

# “New Renewable Energy Generation: Marine Energy, Hybrid Systems & H<sub>2</sub>”

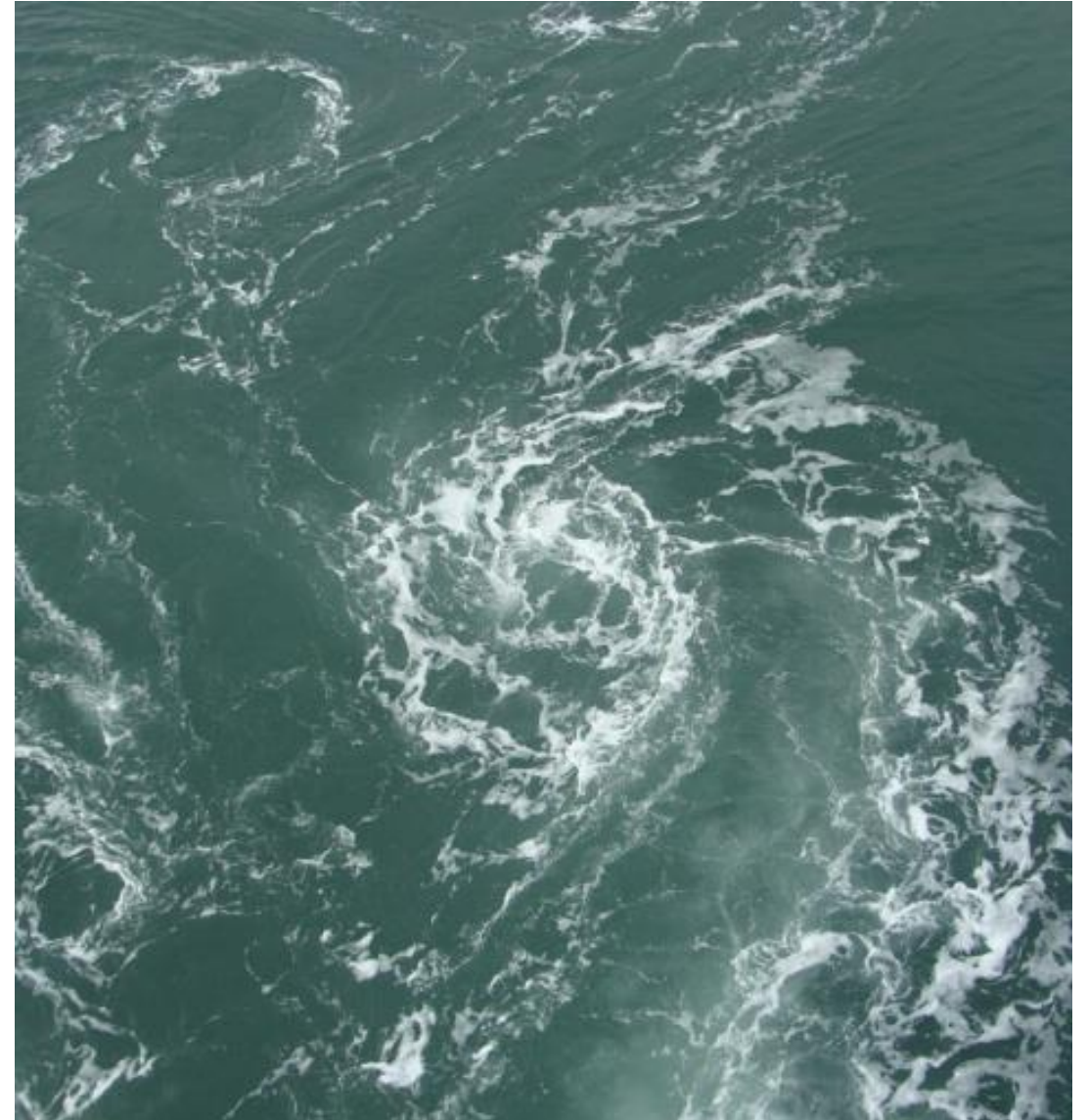
Puhdas Energia Webinaari  
(Clean Energy Webinar)  
September 12<sup>th</sup>, 2023

Jonathan Colby  
President & Founder  
Streamwise Development, LLC

Chair IEC TC 114 | Convener ME-SWG IECRE

# Outline

- Marine Energy
  - \* Tidal Energy (River Energy)
  - \* Wave Energy
- Hybrid Systems
  - \* Wind-Wave-Hydrogen
  - \* Floating Solar
- IEC TC 114 & IECRE
- Young Professionals Workshop

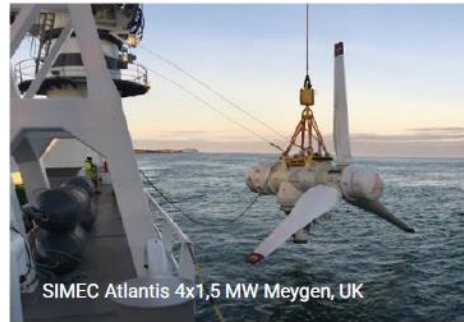


# Global Industry

## TIDAL CURRENT ENERGY | Progress in recent years



- Approaching design **convergence**
- Approaching **commercialisation**, with deployment of full-scale devices and first arrays
- **Progress demonstrated** by operating hours accumulated and electricity generated
- **Need for further technology investigation** and demonstration for long periods of time



# MeyGen

The Crown Estate awarded an agreement for lease to MeyGen PLC

- Stroma, Scotland
- 398 MW consented
  - Phased build out
  - 6 MW (operational) + 28 MW (CfD) + 52 MW (under development) + 312 MW (planned)
- 28.00 MW allocated to MeyGen PLC under CfD Auction Round (AR) 4
- 21.94 MW allocated to MeyGen PLC under CfD AR5
- Developer agnostic (SIMEC Atlantis & Andritz Hydro to date)
- 50+ GWh generated to date [[LINK](#)]



# MeyGen – SIMEC Atlantis



# MeyGen – Andritz Hydro

**MK1 – 5+ YEARS OF OPERATION**



ANDRITZ HYDRO Hammerfest - MeyGen 1A - Turbine 1 - Camera 2 - 2022-09-24 14:20:30



ANDRITZ HYDRO Hammerfest - MeyGen 1A - Turbine 3 - Camera 2 2022-05-03 12:01:18



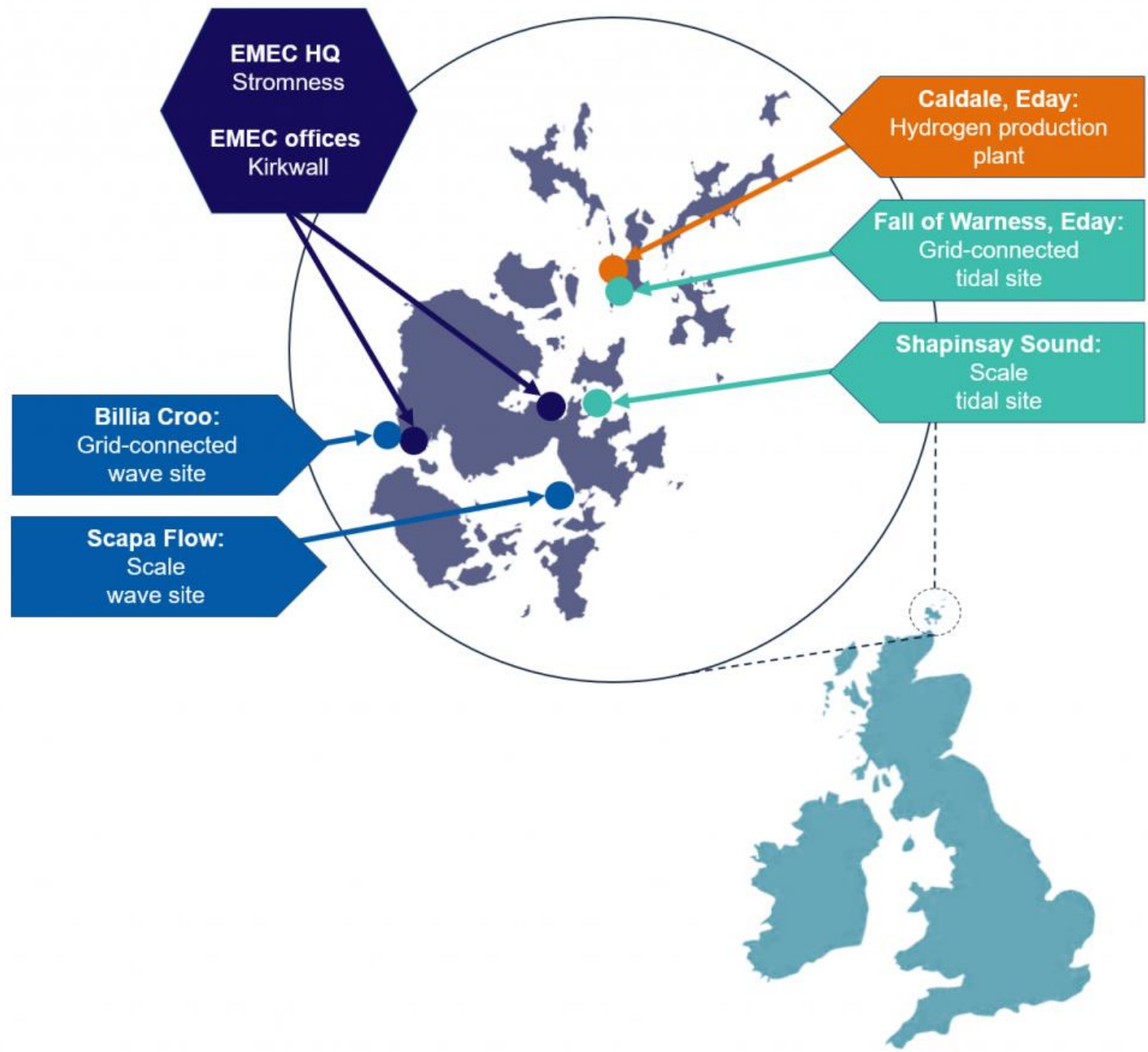
# EMEC

## European Marine Energy Centre (EMEC)

- Orkney Islands, Scotland
- 4 test sites (2 tidal, 2 wave)
- [Hydrogen generation](#) & grid-connected infrastructure
- 1.50 MW allocated to Magallanes Renovables under CfD AR5
- More information available at <https://www.emec.org.uk/>



# EMEC





# Westray

## Orbital Marine Power

- Westray Firth, Orkney Islands, Scotland
- 30 MW project
- Grid-connected infrastructure
- Adjacent to EMEC
- 7.20 MW allocated in CfD AR4 (Eday 1 & Eday 2)
- 7.20 MW allocated in CfD AR5 (Eday 3 & Eday 4)
- More information available [[LINK](#)]



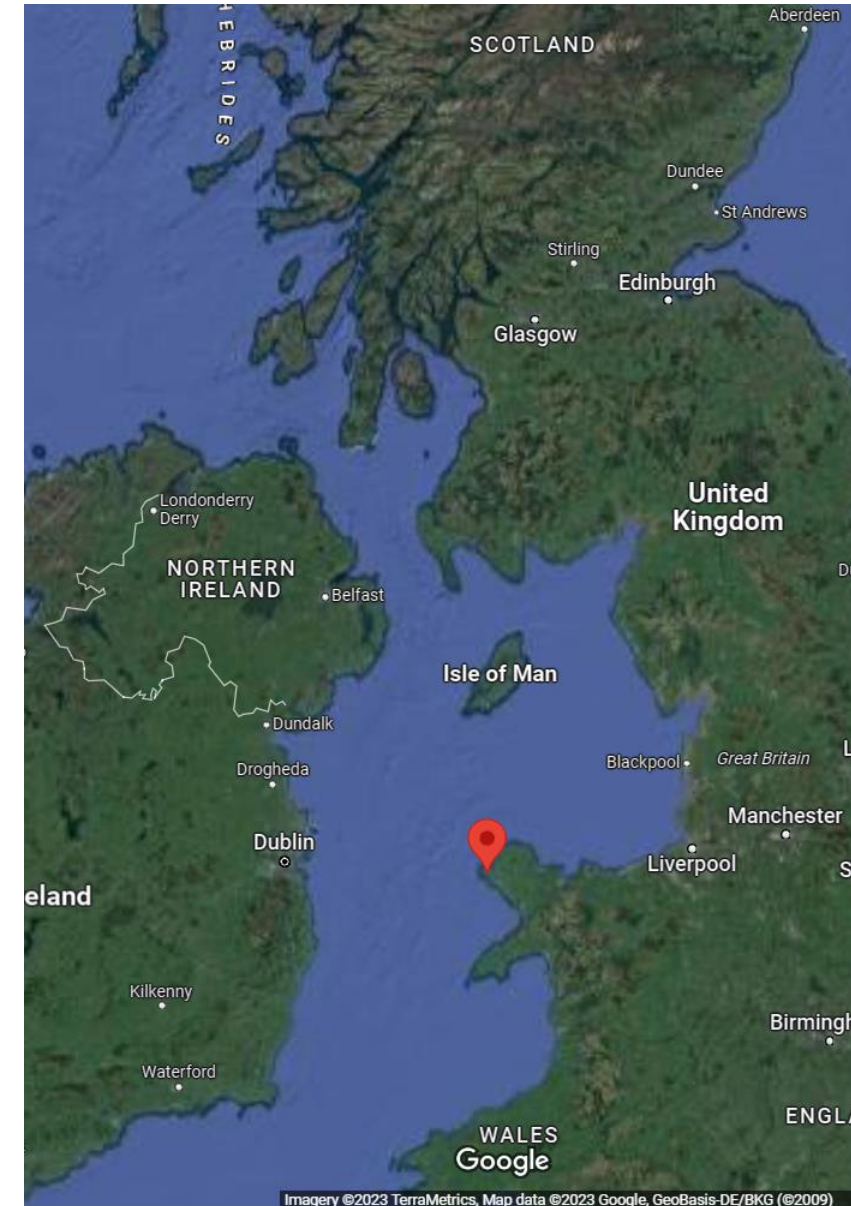
# Westray – Orbital Marine Power



# Morlais Demonstration Zone

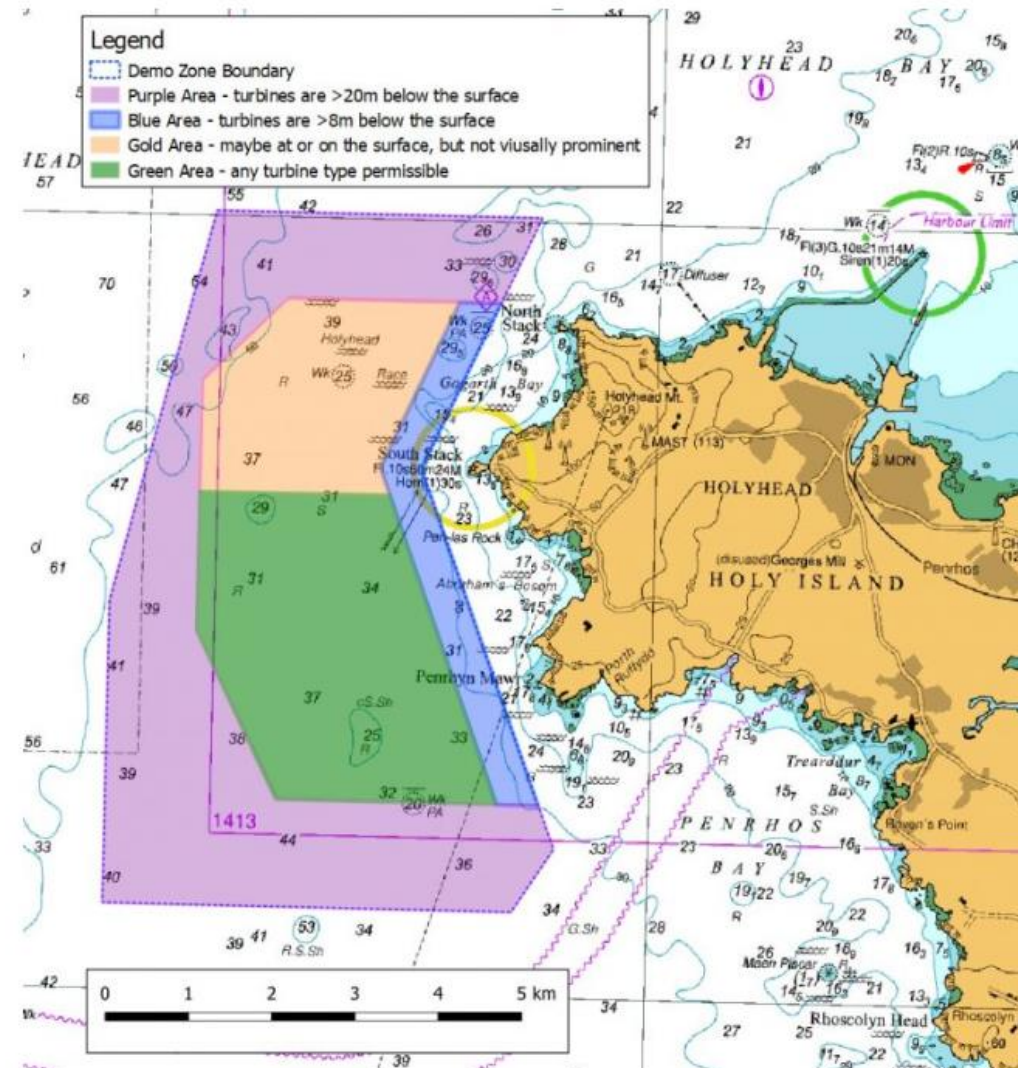
Consent from Welsh Government and Natural Resources Wales was awarded in December 2021

- Holyhead, Wales
- 240 MW Consented (8 x 30 MW berths)
  - Phased build out
  - 7 berths allocated to individual developers to date
- 5.62 MW allocated to Magallanes Renovables under AR4
- 3.00 MW allocated to Magallanes Renovables under AR5
- 4.90 MW allocated to Verdant Isles under AR5
- 4.50 MW allocated to MOR ENERGY LTD under AR5
- Utilizing the Rochedale Envelope
- More information available [[LINK](#)]



# Morlais Demonstration Zone

Coloured areas showing restrictions on the types of turbine permitted and showing operational exclusion zones



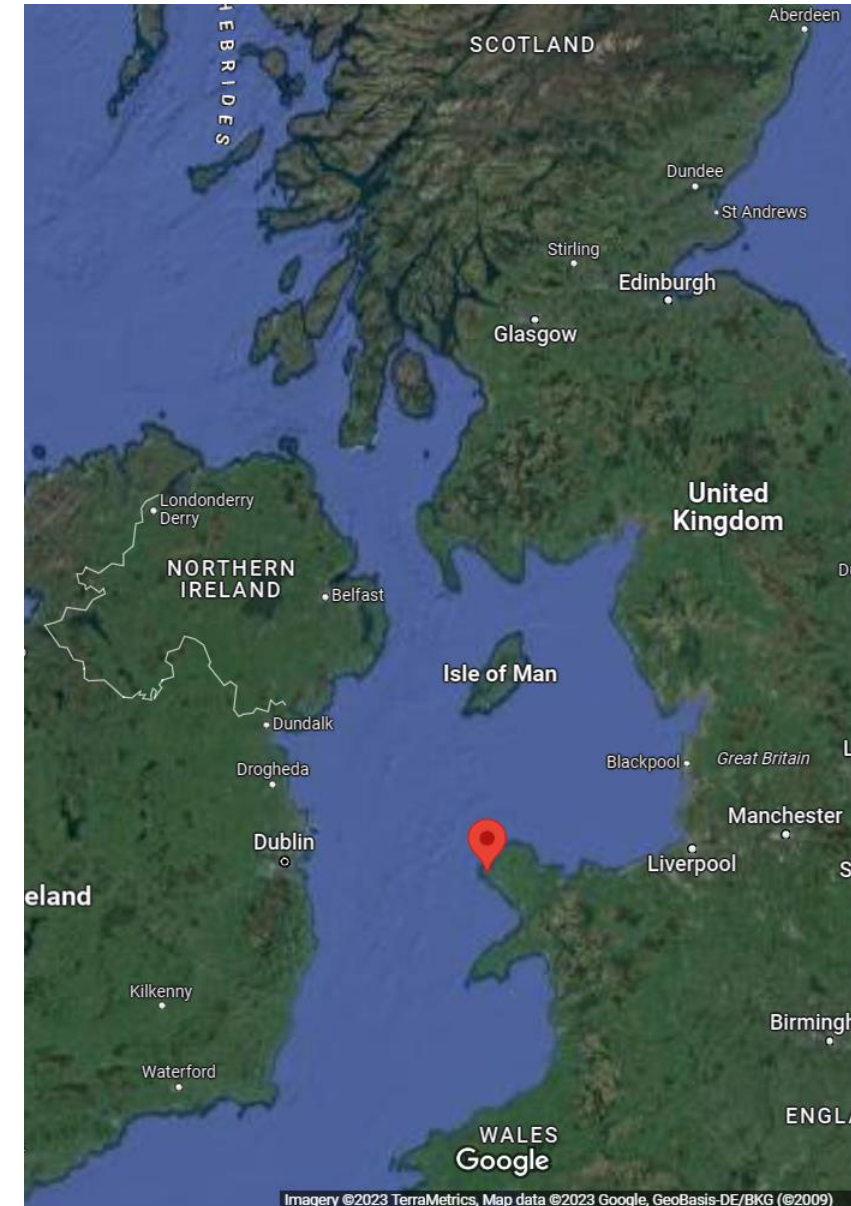
# Morlais Demonstration Zone – Magallanes



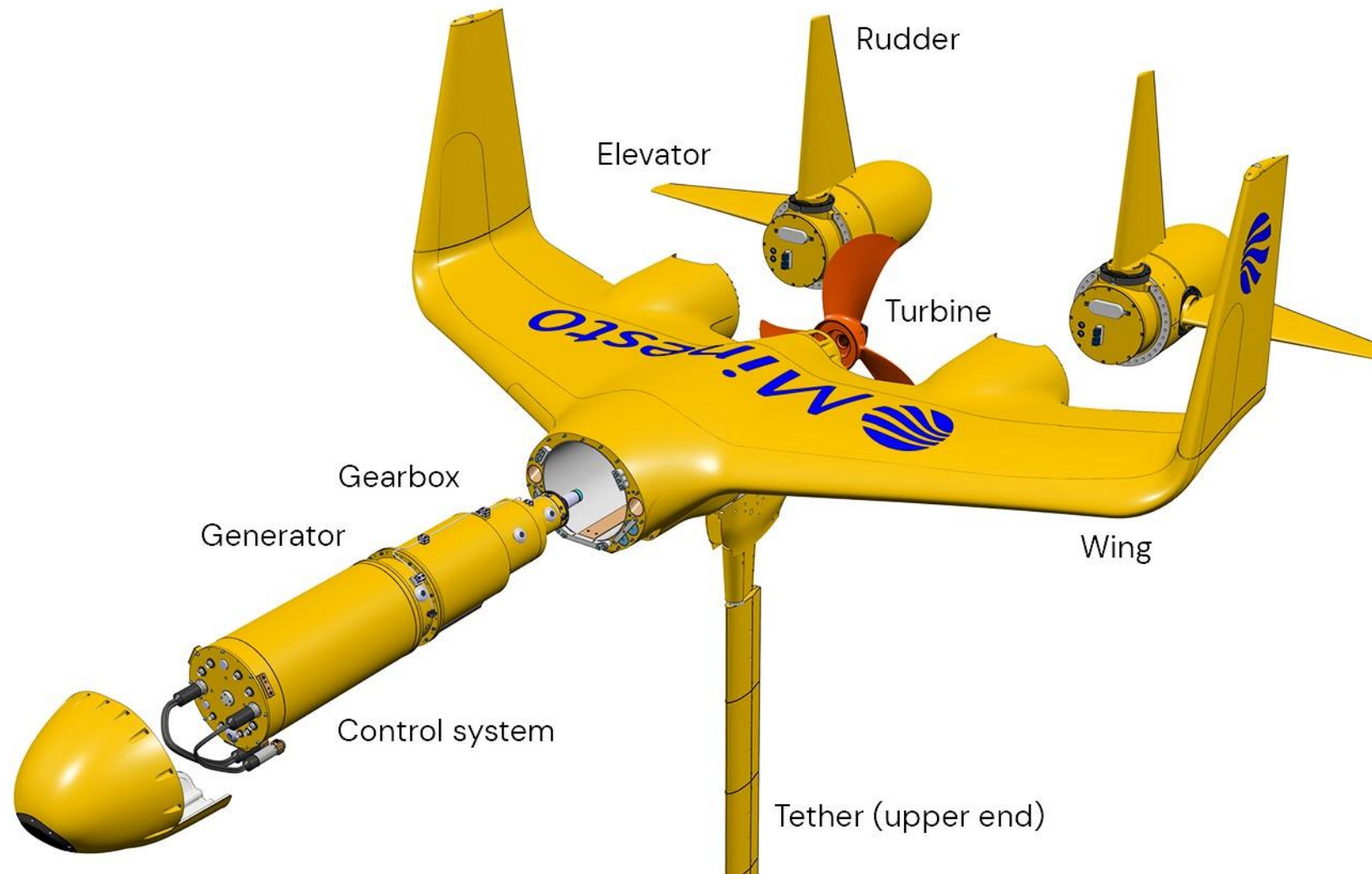
# Holyhead Deep

## Minesto UK

- Holyhead, Wales
- 80 MW maximum
- 10 MW initial installation
- European Union (EU) + Welsh European Funding Office (WEFO) funding
- Adjacent to Morlais
- More information available [[LINK](#)]



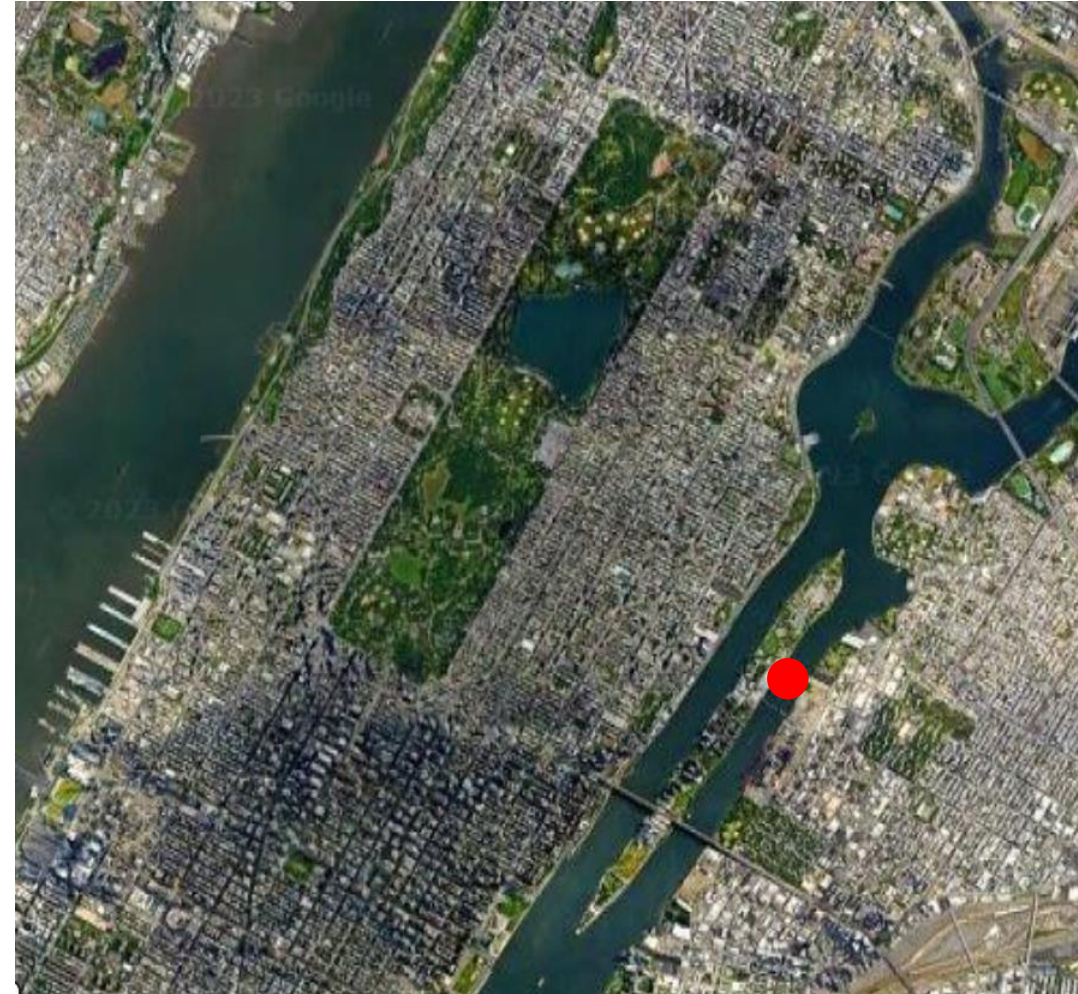
# Holyhead Deep – Minesto



# USA – Verdant Power

Roosevelt Island Tidal Energy (RITE) Project,  
New York, NY

- FERC P-12611
- 1 MW total FERC-licensed, phased deployment
- 105 kW installed
- 350 MWh generated (2021)
- World's first IECRE Test Report (RETR)
- More information [[LINK](#)]





# Roosevelt Island Tidal Energy (RITE) Project



# China



# Japan



# Global Industry

## WAVE ENERGY | Successful deployments



- Several **full-scale devices** in the manufacturing phase or preparing for deployment
- **Continuous evolution** along the TRL scale and first farms are being designed
- A number of **potential breakthroughs** have been developed
- A **wide variety** of wave energy technologies
- **Extensive testing** programmes are still required



GIEC Wanshan, RCP, 2x500 kW



Mocean BlueX, UK for subsea O&G



NIOT navigation buoy, Chennai port, India



Corpower, pilot farm of 4, Sweden & PT



GEPSTechno Wavegem hybrid platform, France



Crestwing Tordenskiod, 14 month test, DK



Ocean Energy Buoy, Ireland 500 kW in Hawaii



Wavepiston, PLOCAN test, DK and SP



WSE Uniwave 200, Australia, 200 kW

# Finnish Wave Energy Industry

Wello

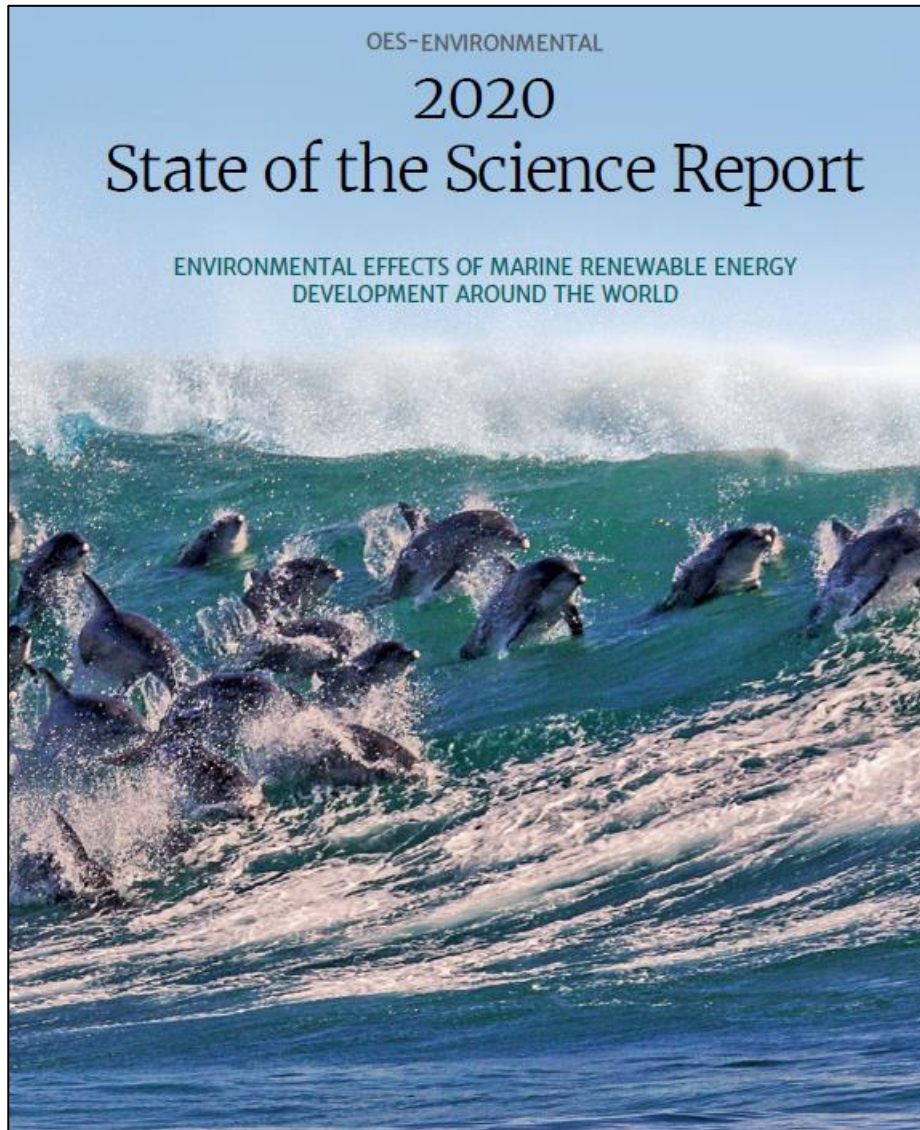


The "Penguin" [\[LINK\]](#)



The "WaveRoller" [\[LINK\]](#) 21

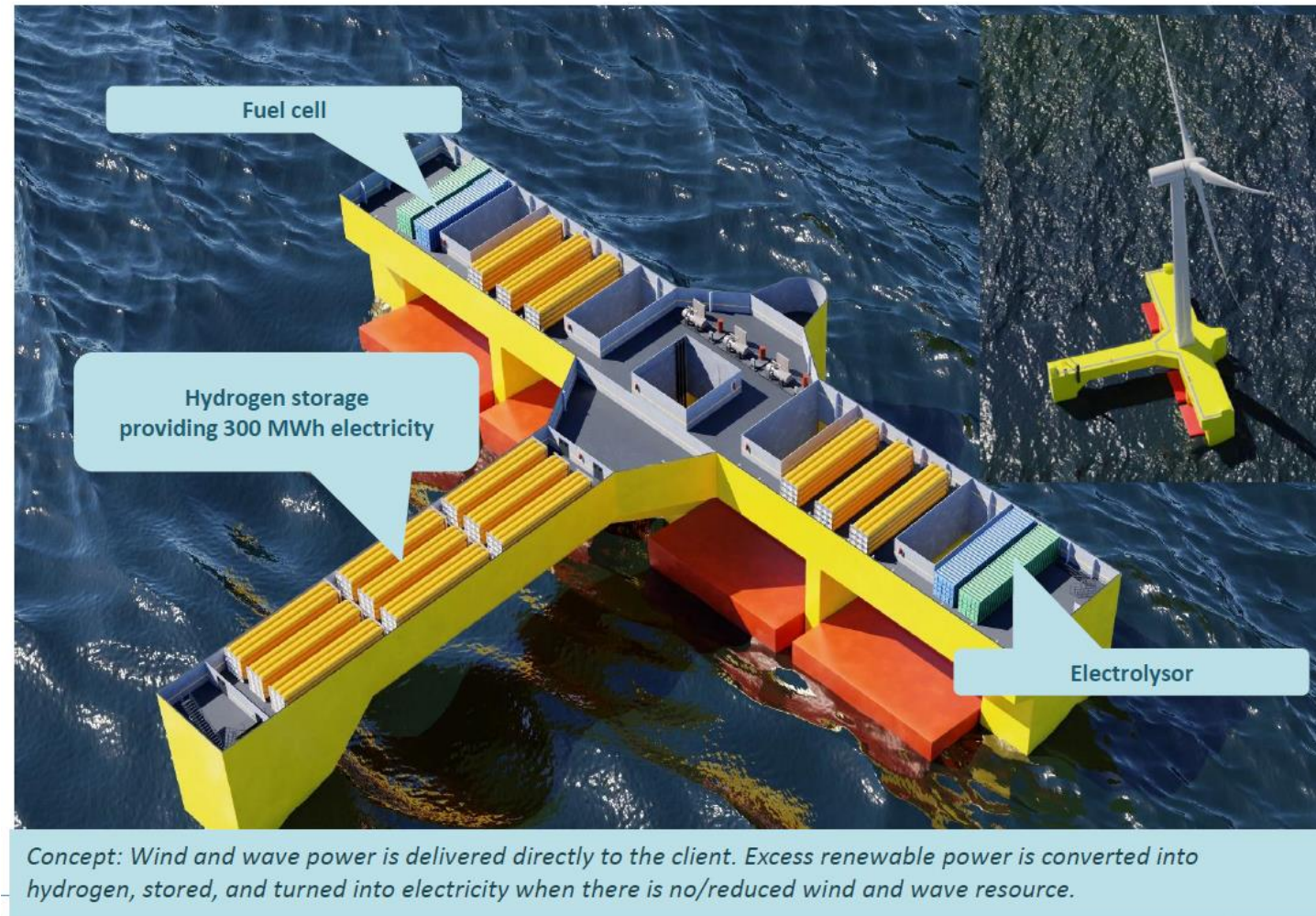
# IEA Ocean Energy System (IEA-OES)



# Hybrid Systems

## Wind-Wave-Hydrogen

- Floating Power Plant (DK)
  - 4 – 15 MW Wind Turbine
  - 1 – 4 MW WEC
  - Hydrogen
- 
- UK Innovation Fund (July 2023)



# Hydrogen in Finland

“Neste Corporation, Gasgrid Finland, Helen and Vantaa Energy have joined forces and started preliminary studies on the development of an industrial hydrogen valley in the Uusimaa region in Finland.”

Offshore Energy, June 20, 2023 [[LINK](#)]

“Neste said the industrial hydrogen valley would combine infrastructure, storage and transmission of **renewable hydrogen**, serving both producers and consumers of hydrogen, adding that sector integration opportunities are a key element in the studies.”



# Hydrogen in Finland

“Large-scale hydrogen valley project between Finland and Estonia set to kick off.”

Offshore Energy, June 1, 2023 [[LINK](#)]

“BalticSeaH2, prepared by Finnish CLIC Innovation as the project coordinator and Gasgrid Finland as a co-coordinator for the collaboration in the project, is set to start at the beginning of June and will last for five years.

The consortium includes 40 partners from nine Baltic Sea region countries: Finland, Estonia, Latvia, Lithuania, Poland, Germany, Denmark, Norway, and Sweden.”

# Hybrid Systems

## Floating Solar

- Significant developments globally
- Select articles since April:
  - SeaVolt in Belgian North Sea
  - Colombia 1.52 MWp (photo)
  - NREL assessment for SE Asia
  - Indiana, USA 8.9 MW
  - Indonesia 561 kWp
  - Nova Innovation in Scotland in 2023
    - Tidal developer diversifying



*Aquasol floating solar pilot in Colombia (Courtesy of URRÁ)*

# IEC TC 114 – Marine Energy Standards

## IEC Technical Committee (TC) 114

“Marine energy - Wave, tidal and other water current converters”

- 200 Subject Matter Experts
  - 100 in c. 2010
- 29 Countries (National Committees)
  - 18 in c. 2010
- 18 Working Groups
  - Advisory Groups, Ad-hoc Groups, Project Teams, Maintenance Teams
- 20 Publications to date
  - 17 1<sup>st</sup> Editions; 3 2<sup>nd</sup> Editions
- Publicly available Vocabulary for Marine Energy ([IEV Part 417](#))



# IEC TC 114 – Participating Members (17)



# IEC TC 114 – Observing Members (12)



# IEC TC 114 – Resource Agnostic Standards

Number	Abbreviated Title	Edition	Publication Year
62600-1	Vocabulary	2	2020
62600-2	Marine Energy Converter Design	2	2019
62600-3	Measurement of Mechanical Loads	1	2020
<b>62600-4</b>	<b>Technology Qualification</b>	<b>1</b>	<b>2020</b>
62600-10	Moorings	2	2021
62600-30	Power Quality	1	2018
62600-40	Acoustic Characterization	1	2019
<i>62600-41</i>	<i>Biofouling Characterization</i>	<i>1</i>	<i>Target 2025</i>

# IEC TC 114 – Resource Specific Standards

Number	Abbreviated Title	Edition	Publication Year
62600-20	Ocean Thermal Energy Conversion (OTEC) Design	1	2019
62600-100	Wave Energy Converter (WEC) Power Performance	1	2012
62600-101	Wave Energy Resource Assessment	1	2015
62600-102	WEC Power Performance at a 2 <sup>nd</sup> Location	1	2016
62600-103	WEC Pre-prototype Device Testing	1	2018
62600-200	Tidal Energy Converter (TEC) Power Performance	1	2013
62600-201	Tidal Energy Resource Assessment	1	2015
62600-202	TEC Device Scale-Testing	1	2022
62600-300	River Energy Converter (REC) Power Performance	1	2019
62600-301	River Energy Resource Assessment	1	2019

# IECRE – Certification

Certification (3rd party verification) to consensus-based, International Standards and Technical Specifications can reduce risk, improve market access and support the commercialization of the Marine Energy industry

## IECRE System: Marine + Solar PV + Wind

- Three Sector Working Groups (SWGs)
- 6 Member Bodies (countries) in Marine Sector
  
- Test Reports, Conformity Statements, Feasibility Statements
- Certificates (Prototype, Component, Type, Project)
- Renewable Energy Certification Bodies (RECBs)
- Renewable Energy Test Laboratories (RETLs)
- Renewable Energy Inspection Bodies (REIBs)





# IECRE Marine Energy (ME) Sector



# IECRE Test Report (RETR)

## IECRE Test Laboratory (RETL)

- EMEC, UK
- Recognized within the IECRE with a scope in the IEC TS 62600-200 (TEC Power Perf.)

## Tidal Energy Converter Developer (i.e., Customer)

- Verdant Power, US
- TriFrame™ at the Roosevelt Island Tidal Energy (RITE) Project, NY, NY

## Result

- EMEC provided 3<sup>rd</sup>-party verification of compliance to IEC TS 62600-200
- Issued first IECRE Test Report: [IECRE.ME.TR.TPP.21-00001-R0](#)
- Cover letter is publicly available; Full report is protected

# IECRE Feasibility Statement

## IECRE Certification Body (RECB)

- Lloyd's Register, UK
- Recognized within the IECRE with a scope in the IEC TS 62600-4 (Tech. Qual.)

## Tidal Energy Converter Developer (i.e., Customer)

- Flex Marine Power Ltd., UK
- SwimmerTurbine™ SW2

## Result

- LR provided 3<sup>rd</sup>-party verification of compliance to IEC TS 62600-4
- Issued first IECRE Feasibility Statement: [IECRE.ME.FS.23-0001-R0](#)
- Cover letter is publicly available; Full statement is protected

# Brief Summary – Reduce Risk!

## IEC TC 114 Technical Specifications and Standards

- Ensure a common language
- Codify global best practices
- Provide the detailed “How to”
- *Experts are encouraged to join!*
- *We need increased Finnish participation!*



## IECRE Conformity Assessment System

- Harmonizes rules for testing and certification activities
- Reduces barriers to trade and enables market access
- Increases confidence in technology
- *Developers are encouraged to request IECRE Deliverables!*



# IEC Young Professionals (YP)



IEC YPs: 2011

# My Insights After 10+ Years Since YP

## Energy In = Energy Out

- Conservation of Energy as applied to success!

## Expertise, Opportunity and Effort

- Capitalize on your abilities, and opportunities, with committed engagement.

## Remain connected to your National Committee

- Attend and contribute to establish, and amplify, your knowledge and voice.

## The community wants to hear your voice!

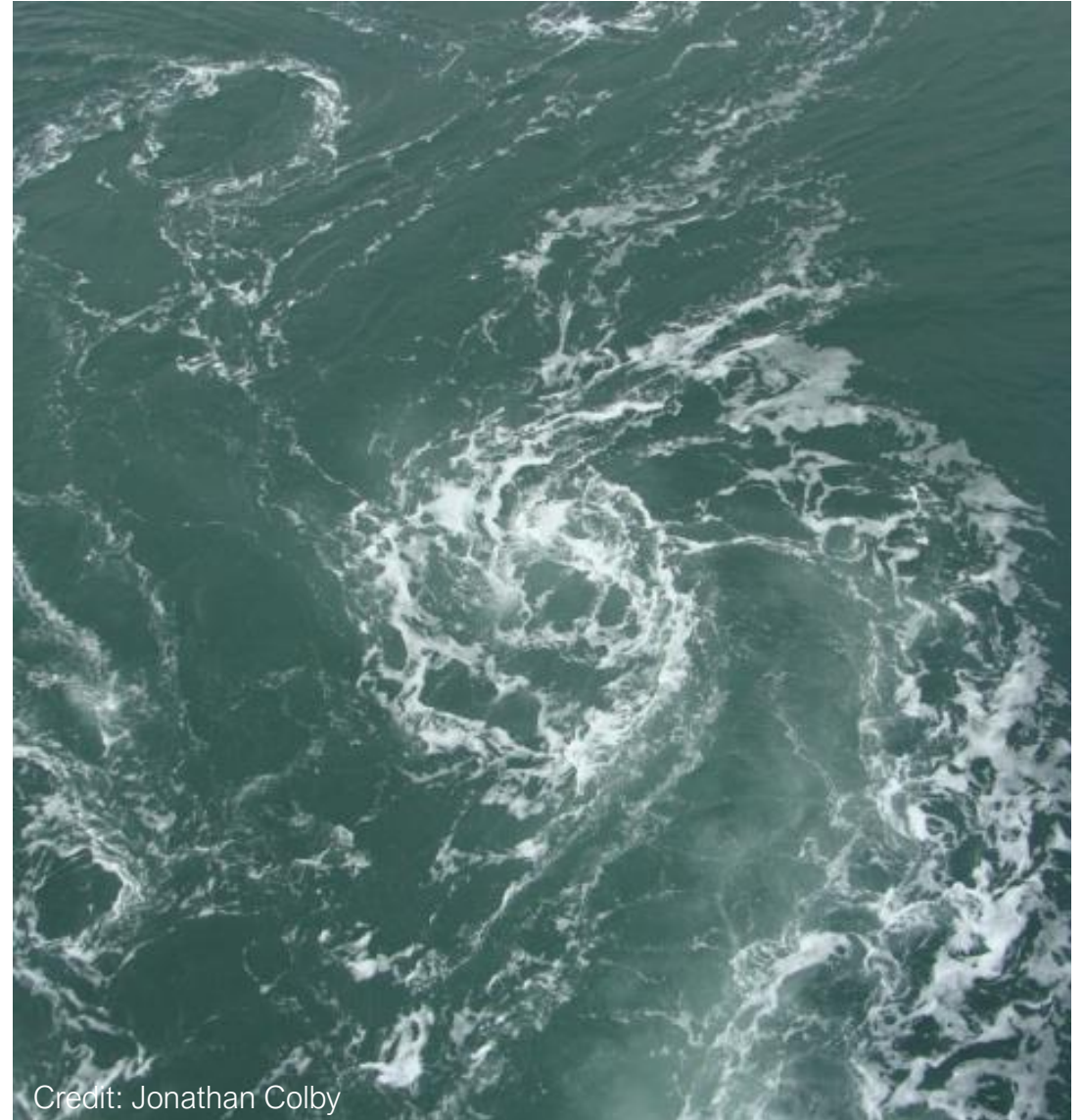
- You are all potential leaders; we are all excited for, and counting on, you!

# THANK YOU

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Credit: Jonathan Colby