Clean Low-Cost Energy from Water Currents

The Company Vortex Hydro Power (VHP) is a start-up, spin-off company from the Marine Renewable Energy Laboratory (MRELab) of the University of Michigan, Ann Arbor, U.S. https://mrel.engin.umich.edu/
The goal of VHP is to commercialize the VIVACE Converter, a technology invented by MRELab and patented through the University of Michigan. VHP has the exclusive rights to 13 patents in the USA, the EU, and Brazil.

The VIVACE Converter is an innovative technology designed to harness clean, renewable energy from slow-moving water sources such as ocean currents, tides, and rivers. As the global Blue Economy — an economic sector focused on sustainable ocean use — grows rapidly, there is increasing demand for reliable and affordable energy solutions that operate directly where energy is needed in offshore and remote locations. The VIVACE Converter offers a ground-breaking way to meet this need by turning the natural energy of water flows into electricity without relying on watermills (turbines). VIVACE is environmentally friendly, silent, and has zero carbon emissions. VIVACE mimics fish-school dynamics, and it is simple as it emulates naturally (w/o control) fish-school kinematics.

VIVACE is a revolutionary approach to extract useful energy from water currents

Vortex Induced Vibrations Aquatic Clean Energy (VIVACE) is a novel, demonstrated approach to extracting energy from water currents. This invention is based on naturally occurring fluid structure interaction phenomena (Vortex Induced Vibrations, galloping, and multibody synergy). Typically, they are suppressed to prevent damaging structures, such as offshore platforms, nuclear rods, cables, buildings, and bridges. By maximizing and utilizing these phenomena rather than spoiling them, VIVACE takes this “problem” and successfully transforms it into a valuable resource for mankind.

The Blue Economy & Markets

Ocean-related industries are expanding fast, contributing over $1.5 trillion annually to the global economy in recent years, with expectations to double by 2030. These industries include marine farming (aquaculture), ocean observation, robotics, biofuels, and mineral extraction from seawater. Additionally, many coastal and island communities require consistent power supply but lack access to traditional electrical grids. Even offshore oil and gas platforms, scientific research stations, and national security operations depend on energy that must be generated directly at sea.
Having on-site, energy that is clean, dependable, and cost-effective is thus critical. Renewable energy from water flows (oceans & rivers) — called Marine Hydrokinetic (MHK) energy — is especially attractive, as it is abundant and omnipresent.
More markets include • Desalination • Irrigation • Low Pressure Hydropower for new freshwater installations and dam replacements • Ocean Sensor Power • Stealthily electricity supply for surveillance.

The Environment: The major challenge for MHK energy, however, is the generally slow speed of ocean currents and rivers. Most ocean currents flow slower than 3 knots and rivers are typically slower than 2 knots, while traditional turbines or watermills require faster flows (~4 knots or more) to operate efficiently. VIVACE is a transformational technology that taps into a vast source of clean and renewable energy: water currents as slow as 1knt (~0.5m/s). It has no upper speed limit.

4-cylinder VIVACE deployed; St. Clair River, June 2016.

Fig. 1: Fish thrive in vortical wakes

Products & Energy Need: Applications in the Blue Economy are numerous as VIVACE is highly scalable. A 4-cylinder unit is shown in **Fig. 1** and a 2-cylinder portable unit in **Fig. 2**.

Revenues will be generated through a mix of small-scale projects, licensing, and proprietary equipment sales. In the future, large-scale products will be built.

Portable 2-cylinder VIVACE with generators …

Fig. 2: … being ocean-tested by PNNL (Pacific Northwest National Laboratory) of DOE, March 2025.

Competitive Landscape

VIVACE will compete with ocean current and wave power concepts, as well as, fresh water, free flowing turbines. Competition also comes from wind, solar and geothermal in addition to conventional technologies. Our studies indicate that VIVACE can generate power at *costs below that of the best renewables* (wind), and potentially competitive with conventional technologies.

Notably though, there is hardly any competition in two areas: (a) Flows below 1m/s and (2) In-situ small applications like ocean observation buoys.

VIVACE Benchmarks

Note: 1. Data from Michigan Public Service Commission (MPSC)
2. Wind variable costs reflect production tax credit (PTC)

Technology	Fixed Costs $/kW	Variable Costs $/MWh	Capacity Factor	Cost per kWh $/kWh
Coal	1,481	12.78	85%	**0.041**
Nuclear	2,248	5.73	90%	**0.046**
Natural Gas	472	45.32	45%	**0.062**
Wind	1,356	-18.00	25%	**0.069**
VIVACE	3,071	0.00	90%	**0.055**

VIVACE has numerous advantages:

Improved installation survivability in the hostile ocean environment, enable low-cost power production by decreasing capital cost and minimizing maintenance.

- High energy density – enables low-cost energy to be produced from relatively small installations.
- Simple and rugged moving parts that can operate for long periods in a hostile underwater environment.
- Low dependence on ocean/river conditions – non-linear resonance permits useful energy to be extracted over a broad range of flow speeds.
- Non-obtrusiveness – installations can be positioned beneath the surface, thereby avoiding interference with other uses, such as fishing, shipping and tourism.
- Compatibility with marine life.

Management Team

Dr. Michael M. Bernitsas, the inventor of VIVACE and founder of VHP, is a renowned expert in offshore engineering and was awarded the Blakely Smith Medal in 2003. He is the Mortimer E. Cooley Prof. of Engineering; Prof. of NA&ME and ME; Director, of the Marine Renewable Energy Laboratory, Naval Architecture and Marine Engineering Dept., University of Michigan. He is tenured faculty and was Chair 1994-2003. Education: NTU Athens: Diploma in NA&ME. MIT: S.M. in N.A&M.E, S.M. in Ocean Engng., Ph.D. in O.E.

Dr. Salman Sadiq, CTO of VHP, is the designer and executor for transitioning VIVACE from a laboratory concept to a deployable industrial energy harvesting solution. He is experienced marine renewable energy technology officer in the last six years. A Naval Architect with twenty-three years of diversified experiences in: Contract Management, Naval Architecture, Experimental/Numerical data Acquisition and Verification, Procurement, Training, Induction of HR, Academia and Industry Collaboration, Logistics and Financial Management.