



# Tidal Turbine Testing (TTT) in Northern Ireland

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**NI041120 Northern Ireland: Innovating to Support the  
Decarbonisation of the Northern Ireland Energy System**

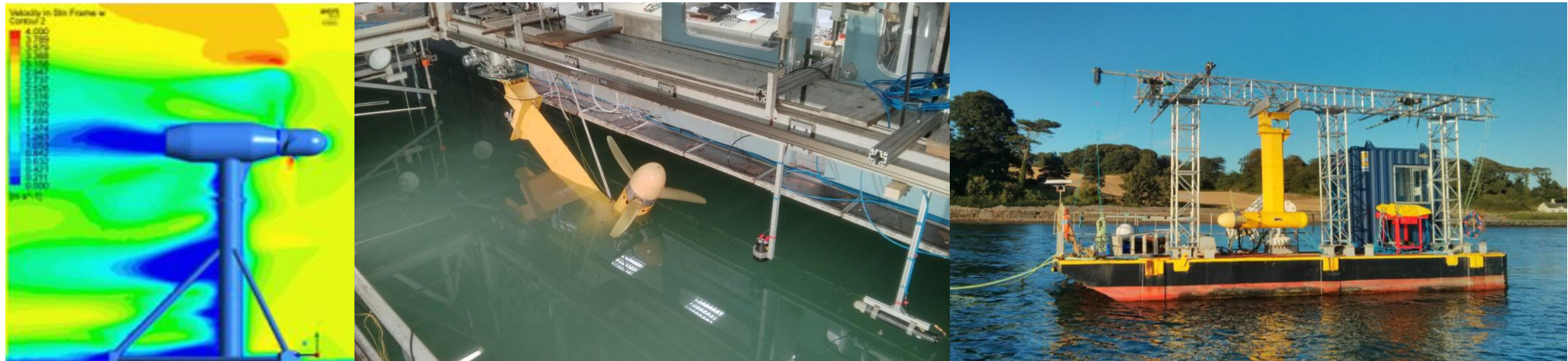
IEMA Regions





### Current research:

- ❖ Hydrodynamics and control of tidal resource sites – H2020 Marinet2, TTT Projects
- ❖ Development of a Novel WEC – H2020 LiftWEC project



### Publications:

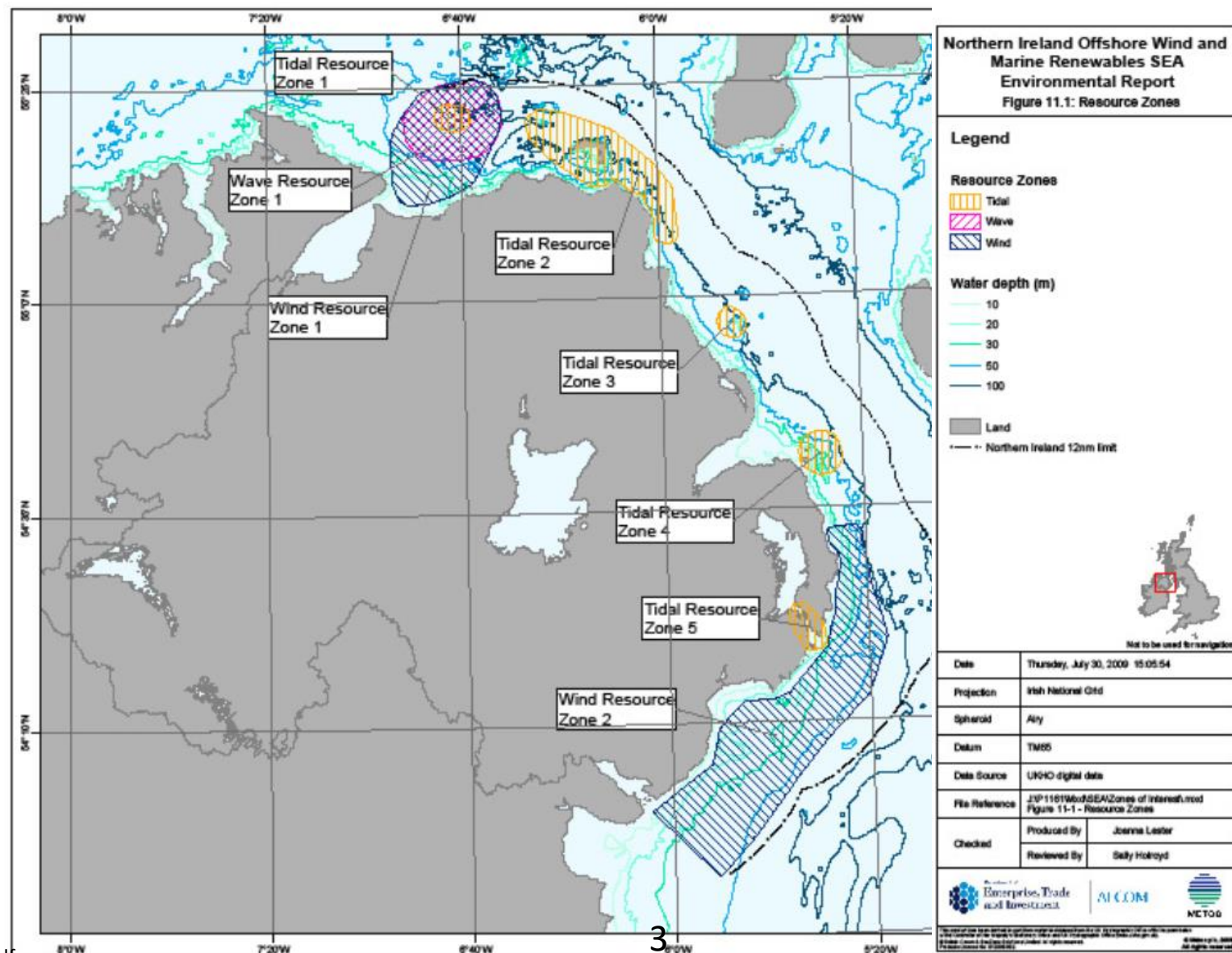
- ❖ Rathnayake, U., Folley, M., Gunawardane, S. D. G. S. P., & Frost, C. (2020). *Investigation of the Error of Mean Representative Current Velocity Based on the Method of Bins for Tidal Turbines Using ADP Data*. *Journal of Marine Science and Engineering*, 8(6), 390. <https://doi.org/10.3390/jmse8060390>
- ❖ Frost, C. et al. (2018) 'The effect of control strategy on tidal stream turbine performance in laboratory and field experiments', *Energies*, 11(6). doi: [10.3390/en11061533](https://doi.org/10.3390/en11061533).



# Tidal Energy in NI

## Good Start

- Offshore Renewable Energy Strategy Action Plan (ORESAP) 2012-2020
- Sites leased by Crown Estate to:
  - DP Energy (Torr Head), Zone 2
  - Fair Head Tidal, Zone 2
  - MCT Seagen (Strangford), Zone 5
  - Minesto (Strangford), Zone 5
  - QUB Test Site (Strangford), Zone 5



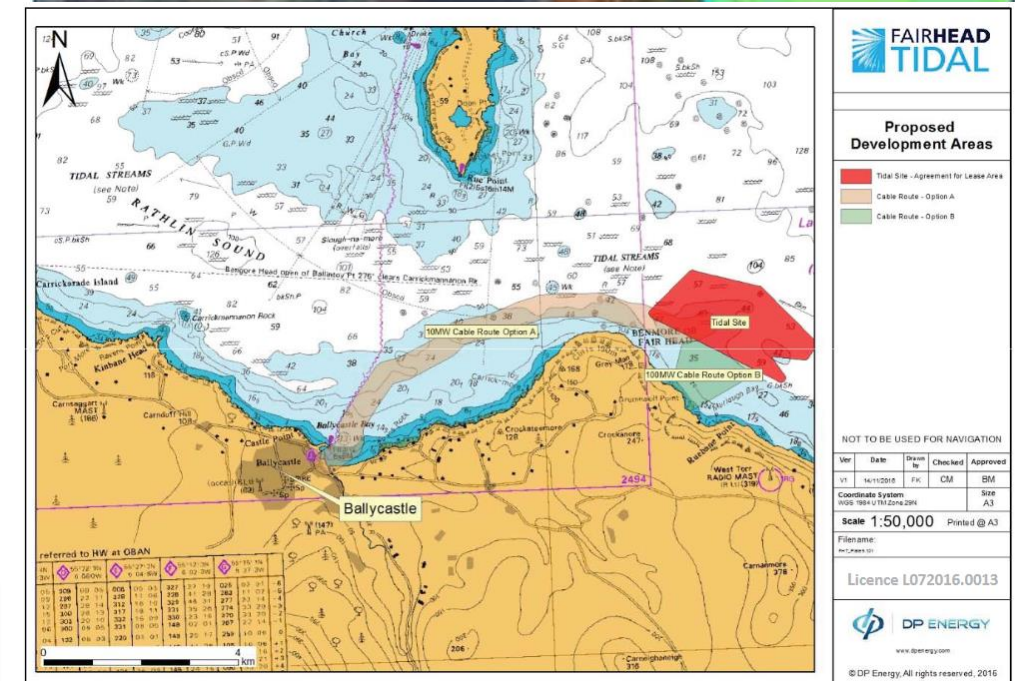
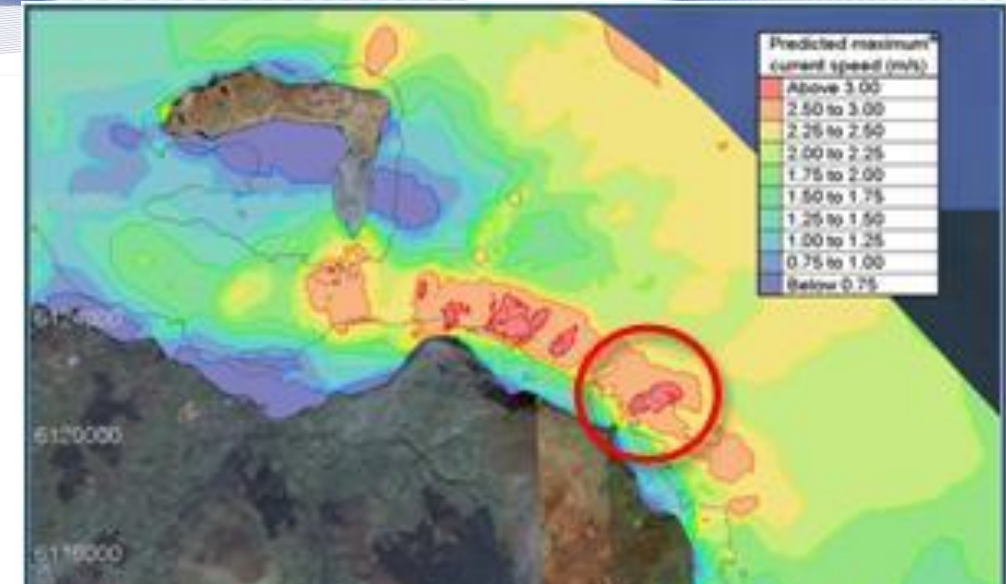
# Torr Head & Fair Head

## Torr Head 100MW

- TVL awarded AfL from Crown Estate 2012
- Marine Construction and consenting awarded in 2015
- Technology Developer was OpenHydro (liquidated in 2018)
- TVL dissolved in 2019

## Fair Head Tidal Energy Park 100MW (10MW Phase 1)

- DP Energy and Bluepower NV awarded AfL from Crown Estate 2012
- Marine Construction and consenting submitted in February 2017
- Issues with cable route and onshore grid connection as well as Navigation risk.
- Phased approach with 4-6 turbines planned for Phase 1 (10MW) Technology Neutral
- Current Status Unknown



**Tidal Sector Support Required – IPPA, Separate CfD**





# Strangford Narrows

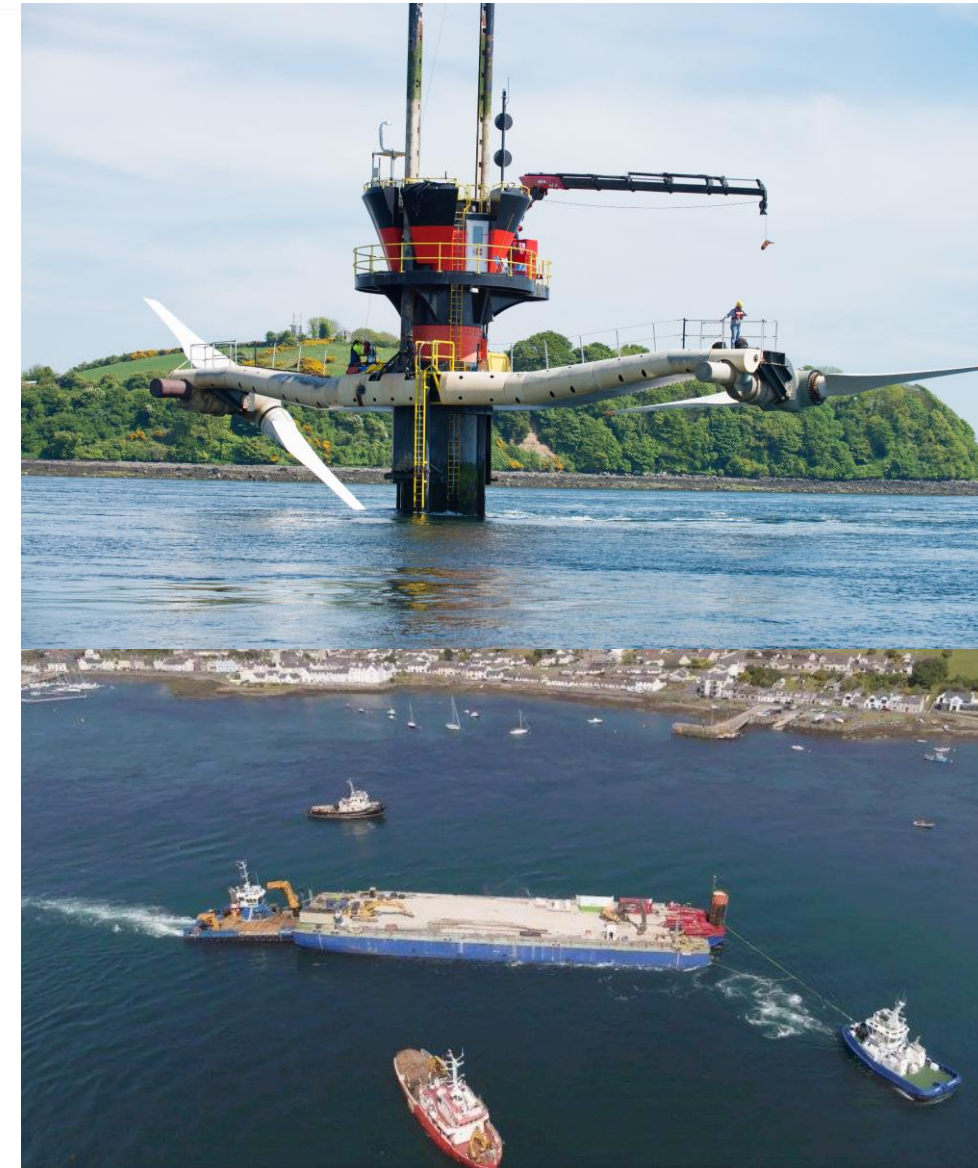


# Seagen 1.2MW - Strangford

## MCT Seagen 1.2MW

- Licensed by EHS NI in 2005, and reissued with changes in 2008
- Marine Construction and Commissioning completed in 2008
- Initial 5 year license was extended till 2019 when decommissioning was completed
- Adaptive management strategy for FEPA license allowed continual improvement from EIA operations
- Comprehensive report on EIA by Royal Haskoning
  - Keenan, G.; Sparling, C.; Williams, H.; Fortune, F. (2011). [SeaGen Environmental Monitoring Programme: Final Report](#). Report by Royal Haskoning. pp 81.
- Exported 11.9GWh in 8 years of operation, powering 1,500 homes
- Local Marine Operators (Cuan Marine Services) now commissioned for Meygen marine operations – Local Knowledge

Operational Turbine has had no negative impact on Environment







# QUB Research

**Man-made structures  
can change local  
hydrodynamics:**

**Localised wakes provided  
predictable foraging  
opportunities  
for terns, with largest  
foraging numbers over  
SeaGen's floodtide wake**

Positive impact on bird life?



Lieber L, Nimmo-Smith WAM, Waggitt JJ & Kregting L. (2019) Localised anthropogenic wake generates a predictable foraging hotspot for top predators *Commun. Biol.* 2:123

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COMMUNICATIONS  
**BIOLOGY**



a nature research journal



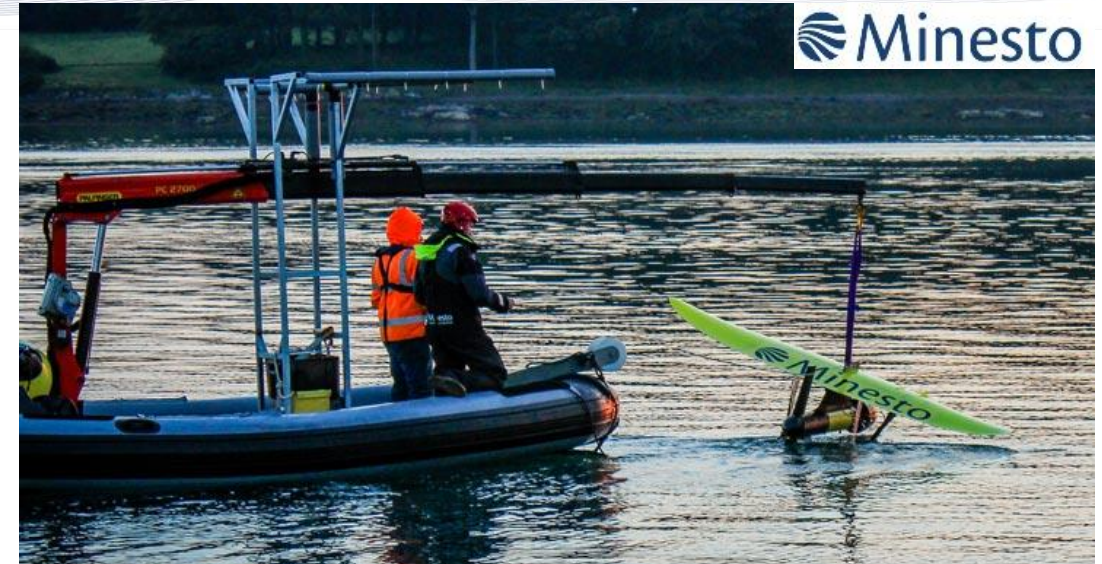


# Minesto Scale Testing Strangford

## Minesto Deep Green Tidal Kite

- Test Site licensed since 2010
- First PTO scaled device deployed in 2013
  - 3m wingspan, 30m water depth, 3kW output at 0.8 m/s flow.
- Vital in understanding the process of control and extracting energy
- Has lead to **Minesto Angelsey Deep Project (DG500)** and **Faroe Project (DG100)**

Developments in NI have far reaching impacts

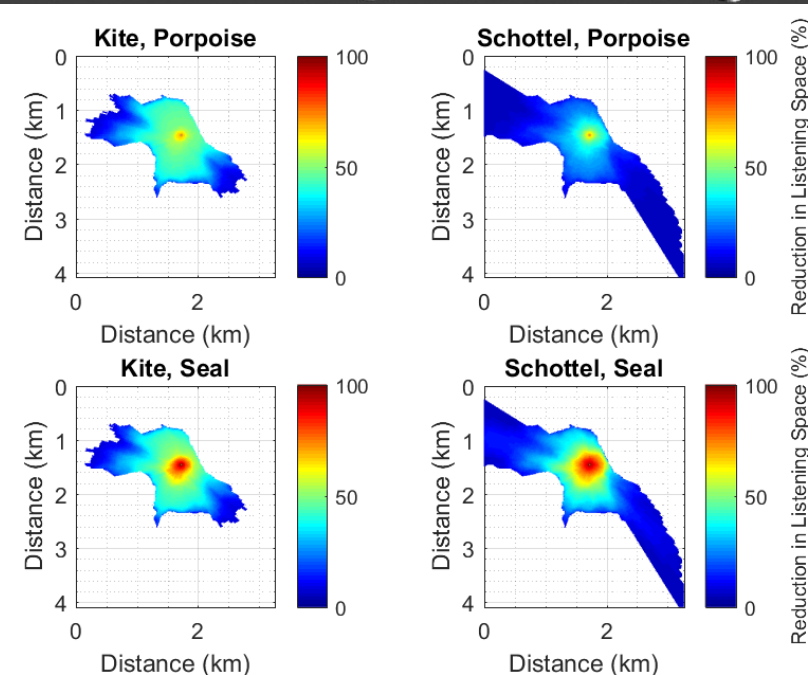
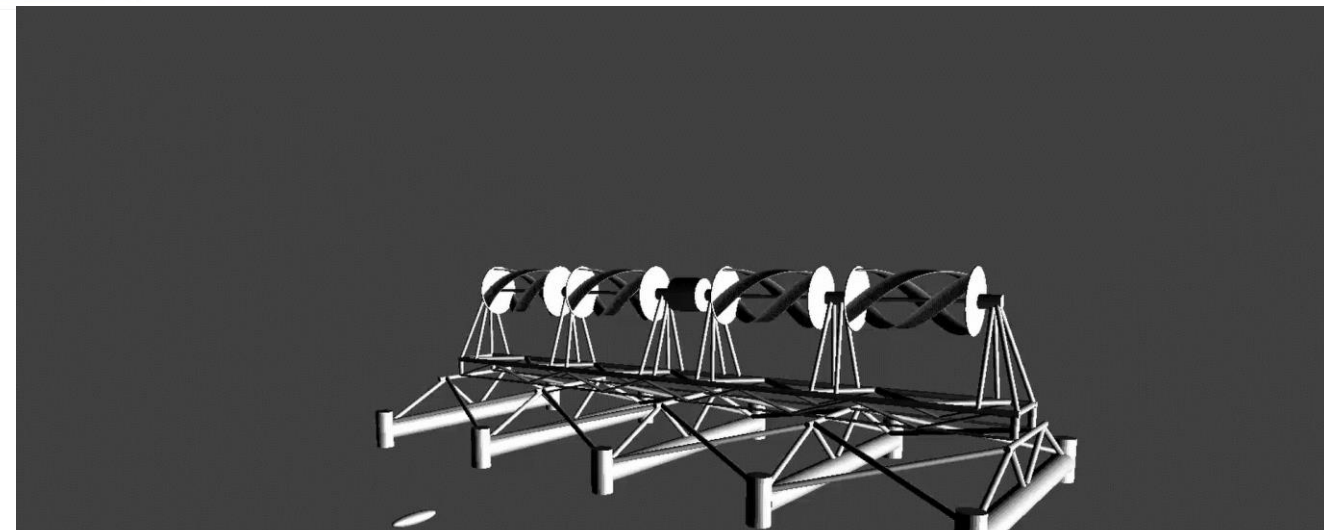




# H2020: Powerkite

## QUB Research

- Collision Risk Model – Using the gaming software ‘Blender’
  - Schmitt P, Culloch R, Lieber L, Molander S, Hammar L, Kregting L. A tool for simulating collision probabilities of animals with moving marine renewable energy devices. *Plos One*, *In review*
  - Horne N, Culloch R, Schmitt P, Lieber L, Molander S, Hammar L, Kregting L. The application of a 4-D tool in deriving collision risk probabilities between a marine renewable energy device and large marine vertebrates. *In prep*
- **Hydrophones** to understand ambient noise and PTO noise underwater
  - Pine, M.K., Schmitt, P., Culloch, R.M., Lieber, L. and Kregting, L.T., 2019. Providing ecological context to anthropogenic subsea noise: Assessing listening space reductions of marine mammals from tidal energy devices. *Renewable and Sustainable Energy Reviews*, 103, pp.49-57.



# TTT Projects Outputs.. So far

## Improved methodologies for assessing turbine power performance data

- Direct **contribution to new Standards** IEC TS62600:202 'Scale testing of Tidal Energy Converters'.
- **Feedback to IEC Maintenance Team** for IEC TS62600:201 for new edition 'Power performance assessment'
- Significance of the **control strategy** operated in subsystem testing

## The key parameters for power/ loading regimes

- **Wave** loading significantly greater impact than **flow misalignment**
- **Turbulence** intensity a function of velocity.

## Array Spacing

- Wake recovery within 6D downstream of turbine
- Constructive interaction through device spacing detectable





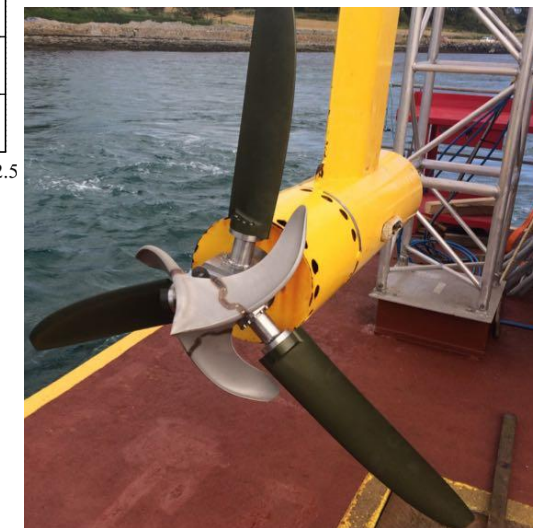
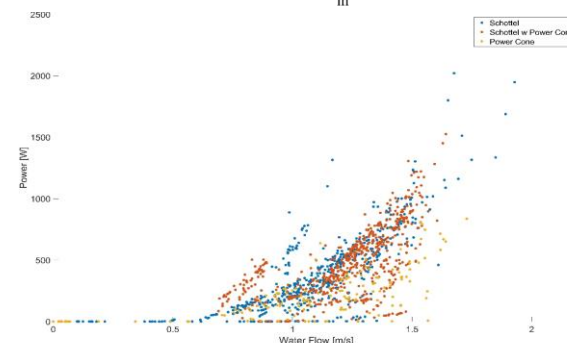
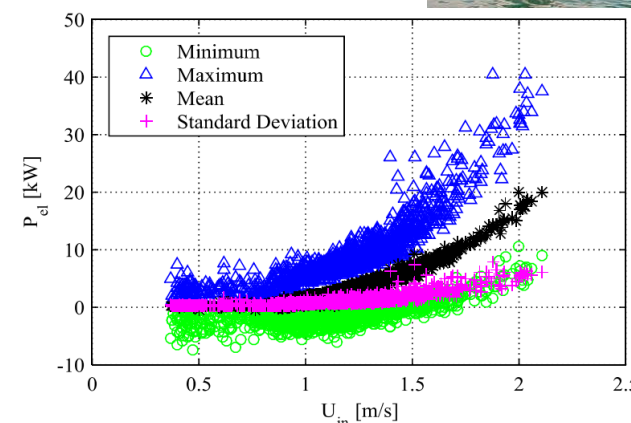
# Marinet 1 & 2 Project

## • Schottel Hydro 2014

- Jeffcoate, P., Starzmann, R., Elsaesser, B., Scholl, S., & Bischoff, S. (2015). *Field measurements of a full scale tidal turbine. IJOME* <https://doi.org/10.1016/j.ijome.2015.04.002>
- Starzmann, R., Jeffcoate, P., Scholl, S., Bischof, S., & Elsaesser, B. (2015). *Field testing a full-scale tidal turbine Part 1 : Power Performance Assessment. Proceedings of 11th EWTEC*, 1–7.
- Schmitt P, Elsässer B, Coffin M, Hood J, Starzmann R. 2015. *Field testing a full-scale tidal turbine part 3: Acoustic characteristics. Proceedings of 11th EWTEC*, 1–7.

## • Biome Renewables 2019

- Stainless 3D printed tidal turbine blades (<https://www.offshore-energy.biz/watch-how-3d-printing-cuts-costs-in-tidal-energy/>)
- Marinet2 Post-access report 2018







# Flex Marine Power 2020

Flex Marine Power are excited to be working with Queens University Belfast (QUB) to carry out tidal energy research in the Narrows tidal channel, Strangford Lough. Based in Scotland, Flex Marine have been developing their community-oriented tidal energy technology since 2015. Marine operations have now commenced at QUB's test site, being delivered by local outfit Strangford Moorings. Activities in the Narrows are scheduled to be completed before Christmas and the work aims to demonstrate the ability of Flex Marine's technology (a floating buoy with a horizontal axis turbine mounted underwater) to generate clean, predictable energy from our oceans.

- Worked closely with DEARA for short term experimental campaigns
- EIA a key part of each project





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**Continued Support Required to  
Meet the Potential**

