# Eni MaREnergy: Marine Renewable Energy for Subsea Robotic Residential System

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#### **MARINE RENEWABLE ENERGY – OVERVIEW & ROADMAP**

- Within Eni Low Carbon emission strategy, an R&D Project MaRenergy has been set up to:
  - harvesting of marine renewable energy
  - integration of such technologies into offshore fields
- Opportunities & benefits
  - Limiting CO2 in offshore development
  - Increase project feasibility in harsh environment
  - Potential existing asset valorisation
  - Exploitation of synergies

## MaREnergy RoadMap:







#### **MARENERGY – Marine Energy Technologies**

- Tidal Energy Conversion (TEC)
  - Sea current
  - Tidal Stream & Tidal Barriers
- Wave Energy Conversion (WEC)

• Energy from sea waves









- Ocean Thermal Energy Conversion (OTEC)
  - Thermal gradient due to water depth
- Salinity Gradient
  - Pressure Retarded Osmosis (PRO)
  - Reverse Electro-Dialysis (RDE)







#### MARENERGY – WORLDWIDE SEA ENERGY MAPS





- *Eni worldwide presence including site in exploitable areas*
- Meteocean data Available at Enisite useful for local energy assessment
- Adriatic Sea as an "open sea validating laboratory" for sub-scale replica of most energetic sea with complete dynamic range replicated—suitable location for Pilot project

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#### **MARENERGY - MARINE ENERGY CONVERSION TECHNOLOGIES**



Marine Energy Devices			
Wave Energy Converters WEC	Tidal Energy Converters TEC		
Attenuator	Horizontal Axis Turbine		
Point Absorber	Vertical Axis Turbine		
Oscillating Wave Surge Converter	Oscillating Hydrofoil		
Oscillating Water Column	Enclosed Tips (Ducted)		
Overtopping	Helical Screw		
Pressure Differential	Tidal Kite		
Bulge Wave	Other		
Rotating Mass			
Other			

TRL 9	Full commercial application, technology available for consumers	
TRL 8	First of a kind commercial system. Manufacturing issues solved	
TRL 7	<u>Demonstration system</u> operating in operational environment at pre- commercial scale.	<b>T</b> 1-1
TRL 6	<u>Prototype system</u> tested in intended environment close to expected performance	
TRL 5	Large scale prototype tested in intended environment	Wave
TRL 4	Small scale prototype built and tested in a laboratory environment.	
TRL 3	Applied research. First laboratory tests completed; proof of concept	
TRL 2	Technology formulation. Concept and application have been formulated	
TRL1	Basic research. Principles postulated and observed but no experimental proof available.	

 Limited maturity technologies allows for business needs customization and exploitation of synergies for risk and cost reduction

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## **MARENERGY - TECHNOLOGY SCREENING**



- Ad-hoc screening methodology developed for technology selection based on business case & risk reduction
- Assessment criteria based on API17N risk categories
  - Maturity
  - Reliability
  - Configuration
  - Operative envelope
  - Risk organization
  - 150+ technologies screened ranking list for each marine technologies including (WEC, TEC, OTEC and Float. Wind)











Power Range	Business Case
Up to 15 kW	<b>CleanSea</b> Subsea field Unmanned monopole
From 15 kW to 500 kW	Unmanned satellite platforms Partially manned platforms
Above 500 kW	Pre-process & compression

## **MARENERGY – PILOT SYSTEM TECHNOLOGY SHORTLIST**



#### Rotating mass

- Passive: flywheel
- Active: gyroscope



- No moving parts exposed: PTO is fully within the hull
- Possible Drawback: mooring line





- Point Absorber
  - Submerged
  - Floating/SPAR like



- Exploiting relative motion of a moving part and a fixed one
- Can provide both electric and hydraulic power





WEC (Point Absorber): Carnegie, OPT

### **OPT PB3 POWERBUOY™ - PILOT SYSTEM**

- Technology type: Point Absorber
- High maturity: 1:1 scale already deployed and field proven
- Peak power: 3 kW suitable for Adriatic Sea
- Water depth: 30 up to 1000+ m
- Simplified management for installation/mooring/operation





Eni OPT PB3 construction in Monroe Township NJ USA









## **OPT PB3 POWERBUOY™ - PILOT PLANT ARCHITECTURE**



- OPT PB3 pilot site could be located close by an Eni platform in the Adriatic Sea
- OPT System shall be connected with a power & telecom. cable to a subsea test setup (AUV docking station mock-up) in order to demonstrate full compliance with Cleansea residential system requirements
- Sea trials will validate OPT performances and S/S capabilities in particular:
  - OPT PTO performances
  - OPT Energy Storage and energy transfer
  - Real-time communications for fully autonomous and unmanned monitoring and data transmission
  - Monitoring, control and data acquisition of low power subsea
    equipment















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