FLOATING WIND

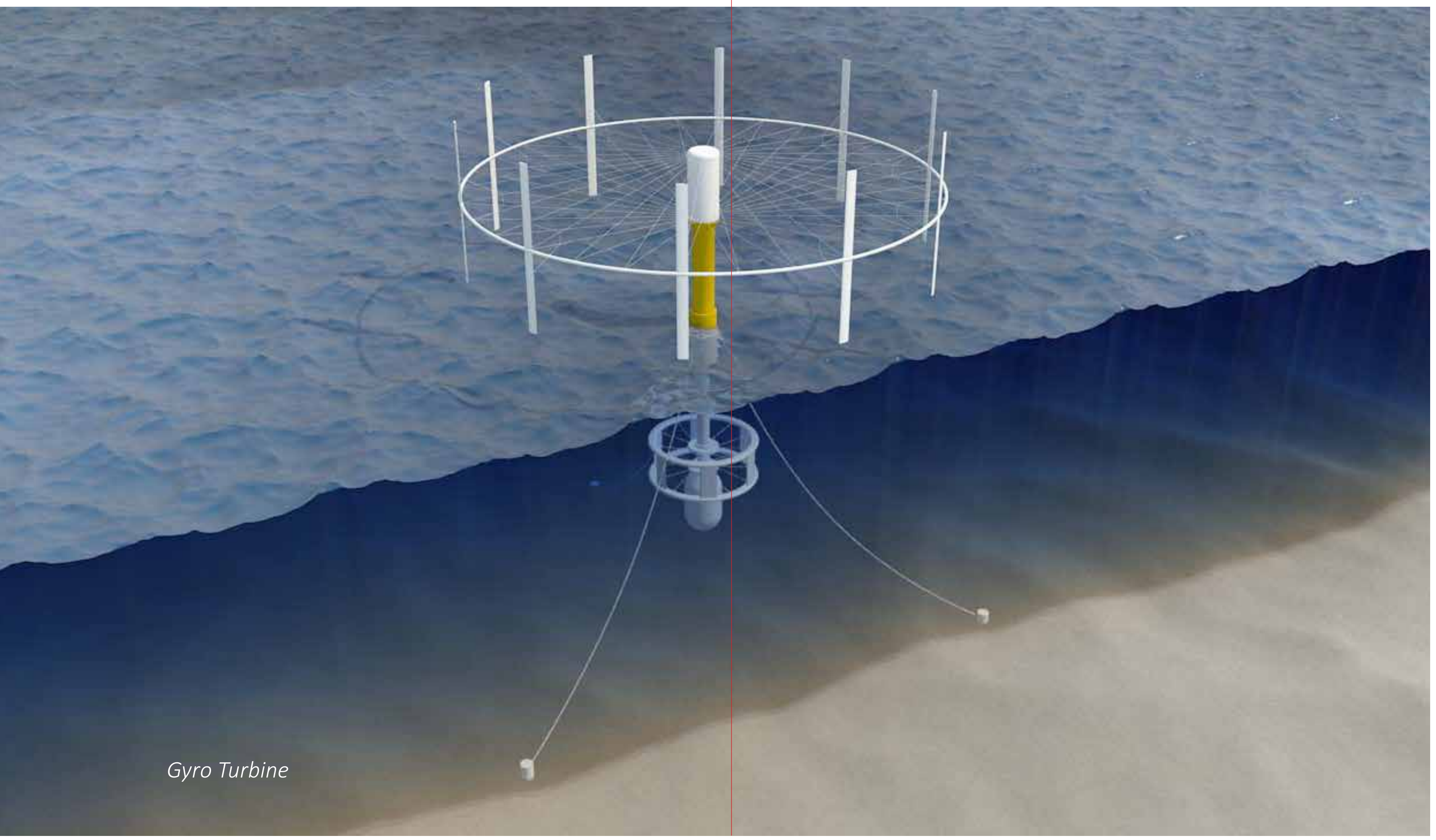
AN OCCASIONAL LOOK AT NOVEL DESIGNS

GYRO TURBINE

An ingenious floating wind energy harvester, the *Gyro Turbine*, has been developed by Prof. Friedrich Grimm from the RES-Institute in Germany. This novel turbine uses the mass inertia caused by gyro forces to stabilise the turbine around the vertical axis of rotation.

"Coaxial and concentric to the axis of rotation, the hub of the horizontal spoked wheel is connected about 70m above sea level to a rod-shaped buoy, the extended lower end of which is designed as a ballast body," said Grimm.

"Ten rotor blades arranged parallel to the axis of rotation are designed as cantilevers and project 50m upward and downward from the rim of the spoked wheel, which has a radius of 150m



Gyro Turbine

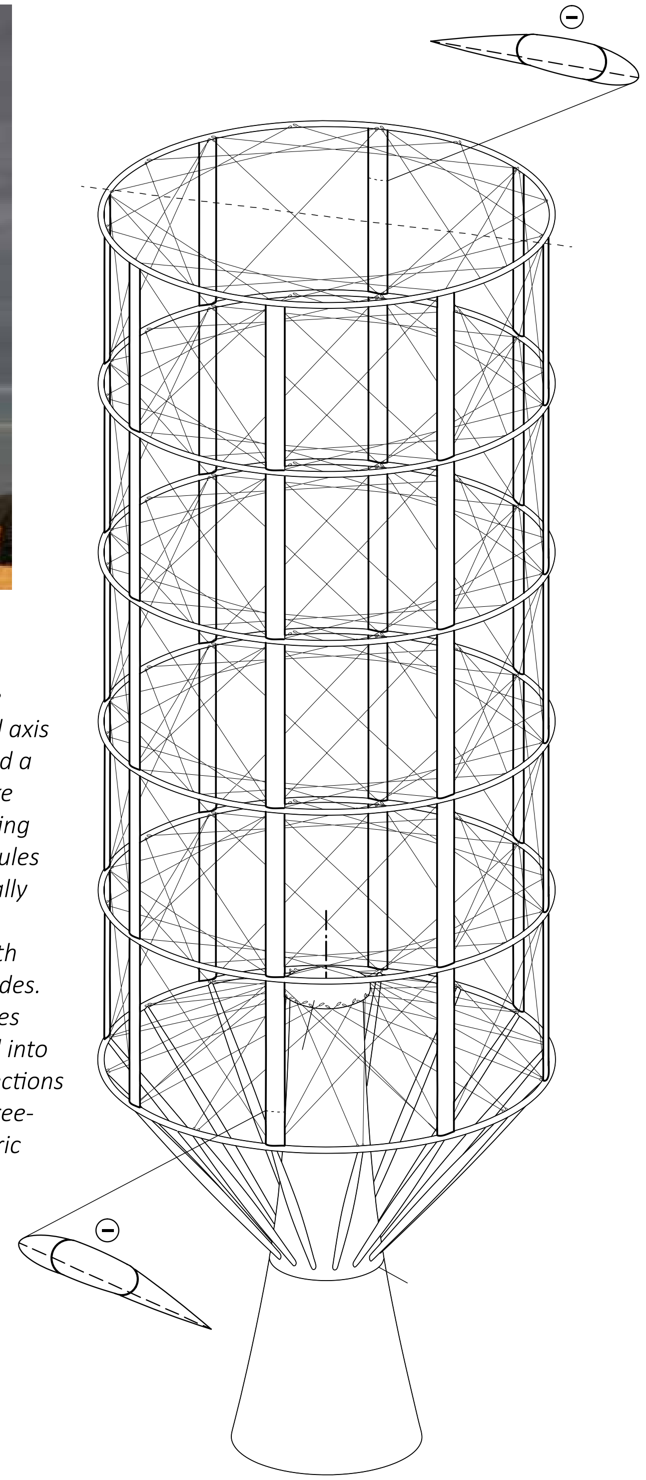
"Supporting and tensioning cables stabilise the rotor as radial spokes and, together with the hub and rim, form a lightweight structure that meets the Buckminster Fuller tensegrity structure criteria."

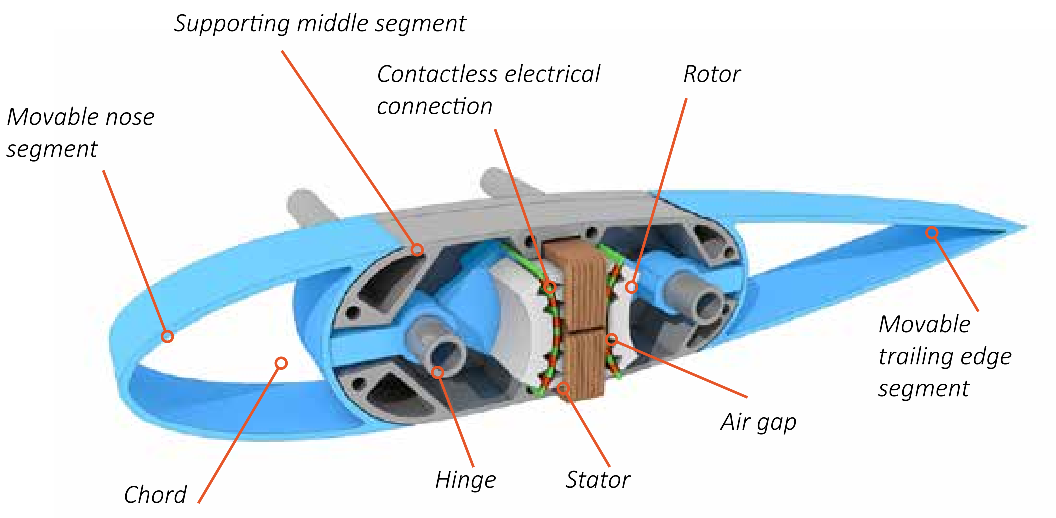
"Below the water surface, a much smaller water turbine, also of spoke-wheel construction, rotates in the opposite direction around the rod-shaped buoy to compensate for the precession of the upper gyro. The water turbine is driven by the tidal current or by the current of a flowing water.

The peak power of both turbines sums up to more than 50 MW, so that one buoy can replace seven of today's most powerful floating offshore wind turbines with horizontal axis of rotation.

Also much less material is needed to build this structure, drastically

A wind turbine with a vertical axis of rotation, and a base-side spoke wheel supporting five rotor modules stacked vertically one above the other, each with eight rotor blades. The rotor blades are subdivided into longitudinal sections and have a three-part asymmetric airfoil





lowering production costs for electricity," he said.

One particularity interesting part of the design is the rotary wing blade itself which has an asymmetric profile specifically designed for a turbine.

The rotor blade consists of three parts: a movable nose segment, a supporting middle segment and a movable trailing edge segment. The supporting middle segment is an abutment for the movable nose and trailing edge segments formed by the stator of an integrated electric motor.

The rotor of the electric motor is connected by a hinge and separated from the stator by an air gab revealing a contactless electric connection between the three parts of the rotor blade.

In one design, eight rotor blades are spaced at a radius from the vertical axis of rotation and are each connected at their upper and lower ends to a circumferentially subspanned ring beam. Unspecified photovoltaic cells cover the surfaces of the three-part airfoil sections of the rotor blades and are oriented

alternately on the inside and outside of the orbit toward the sun as the rotor modules rotate.

The base-side ring beam has sixteen compression bars connecting the rotor formed by the five stacked rotor modules to the lower pivot bearing of a hub, while sixteen pairs of V-shaped tension spokes are braced to the upper pivot bearing of the hub in such a way that a vertical lever arm is formed between the upper pivot bearing and the lower pivot bearing to dissipate the tilting moment of the rotor via the hub into a base of the wind turbine formed as a cantilever arm.

"The wind turbine's inflow area of 14 000m^2 corresponds to the rotor diameter of a conventional 7MW wind turbine with a horizontal axis of rotation, so that up to a wind speed of 12 m/s, the wind turbine can also generate a peak output of 7 MW, while when the speed of a conventional wind turbine already has to be throttled at wind speeds of more than 12 m/s, it can achieve double to triple the output in comparison," said Grimm.

"The wind turbine, which stabilises itself as a gyroscope, requires only half the design weight compared to a conventional wind turbine with a horizontal axis of rotation due to consistent lightweight construction technology with predominantly axially loaded load-bearing elements."

Another wind turbine features ten rotor blades with an asymmetrical airfoil profile, supported by a horizontally arranged spoke wheel forming one large rotor module. The rotor blades are connected to an outer ring beam, which is connected to a hub by means of a plurality of radial spokes.

The spoke wheel has a diameter of 300m, the rotor blades being divided by the ring girder into two halves, each 50m long.

A flexurally rigid connection formed by a cable tensioning system is formed between the ring girder and the longitudinal girder of the three-part airfoil. The hub of the spoke wheel, which is arranged coaxially and concentrically to the vertical axis of rotation, is rotatably mounted by means of an upper pivot bearing and a lower pivot bearing on a central support structure which accommodates at least one motor generator in the area of the hub.

By means of the lattice tower, which extends towards the foundation soil, the wind turbine can be anchored in a foundation soil both offshore and onshore. With an inflow area of 30,000 square meters, the wind turbine is layed out for 30mW peak.