

Sigma WEC

Harvesting the energy of the waves

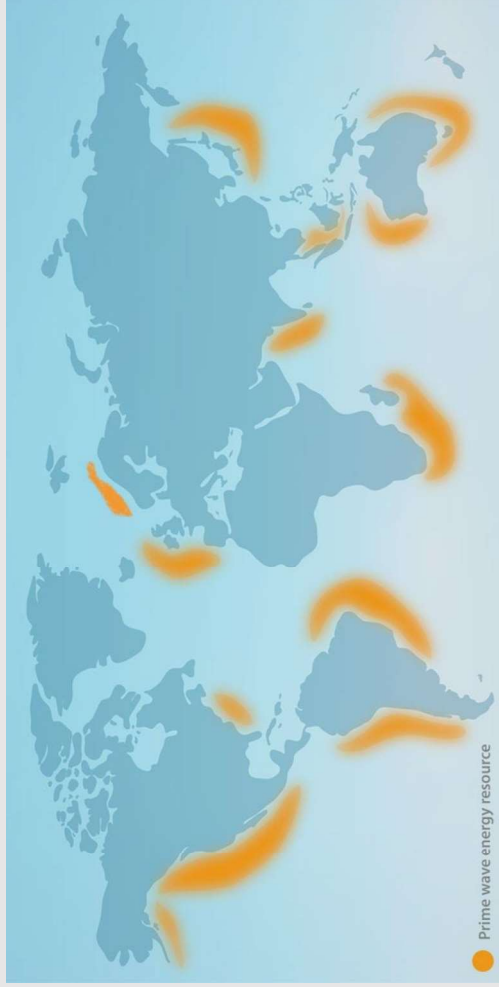


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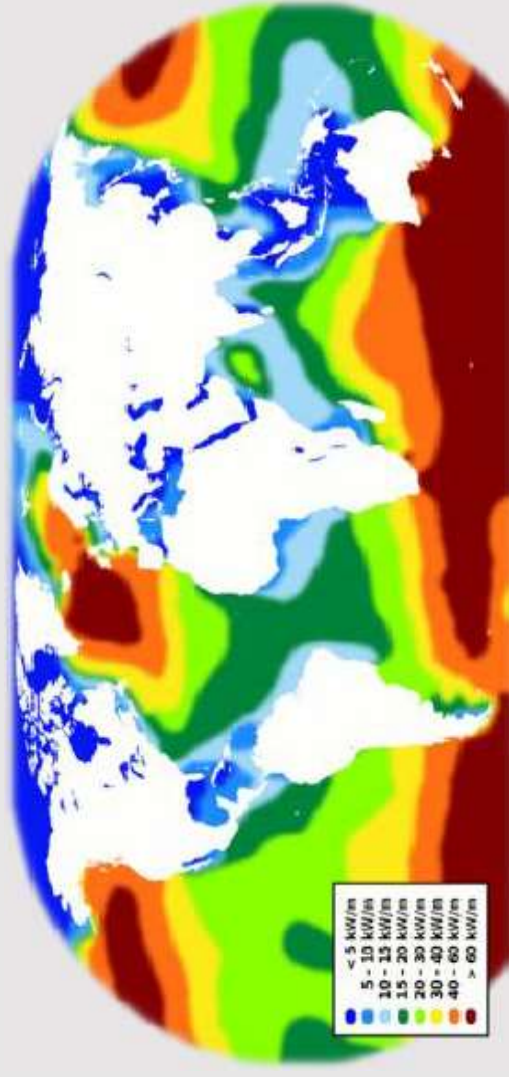
Wave energy potential



- \approx 70% of planet is covered by oceans
- Global wave energy resource estimate $>$ 80,000 TWh/year
- Global electricity consumption in 2019 = 22,848 TWh¹
- **Wave energy can satisfy world's electricity consumption multiple times**



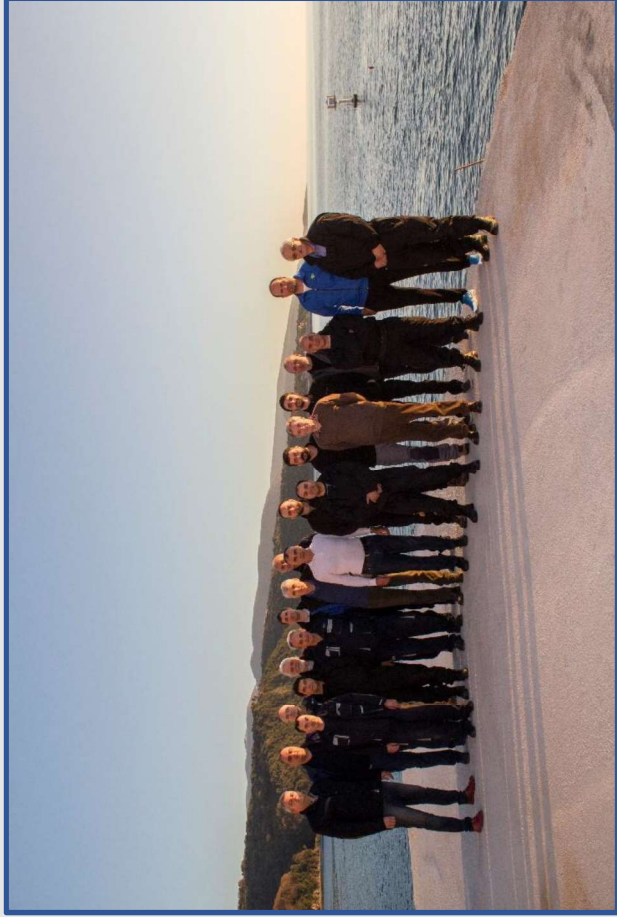
¹International Energy Agency



Who are we?



- Sigma Energy was founded by Mile Dragič PhD, lead engineer, in Slovenia in 2008
- Team of experts devoted to Sigma WEC technology commercialisation

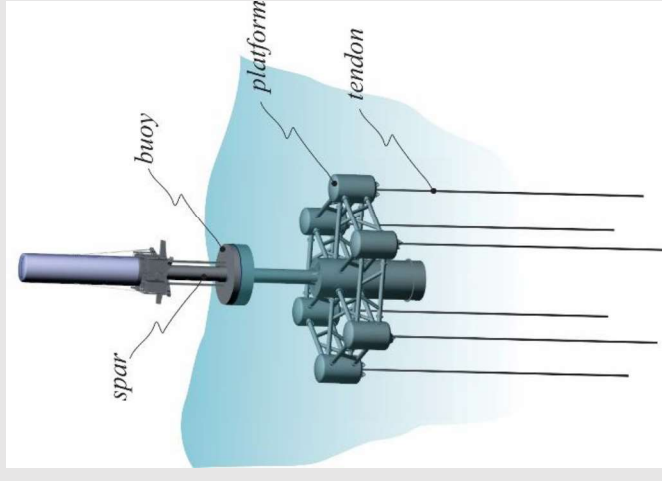


Sigma WEC Technology



- Point-type absorber with original mechanical PTO system
- Technology patented in more than 40 countries, includes more than 100 novelties

SOME OF THE ORIGINAL AND PATENTED SOLUTIONS	
PTO SYSTEM	Mechanical losses of 4%
TLP PLATFORM	Installation at various depths
SURVIVABILITY	Unique system for buoy submersion
MONITORING	Device monitoring and control from any place with internet connection
GENERATOR CONTROL	Original software for Capture Width Ratio (CWR) maximisation
	Higher overall efficiency
	Adaptable to different locations
	Lifetime 25 years
	Maintenance costs at minimum
	Higher energy output

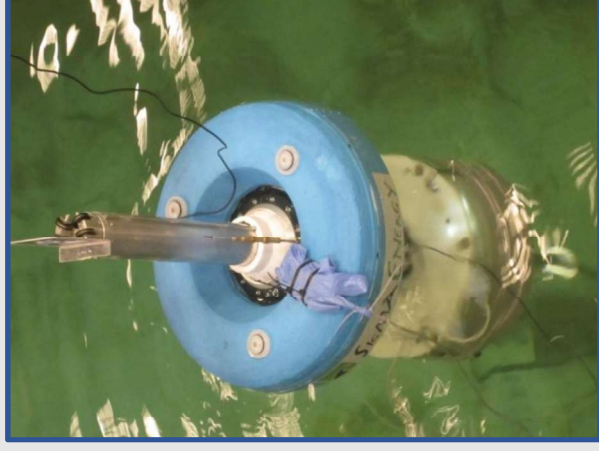
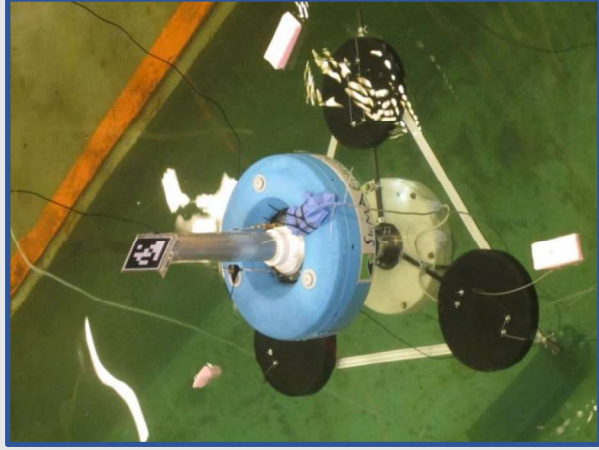


Testing



Small scale tests

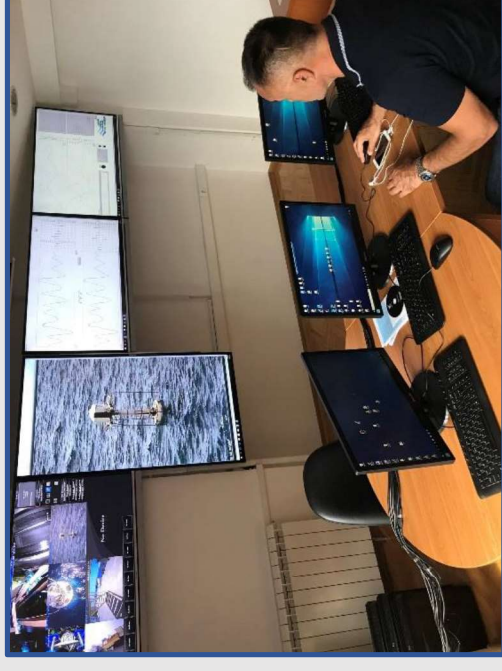
- Small scale tests were performed in wave tanks across Europe
 - 1:30 scaled prototype in Trondheim, Norway (2010)
 - 1:35 scaled prototype in Aalborg, Denmark (2013)
 - 1:18 scaled prototype in Brest, France (2014, 2016)



Sigma WEC in Adriatic Sea I



- 1:5 in scale prototype was feeding clean electricity into Montenegrin power grid for a year
- It was equipped with 9 cameras and over 40 sensors measuring mechanical, electrical and environmental parameters
- Prototype was remotely accessed, monitored and controlled



Sigma WEC in Adriatic Sea II



- Sigma WEC withstood several intense storms
 - single wave measured 5.5 m = 27 m at full-scale
- **Patented survival regime** - buoy submersion
- Completely harmless to the environment
- Artificial reef for marine life

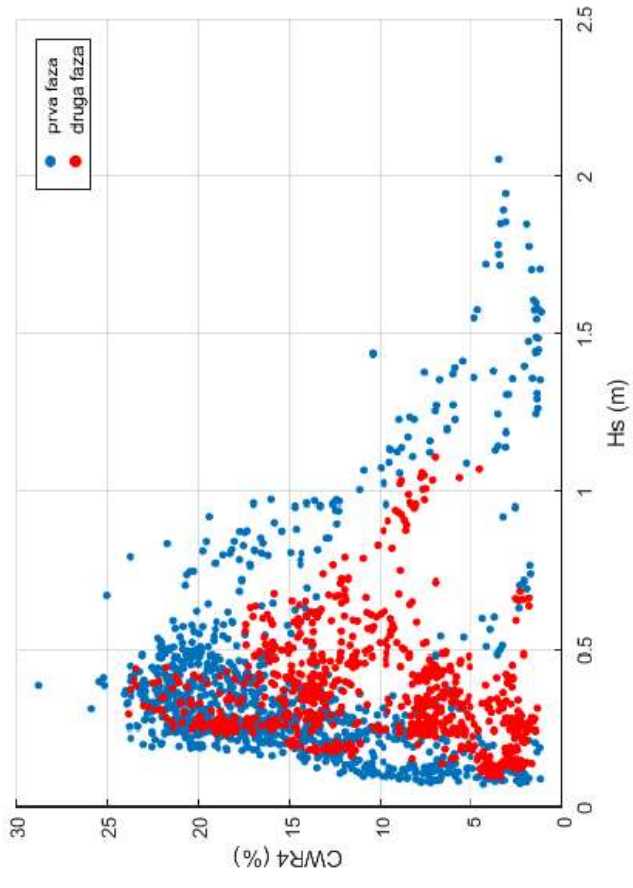
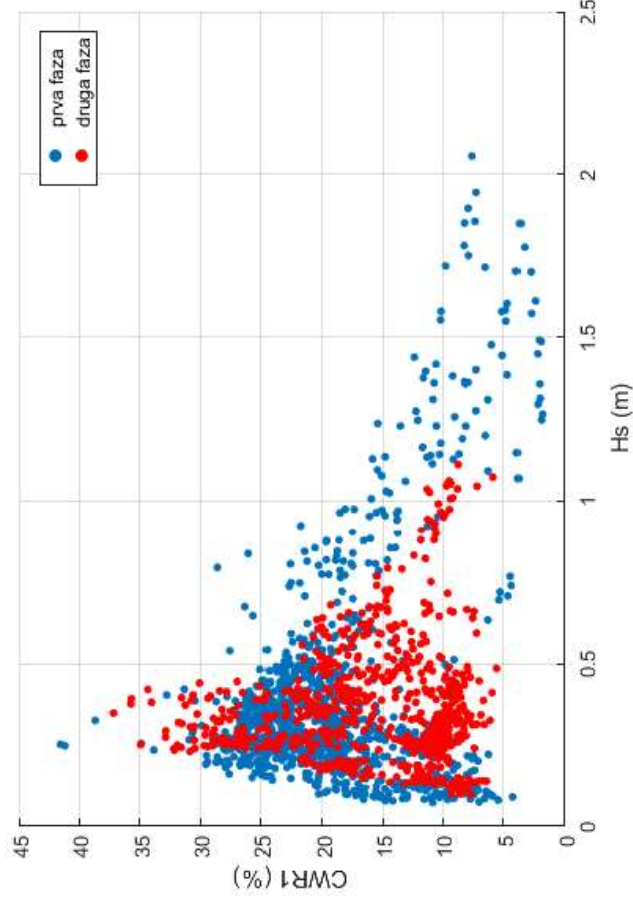


Results



Capture Width Ratio (CWR)

- Fraction of the wave power absorbed by the device
- Common performance measure
- In some tests almost **30% of wave energy was fed into the grid**

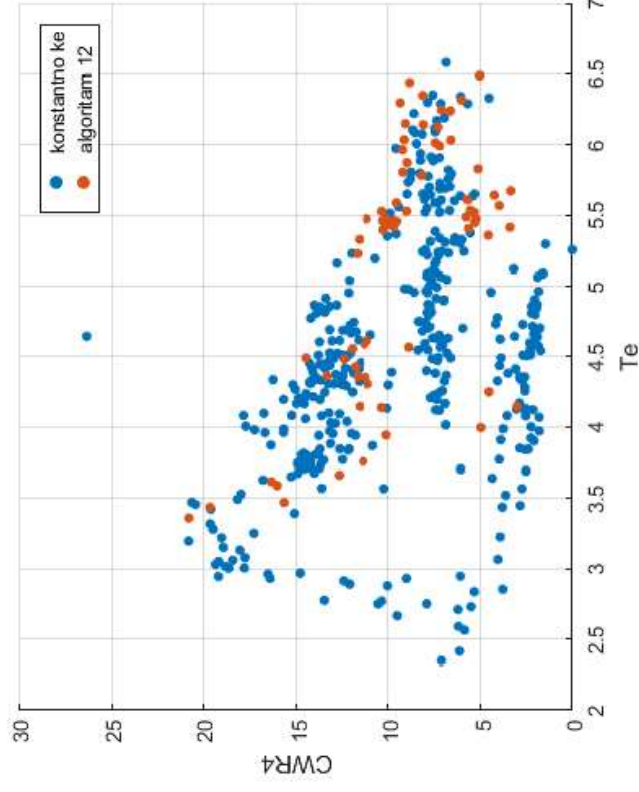
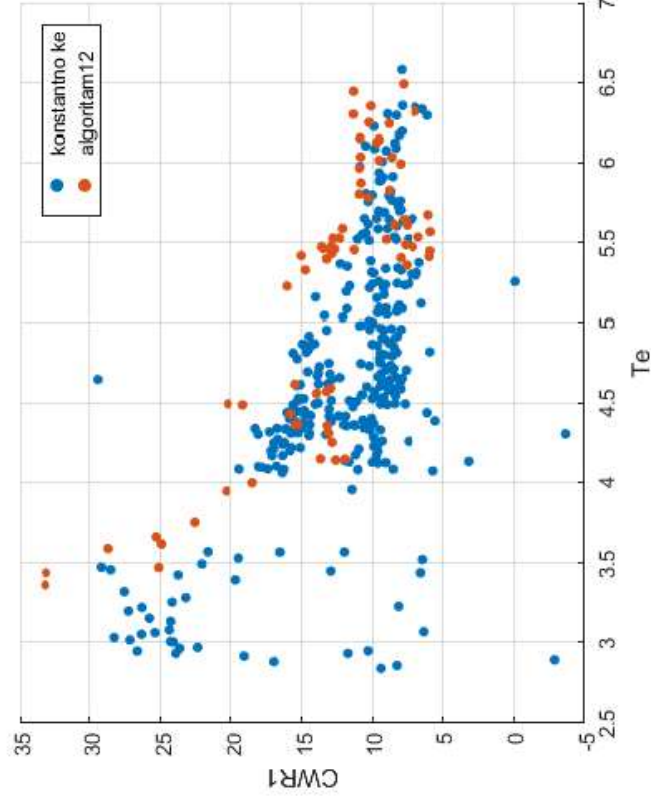


Results



Sigma's algorithm for CWR maximisation

- **Basic concept:** Body oscillating in resonance with incident wave
- We do this by controlling the generator torque in real time



Achievements

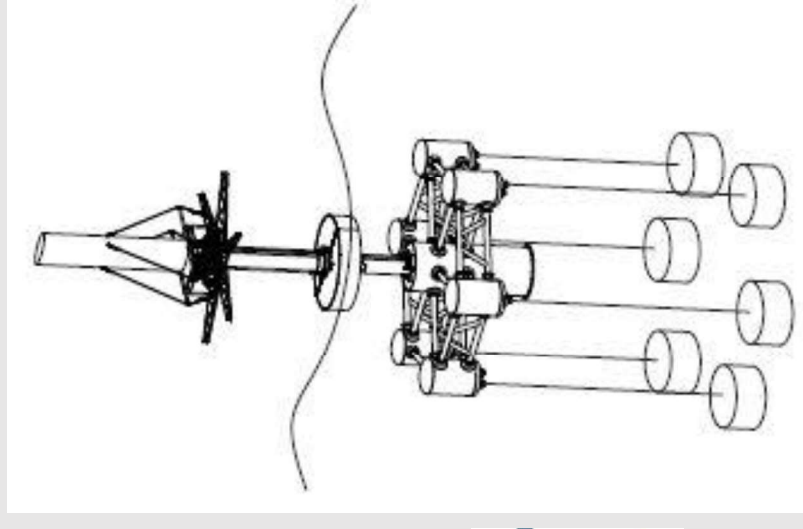


„Sigma WEC – deployment and testing“ I



About the project

- Project co-financed by the Republic of Slovenia and the European Union from the European Regional Development Fund started in december 2019
- **Goal:** Deploy and test the first full-scale WEC for Adriatic Sea
- Test algorithms for generator control – Capture Width Ratio (CWR) maximisation



REPUBLIC OF SLOVENIA
MINISTRY OF ECONOMIC DEVELOPMENT AND
TECHNOLOGY



„Sigma WEC – deployment and testing“ II



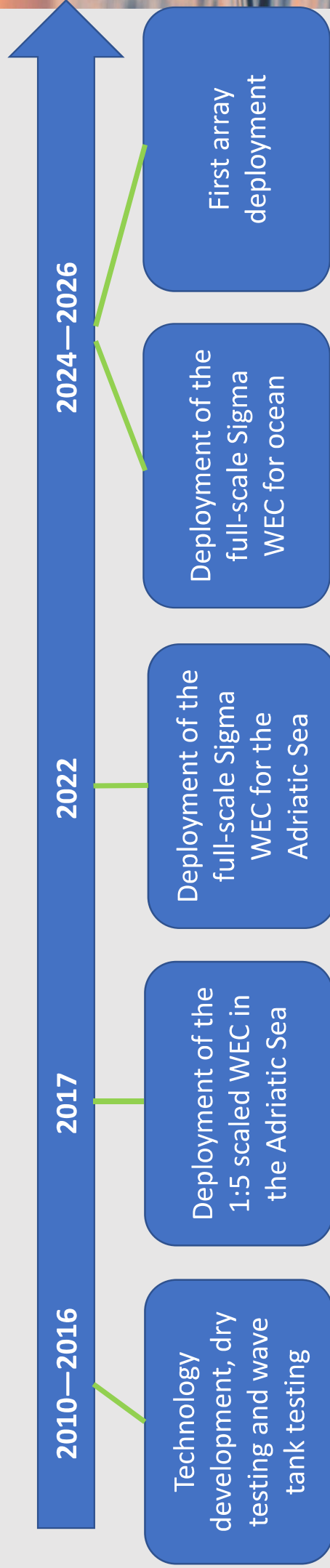
Current status



REPUBLIC OF SLOVENIA
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Plans for the future



Thank you for your attention



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