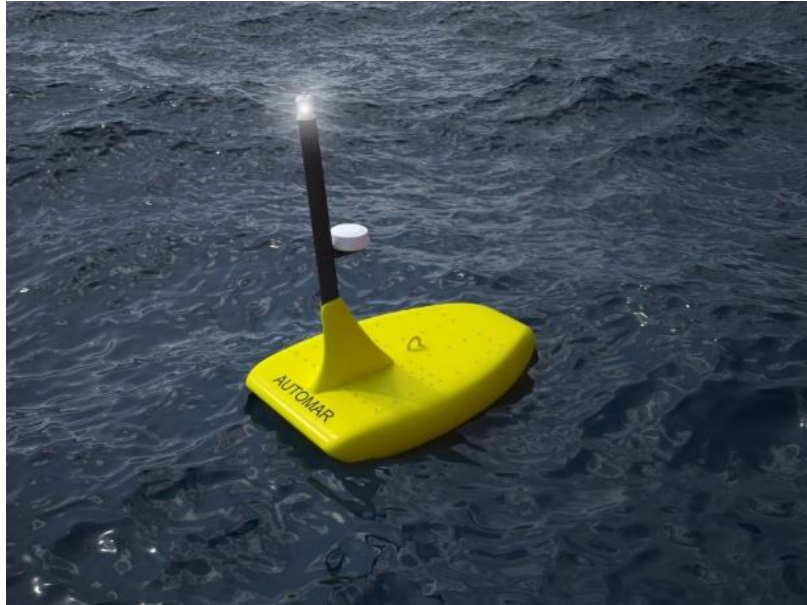


TECHNICAL DESCRIPTION



The proposed technology

Automar is an unmanned surface vessel that can remain in a fixed position without anchoring for years, powered by energy from a wave energy converter that hangs in a cable under the vessel, preferably below the wave zone, i.e. at up to 100 meters depth. Solar cells integrated into the deck can provide additional energy. Both the vessel and the turbine are designed to exert the least possible resistance to wind, waves, and ocean currents. Thrusters on the vessel will provide the necessary propulsion to maintain the position. The payload will also be

powered by the turbine.

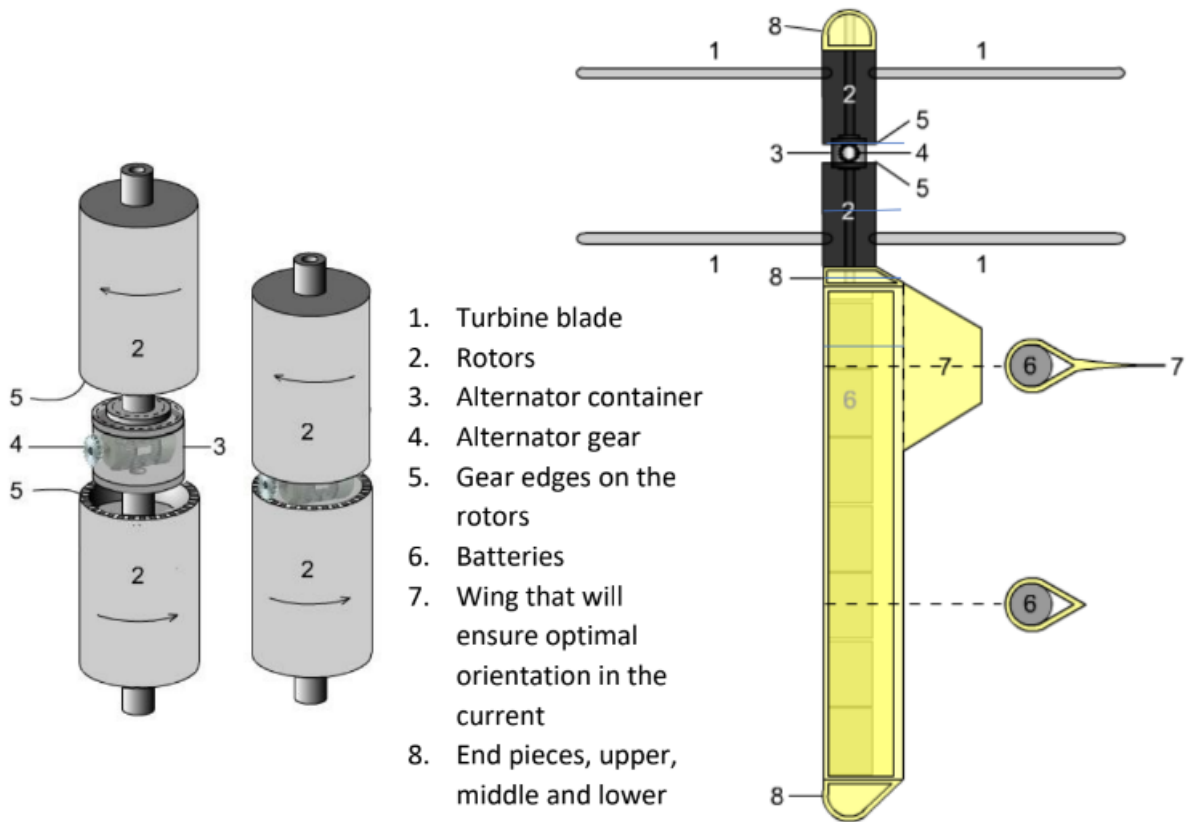


The Surface Vessel

The surface vessel is the size of a small recreational boat, about 5 m long with a flat deck and a low freeboard. Two electric thrusters on the stern operate independently and can control the vessel based on GPS signals.

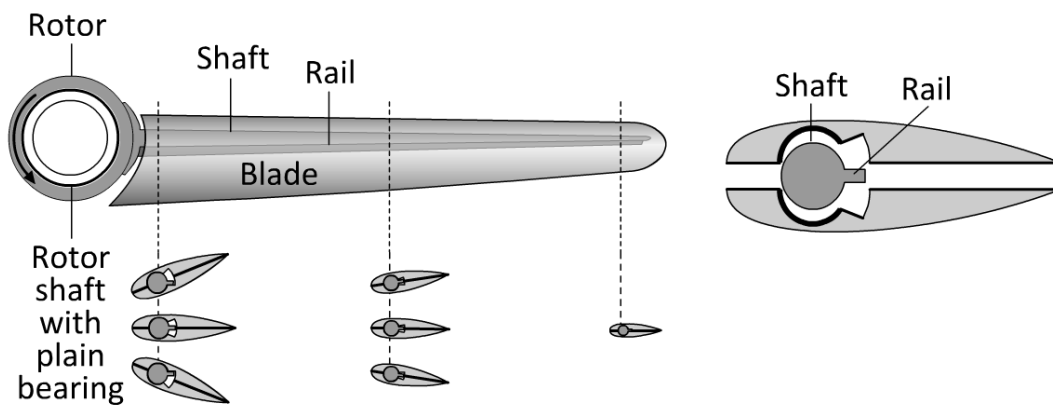
The Wave Energy Converter

The wave energy converter, next page, is a 6 m long vertical body with two rotors in the upper part surrounding a generator, and a large modular battery section in the lower part. Foil-shaped cross-section and a vane, in combination with the large weight in the lower part, ensure that the current in the sea affects the turbine inclination as little as possible.



The Turbine Blades

The two rotors rotate opposite to each other, each of them the same way all the time. This is due to innovative flexible twisting turbine blades developed by Wavenco, shown below. Since they will operate under high pressure at a depth of up to 100 metres, the blade is made of massive plastic material, for example, high-density polyethene.



Current state of development

The wave power turbine was granted a patent in Norway on 2016.07.25.

A model was built in 2017 and tested in the Stadt Towing Tank by students from the University College of Western Norway in 2018.

Dutch Marine Energy Centre (DMEC) did a computer analysis of the turbine blade concept in 2020. This resulted in a conference publication for the European Wave and Tidal Energy Conference in Plymouth in September 2021.

In 2021, NORCE Norwegian Research Center analysed the Automar concept concerning the relationship between calculated energy production from the turbine and the energy requirement for maintaining the position and for payload. The conclusion was that the turbine would cover the need under average wave and current conditions in the North Atlantic, as this clip from the report's spreadsheet shows:

Floater			Energy balance	
Mass, kg	2000	M_F	Available energy, W	10728
Width, m	1,70	d	Propulsion, W	10237
Length, m	4,30	l	Onboard needs, W	450
Draft, m	0,90	h	Balance	41 ok if positive
Vert drag, N	62,4	F_{DTz}		
Inert force, N	2467,4	F_I	Rotor diameter	4,92
Sub weight, N	31304,1	F_G	Blade length	2,34
Added mass, N	499,0	F_A		
Resist rotors, N	12523,3	F_R		
Sum, kg	4776,4			
Displacement, kg	809,0		Maximum horizontal forces	
Turbine			Wave drift force, N	5726 F_{wx}
Mass, kg	4000	M_t	Sea current drag, N	70,92 F_{Dx}
Radius, m	0,25		Max horizontal drag, N	92,70 F_{DTx}
Length, m	4,00		Hor resist rotors, N	1337 F_R
Displacement, m ³	0,79	V_t	Thrust requirement, kg	736,64
Sub weight, N	31304	F_G		

Installation strategy

Automar with turbine can be deployed in a calm sea area with sufficient depth on a coast at about the same latitude as its destination. If sufficient wave action along the route, it will go to the desired position. The speed through water will be about 0.3 m/s on average. Speed over ground will depend on sea currents. When it reaches the position, it will stop and stay there. Energy will then be allocated only to station holding and payload.

The use of Automar is restricted to sea areas with a significant annual average of wave energy. Such areas will be found in the westerly wind belts between about 40 and 60 degrees latitude of the northern and southern hemispheres. But there will be long periods of calm weather even there. Therefore, Automar must have a large battery backup that is charged during normal and stormy periods and used during quiet periods. As the battery part of the wave power converter is modular, the battery capacity can be adapted to the needs at the operating site.