

# **TWIND**

## ***Twinning for an Offshore Wind Energy Partnership***

Call identifier: H2020-WIDESPREAD-2018-2020

### ***D3.4 – Report on the secondment activities and skills learned***



<b>Lead beneficiary</b>	TU DELFT
<b>Authors List</b>	Axelle Viré
<b>Due date</b>	31/12/2022
<b>Completion date</b>	26/01/2023

Dissemination Level		
<b>PU</b>	Public	X
<b>PP</b>	Restricted to other programme participants (including the Commission Services)	
<b>RE</b>	Restricted to a group specified by the consortium (including the Commission Services)	
<b>CO</b>	Confidential, only for members of the consortium (including the Commission Services)	

## Document History

Issue Date	Version	Changes Made / Reason for this Issue
10/02/2023	V1	Original version

*This document only reflects the author's view. The programme authorities are not liable for any use that may be made of the information contained therein.*



## INDEX

<b>INDEX</b> .....	<b>3</b>
<b>1 EXECUTIVE SUMMARY</b> .....	<b>4</b>
<b>2 OVERVIEW OF THE JUNIOR STAFF EXCHANGES</b> .....	<b>4</b>
<b>3 SUMMARY OF OBJECTIVES, ACTIVITIES, AND SKILLS LEARNED</b> .....	<b>4</b>
<b>4 DISSEMINATION</b> .....	<b>15</b>
<b>5 CONCLUSIONS</b> .....	<b>15</b>



## 1 EXECUTIVE SUMMARY

Several junior and senior staff exchanges took place during the project. This report focusses on the 14 junior staff exchanges whilst D2.4 targets the senior staff exchanges. Because of the COVID pandemic, the earliest junior staff exchanges took place online. It consisted in new collaborations with multiple online meetings taking place on a regular basis, e.g. monthly. Once travel restrictions were lifted, face-to-face staff exchanges took place with duration varying between a few days to a few months (mostly for those developing online). All the exchanges took place between April 2020 and December 2022. More details about the type of junior staff exchanges, the persons/institutions involved, and the topic/skills learned are further detailed in this report.

## 2 OVERVIEW OF THE JUNIOR STAFF EXCHANGES

In total, 14 junior staff exchanges were conducted during TWIND and involved all the partner organisations. The list of exchanges is summarised in Fig. 1. The exchanges involved 12 early-stage researchers, as one person did multiple exchanges on different topics. Almost all the exchanges took place face-to-face. However, the earliest ones took place online due to the COVID pandemic. The latter also explains why, although we had originally aimed for 18 junior staff exchanges (at the time of the proposal writing in 2019), we achieved only 14. This is largely because the COVID pandemic severely impacted the ability of early-stage researchers to travel during a large part of TWIND. It is worth noting that the staff exchanges that took place online were also very effective in strengthening collaborations between the partners, with regular online meetings taken place over multiple months which also led to e.g. scientific dissemination.

The process for organising all the exchanges was achieved by each of the partners, under the coordination of TU Delft. This was performed in two ways: (i) top-down, with a call of interest disseminated in each of the consortium organisations and highlighting the possibility of staff exchanges, and (ii) bottom-up, where early-stage researchers put forward a topic of interest for further training/exchange and a match was found within the consortium.

10 SENIOR and 14 EARLY STAGE STAFF EXCHANGE									
EARLY STAGE	SENIOR	DATE	IN-PERSON/ONLINE	ENTITY	HOST	TUTOR	TUTORED	TOPIC	STATUS
1	1	30.4.2020 – 31.12.2021	Online	WavEC	TUD	Pranav Chandramouli	Manuel Rentschler	CFD for floating wind hydrodynamics	Completed
		30.7.2020 – 28-10.2021	Online	WavEC	OREC	Anthony Gray	Craig White		Completed
1		Feb/20	in-person	OREC	WavEC	Miriam	Amorina	techno-economic assessment and analysis	Completed
1		Sept	in-person	WavEC	TECNALIA	Joseba Lopez	Miguel Sá	techno-economic analysis and hydrogen	Completed
	1	11-14 Oct 2022	11-14 October	WavEC	OREC	heron Wilson + Kacper Stefan	Paula Bastos	Roadmapping and Strategy Development.	Completed
		15/Nov/22	in-person	WavEC	OREC	Luke Eatough	Luana Clementino	environmental assessments, environmental monitoring, underwater noise/acoustics	Completed
	1	12-15 september 2022	in-person	WavEC	TECNALIA	Alberto del Pozo	Luís Amaral	Logistics, O&M	Completed
1		14-15 Nov	in-person	WavEC	OREC, Blyth	Michael Smailes	Alessandra Imperadore	grid compliance	Completed
1		16-17 Nov	in-person	WavEC	OREC, Blyth	Charlotte Strang-Moran	Alessandra Imperadore	cables modelling	Completed
1		18/Nov	in-person	WavEC	OREC, Glasgow		Alessandra Imperadore	cables	Completed
	1	14-22 December	in-person	WavEC	OREC		Craig White		Completed
		20/Jul	in-person	WavEC	TECNALIA	Pilar Ruiz	Janete Goncalves	Communication	Completed
	1	22/Nov	in-person	WavEC	OREC	John Lang	Janete Goncalves	Communication	Completed
		July	in-person	WavEC	OREC	Claran Frost	Craig White	LCOE minimisation for floating offshore wind	Completed
	1	Sept	in-person	OREC	TECNALIA	Ilgo Mendikoa	Will Brindley	Dynamic Cables	Completed
		07/Nov	in-person	OREC	TECNALIA	Imanol Touzon	Daniel Milano	Numerical Modeling (Orcaflex etc)	Completed
2			in-person	OREC	WavEC	Inés/Luana	atough and Kacper Stefaniak and Camaron V	Consenting and Environmental Monitoring	Completed
1	1		in-person	OREC	TECNALIA	Ainhoa Pujana	Matt, Anup	Grid	Completed
1		December	in-person	OREC	TECNALIA	Pablo Alonso	James Ferguson	Hydrogen	Completed
1		07-10 Nov	in-person	OREC	WavEC	João	Thomas Smith	Ports, O&M, Floating wind	Completed
1		07-10 Nov	in-person	OREC	WavEC	João	Brian Jenkins	Ports, O&M, Floating wind	Completed
1		21-25 Nov 2022	in-person	OREC	WavEC	Alessandra or Luis	Nathan Haley	failure/damage analysis	Completed

## 3 SUMMARY OF OBJECTIVES, ACTIVITIES, AND SKILLS LEARNED

<b>Early-stage staff</b>	Alessandra Imperadore
<b>Affiliation of early-stage staff</b>	WavEC
<b>Host institution during exchange</b>	OREC
<b>Dates of exchange</b>	14-18 Nov 2022
<b>Objectives</b>	

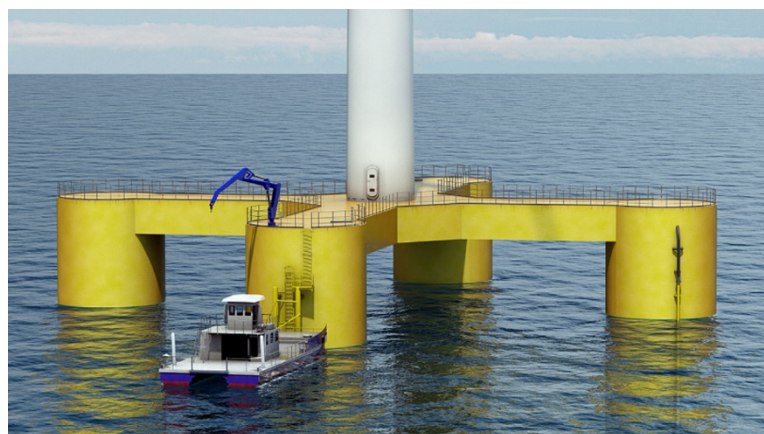


<ul style="list-style-type: none"> <li>- Networking</li> <li>- Tour of the facilities in Blyth</li> <li>- Learning about grid compliance, subsea cables and operation and maintenance (O&amp;M)</li> </ul>
<b>Activities and skills</b>
<ul style="list-style-type: none"> <li>- Out of the five day of staff exchange, 4 were spent in Blyth and 1 in the office in Glasgow.</li> <li>- During the staying in Blyth: <ul style="list-style-type: none"> <li>- Tour of the facilities</li> <li>- Learning about grid compliance: reading standards and modelling the test suggested by the standard (focus on the ride through fault)</li> <li>- Networking</li> </ul> </li> <li>- During the staying in Glasgow: <ul style="list-style-type: none"> <li>- Networking with the people working in the offshore wind team</li> <li>- Learning about subsea cable and Compass (O&amp;M tool)</li> </ul> </li> </ul> <p>The staff exchange was particularly interesting and useful because, besides learning about the topic discussed above, there were opportunities to speak to people about the everyday work and receive important insights.</p>
<b>Contacts made during the exchange</b>
<p>Overall, contacts were made with the following staff members at OREC:</p> <ul style="list-style-type: none"> <li>- Michael Smailes, Principal Research Engineer</li> <li>- Will Brindley, Research Engineer</li> <li>- Charlotte Strang-Moran, Electrical Engineer</li> </ul>

<b>Early-stage staff</b>	Luana Clementino
<b>Affiliation of early-stage staff</b>	WavEC
<b>Host institution during exchange</b>	OREC
<b>Dates of exchange</b>	15 Nov 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Learn about OREC's activities on the topic of Environment and Consent and meet the team there</li> <li>- Identify similar areas of action</li> <li>- Establish opportunities for collaboration in the future</li> </ul>	
<b>Activities and skills</b>	
<ul style="list-style-type: none"> <li>- Participation in Fishing Liaison with Offshore Wind and Wet Renewables (FLOWW) group meeting</li> <li>- Insight on a different organization, their areas of action and their projects</li> <li>- Potential for future collaboration was identified</li> </ul>	
<b>Contacts made during the exchange</b>	
<p>Overall, contacts were made with the following staff members at OREC:</p> <ul style="list-style-type: none"> <li>- Luke Eatough, Project Engineer – Development &amp; Consent</li> </ul>	
<b>Relevant documents</b>	
FOW – Development and Consenting Process – Risks and Opportunities	<a href="https://ore.catapult.org.uk/?orecatapultreports=fow-coefow-development-consenting-process-risks-opportunities">https://ore.catapult.org.uk/?orecatapultreports=fow-coefow-development-consenting-process-risks-opportunities</a>
Floating Offshore Wind Technology and Operations Review	<a href="https://ore.catapult.org.uk/?orecatapultreports=floating-offshore-wind-technology-operations-review">https://ore.catapult.org.uk/?orecatapultreports=floating-offshore-wind-technology-operations-review</a>
Floating Offshore Wind and Fishing Interaction Roadmap	<a href="https://ore.catapult.org.uk/?orecatapultreports=floating-offshore-wind-fishing-interaction-roadmap">https://ore.catapult.org.uk/?orecatapultreports=floating-offshore-wind-fishing-interaction-roadmap</a>
An Overview of Scottish Fisheries Prepared for the Floating Offshore Wind Industry	<a href="https://ore.catapult.org.uk/?orecatapultreports=overview-scottish-fisheries-prepared-floating-offshore-wind-industry">https://ore.catapult.org.uk/?orecatapultreports=overview-scottish-fisheries-prepared-floating-offshore-wind-industry</a>



Changes to fishing practices around the UK as a result of the development of offshore windfarms – Phase 1	<a href="https://www.thecrownestate.co.uk/media/2600/final-published-ow-fishing-revised-aug-2016-clean.pdf">https://www.thecrownestate.co.uk/media/2600/final-published-ow-fishing-revised-aug-2016-clean.pdf</a>
FOW CoE: Floating Offshore Wind – Environmental Interactions Roadmap	<a href="https://ore.catapult.org.uk/?orecatapultreports=fow-coe-floating-offshore-wind-environmental-interactions-roadmap">https://ore.catapult.org.uk/?orecatapultreports=fow-coe-floating-offshore-wind-environmental-interactions-roadmap</a>
JNCC, Offshore Wind Evidence and Change Programme, Offshore Wind Environmental Evidence Register	<a href="https://www.marinedataexchange.co.uk/details/3480/2021-jncc-offshore-wind-evidence-and-change-programme-offshore-wind-environmental-evidence-register-/packages">https://www.marinedataexchange.co.uk/details/3480/2021-jncc-offshore-wind-evidence-and-change-programme-offshore-wind-environmental-evidence-register-/packages</a>

<b>Early-stage staff</b>	Miguel Matos Sá (MMS)
<b>Affiliation of early-stage staff</b>	WavEC
<b>Host institution during exchange</b>	Tecnalia
<b>Dates of exchange</b>	Sept 2022
<b>Objectives</b>	
Techno-economic modelling considering hydrogen production offshore.	
<b>Activities and skills</b>	
<b>VISIT TO TECNALIA LABS AND INFRASTRUCTURE</b>	
<p>- Alberto del Pozo (AdP) provided MMS a visit to Tecnalia Edif.700 infrastructure. Main highlights to the lab infrastructure Tecnalia owns</p> <ul style="list-style-type: none"> <li>- Several model-scale floaters for NAUTILUS:           <div data-bbox="443 1048 1209 1480" data-label="Image">  </div> <ul style="list-style-type: none"> <li>▪ Allows towing</li> <li>▪ Allows construction on site with low depths in constraints to other semi-sub topologies</li> <li>▪ Lower footprint and civil works required</li> <li>▪ Does not have an active ballast system</li> <li>▪ AdP mentioned that every floater has a small crane which is used to support O&amp;M</li> </ul> </li> <li>○ Grid equipment showroom (namely smart meters to detect energy theft from the grid)</li> <li>○ Energy storage/demand-side energy management facilities           <ul style="list-style-type: none"> <li>▪ Lithium iron phosphate battery, which are safer do not decrease in terms of voltage for lower SOC and have slightly longer Lifetime expectancy.</li> </ul> </li> </ul>	

However, these are not able to provide the discharging capacity as Lithium-Ion batteries. The energy storage density is quite similar.

- Mooring system mechanical forces excitation testing “chamber” for fatigue tests
  - Basically, a mooring line developer brings their mooring to Tecnia and inserts it in a “chamber” which repeatedly pulls the mooring at a given frequency and force (simulating given metocean conditions) for a given period of time.
- Testing building with several different type of windows, walls etc. and several meters, for evaluating material in terms of energy efficiency for households
- A small PV field with PVs across several generations
  - Namely had 2 floating PV modules, which were installed at Mutriku harbor.
    - The floaters were a mix of cement and a hollow composite to make lighter and float. One of the floaters had some cracks
    - Lessons learnt: it appears that having a floating PV on real offshore conditions (not dams) will require very careful material selection for its equipment in order not to lead to significant failures and unfeasible project feasibility overall.
  - Different types of PV technologies under test in different conditions and configurations.

#### VISIT TO BIMEP

- A visit to Bimep was done. Bimep is a testing site-owner and promoter which allows developers (like Tecnia, SAITEC, IDOM and others) to test their equipment under offshore conditions (wave energy and floating wind devices). Bimep has a wide array of sensors that provide the information to the developers through optic fiber that connects to its owned substation.
- **BIMEP possesses a streamlined process and agreements with the government to freely install the capacity on their testing sites without several additional documentation, in contrast with Portugal**
- Its testing area has cabling with a total of 20 MW with 13kV of rated voltage
- A redundancy drill to install a new cable is also available
- The subsea cables connect at shore to underground cables which lead to a Bimep owned substation
- The substation increases the voltage from 13kV to 130 kV which then goes to another neighboring facility to reduce once again and flow into the distribution grid
- A transformer for each testing technology is available. However, developers have also purchased their own transformers for testing, whether the project requires so
- The connection type to the technology is based on the agreement between Bimep and the developer. Bigger developers can strike more bargain with Bimep.
- Bimep is not responsible for any maintenance campaigns or equipment maintenance and installation. This is to be carried out by the developer or any sub-contracted company.
- Bimep after every major installation milestone performs testing on the technology and support structure condition, to both ensure legal protection and project feasibility.

#### MEETINGS W/ JOSEBA Lopez (JL) (Miguel)



- The main topic addressed was techno-economic modelling for offshore wind and hydrogen. However, topics related to O&M logistics and its relationship with metocean conditions were also reviewed.
- Hydrogen:
  - JL is developing a project (Hyshore) funded by the Basque government, together with other Basque research institutions. Its objective is to evaluate several logistic approaches to export hydrogen produced by offshore wind turbines
  - In this work, the scenario of stand-alone offshore wind is compared against a offshore wind + hydrogen system. The LCOE of the joint system considers the added CAPEX and OPEX of the hydrogen system but also considers a selling tariff for selling the hydrogen produced. The techno-economic modelling is not very detailed as it is only to provide a rough estimation between different approaches. Sensitivity analyses are done on the several parameters considered to allow to determine the most critical parameters for project feasibility.
  - Learning rates were assumed for hydrogen CAPEX and OPEX, as JL believes that the cost per MW installed will reduce throughout the project (Unclear whether all the CAPEX for hydrogen is incurred on Y1, if so, only makes sense to create a learning rate based on the previously installed capacity and not time dependent).
  - The current approach JL is considering is having offshore reservoir tanks, that keep the hydrogen under a given pressure. Vessels need to come at a given frequency (flow into the tanks = flow out the tanks so there are no over or under storage of hydrogen)
  - Joseba does this by assuming the installed capacity of wind and a 40% capacity factor. From the average generated electricity 20% is allocated to hydrogen. Knowing the electrolyser's efficiency (from kWh to Kg H<sub>2</sub>) one knows the hourly flow rate of the electrolyser and as so can dimension the storage system accordingly.
  - Several aspects in approach were discusses:
    - Having the tanks onshore vs. offshore. Maintaining the tanks offshore will require vessel chartering and dependency on metocean conditions, which can really increase the direct operation costs and even sometimes lead to energy curtailment (if the tanks are full and one cannot access the wind farm due to unfavorable metocean conditions)
    - The optimal sizing of the electrolyser: Wind farms in Spain sometimes have to shutdown during the night due to low energy demand. By having electrolysers that ideally require to be working 24/7 to avoid equipment damage, could benefit from the low cost at which these turbines would be generating electricity at during the night (very low "cost of opportunity"). Moreover electrolysers have decreasing efficiency for higher partial loads, so having a oversized electrolyser would not be a bad option.
    - Using pipelines for hydrogen distribution: Classically, pipelines are economically feasible if the distance travelled by the hydrogen is significant and pays off the investment in hydrogen. An alternative would be NG pipeline retrofit.
- Offshore O&M
  - JL presented a report of OPERA (a project which IST was involved) where a WEC (MARMOK-A-5) was tested for 3 years in Bimep's testing site





<ul style="list-style-type: none"> <li>○ A collection of all the operations (installation + O&amp;M) was done throughout the project</li> <li>○ Holds good historical data values for failure rates in WECs</li> <li>○ JL mentioned a good approach to O&amp;M is to group O&amp;M activities</li> </ul> <p>JL thinks that in Iberia, the installation and O&amp;M costs for offshore renewable technology will be high (especially when technology scales in production). As of today, there is not enough personnel learning and resource availability (ports, specialized vessels, etc.) to perform cost-efficiently the installation and O&amp;M task that need to take place. Most of the value/supply chain is located in the northern sea which can be a big disadvantage for the southern countries that will require to invest in infrastructures to have significant deployed installed capacity offshore.</p>
<p><b>Contacts made during the exchange</b></p> <p>Overall, contacts were made with the following staff members at Tecniaia:</p> <ul style="list-style-type: none"> <li>- Alberto del Pozo, Researcher</li> <li>- German Perez Moran, Head of Offshore Renewables</li> <li>- Josepa Lopez Mendia, Researcher</li> </ul>

<b>Early-stage staff</b>	Brian Jenkins
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	WavEC
<b>Dates of exchange</b>	7-10 Nov 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking whilst working at WavEC's office</li> <li>- Participate in WavEC's annual seminar</li> <li>- Identify synergies on floating offshore wind</li> </ul>	
<b>Activities and skills</b>	
<p>Lots of general networking was done whilst working in the WavEC office and dedicated sessions were also arranged for knowledge sharing between WavEC and OREC's staff who were there at the time. During these sessions WavEC shared their knowledge and experience on floating wind operations and maintenance, numerical modelling tools, offshore logistics modelling and floating wind techno-economic modelling. I also gave a presentation explaining our floating wind O&amp;M modelling capabilities and giving an overview of various upcoming marine operations projects in the Floating Wind Centre of Excellence. Over this time there was a lot of common areas of working identified and several opportunities for collaboration going forward. The WavEC Annual Seminar on the final day was also a great opportunity for me to find out more about floating wind in Portugal and Spain and understand some of the differences there compared to the UK.</p>	

<b>Early-stage staff</b>	Thomas Smith
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	WavEC
<b>Dates of exchange</b>	7-10 Nov 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking whilst working at WavEC's office</li> <li>- Participate in WavEC's annual seminar</li> <li>- Gain better understanding of the Portugese offshore wind sector</li> </ul>	
<b>Activities and skills</b>	
<p>The networking activities and exchange of knowledge with WavEc staff was extremely valuable. It was great to learn about their research activities and advanced modelling experience. It's evident Portugal is at the forefront of floating wind development. The exchange has expanded my</p>	



knowledge of the Portuguese offshore renewables sector. Attending the WavEc seminar during the exchange week was very beneficial, giving a great overview of all aspects of renewables in the Iberian Peninsula, from development and consenting challenges ahead of Portugal's first leasing rounds to new and novel floating wind technologies currently being demonstrated. Myself and my colleagues gladly shared our knowledge of the sector in the UK and some learnings we have identified from the Offshore Renewable Energy Catapult. One thing that will be hard to beat from future exchanges is the excellent hospitality shown by WavEc staff, which was second to none, I look forward to continuing to collaborate with members of the WavEc team helping to accelerate the transition to renewable energy and net zero.

<b>Early-stage staff</b>	Cameron Wilson
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	WavEC
<b>Dates of exchange</b>	7-10 Nov 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking whilst working at WavEC's office</li> <li>- Participate in WavEC's annual seminar</li> <li>- Gain better understanding of the modelling</li> </ul>	
<b>Activities and skills</b>	
<p>The staff exchange was beneficial as it highlighted what areas of focus both us and WavEC are prioritising in the short to medium-term. Their presentations helped us to better understand the modelling work they are undertaking both in aiding environmental surveys as well as modelling estimates for whole wind farm yield and the control strategies that can be implemented to minimise LCoE across the duration of a given project. Many of the topics that were covered during WavEC's presentation are included in the OWIH roadmaps, meaning contacts from WavEC could be of potential assistance in supporting future OWIH roadmap updates. The annual WavEC seminar was of particular benefit as it highlighted parallels between the UK and Iberian FOW sectors and the challenges that each sector faces in reaching 2030 installation targets. The seminar also highlighted the relative areas of strength that the Iberian FOW supply chain has in comparison to other European players (e.g., UK, France, Norway). Additionally, it was a good networking experience with enjoyable cultural exchange.</p>	

<b>Early-stage staff</b>	Luke Eatough
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	WavEC
<b>Dates of exchange</b>	7-10 Nov 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking whilst working at WavEC's office</li> <li>- Understand WavEC's environmental research</li> <li>- Participate in WavEC's annual seminar</li> </ul>	
<b>Activities and skills</b>	
<p>The first three days of my visit were spent in meetings and conversations with WavEC's environmental and engineering teams. Before the visit, I had assumed that I would spend approximately 50% of my time there on engagements with the WavEC team, and the other 50% on my "day-to-day" work. However, in practice the split was closer to 70/30 in favour of collaborative discussions, and the visit was much busier than expected in a positive way. During these discussions, we identified several synergies between our respective programmes, notably the areas of floating</p>	



offshore wind spatial planning, commercial fisheries interactions, as well as marine growth and electromagnetic field (EMF) impacts.

On the fourth day, I attended the WavEC annual seminar. This included presentations from a range of local industry figures, which gave me new insights to the ambitions and challenges facing the Portuguese and Spanish offshore wind industries. I had booked in advance the fifth day of the visit as annual leave, which I used as an opportunity to explore Lisbon, as it was my first time in the city.

The following week, we hosted two WavEC staff in a return visit, during which we provided a more detailed overview of the FOW CoE's research programme, and continued some of the discussions that we began in Lisbon. I believe that this visit has meaningfully increased the chances of potential future collaborations between WavEC and ORE Catapult/FOW CoE. Prior to the visit, we had a very limited insight into the specifics of our respective projects. However, we now understand where our shared priority areas lie, and what our respective strengths are. We have therefore committed to maintaining a dialogue going forward in order to explore those opportunities.

<b>Early-stage staff</b>	Kacper Stefaniak
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	WavEC
<b>Dates of exchange</b>	7-10 Nov 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking whilst working at WavEC's office</li> <li>- Understand the Iberian offshore renewables market</li> </ul>	
<b>Activities and skills</b>	
<p>My participation in staff exchange has enabled me to understand the Iberian offshore renewables market, ambitions and troubles that the sector is facing. Many of the technical challenges the floating wind industry is facing are common across Europe. WavEC has been very hospitable and over the few days of the visit has introduced us to all databases they have, went through their models and shown us the laboratory where they undertake equipment tests. We've discussed a few collaboration opportunities in the future and understood better their capabilities. It is likely that we will remain in touch for future project opportunities as partners or contractors.</p>	

<b>Early-stage staff</b>	Nathan Haley
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	Tecnalia
<b>Dates of exchange</b>	21-25 Nov 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking whilst working at Tecnalia's office</li> <li>- Introduction of local fatigue modelling software UFLEX to Tecnalia with an aim to transfer knowledge for Tecnalia to use in further projects</li> </ul>	
<b>Activities and skills</b>	
<p>During the week of November 21<sup>st</sup> to 25<sup>th</sup> 2022, I visited Tecnalia in Bilbao, Spain to conduct a weeks staff exchange under the TWIND collaborative project. Tecnalia are the Spanish equivalent company of the UK ORE Catapult within the offshore wind research and development industry.</p> <p>In summary, the staff exchange resulted in the introduction of local fatigue modelling software UFLEX to Tecnalia with an aim to transfer knowledge for Tecnalia to use in further projects, and successfully laid foundations for ORE Catapult and Tecnalia to continue research collaboratively to compare software results of fatigue analysis.</p>	



Prior to arrival in Bilbao, Imanol and myself exchanged ideas of work to collaborate on regarding an umbilical cable fatigue test conducted in their laboratory and how this could be simulated in software to verify and compare results. On my first day with the team, the laboratory procedure was explained and physical cable model was shown which I then modelled in the local analysis software UFLEX used by ORE Catapult. It was very interesting to see a physical dynamic umbilical cable in my hands and better understood the variety of layouts and materials used in a prototype model compared to reading theoretical models with no real-life model to compare drawings too. Following an informative tour of the Tecnalia laboratory and work they are involved with, I worked closely with Imanol and the offshore renewable energy team to introduce them to UFLEX software and its capabilities for 2D local analysis of dynamic umbilical cables and discussed how to progress further with their work at ORE Catapult. They conducted fatigue analysis resulting in an S-N diagram for the cable which they hope to verify using simulation software. It was decided that my UFLEX simulations would be compared to their own Ansys simulations and both compare to the laboratory fatigue assessment.

Although a site visit to the Saitech DemoSATH floating wind turbine and the HarshLAB floating test site was discussed, workload from the team and weather was a limitation but I was able to see much of the Tecnalia office and facilities.

I thoroughly enjoyed my week meeting the team at Tecnalia sharing knowledge whilst also having the opportunity to explore Bilbao and the Basque Country culture and cuisine.

<b>Early-stage staff</b>	James Ferguson
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	Tecnalia
<b>Dates of exchange</b>	12-17 Dec 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking whilst working at Tecnalia's office</li> <li>- Gain better understanding of the work on hydrogen at Tecnalia</li> </ul>	
<b>Activities and skills</b>	
<p>ORE Catapult's Research Engineer in Hydrogen Systems (James Ferguson) visited Tecnalia over several days on the week starting the 12th of December. At the start week, James visited the Tecnalia offices in San Sebastian, as these host most of Tecnalia's hydrogen work. The visit was led by Pablo Martinez Alonso, who leads R&amp;D projects which work on implementing technologies around the hydrogen chain.</p> <p>Pablo introduced Tecnalia as an organisation, and some of the work the organisation is doing in hydrogen. This includes hydrogen generation, through electrolysis and steam methane reforming, membranes for separating hydrogen from gaseous mixtures, as well as membrane reactors, the development of manufacturing pilot lines, refuelling stations, hydrogen sensors, ammonia, liquid organic hydrogen carriers, and more.</p> <p>We discussed modelling. We discussed Tecnalia's expertise in modelling compression, storage, hydrogen's interaction with materials (embrittlement), fluid dynamics, including in electrolysis cells, and thermal simulation, both of hydrogen tanks during refuelling and of electrolyser stacks. James outlined ORE Catapult's capabilities in modelling electrolysis in terms of hydrogen production and power consumption (looking specifically at stack current, voltage and temperature), simplified models for finding production rates, unit costs, and optimal sizes, and the organisation's early work in modelling electrically integrated wind turbine – electrolyser devices.</p>	



Following these discussions, we visited Tecnalia’s membrane lab, where a range of membrane technologies are testing and created, including membrane reactors. We also visited an area where Tecnalia is in the process of building new hydrogen labs. This will host four different types of electrolyser, at the kW scale, and a high pressure (up to 400 bar) storage testing rig.

We also discussed future collaboration possibilities, such as: the behaviour of electrolysis when deployed on floating platforms, modelling of hydrogen systems, technoeconomic analysis, and integration of offshore renewables with electrolysis.

The next day, James visited Tecnalia’s Bilbao office, for a visit led by Germán Pérez Morán, Head of Offshore Wind in the Energy, Climate and Urban Transition team. The visit included a site tour of Tecnalia’s facilities, including the engineering laboratories. Following this, James joined a meeting with ORE Catapult colleagues Mathieu Kervyn and Anup Nambiar about some of Tecnalia’s grid integration work. James presented how ORE Catapult sees the UK and global hydrogen sectors, explained the capabilities the organisation is developing, and reviewed technoeconomic assessments of the cost of hydrogen produced from electrolysis powered by offshore wind turbines.

Overall, the trip was a very successful exchange of expertise and ideas. It developed connections and uncovered potential areas of future work which Tecnalia and ORE Catapult plan to develop in the coming months and years.

<b>Early-stage staff</b>	Anup Nambiar and Mathieu Kervyn
<b>Affiliation of early-stage staff</b>	OREC
<b>Host institution during exchange</b>	Tecnalia
<b>Dates of exchange</b>	12-16 Dec 2022
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Exchange knowledge and skills</li> <li>- Identify synergies between Technalia and ORE Catapult</li> <li>- Identify collaboration areas for future projects</li> </ul>	
<b>Activities and skills</b>	
<p>Preparations for the staff exchange programme began about two months prior to the visit with a call with Germán. Mathieu and I had identified research groups at Tecnalia of interest to us before the call. Germán was then kind enough to liaise between us and the research groups we had identified. With his assistance we were able to interact with members of the Offshore Renewables Group, the Power Electronics and System Equipment Group and the Digital Energy Group while we were there. We also got the opportunity to visit the Biscay Marine Energy Platform (BiMEP) wave and floating wind test site on one of the days.</p> <p>The week Mathieu and I were at Tecnalia went very smoothly. We had our own desks to work at and Germán had left the second half of the days free for us to continue discussions from the mornings or to work on our projects. The work culture at Tecnalia was very similar to what we have at the ORE Catapult. The main difference was the “formal” coffee and lunch breaks – when research groups went away to the coffee room or the lunch hall to have coffee/lunch. I found these to be very good opportunities to network beyond those who we had scheduled meetings with, to continue discussions from earlier and welcome breaks from work.</p> <p>One of my three main work-related highlights from the week there was the power electronics and HVDC lab that we got to visit and some of the advanced control and hardware experiments that were shown to us. Tecnalia had a set up for fast prototyping in the lab wherein they could test</p>	



novel control algorithms in control hardware-in-the-loop systems and then quickly move onto testing those algorithms on a pure hardware test bed in a short period of time.

My second highlight was when one of the researchers at Tecnia we were meeting brought up an old project proposal that Tecnia had worked together with ORE Catapult on. This clearly showed that we just had to revive some of the older relationships that already existed between the two companies.

My third highlight was our boat trip at BiMEP to see Tecnia's HarshLab and their measurement buoys. That trip gave me an appreciation of the energetic sea conditions wave and floating wind devices need to operate in.

From the discussions and meetings we had at Tecnia over the week, possible areas of collaboration like: grid emulation and hardware-in-the-loop testing, modelling of power converters and their grid forming/following control, and digital twins for wind turbine generators and power converters were identified. There were also other topics, slightly outside the scope of our day-to-day work, that were recorded as well. Relevant researchers at ORE Catapult will be introduced to their counterparts at Tecnia in early 2023 to hopefully start/continue collaborations with them. Mathieu and I spent most evenings after work walking around in Bilbao. Since the exchange was just before Christmas the city was beautifully decorated and the weather was lovely as well. We also went pintxo bar hopping most evenings for dinner, as suggested to us by some of the researchers we met at Tecnia. The week there also improved my, albeit poor, Spanish by a few words/phrases! My visit to the Guggenheim Museum on the last afternoon there was the icing on the cake of the exchange programme.

Participating in the staff exchange program was an enriching and rewarding experience for me. It gave me the opportunity to experience working in and to learn about another research organisation. The measure of success of the exchange programme stems from how we, participants in the exchange programme, continue communicating with and collaborating with those whom we met. I am hopeful that we will make something positive grow from the seeds that were planted during the exchange.

<b>Early-stage staff</b>	Manuel Rentschler
<b>Affiliation of early-stage staff</b>	WavEC
<b>Host institution during exchange</b>	TU Delft
<b>Dates of exchange</b>	Online, regular between 30 April 2020 and 31 Dec 2021
<b>Objectives</b>	
<ul style="list-style-type: none"> <li>- Networking</li> <li>- Training on computational fluid dynamics (CFD) for wave-structure interactions with a floating support structure for floating wind.</li> </ul>	
<b>Activities and skills</b>	
<ul style="list-style-type: none"> <li>- Regular meetings and training sessions on meshing, simulation setups, and results analysis for the hydrodynamic analysis of a floating wind turbine</li> <li>- Cross-comparison between the results of 2 different CFD codes: OpenFOAM and Refresco.</li> <li>- Training and feedback on presentation skills, both orally (conference presentation) and in writing (paper writing).</li> </ul>	
<b>Contacts made during the exchange</b>	
<p>Overall, contacts were made with the following staff members at OREC:</p> <ul style="list-style-type: none"> <li>- Pranav Chandramouli, Post-doctoral researcher at TUD (now software engineer at eScience Centre Amsterdam)</li> </ul>	



- Axelle Viré, Associate Professor
<b>Relevant documents</b>
The exchange led to a scientific paper published in open access in 2022: M. Rentschler, P. Chandramouli, G. Vaz, A. Viré, R.T. Gonçalves, “CFD code comparison, verification and validation for decay tests of a FOWT semi-submersible floater”, Journal of Ocean Engineering and Marine Energy (2022).

## 4 DISSEMINATION

Some of the junior staff disseminated their exchanges through blogs that are publicly available on the TWIND website, <https://twindproject.eu/blog/>. Additionally, some of the exchanges led to new collaborations that resulted in publications (see above).

## 5 CONCLUSIONS

A total of 14 early-stage staff exchanges took place during the TWIND project. These exchanges enabled significant exchange of knowledge between the TWIND consortium members and trained researchers to technical skills, as well as a better knowledge in environmental/consenting processes and project development. It also increased the understanding of the researchers in the international landscape and offshore wind markets in the respective countries of the host institutions. The early-stage researchers were very pleased by their exchanges and stressed the fact that these exchanges are only the beginning of longer-term collaborations and networking.

