GEM - the "*Ocean's Kite*" Horizontal axis marine turbine

ADAG
Aircraft Design & AeroFlightDynamics Group

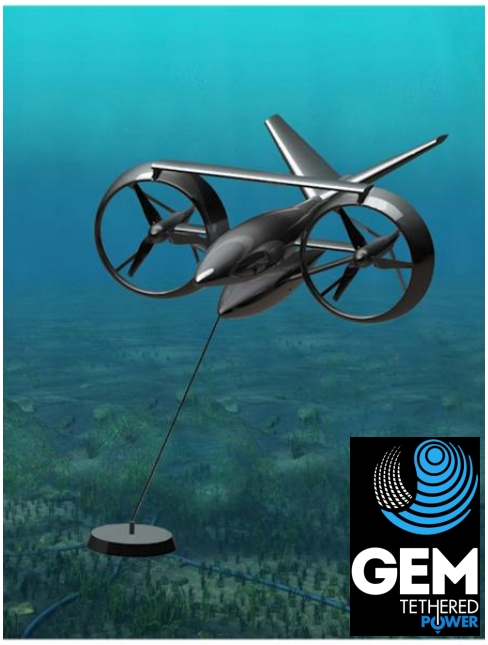
The horizontal axis marine turbine GEM "the Ocean's Kite" is a hydrokinetic turbine designed to produce clean energy exploiting slow-moving flows of water, namely river, tidal or water currents in general

The patented turbine has been developed since 2005 after a research project done in collaboration with Eng. Nicola Morrone, who is the patent owner together with Prof. Domenico Coiro.

Placed under water at the desired depth thanks to its self-towing winch, it works like a kite, aligning itself to the current independently form its direction

The GEM is basically made by the following parts:

- a buoyant unit and an eventual wing;
- two contra-rotating turbines, with three blades, connected to two electrical generators, symmetrically positioned on the two sides of the frame;
- two diffusers, mounted around the two turbines, shaped to double the power output;
- a barrel-shaped container placed at the foot of the frame, and containing a winch;
- a mooring block, laid on the sea bed to which a mooring line is connected;
- an electrical cable to connect the electrical generators to the grid; the electrical cable runs along the mooring line;
- tailplanes to provide the system stability;
- an automatic control system based on the differential turbine action to control the orientation during current direction reversal.



INNOVATION

Due to its special characteristics has been patented in 2010.

ADVANTAGES

- relatively cheap
- easy to maintain
- low environmental impact
- installable almost anywhere

BUSINESS PLAN

For a single 500 kW plant deployed in Italy:

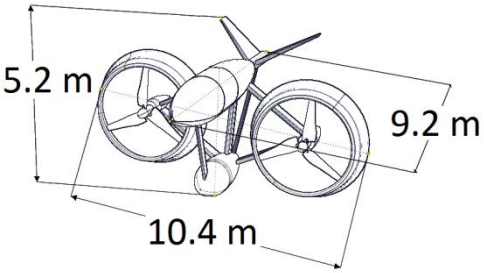
- Cost of System: 1,7 mln di €
  + maintenance: 20.000 €/year
- Annual income: 510.000 € for a site with the maximum current speed of 2.6 m/s
- Government incentive: 34 € cent/kWh
- Return on investment: 3.4 years
- Income 20 years: 8.5 mln of €

Performance data of 100 kW prototype

- Total weight: 10700 kg Buoyancy force: 5200 kg
- Depth (range): 15 m to 9.8 m (without current)
- Nominal power 100 kW with a tidal current of 2.6 m/s
- Three-blades 3 m diameter rotor
- Innovating blade section profiles
- Carbon blades - Fiberglass diffuser
- Rated rotation speed: 65 rpm
- Rotor Efficiency: 0.8
- Expected average yearly production with 2.5 m/s maximum speed site: ~ 300 MWh

Dimensions

- Length: 9.2 m
- Height: 5.2 m
- Width: 10.4 m



www.gemtidalpower.com
www.dias.unina.it/adag

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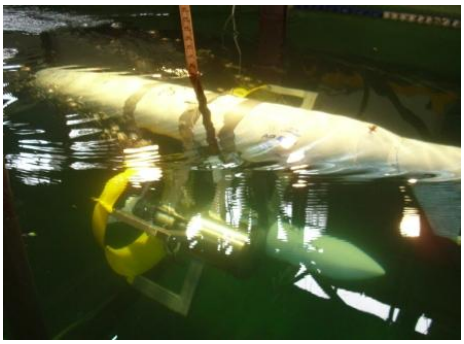
Detailed numerical analysis and two different scaled models (see figure below) have been tested in the towing tank of the "Federico II" University in Naples, Italy.



First full-scale prototype, built by a consortium of Venetian companies and partially sponsored by Veneto Regional Authority, has been deployed in the Venice Lagoon.

Expected power is about 20 kW with lagoon maximum current speed of 1.5 m / s.

GEM Project

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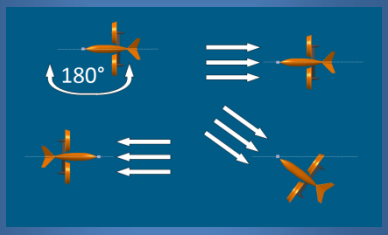
in cooperation with
Eng. Nicola Giorgio Morrone

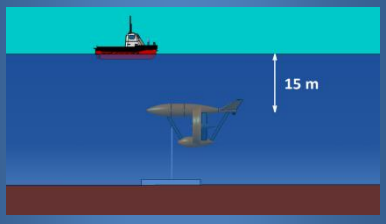
ALLIGNMENT WITH CURRENT

Fully controlled for alignment with the current direction.

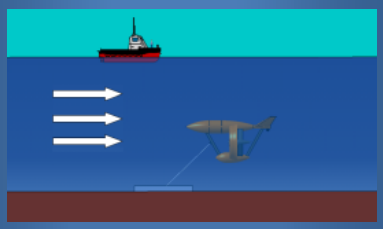


OPERATING CONDITIONS

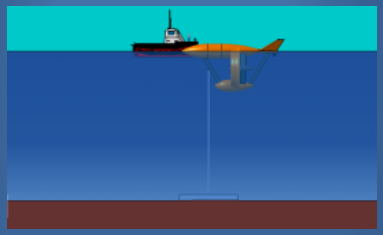
The three images below show how GEM works:



In absence of current (depth=15 m)



In presence of current



raised up and towed to shipyard for maintenance.

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