

## TOWIN JIP - Towing Resistance and Dynamics of FOWTs

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# Objective

The **TOWIN** JIP aims at reducing the cost of the towing operation of FOWTs by safely increasing the towing speed and expanding the operational criteria.

Focus on **semi-submersibles** and possibly **spar** types of substructures.

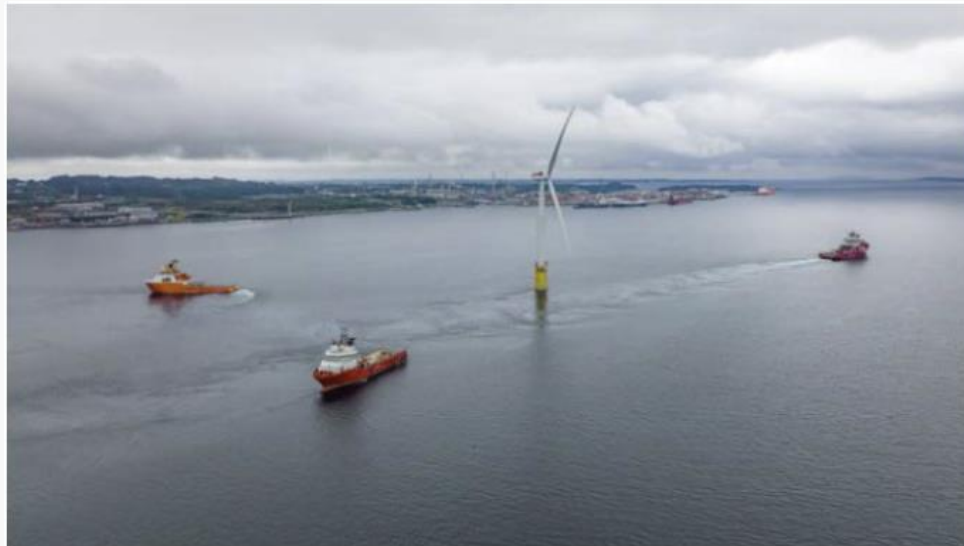


Figure 1 Tow-out of Hywind Tampen FWT.  
Source: Jan Arne Wold/Woldcam/Equinor [1].



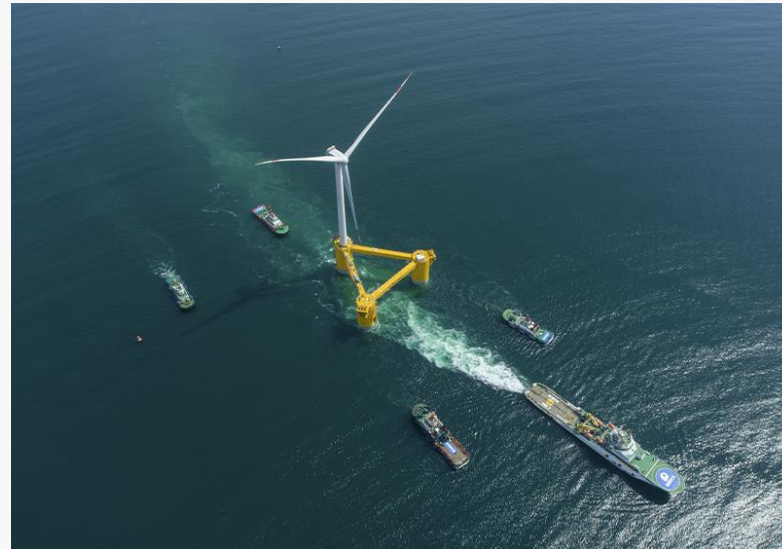
# Background

a) Number of tow operations expected to increase very much.

b) Potential to reduce the cost of transportation to site location.

c) Potential to reduce the cost of heavy maintenance operations requiring tow-back (1 GW FW farm estimated to have a minimum of 7 tow-back per year).

- By increasing the towing speed
- By expanding the operational criteria

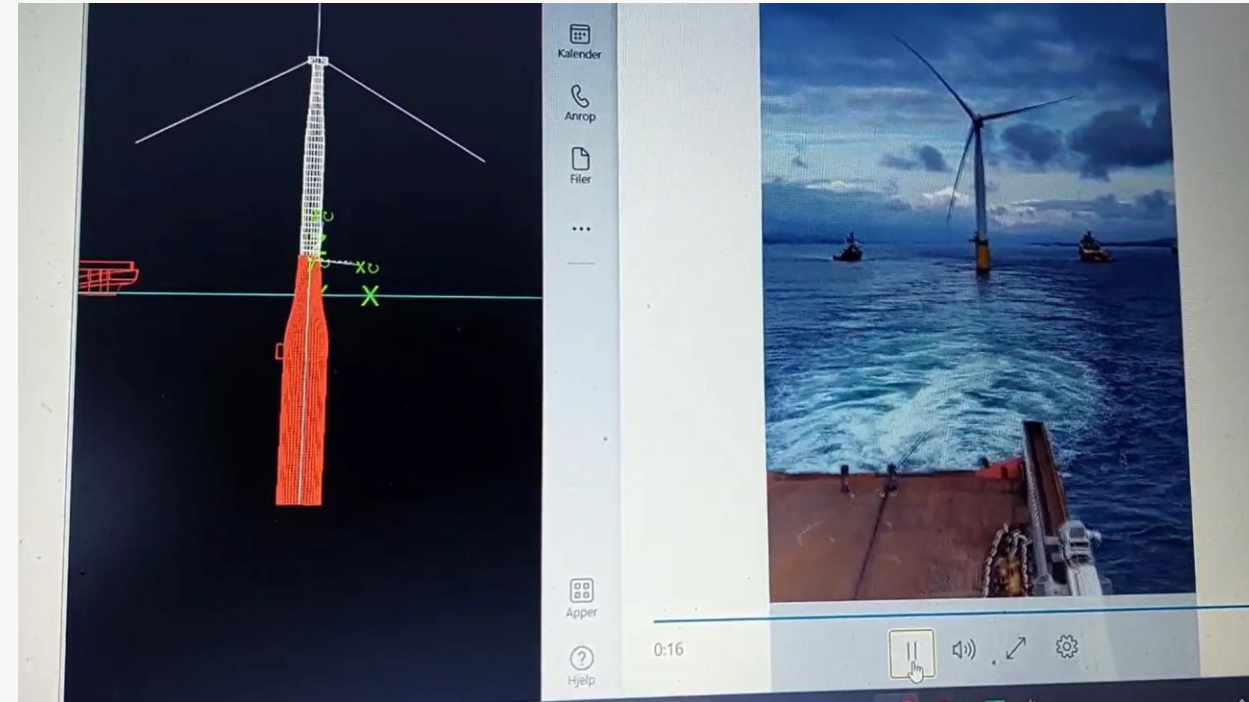


FuYao FOWT from CSSC Haizhuang Windpower.  
Image retrieved from <http://cssc-hz.com/>, June 2023.

# Challenges

## Several challenges:

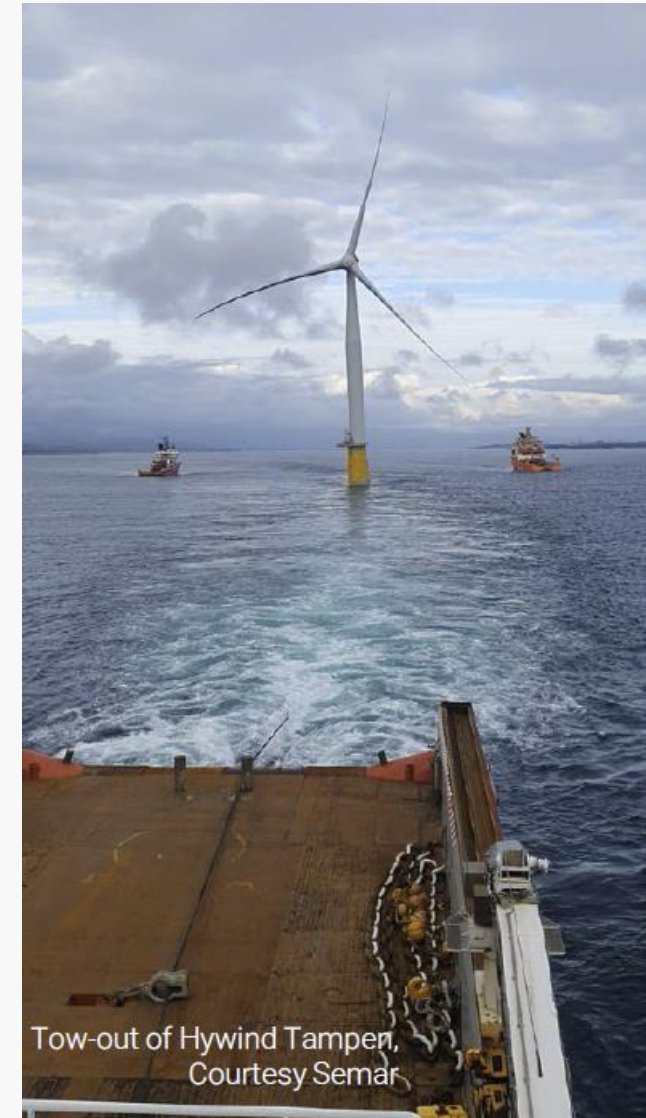
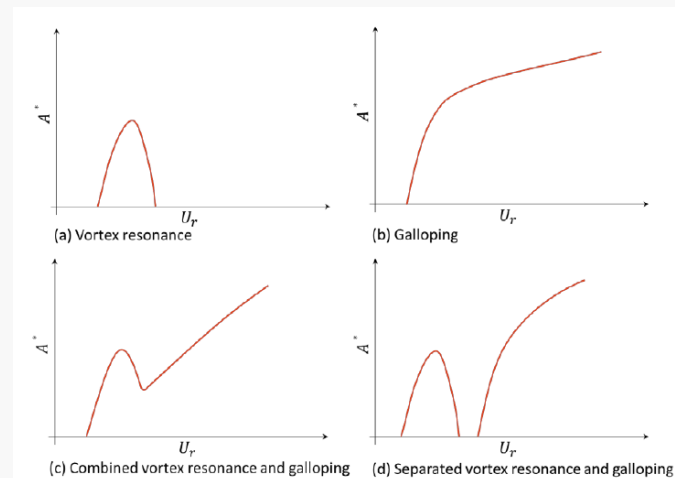
- Estimation of towing line tensions due to uncertainties in predictions of dynamic effects.
- Possibility of flow induced motions (FIM), such as VIM, galloping and yaw instabilities.
- Possibility of complex coupled motions.
- Limited weather windows complying with operational criteria.



Retrieved from LinkedIn June 2023.

# Detailed objectives

- a) Test and validate methods for accurate prediction of towing resistance in calm water and in waves.
- b) Propose semi-empirical calculation methods for VIM, galloping and tow stability.
- c) Test and validate methods for simulation of the tow operation.
- d) Use the updated tools to investigate optimum tow arrangements and mitigation solutions.



# Methods and Scope of Work

## Methodology:

Combine existing best knowledge, model testing, field data and numerical modelling.

### WP1: Prediction of tow resistance

Calm water resistance and added resistance in waves.

### WP2: Time domain FIM solver

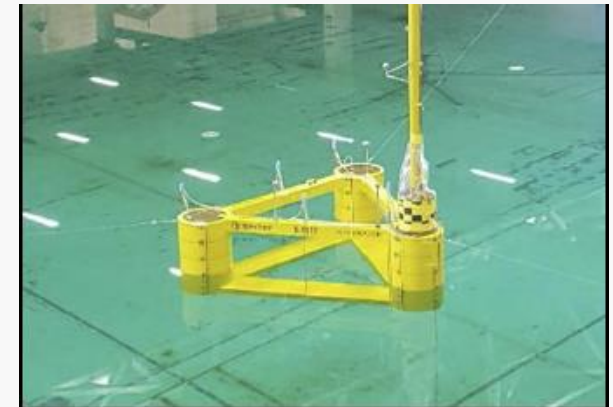
Establish design methods for FIM. VIVANA-TD is the basis for the VIM model.

### WP3: Model tests and field data

Model test and field data to provide physical insight and validation of methods.

### WP4: Towing studies and recommendations

Apply updated force models to a case study to investigate tow arrangements, operational limits and mitigation solutions for excessive dynamic responses.



# Project organization and deliverables

## Organization

- Project execution by SINTEF Ocean.
- Duration of 2 years with tentative start-up Q1 2024.
- Prospective participants:
  - Energy companies
  - Offshore contractors
  - Designers of FWTs
  - Offshore wind-park developers

## Deliverables

- Model tests report.
- Report with methods for prediction of towing resistance, FIM, towing stability and towing line loads.
- Report with optimum tow arrangements and operational limits for representative scenarios.
- Recommendations for simulation of the towing operation

