# Magallanes Renovables

UNLOCKING THE POTENTIAL OF TIDAL ENERGY

#### **TIDAL ENERGY**

#### **Definition of Tidal Energy**

Tidal energy is energy derived from the movement of the ocean tides.

#### What causes tides?

Ocean tides are the response of the ocean to the gravitational attraction of the moon as it orbits the Earth. Tides also respond to the gravitational attraction of the Earth as it orbits the Sun but to a lesser extent.



TIDES

Due to the **Moon's gravitational pull**, tidal bulges develop. The tidal bulges move as the Earth rotates and the Moon changes position relative to the Earth.

The part of the Earth **closer to the Moon** is more **strongly attracted** to the Moon than the part farther from the Moon which is less strongly attracted. So, the close part gets closer and the far part gets farther. This makes the elongation in both directions that we observe in the illustration.



Since the **Earth rotates** a full turn every day, **the point** on the Earth that is being pulled toward the moon **is constantly changing**. As the angle changes between the Moon and the Equator, the tidal bulges change position on the Earth. Most places on Earth have **two high tides and two lows every day** because of the Earth's rotation and the Moon's change of position.

#### **WORLD TIDE PATTERNS**



A **tidal bulge moves around the Earth** every day. Since the Earth has **continents** that disrupt the even flow of water, a complex pattern emerges. In some places, the water stretches out more toward the Moon. In other places, tidal nodes occur where the water does not really deform at all.

#### **BRIEF HISTORY OF TIAL ENERGY**

People have harnessed the tides and used its energy for many centuries. **Tide mills**—which are the precursors to today's tidal power plants— have **great similarity to water wheels**. The difference is that water must first be collected from the incoming tide before it can be released to rotate the water wheel.



The oldest, excavated tide mill is dated to the year **619**. It was discovered at **Northern Ireland's Nendrum Monastery** on Mahee Island in Strangford Lough. The power generated by this mill was probably used for grinding grain. Video: <u>https://youtu.be/y6vFo6BuQTc</u>



#### **BRIEF HISTORY OF TIAL ENERGY**

By the **18th century**, 76 tide mills were being used in London alone. At one time there were about **750 tide mills** in operation around the shores of the **Atlantic Ocean**. This included about 300 on North American shores, about 200 in the British Isles, and about 100 in France.



The **Rance estuary** in France was home to some of the historical tide mills. Now the Rance river has the **world's first tidal power generating station**. It opened in **1966**. As an improvement to early tide mills, it generates power during high tide and low tide.



Pros	Cons
<b>Renewable</b> : the energy doesn't deplete as it is used	<b>Limited site availability</b> : In order for a tidal power plant to be built, the potential installation site must meet very specific requirements
<b>Zero-carbon emissions</b> : tidal power stations do not emit greenhouse gasses during electricity generation.	<b>Expensive</b> : high upfront costs. Tidal energy turbines need to be much sturdier than wind turbines, because of the high density of water.
<b>Predictable</b> : Low and high tides follow well- known cycles, making it easier to know when power will be produced throughout the day.	<b>Environmental impact</b> : . The construction of tidal energy power stations can have a substantial impact on the surrounding ecosystem.
<b>High power output</b> : Tidal power plants are able to produce high amounts of electricity. One of the main reasons for this is because water is so dense - almost 800 times more dense than air.	<b>Energy demand</b> : While tidal power does have predictable power generation, it doesn't have constant power production

#### **MODERN TYPES OF TIDAL ENERGY SYSTEMS**

A **tidal barrage** is a dam-like structure used to capture the **energy** from masses of water moving in and out of a bay or river due to **tidal** forces.

- High Costs
- High environmental impact

**Tidal Stream** When tide movements find obstacles it can generate fast sea currents which are often magnified by topographical features, such as islands and straits, or by the shape of the seabed when water is forced through narrow channels





#### **FOCUSHING ON TIDAL STREAMS**

When tide movements find obstacles it can generate fast sea currents which are often magnified by topographical features, such as islands and straits, or by the shape of the seabed when water is forced through narrow channels

#### **THE CHALLENGE:** Too much power





#### **PILAR SYSTEM:** 1<sup>st</sup> generation







#### **SEABED TURBINE: 1st Generation**







### **FLOATING PLATFORM**

Description	Low Investment	Low O&M Costs	Economically Viable	NO Environmental Impact	Deep waters
<b>FLOATING PLATFORM</b> Floating structures, anchored to the seabed, with tidal generation turbines attached beneath	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$



#### **MAGALLANES RENOVABLES: Beginnings**

Magallanes Renovables is a Spanish company independently established in **2009**.

It is focused on the **development**, **industrialization** and **exploitation** of a technology capable of harnessing energy from the sea currents in an **efficient**, **reliable** and **profitable** way.

A Magallanes Renovables



### **MAGALLANES RENOVABLES:** Philosophy

Leverage the existing technology developed by the already mature wind and naval industries, minimizing the technology risk.



#### **MAGALLANES RENOVABLES: 1:10 Prototype**

We developed our first 1:10 scale **prototype** in **2010** with the help of the university of Vigo, the device was tested in Vigo, there are no tidal currents in Vigo, so we had to tow it in order to test the system. We learned a lot form this tests. We improved the prototype and had successful results



# Universida<sub>de</sub>Vigo



### **MAGALLANES RENOVABLES: Full Scale**

After conducting tests on the 1:10 prototype we decided to build a **full size** machine. This would have **1.5 MW of installed power** 







# MAGALLANES RENOVABLES: Full Scale



## **MAGALLANES RENOVABLES: How it Works**

1 The platform is **anchored** to the seabed

2 Tidal currents cause the blades to rotate, powering a generator that produces electricity

<sup>3</sup>An underwater cable carries the electricity to an onshore substation 15m Mast

The **substation** is connected to the **grid** which **distributes** the electricity

4

Underwater cable

10,5m J

#### **KEY Characteristics**

**Electrical Substation** 

Capacity	1.5 MW		
Easy Installation	3 Days		
Modular Construction	5 Modules		
Easy Maintenance	Standard Equipment		

## **MAGALLANES RENOVABLES:** How it Works







The European Commission has estimated that 1,5 GW will be installed by 2030 in Europe



#### **TIDAL ENERGY AND AFRICA**

In Africa, there greatest potential lies in Morocco, but it yet to be studied in other parts of the continent.

- The Strait of Gibraltar: This strait ha the potential to install up to 7.000 MW
- West Africa: Tidal Maps show high sea level difference around Sierra Leona and Liberia.
- Mozambique Channel
- Horn of Africa
- There is a high potential of Ocean energy to be harnessed in Africa. There is a need to have further studies on the tidal and wave potential



# Thanks For Your Kind Attention

