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Offshore wind energy

Hydraulic air compressor driven by a suction wind turbine

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Why this plant?

The increasingly environmental disasters caused by extreme weather conditions call for a faster transition towards an economy based, if possible, on the exclusive use of green energy.

A key role can be played by compressed air, as it is storable energy which can, therefore, be supplied continuously.

Among the various technologies used to produce compressed air, the best is the one that utilizes a hydraulic compressor because:

- It has a very **high efficiency** (performance is around 65%-70% up to 80%);
- There are **no moving mechanical parts**;
- The air compression can be considered **isothermal**;
- The compressed air produced is very **dry and devoid of oily contaminants**.

Nevertheless, it didn't have a great industrial development because of the extreme difficulty of finding the environmental conditions for the installation of the plant:

- a body of water from which flow rates of several cubic meters per second can be drawn;
- a waterfall of at least 10-15 meters;
- a conformation of the ground, such as to have a drop, in meters of water column, sufficient to compress the air to the required pressure, with no need for particular excavation works.

All these limits are overridden by providing:

1. the installation of this system in the marine environment;
2. the creation of a geodetic jump (partly artificial, partly virtual) of about 15 meters - using an airlift pumping system driven by a suction wind turbine - which makes the water column circulate and compress the air.

These are the reasons behind the conception of this plant, submitted to the attention of the Conference in this poster.

Elements of the plant

In its essential core, this plant consists of:

1) an Andreau wind turbine (A), - whose tower, hub and blades are hollow and the latter have openings at the ends (or, in Endre Mucsy's version, more or less in the middle of the blades) - which operates as an air suction pump. The base of the tower is immersed, for some meters, in the sea (or in a lake). Inside the tower, a vertical wall separates the inner space in two different sections, A1 and A2.

In another version of the plant - in addition or alternatively to the Andreau wind turbine - the suction pump consists of a Venturi hydro-aspirator driven by the wave motion;

2) an hydraulic air compressor, made of a discending duct, B (motor pipe), a tank (S) and an ascending duct (C). The hydraulic air compressor works almost entirely immersed into water - only the upper parts of duct B and C emerge respectively around 17 and 8,5 meters. It is powered by the same water it is immersed into;

3) three ducts, d1, b1, c1, each provided by a tap which regulates/prevents the atmospheric air to enter respectively into section A1, into duct B and into duct C.

Operating principle

The functioning of the plant can be summarised as follows.

When the wind driven turbine is in operation:

- the air present in the blades, due to centrifugal force, is expelled outside;
- a depression takes place inside the tower (in this example 0,1 atm), and the water inside section A1 and A2 rises up to the equilibrium height;
- due to the higher pressure, once the taps are opened, the outside air can enter through duct d1 inside section A1- that houses the motor pipe (B) - and into the ascending duct (C). A mixture air-water is formed at 50%;
- because of its lower density, the mixture air-water in the section A1 can rise up to 18 meters, and, therefore, supply the underlying motor pipe (B) with the water that, separated from the air, falls down by gravity;
- as a result of the reduction in the density of the water that rises up to the last 17-18 meters of the ascending duct (C), a virtual geodetic jump of almost 8-9 meters is created inside this duct;
- at the same time, the air entering the motor pipe (B) - through duct b1 - is dragged downwards and gradually compressed by the discending column of water towards the tank.

The drawings are merely indicative of the functioning of the pump and are not in scale

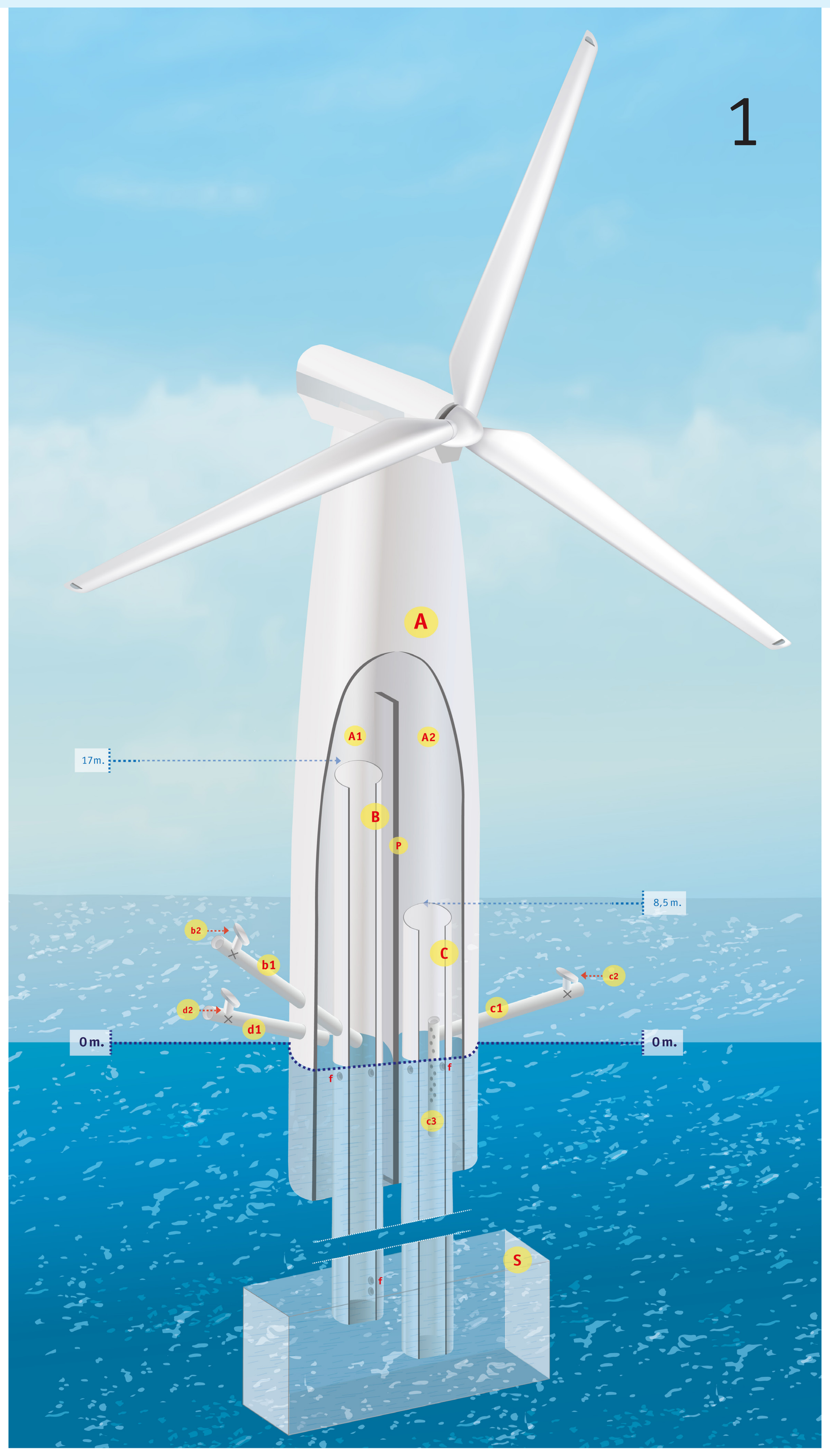

FIGURE 1: shows the plant in condition of non-operation: the blades of the *Andreau* turbine are not moving; the taps d2, b2, c2, which allow, regulate, prevent the air at atmospheric pressure to flow inside the plant, through the ducts d1, b1 and c1, are closed; the pressure in the plant is atmospheric; all the water - outside and inside the tower, inside the tubes B and C - is at the same level.

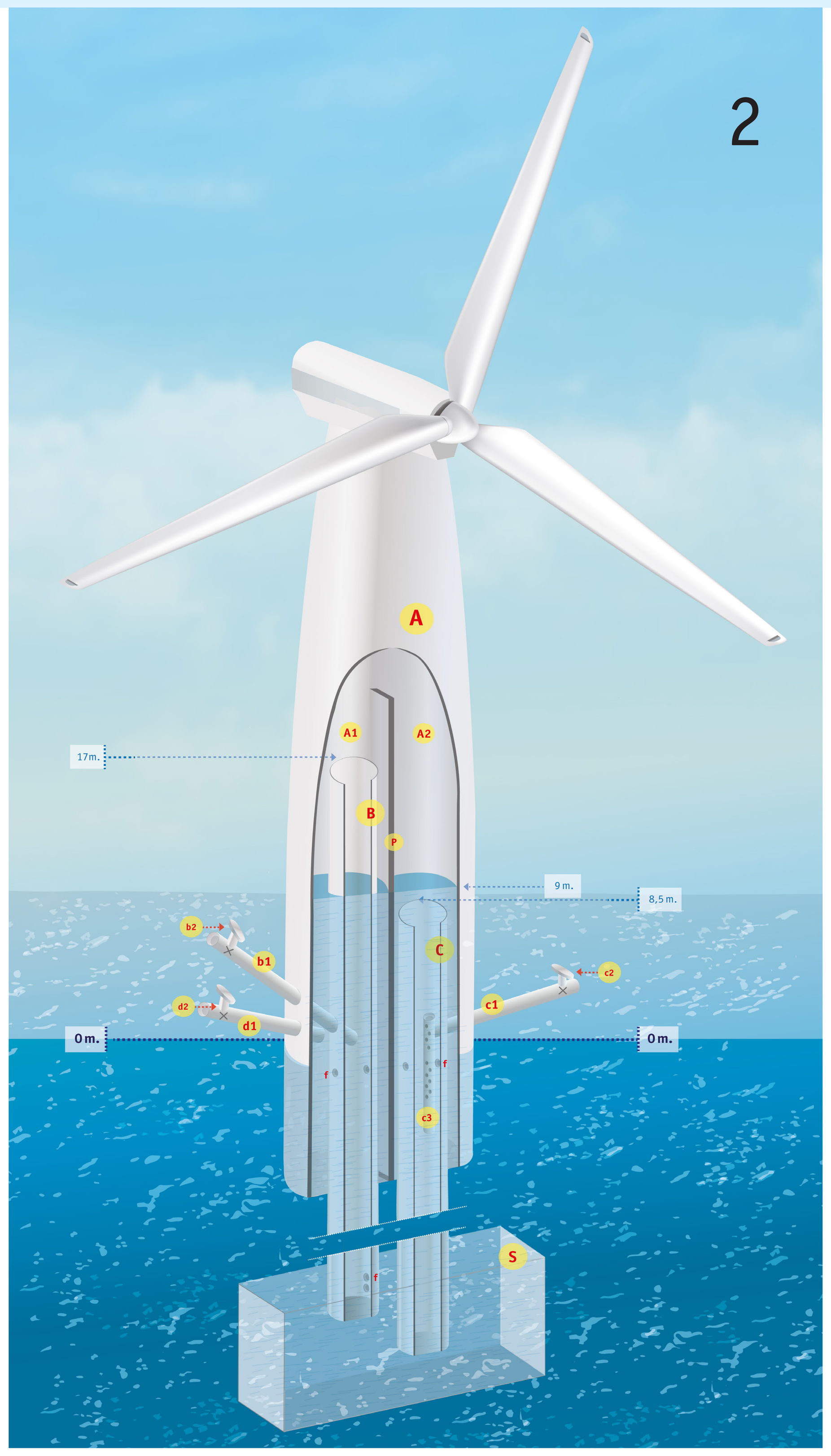

FIGURE 2: shows the plant with the suction wind turbine in operation and the valves d2, b2 and c2 closed. Due to the vacuum created by the rotation of the blades (hypothetically 0,1 atm), the water inside the sections A1 and A2 of the tower and inside the tubes B and C rises up to roughly 9 meters.

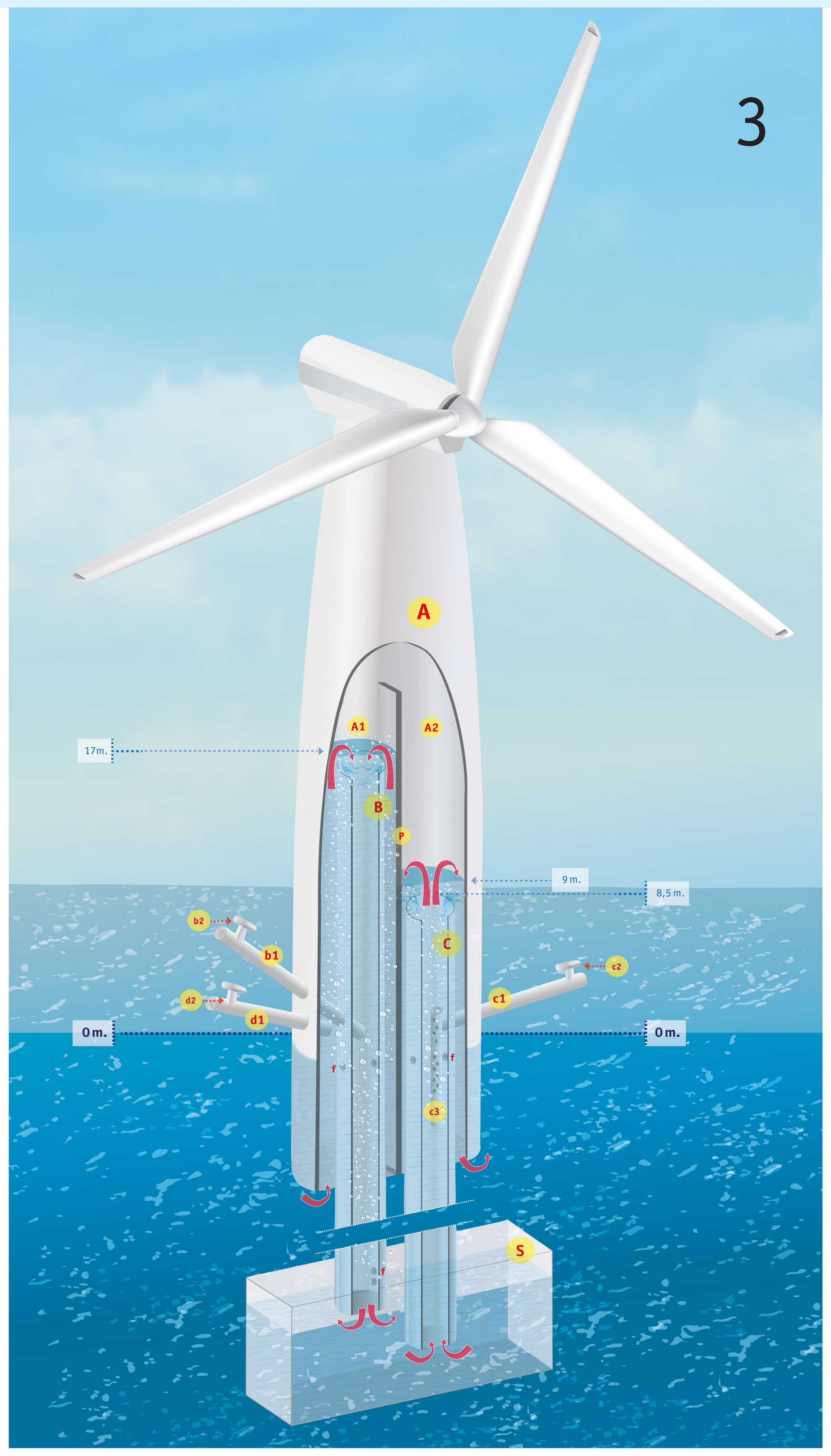

FIGURE 3: shows the plant with the suction wind turbine in operation and all the taps d2, b2 and c2 open. In this situation, the air at atmospheric pressure:
1) through the duct d1, it flows into the section A1 and forms a mixture of air and water (hypothetically 50%) which, having a lower density, is pushed upwards. When this mixture passes the height of duct B (17 m), the water is separated from the air and falls into B sinking the water column below;
2) through the duct c1, it goes into tube C, creating a mixture air-water. Once it reaches the level of 8,5 m it comes out of pipe C, the air separates from the water which falls within section A2;
3) at the same time, through the tube b1, the outside air gets into the motor pipe B, it is dragged downwards and gradually compressed by the water column which flows downwards into the tank (S).

What I hope for

I am a lawyer, not an engineer.

Therefore, I am aware that the system presented with this poster is only a rough representation of an invention and that for it to be implemented it needs to be verified, modified and calculated by experts in this field.

Nevertheless, I am convinced that the idea at the base of this system is correct: producing compressed air - clean, dry and at very high pressure to be stored in underwater containers - with the use of hydraulic air compressors in which the artificial and or virtual geodesic drop, necessary for the water to circulate, is obtained with one or more airlift pumps activated by the natural force of the wind or the waves.

Hence, its construction could contribute to the reduction of greenhouse gas emissions thus, the reduction of global warming. If so, my hope would be to find someone interested in verifying the soundness of the idea and its possible feasibility.

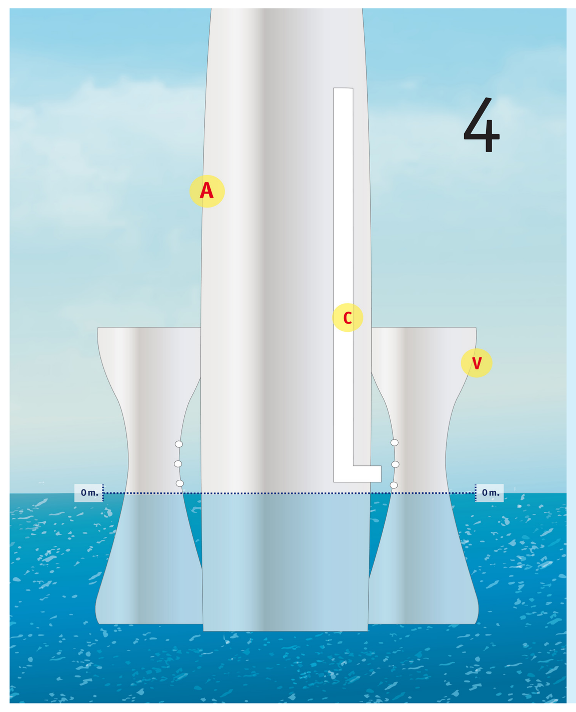

FIGURE 4: shows a version of the plant in which the suction pump has a structure which operates like a Venturi tube, activated by the waves. This structure has two opposing, converging, diverging walls, whose section corresponds to that of a Venturi tube, which surrounds the body of the tower and develops, in one part on top and in the other underneath, of the free water surface.