ADMISSION TO 2° YEAR

OCEAN ENERGY SYSTEMS

TOPIC: HYBRID OFFSHORE ENERGY SYSTEMS

1st year / 35th cycle

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OCEAN ENERGY SYSTEMS
HYBRID POINT ABSORBER

PHD PROGRAMME IN APPRENTICESHIP

Academic supervisor: Prof. **Giuliana Mattiazzo**

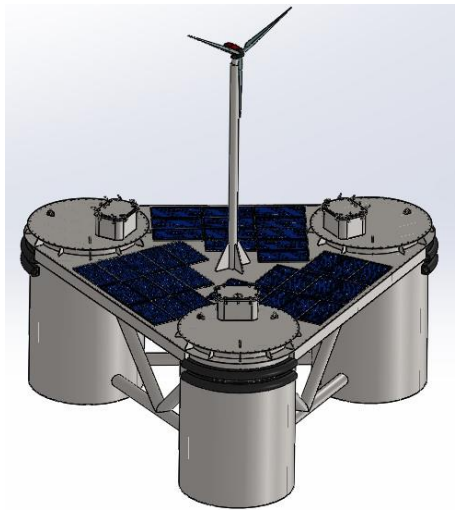
Academic co-supervisor: Ing. **Giovanni Bracco**

Company supervisor: Ing. **Vincenzo orlando**

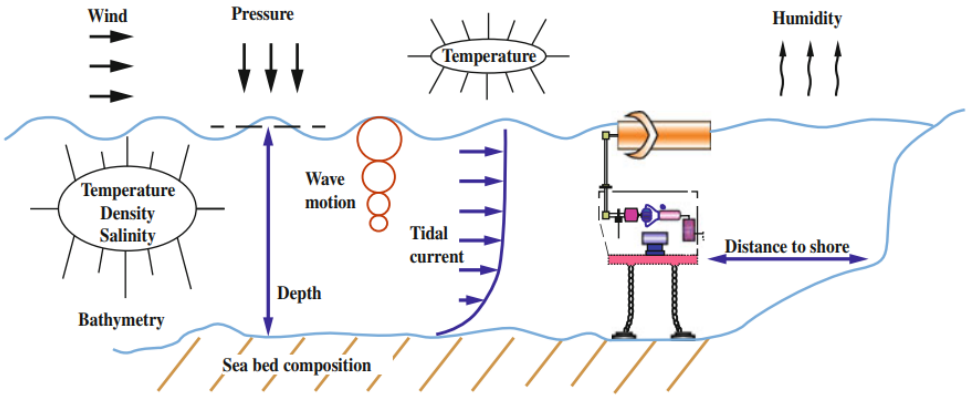
FOCUS

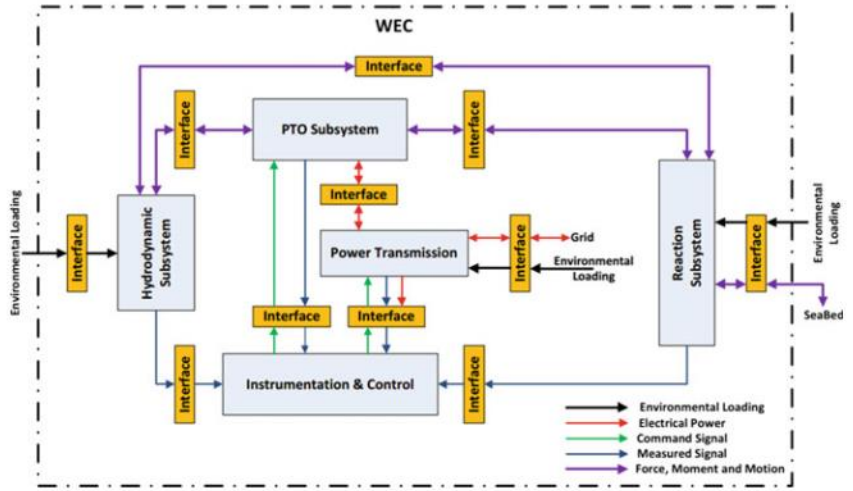
- Point absorber WEC and hybrid systems
- Integration of different renewable sources
- Mooring system analysis
- Design

Point Absorber (PA)

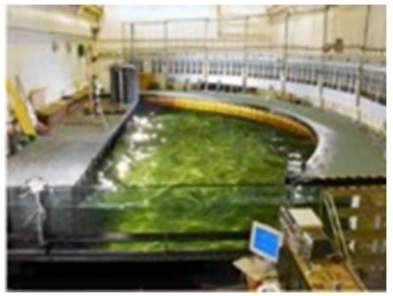


Offshore Power Unit (OPU)





THE PROPOSED APPROACH



The approach proposed is based on 4 main steps:

1. Modelling of subsystems and entire device

2. Small scale prototype **design** and **construction**

3. Small scale prototype **testing** in protected environment

4. Larger scale prototype **design, construction** and **testing** in real environment

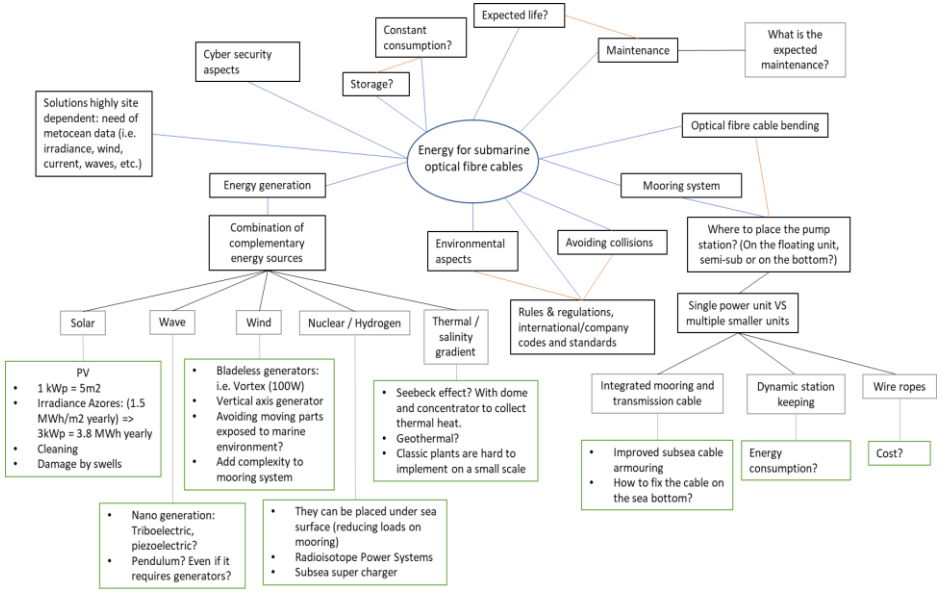
OCEAN ENERGY SYSTEMS
HYBRID POINT ABSORBER

MARINE OFFSHORE RENEWABLE ENERGY LAB

WAVE FOR ENERGY

ScuDo
Scuola di Dottorato ~ Doctoral School
WHAT YOU ARE, TAKES YOU FAR

WORK DONE - OPU



- Case study selection
- Resource analysis
- Screening of available technologies
- Decision support model based selection
- Integration of different technologies
- Modelling different energy sources, back up systems and storage
- Preliminary system design
- Found raising

$$V(a) = \sum_{j=1}^{n} k_j v_j(a)$$

With:

$$\begin{cases} v_j(best_j) = 100, \ \forall j \\ v_j(worst_j) = 0, \ \forall j \\ V(best\ allover) = 100 \\ V(worst\ allover) = 0 \end{cases}$$

$V(a)$ overall value of option a

$v_j(a)$ partial value (score) of option a in terms of criterion j

k_j scaling constant (relative weight) of criterion j

$$\sum_{j=1}^{n} k_j = 1 \quad \text{and} \quad k_j > 0 \ (j = 1,\ldots,n)$$

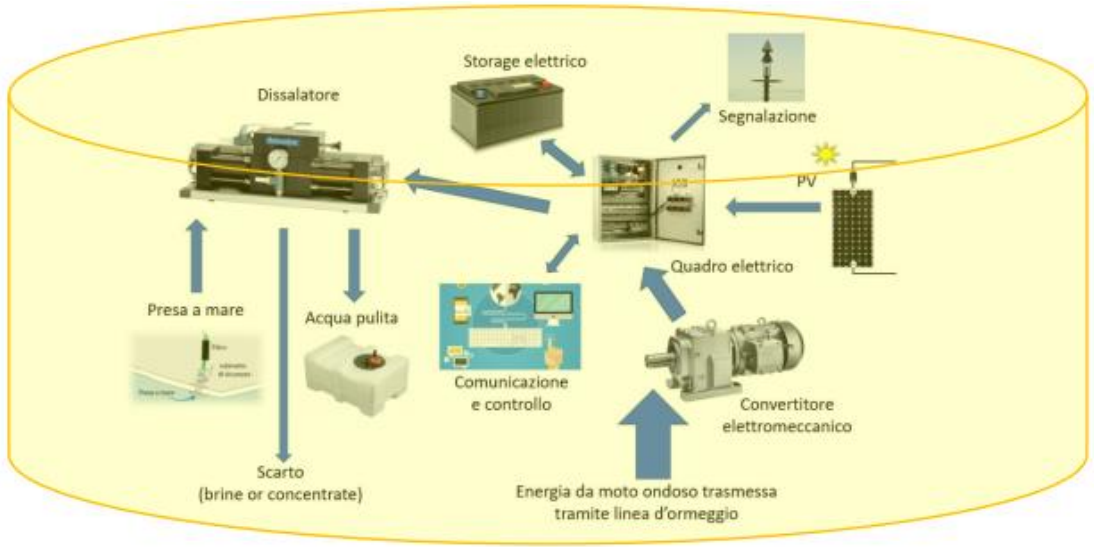
Criterion	Relative weight	Photovoltaic		Thermoelectric generators		Wind		Wave		Fuel cell-based energy storage system		Electrochemical energy storage system		Diesel generator	
		Assessment against criterion		Assessment against criterion		Assessment against criterion		Assessment against criterion		Assessment against criterion		Assessment against criterion		Assessment against criterion	
1) Capital Investment Cost (CAPEX)	25%	HIGH	22.5	LOW	2.5	HIGH	22.5	LOW	2.5	MEDIUM	12.5	HIGH	22.5	HIGH	22.5
2) Operation & Maintenance costs (OPEX)	25%	HIGH	22.5	LOW	2.5	MEDIUM	12.5	MEDIUM	12.5	LOW	2.5	HIGH	22.5	MEDIUM	12.5
3) Availability of resource at the given site	15%	HIGH	13.5	HIGH	13.5	HIGH	13.5	MEDIUM	7.5	LOW	1.5	LOW	1.5	HIGH	13.5
4) Reliability	15%	HIGH	13.5	LOW	1.5	MEDIUM	7.5	LOW	1.5	MEDIUM	7.5	HIGH	13.5	HIGH	13.5
5) Quality (constancy) of energy production	10%	LOW	1	LOW	1	LOW	1	LOW	1	HIGH	9	HIGH	9	HIGH	9
6) Environmental impact	5%	HIGH	4.5	HIGH	4.5	HIGH	4.5	HIGH	4.5	HIGH	4.5	HIGH	4.5	LOW	0.5
7) Dimensions (volume, area, weight) & Integrability	5%	LOW	0.5	LOW	0.5	HIGH	4.5	MEDIUM	2.5	MEDIUM	2.5	MEDIUM	2.5	HIGH	4.5
TOT	100%	78		26		66		32		40		76		76	

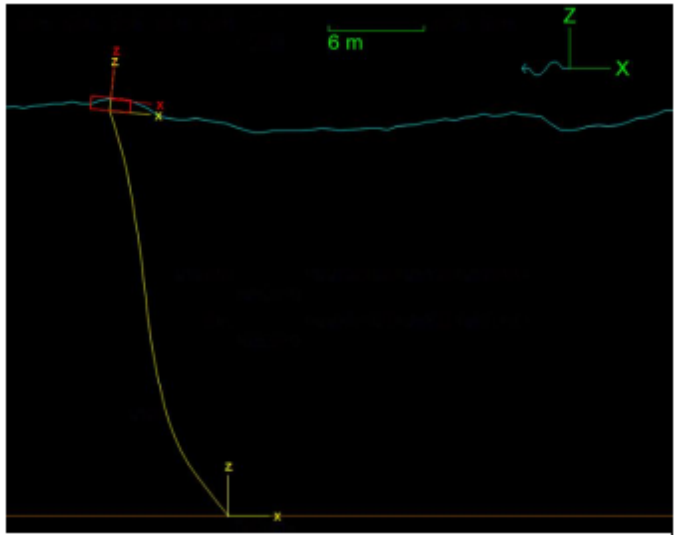
WORK DONE - PA

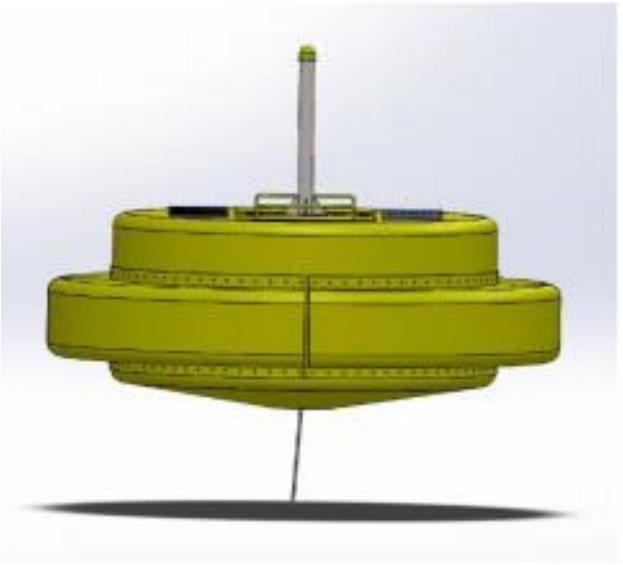
- Case study selection
- Resource analysis
- Integration of PV and wave to electricity and water
- Modelling of the system to predict performance
- Preliminary system design
- Mooring architecture analysis
- Technoeconomic analysis
- Found raising

Dimensioni e caratteristiche WEPA	
Geometria	Cilindrica
Power Take off	Elettromeccanico
Massa (ton)	5 - 15
Raggio esterno (m)	1.5 – 2.0
Altezza (m)	1.5 – 2.0
Potenza nominale (kW)	3-10

$$LCoE\ \left[\frac{€}{MWh}\right] = \frac{Inv + D}{87.6 \cdot CF} \cdot \frac{r \cdot (1+r)^n}{(1+r)^n - 1} + \frac{OM}{87.6 \cdot CF}$$







PLANNED ACTIVITIES

- Models development
- **Small** scale prototype **design, construction** and **testing**
- Model validation
- **Large** scale prototype **design, construction** and **testing**
- Final design

THANKS FOR YOUR ATTENTION!