



Project Assessment

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*Strategic Development of Marine Energy
Projects: The EquiMar Contribution*

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Objectives of this presentation

- Provide overview of ‘High Level Protocol’ IIIA: “Project Assessment”
- Briefly explain content of Protocol IIIA in terms of existing deliverables
 - Capital Expenditure
 - Operating Expenditure
 - Revenue
 - Risk Assessment
 - Economic Assessment
- Example content from EQUIMAR Deliverables



Objectives of economic assessment

Facilitate fair comparison of alternative marine technologies for large-scale deployment. (e.g. 100 MW farms)

A To provide a summary measure of economic viability to allow comparison to alternative project options.

Economic Assessment of a Project

- Standard procedure for determining economic indicators
- Identify the underlying processes that influence cost and revenue
- Account for uncertainty consistent with the level of development

B To provide comparison between electricity generating options (e.g. between individual wave or tidal technologies).

Economic Assessment of a Technology

- Quantify limits to performance and to cost reductions
- Quantify range of possible cost variations



Objective of protocol IIIA

To define a procedure for conducting an economic assessment such that direct comparison can be made between projects.

- The protocol should provide a set of guidelines:
 - for assessing a given combination of technology and site; a project.
 - to ensure that all assessments have a similar level of transparency.
 - for estimating, valuing and mitigating for site-specific risk.
- The protocol should not:
 - be a cost-database or attempt to forecast future costs
 - represent a model of ALL major variables and their values.
 - merely restate well known methods for modelling financial outcome,



Content & Reporting

1. Capital Expenditures

2. Operating Expenditures

3. Revenue

4. Risk Assessment

5. Project Assessment

Conduct of an economic assessment should produce statements detailing:

- Economic indicators against which the project is assessed
- Major capital cost components
- Major contributions to annual expenditure
- Expected project revenue
- Risk assessment and mitigation



IIIA Summary

1. Capital Expenditures



2. Operating Expenditures

3. Revenue

4. Risk Assessment

5. Project Assessment

Purpose of activity

Identify and quantify all expenditures required to commission a project with the availability and power output used in revenue calculation

Content of protocol

Major items of capital expenditure

Device costs are not addressed.

- Moorings (Source: **D7.3.1**)
- Bed connected structures (**D7.3.2**)
- Wave device support structures (**D7.3.3**)
- Offshore activities (**D7.3.3 & D7.4**)
- Inter-array configurations (**D5.1**)

- Transmission (by an appropriate method)
- Decommissioning activities



Capital Costs: Infrastructure

Infrastructure studies (D7.3): Identify drivers of capital cost and installation time:

- Mooring systems: relative complexity
- Bed connected devices for marine current turbines
- Supporting structures for wave devices: Engineering report
- Variation with scale of deployment

Relative cost of mooring system design choices. (D7.3.2)

		■ Novelty		
		Gravity-base	Mid-weight anchored	Mono-pile
Cost	Installation	Cheap	Cheap	Expensive
	Maintenance	Expensive	Medium	Cheap
Time	Installation	Long	Short	Short
	Maintenance	Long	Short	Short
Logistics	Installation	Float over	Mid- lift	Heavy-lift
	Maintenance	Heavy-lift	Mid- lift	Small vessel
Use	Large-scale	Difficult	Possible	Feasible
	Visual Impact	Immersed	Immersed	Surface piercing

Buoy

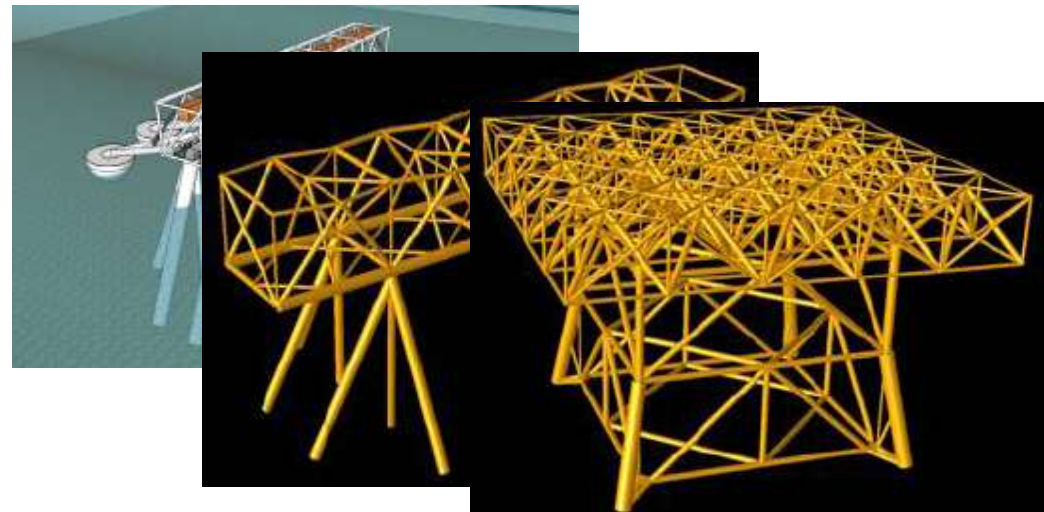
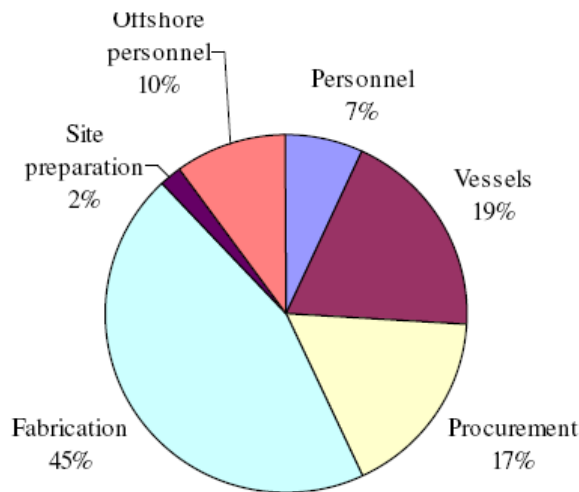
■ Anchor Type



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IIIA Summary

1. Capital Expenditures

2. Operating Expenditures



3. Revenue

4. Risk Assessment

5. Project Assessment

Purpose of activity

Identify and quantify all expenditures required to sustain the energy output stated in revenue calculations.

Content of protocol

Periodic expenditures

Maintenance Planned and Unplanned
Maintenance strategies to sustain
availability assumed (**D7.2.1 and IIC**)

Device reliability as **IIA & IIB**

Vessels, types & operating conditions
(**D7.3, D7.4, D5.5, D5.7**)

Access considerations (**D7.4**)



Accessibility

Site access study (D7.4): Assess deployment rates required for installation of commercial farms
– multiple units (e.g. 100 MW) at high energy sites.

Weather windows suitable for installation

H_s < threshold value (~ 1.5 to 2 m approx.)

Wind speed < threshold value (range considered)

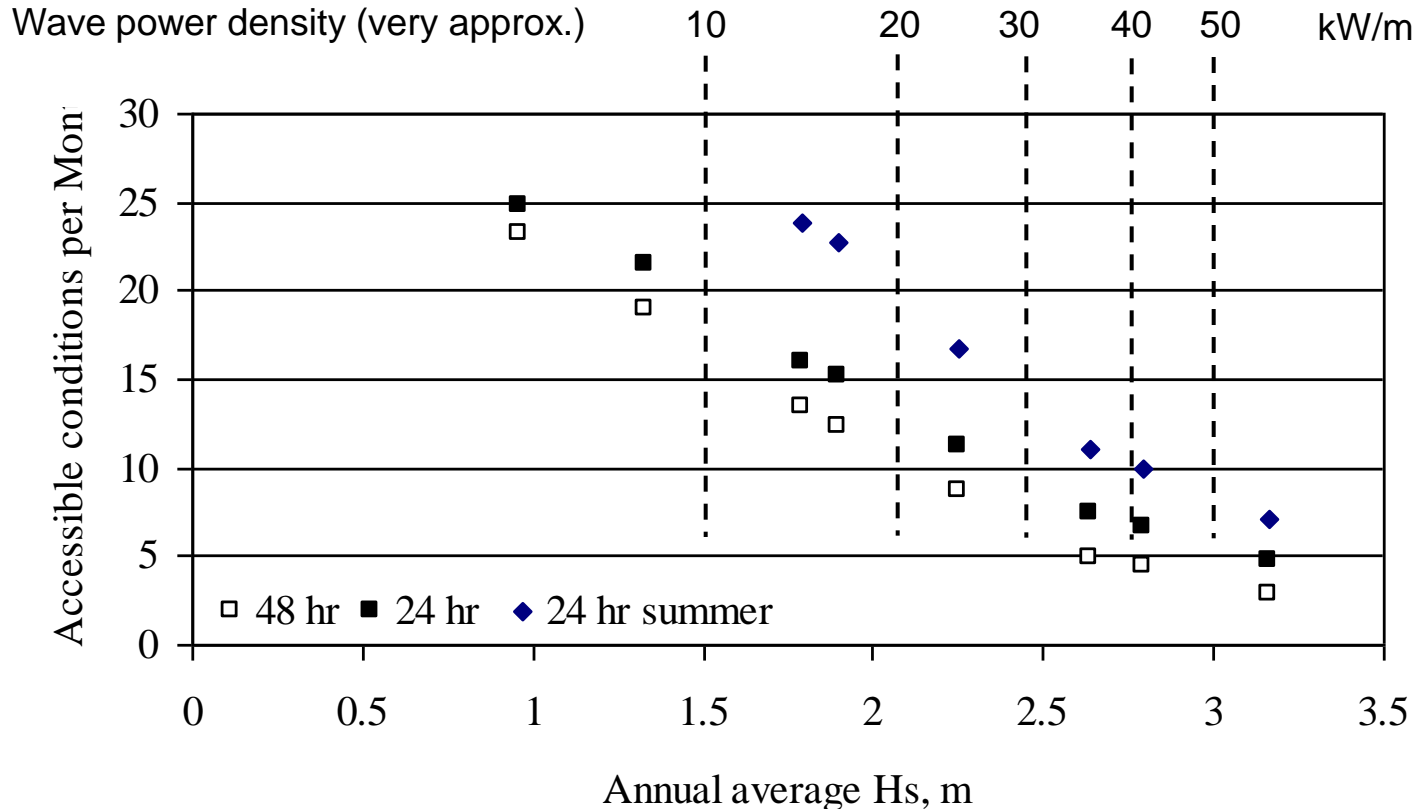
Current speed < threshold value (1+ m/s considered)

... of sufficient duration to complete work at site

- Wave Site – statistical model
- Tidal Site – time series analysis



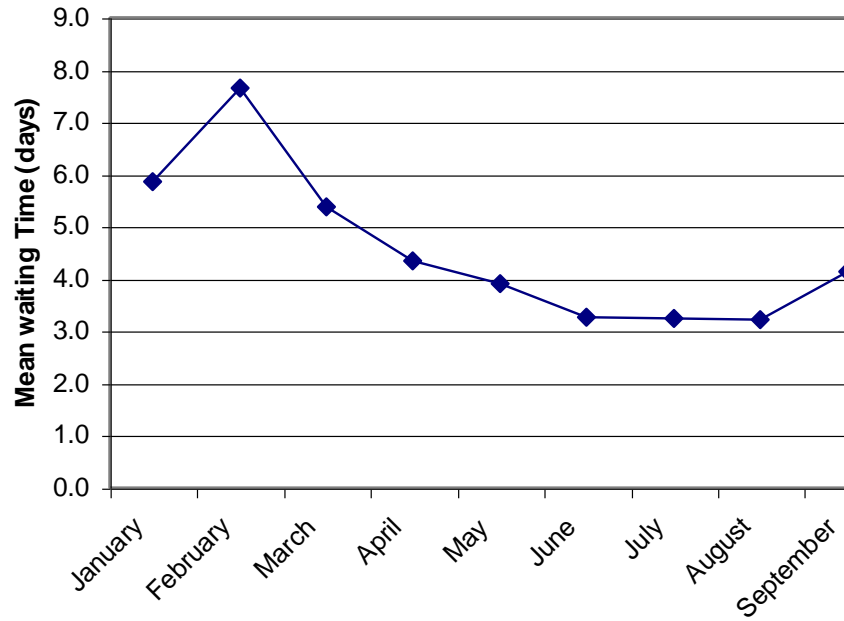
Wave Site Access



Average number of occurrences, per month, of 1-day and 2-day weather windows ($H_s < 2$ m)



Tidal Stream Access

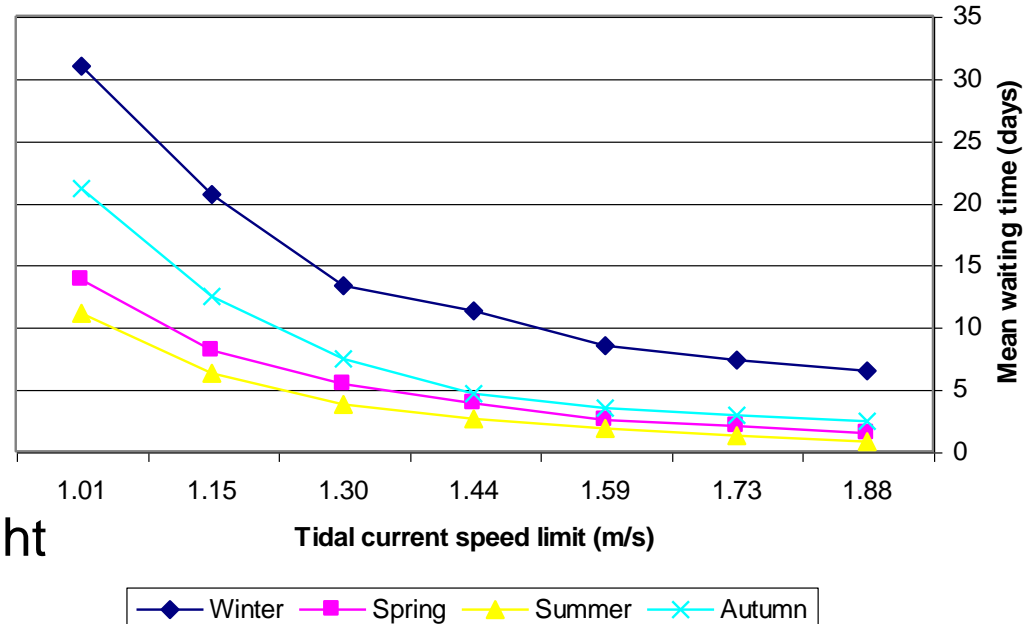


Monthly variation of mean waiting time

Average spring tide = 2.5 m/s
Average neap tide = 1.5 m/s

Sensitive to:

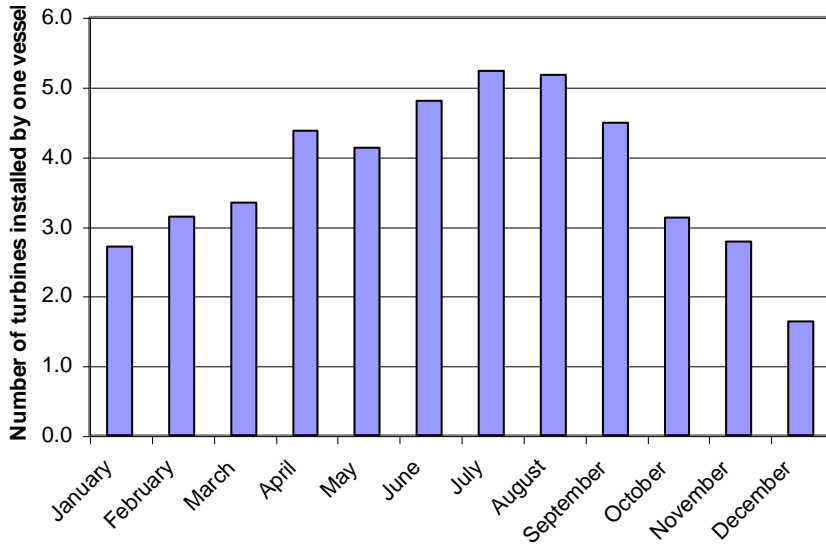
- Current speed
- Wind Speed
- Sig. Wave Height





Tidal Stream Deployment

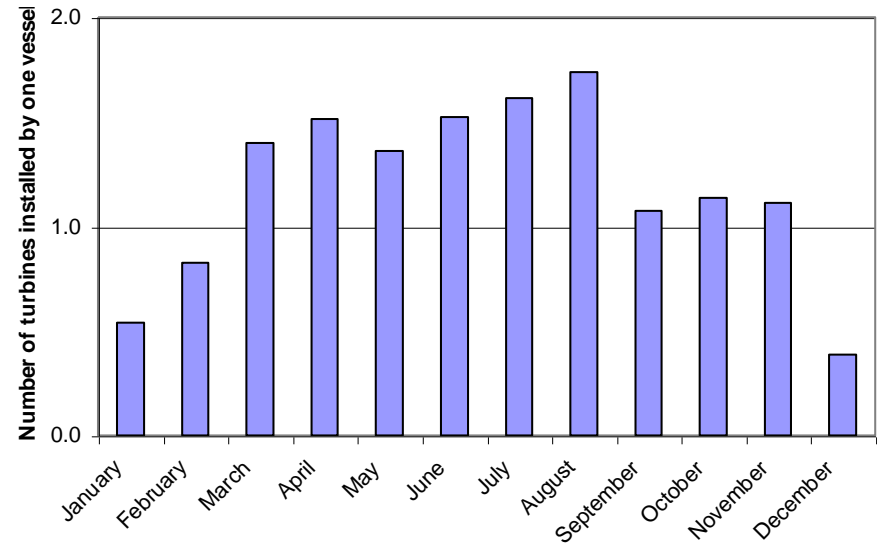
Number of installations per Month



Installation whilst $U_c < \underline{1.33}$ m/s

28 devices (~ 14 MW) in six months

100 MW capacity if install
7 devices per 24 hr window



Installation whilst $U_c < \underline{1.13}$ m/s

15 devices (~7.5 MW) in six months

100 MW capacity if install
14 devices per 24 hr window



IIIA Summary

1. Capital Expenditures

2. Operating Expenditures

3. Revenue



4. Risk Assessment

5. Project Assessment

Purpose of activity

Quantify the financial return generated by the project comprising the items identified in Part 1 and subject to the operating strategy of Part 2. Quantify uncertainty.

Content of protocol (D7.2, D7.5, D5.3)

Energy Production

Site metocean conditions – by **IA**

Device power output – by **IIA** or **IIB**

Device availability by **IIA** or **IIB** or **IIC**

Unit Value of electricity

Appropriate to operating period, market, relevant to location, predictability of energy output. Plus relevant incentives.

Revenue calculation appropriate to development stage

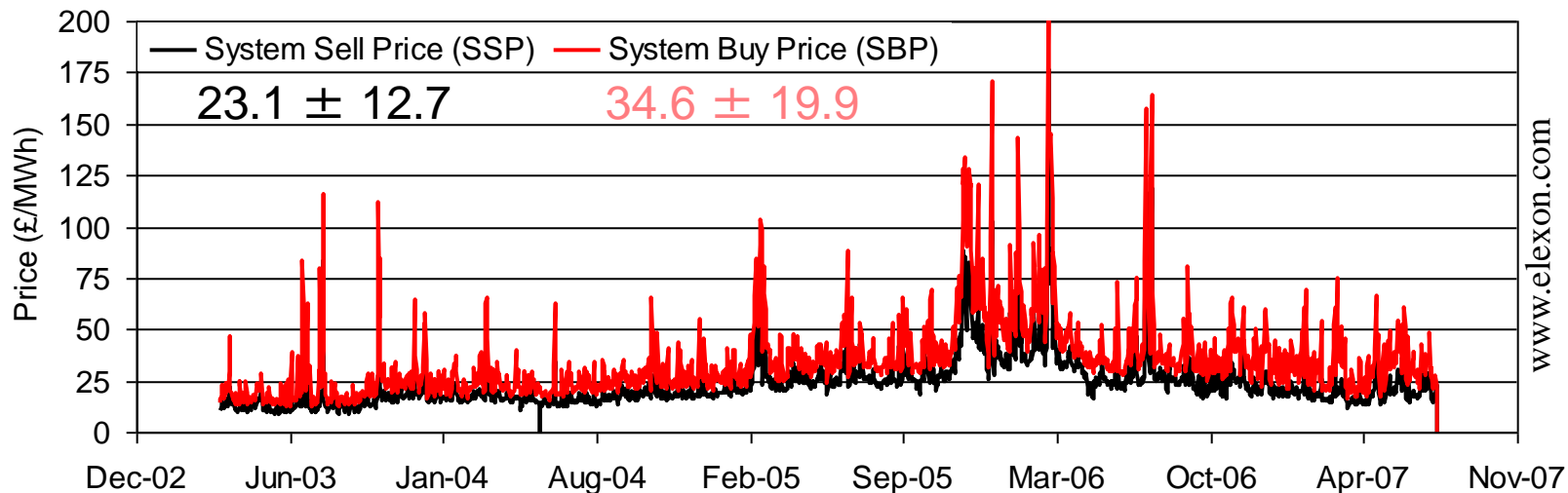


Unit Value

Market value: short-term volatility and long term uncertainty

- Premium on predictability (UK)
- Initial projects: price takers – cannot influence market
- Early projects: likely to be discount to average wholesale market prices (power purchase agreement) to mitigate price variation risk.
- Large projects: potential to affect market rates.

Support mechanisms & other incentives appropriate to site





IIIA Summary

1. Capital Expenditures

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Purpose of activity

Identify: Factors, or events, that could alter the outcome of the project assessment.

e.g. that could alter a quantity or unit value.

Quantify: Impact of each factor on outcome of project assessment.

Mitigate: Explain measures taken to limit risk.

Content of protocol

Investment Risk

Outline given in **D7.2.1**

Project Specific Risk

Example of marine energy project risks

(source: EdF, PWP, **D7.5**)

- Expenditures
- Revenue
- Array deployment risks **D5.6**



Risk Assessment

e.g. Revenue risks

Factor / Event	Mitigation
<i>Energy production below predictions</i>	
- Resource different to predictions	Resource Accuracy (I.A)
- Performance below prediction in known conditions.	Testing II.A – II.C (developer), Warranty to specification (investor).
<i>Availability below prediction</i>	
- Severity of resource extremes	Resource Accuracy (I.A)
- Lower reliability than predicted	Testing II.A – II.C (developer), Warranty to specification (investor).
<i>Value of generated electricity lower than predicted</i>	
Inaccurate prediction of output	Testing II.A – II.C (developer), Warranty to specification (investor).
Market value (€/kWh) changes	Risk for all projects over same period
Incentives (e.g. political)	



IIIA Summary

1. Capital Expenditures

2. Operating Expenditures

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Purpose of activity

Determine summary measures of viability
Identify conditions for validity of assessment.

Content of protocol (D7.2.1, D7.2.2)

Description of indicators

Early projects may not satisfy commercial criteria

- Strategic investment decision
- Risk mitigation plan

Commercial projects

- Investment criteria



Measures for Project Assessment

Cost of Electricity (€/kWh) widely used for technology comparison

Project criteria include:

- Profitability for:
 - funder: e.g. Net Present Value with WACC discount rate > 0
 - shareholder: e.g. Net Present Value with shareholder discount > 0
- Financial profitability
 - Return on Capital Expenditure $> \text{WACC}$ after n years
- Operational profitability – Net profit / Turn over $> x\%$ after n years
- Risk mitigation plan



Ongoing

Project assessment protocol content in ongoing deliverables:

Analysis and guidance on risk reporting / remediation.

Summary of performance limits of device types.

- A method for investors and policy makers to assess the potential of early-stage designs with developed technologies.

Guidelines for assessing technologies...

- In terms of performance increase required to generate electricity at a target unit cost.