POWERING AQUACULTURE WITH OFFSHORE VERTICAL AXIS WIND AND CURRENT TURBINES

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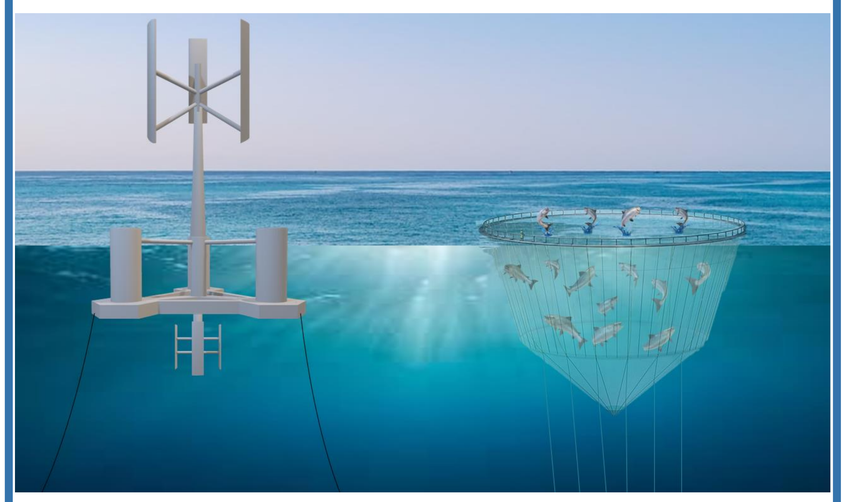
A. Our Goal

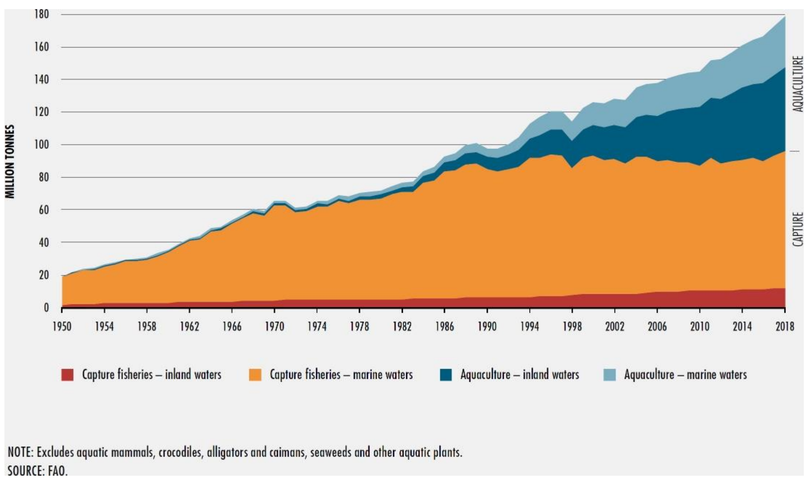
The team designed & studied an offshore floating Dual-Turbine Platform (DTP) consisting of a Vertical Axis Wind Turbine (VAWT) and an Underwater Current Turbine (UCT). This project is due to the increased interest in Blue Energy & studies involving the stability of complex floating structures in the ocean & the economics associated

B. Application



Schematic of the proposed Dual-Turbine Platform

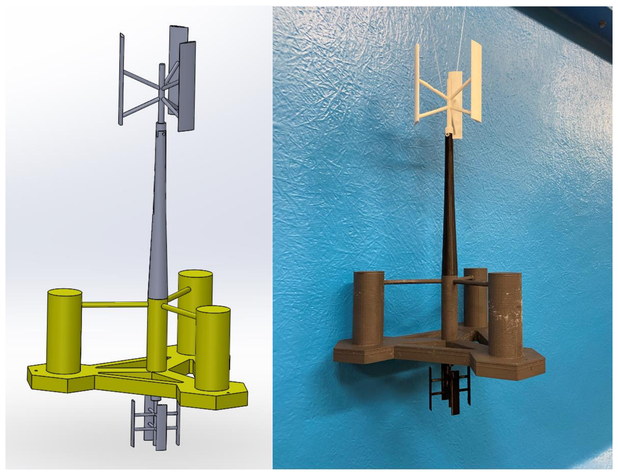
The global aquaculture market is expanding offshore for abundant space and nutrients due to regulatory environments and technologies improving. Finfish dominate this market, securing roughly 67% of the total market share.



Historical and Estimated Growth of Aquaculture Farms vs. Wild Fisheries

- Sustainable, reliable, and consistent electricity
- Significantly lowering farms carbon footprint
- Saves farms costs and time by making operations more efficient and profitable

C. Design and Operation

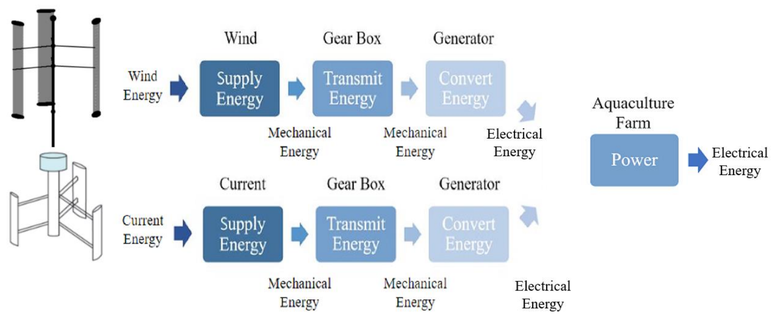


SolidWorks Model (Left) 3D Printed Prototype (Right)

- Semi-submersible platform - consists of two turbines, one wind and one current.
- **Platform**
  - 3 outer large columns help stabilize the platform.
  - Center column connects the VAWT and UCT to the platform.
  - Pontoons at the bottom connects all the columns together.
- Scaled down prototype was 3D-printed in order to test stability.

Feature	Full Scale Dimension
Wind Turbine Mast	22 m tall x 0.76 m diameter
Wind Turbine Rotor	132 m^2 (Swept Area)
Outer Columns	3.06 m tall x 1.31 m diameter
Center Column	2.84 m tall x 0.76 m diameter
Pontoon	9.12 x 0.55 x 9.18 m
Support Members (3x)	2.54 m long x 0.196 m diameter
Current Turbine Mast	1.42 m tall x 0.76 m diameter
Current Turbine	2 m^2 (Swept Area)
Total Weight	26,366 kg

The VAWT will harness the excess of wind energy that is located out at sea, taking advantage of the much higher wind speeds over open waters compared to that on land. The UCT will harness the vast amount of ocean energy that is currently under-utilized in the world of renewable energy. With the added power of both turbines, our design aims to compete against the powerhouse diesel generators that are currently being used in its place at aquaculture farms.



Functional Model of Offshore Wind and Current Turbine

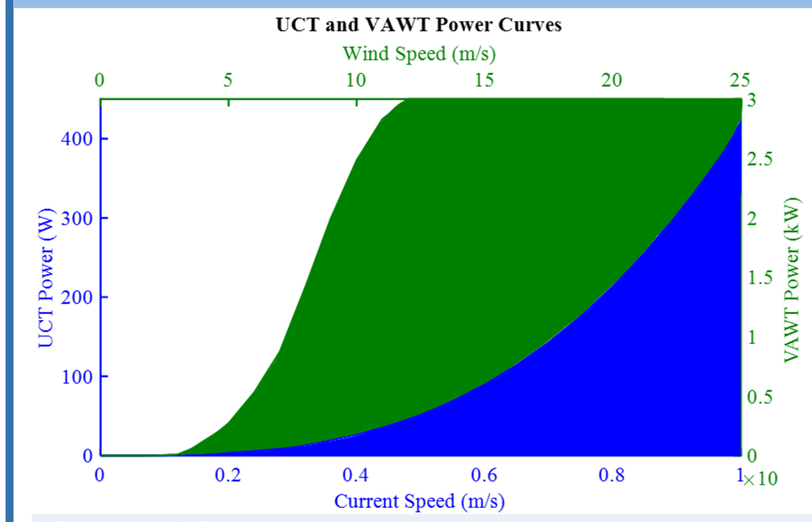
D. Challenges

Platform Design

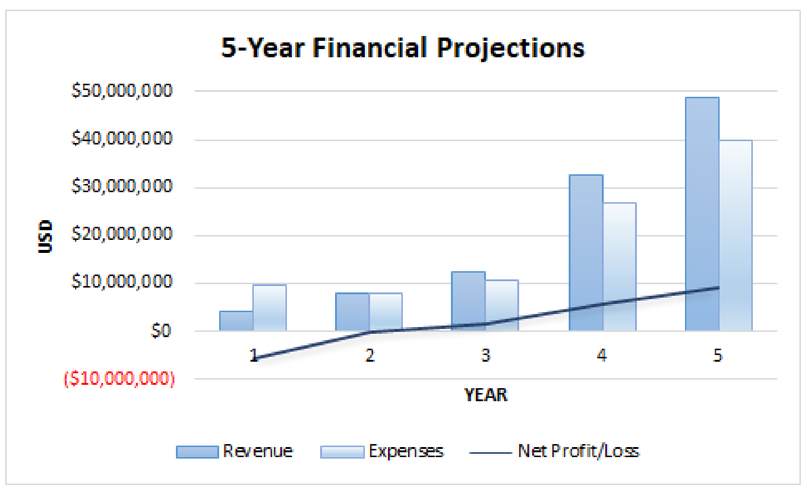
- Platform Stability
  - Withstand Wind, Current & Waves
- House a VAWT & UCT

In our experiments conducted we tested our designed platform at various wind/current conditions to ensure such stability. We even tested an unrealistic scenario of extreme flow condition, where the platform tipped over, as shown to the left!

E. Estimated Power Performance



The VAWT has a maximum power output of 30 kW, at a wind speed of ~ 12 m/s and above. The UCT has a maximum power output of ~ 420 W, at current speeds of ~1 m/s and above. In offshore aquaculture, anywhere from 450 to 81,600W is needed to perform the necessary requirements for the farm, of a given size, to operate.



F. Business Model

Benefit for Individual Farms

Based on increased self-sufficiency

Cost/Savings Breakdown	
Platform implementation expenses	
Purchase Expense of the DTP	$(1,250,000)
Annual Leasing Expense of the DTP	$(80,000.00)
Annual Maintenance/Repair Expense	$(20,000.00)
Annual savings from platform implementation	
Fuel Expense	$19,050
Labor Expense	$52,526
Supply Boat Expense	$30,277
Carbon Credit Revenue	$8,355
Total Annual Savings	**$120,302**

INNOVASEA
green coast enterprises
GETS green energy tower system
UMass Dartmouth

Key Partnerships

The DTP will be available for purchase or lease for aquaculture farms and offshore operations.

Worthwhile investment due to a positive NPV

DTP will be fully customizable and scalable to fit the specific needs of each customer

Partnerships allow our team the benefits of economies of scale and lower investment cost for the customer

10-Year Development Plan

Stage 1
Year 1
Proof of concept, Intellectual property

Stage 2
Years 2-3
Modification & Optimization

Stage 3
Years 4-10
Full global commercialization

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