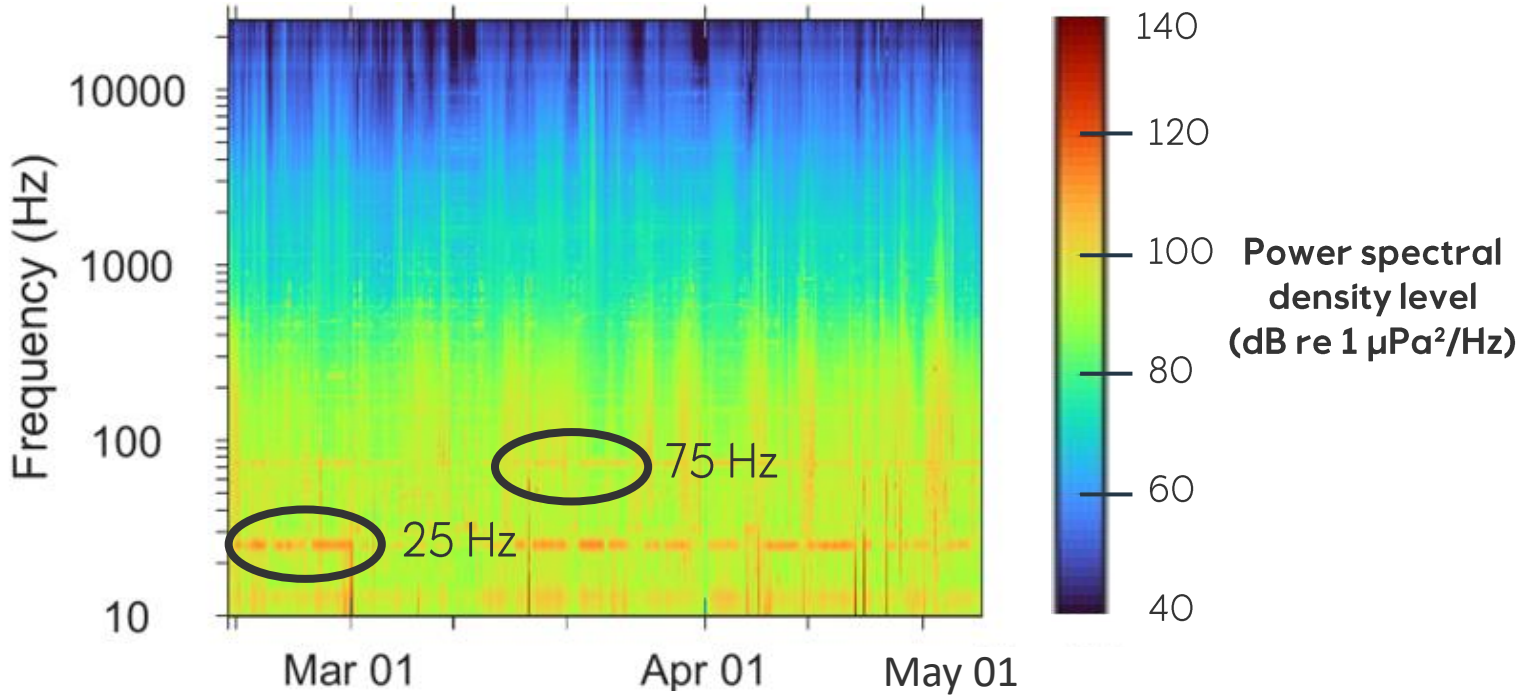


3 months:
Feb – Jun 2024

15 months:
Feb 24–May 25

Hywind Tampen sound measurement results

Long term spectrogram

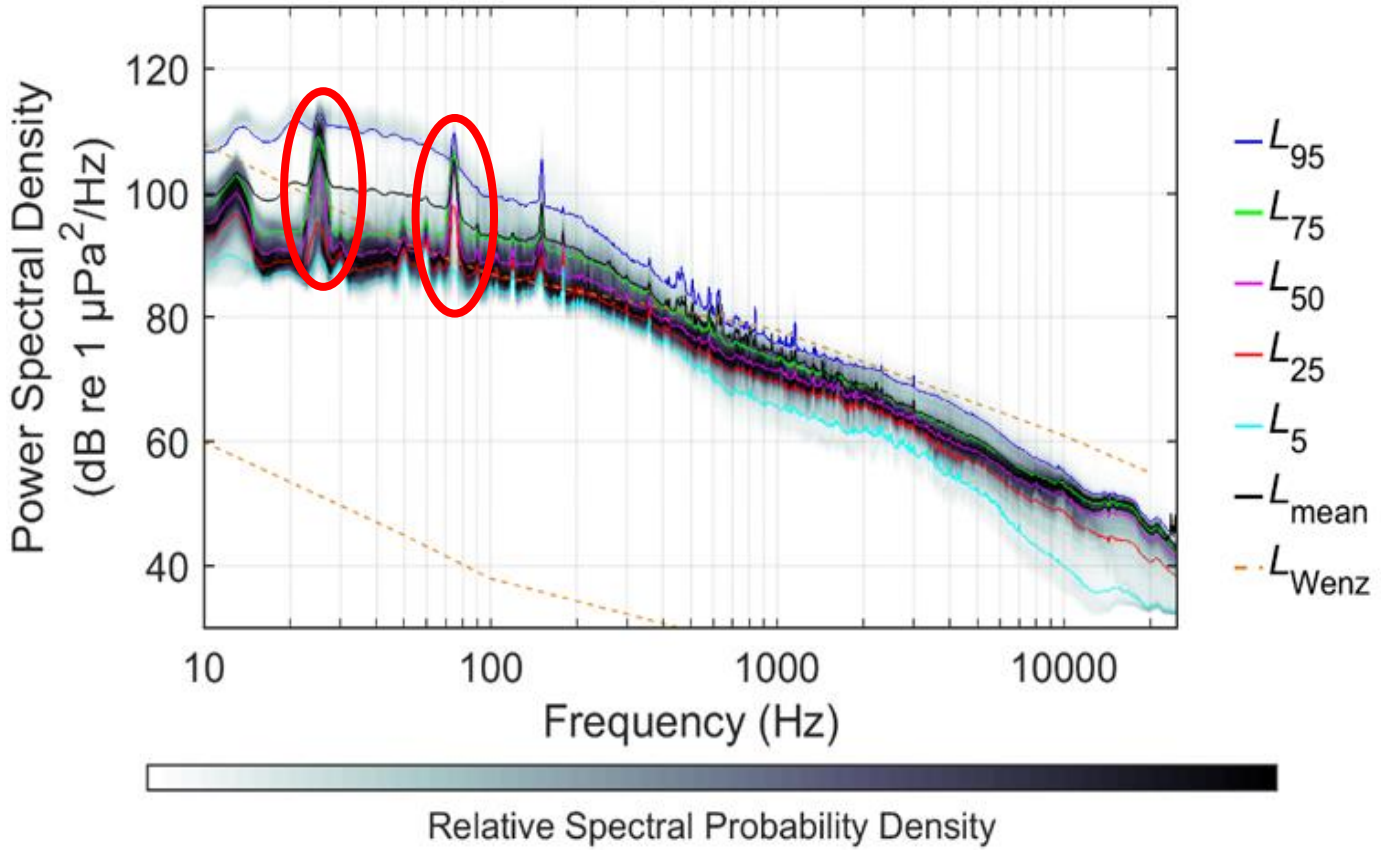


Hywind Tampen sound measurement results

Power spectral density levels

-

25 Hz and 75 Hz tonals

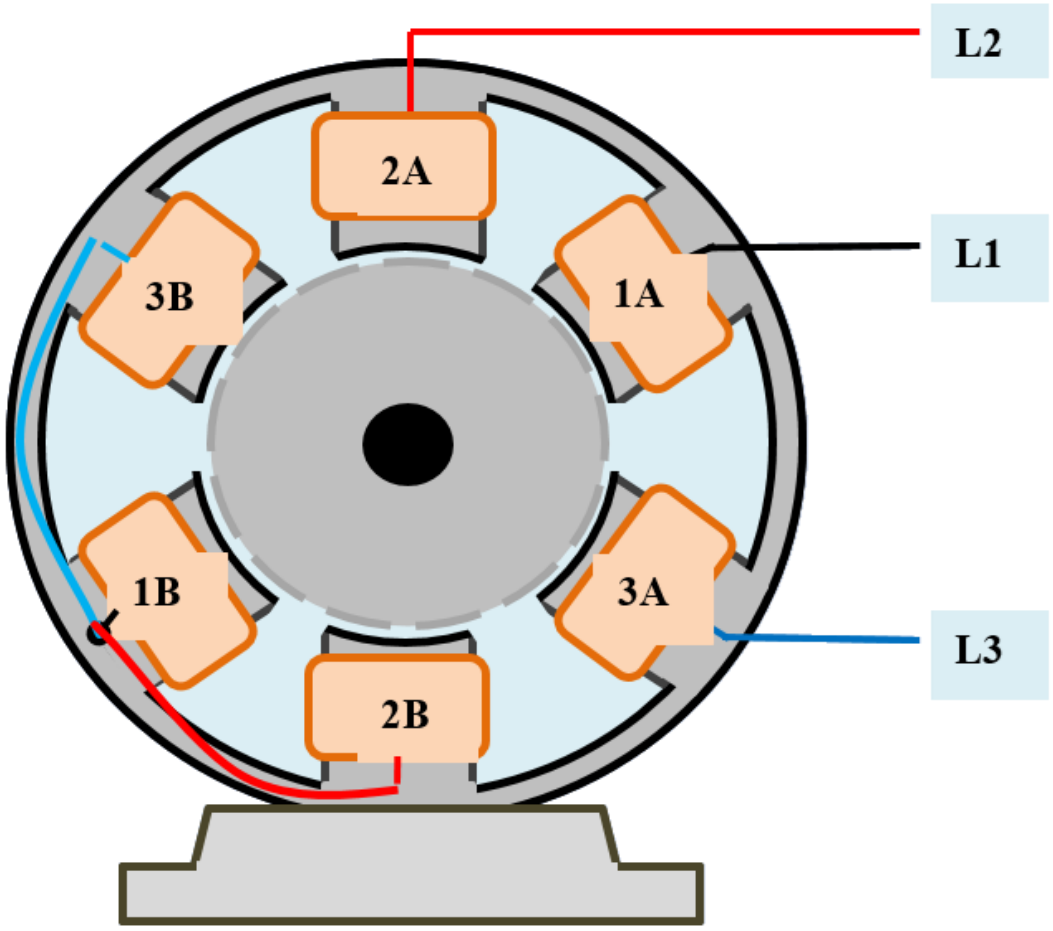


Hywind Tampen sound measurement results

Where do the 25 Hz and 75 Hz tonals come from?

From the rotational motion of the turbine:

10.5 RPM =0.175 revolutions/s, multiplied with 144 (the generator pole pairs) = **25.2 Hz**

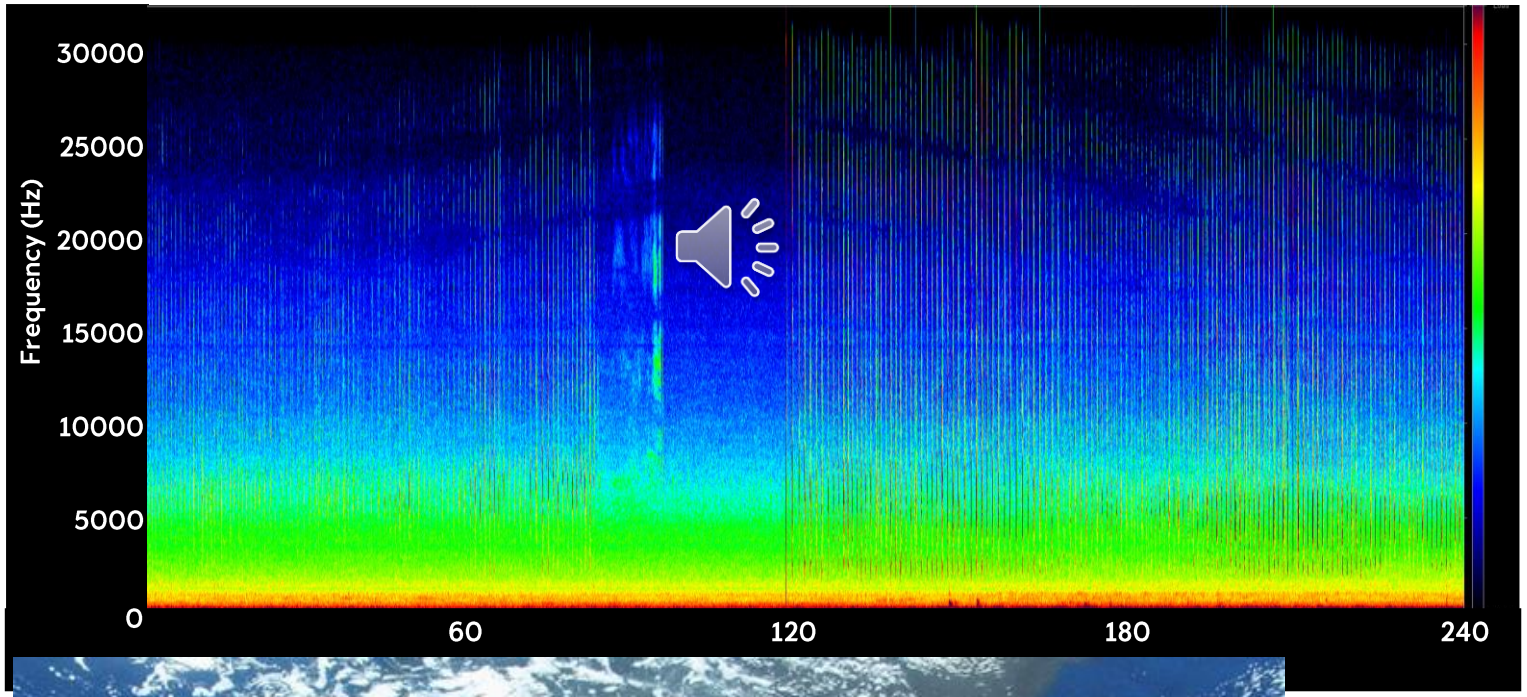


Hywind Tampen – mooring noise?

Suspicious recordings…

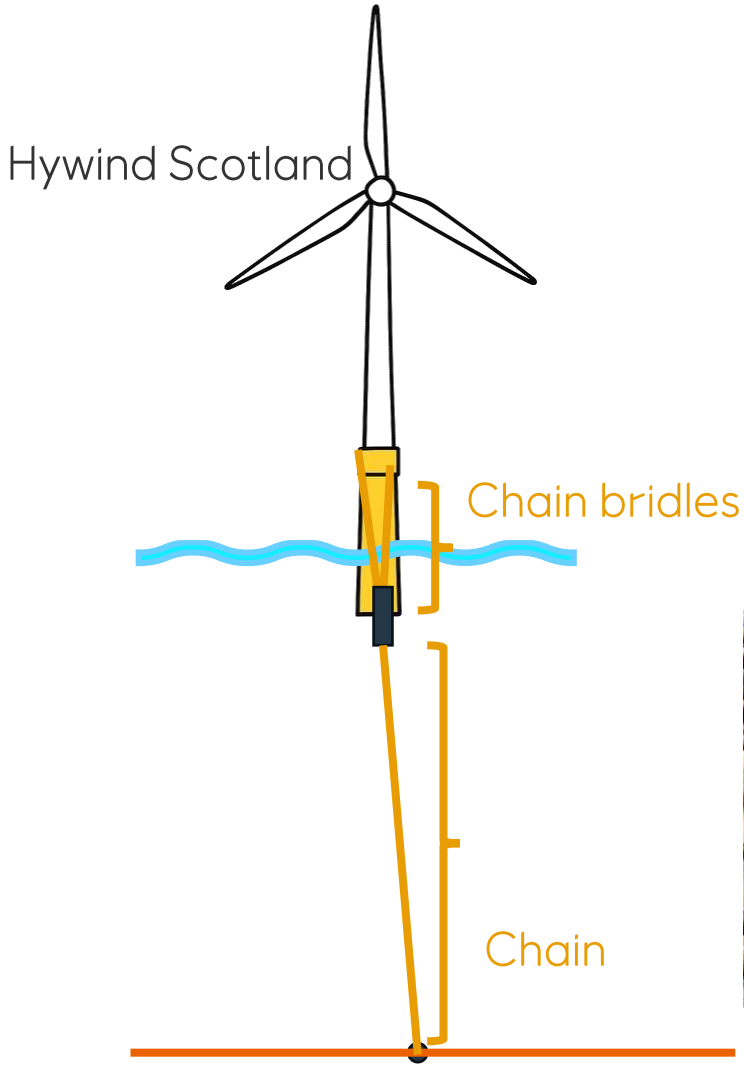
Directivity analysis revealed…

Sperm whales!



Hywind Tampen – mooring noise?

Very different mooring systems



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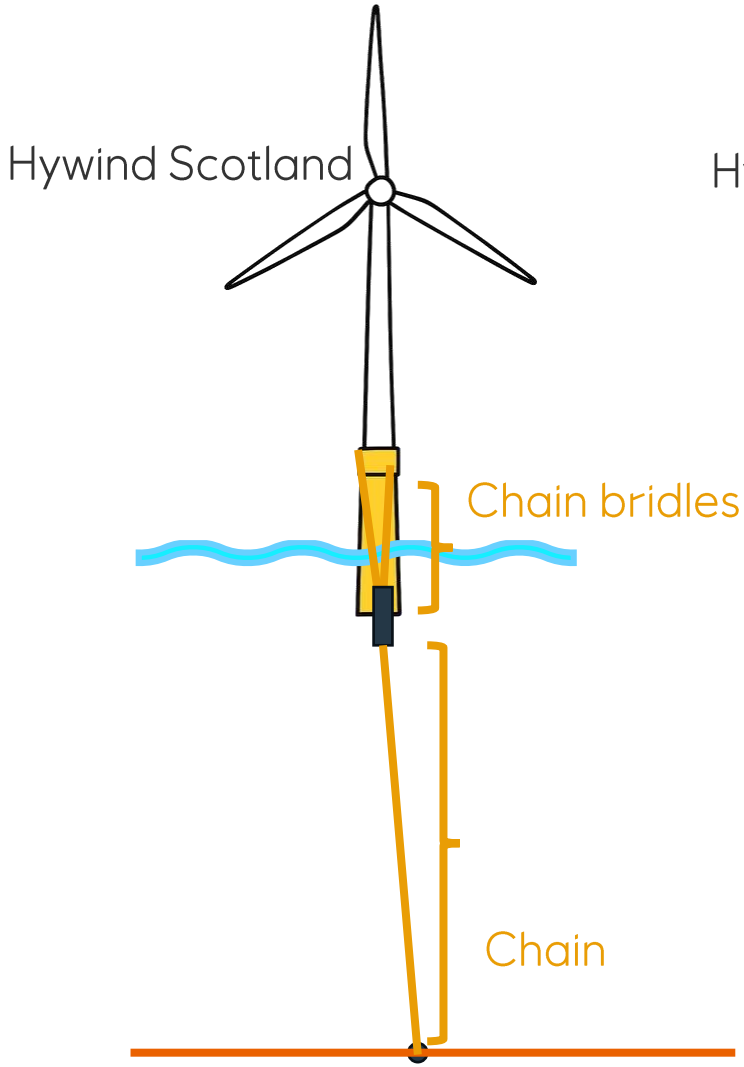
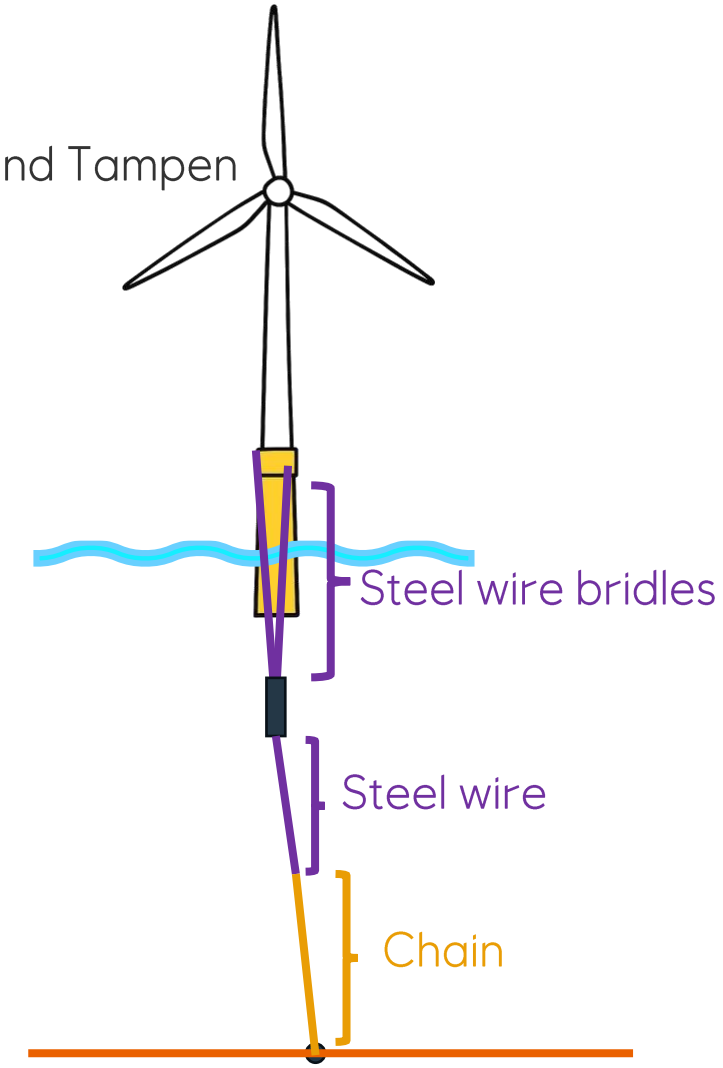




Hywind Tampen – mooring noise?

Very different mooring systems

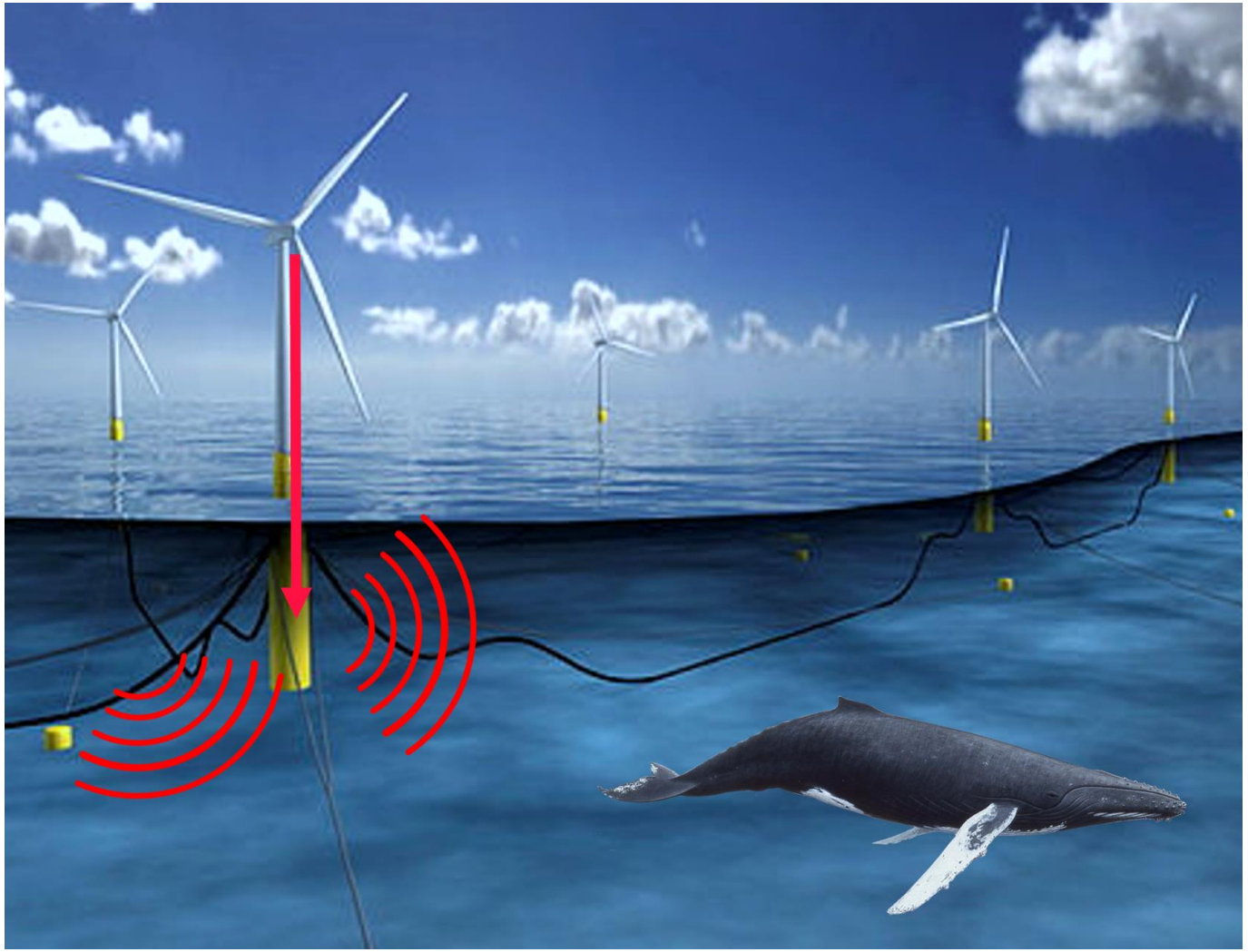
Steel foundations in Scotland versus concrete in Tampen

Scotland: Steel substructures

Tampen: Concrete substructures

Hywind Tampen – Source level characterisation

Requirement for impact assessments



Hywind Tampen – Source level characterisation

Backpropagated source levels for single turbine

Wind speed (kn)	Broadband source level (dB re 1 µPa²m²)				
	5th percentile	25th percentile	Median	75th percentile	95th percentile
5	153.6	155.4	157.1	158.8	160.5
10	153.7	155.7	158.2	160.8	163.5
15	154.6	155.7	156.5	157.7	159.1
20	159.9	161.1	162.3	164.0	166.4
25	159.6	162.0	163.8	165.7	168.7
30	160.3	162.0	163.0	164.0	166.0
35	161.0	162.3	163.2	164.3	166.1
40	160.1	161.3	162.1	162.9	164.1

Hywind Tampen – Noise impact assessment modelling

Conservative predictions for marine mammals:

- TTS within 150 m over 24 hours for VHF (Southall et al. 2019)
- No risk for PTS

Predictions for fish species (filter functions from Lucke et al. 2024):

- No risk for hearing damage

Very high frequency cetacean weighting

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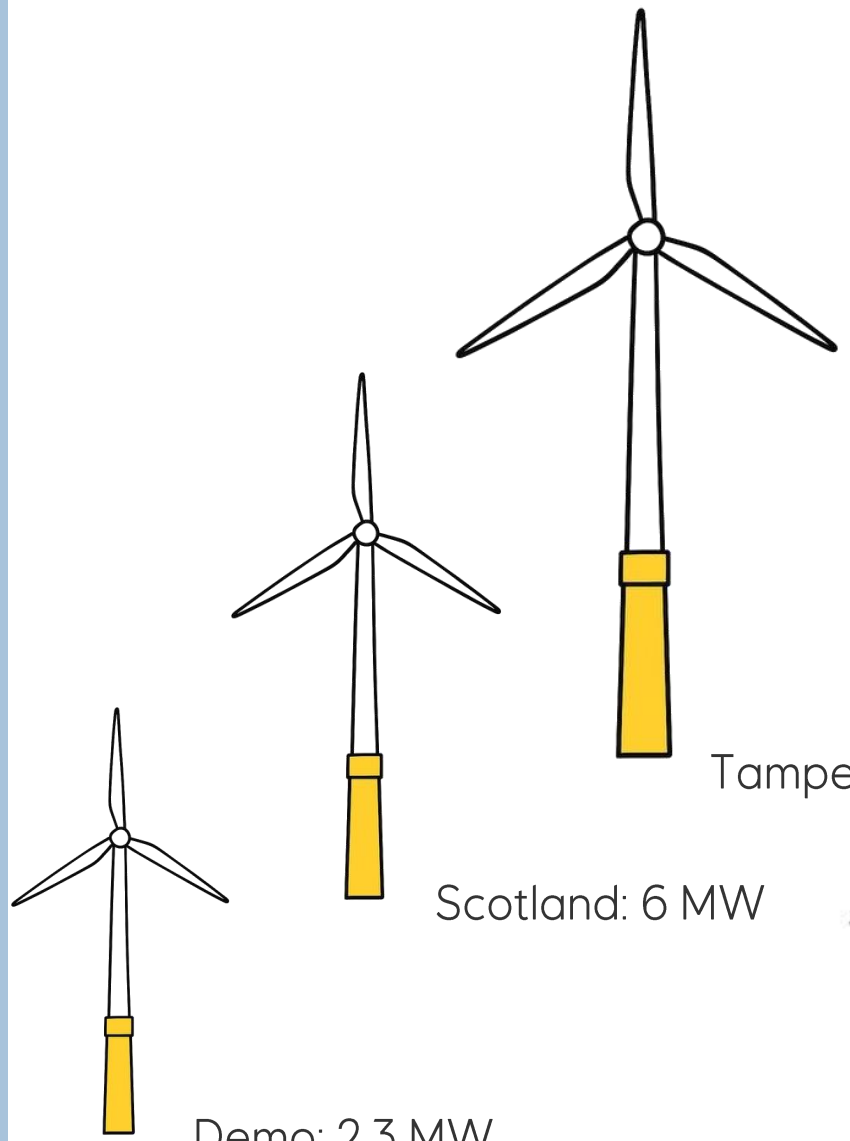
• 11 turbines, 8.6 MW • 18.3 m substructure	Two 4-channel array (in park & outside) + two omnidirectional outside • **No mooring noise** • **Tonal sounds** • **On average 3dB lower than Hywind Scotland**

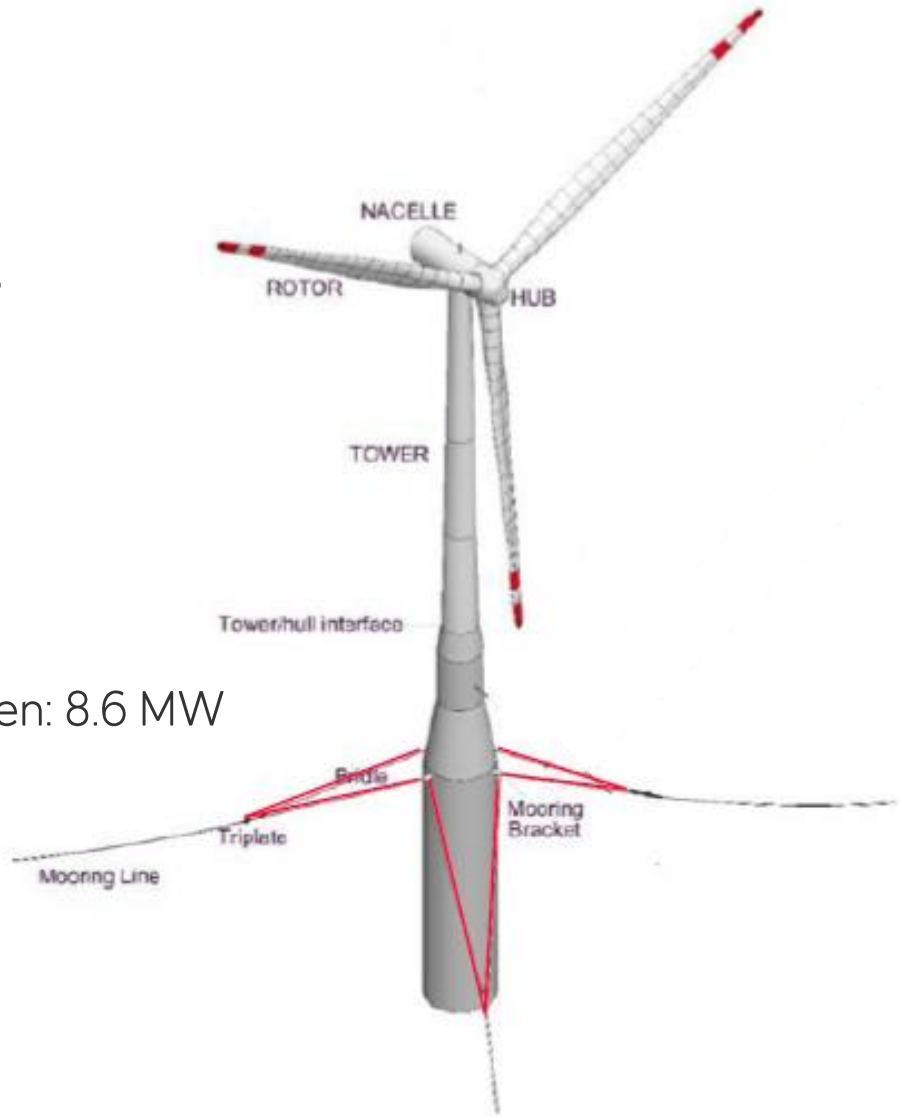
Hywind Tampen – sound summary

Bigger ≠ Noisier

Mooring /substructure material and engineering solutions for quieter operations

Very low or no risk for TTS and PTS – other impacts?
Tonal noise

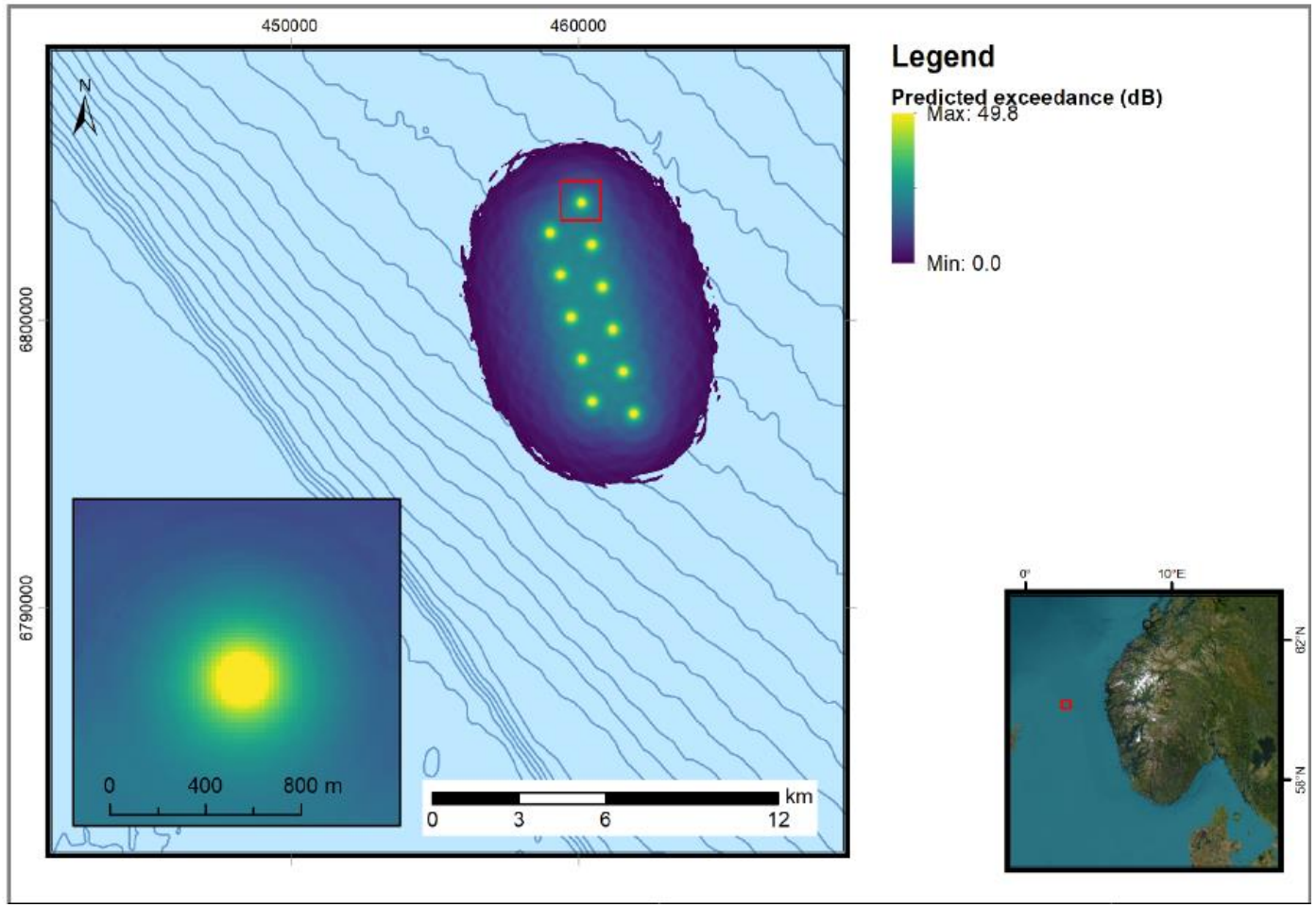




Hywind Tampen – sound summary version 2.0

No directionality

Hywind Tampen noise levels are at ambient sound level at 3.75 km (95 percentile data/20 knot wind)



Thank you for your attention!

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