



Research to reduce the risk & uncertainty in marine energy development

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Lifetime Economics

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The Question

- How can the economic viability of marine technologies be compared in an unbiased way?
 - Provide guidance on the types of devices which are likely to be economic at large scales of installation.
 - How do engineering design choices affect the economic efficiency of marine energy?
 - Which generation system offers best prospects for commercialisation?



Objectives

- Identify parameters affecting economics of large scale marine energy generation.
- Develop an unbiased method for comparing marine energy schemes.
- Investigate the influence of engineering design choices on large scale economic viability.
- Offer alternative design criteria by interaction with macro-economic models



Economic Model Approaches (1)

- Engineering costing (per component)

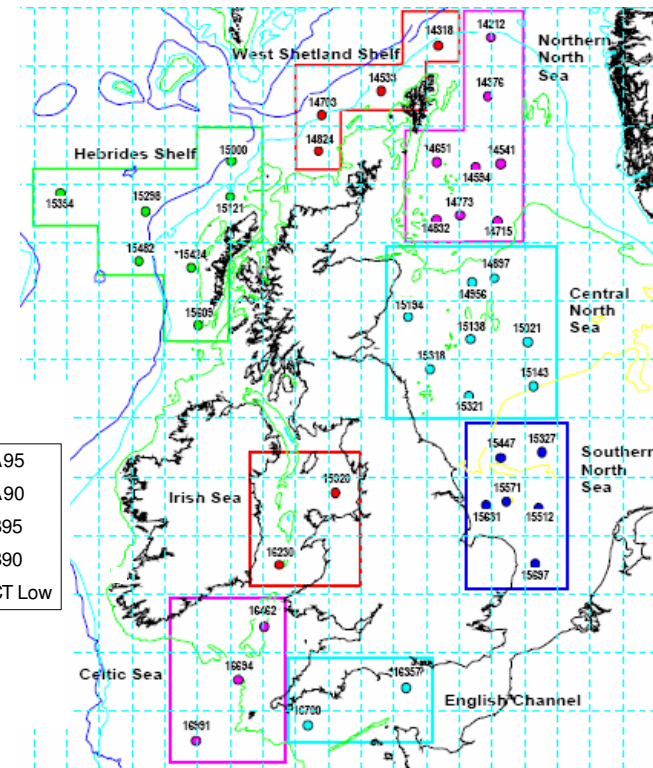
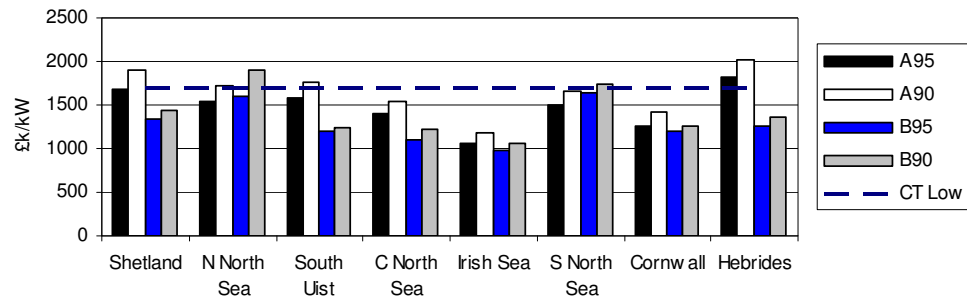
Consider cash flows and present value CoE

- Inclusion of risk by Capital Asset Pricing Model
- Dependent on detailed design
- Monte Carlo approach to accommodate uncertainties

Device Comparison

- 100MW scheme comparison

- Types of MEC compared at several sites in UK waters
- Compares type and rating

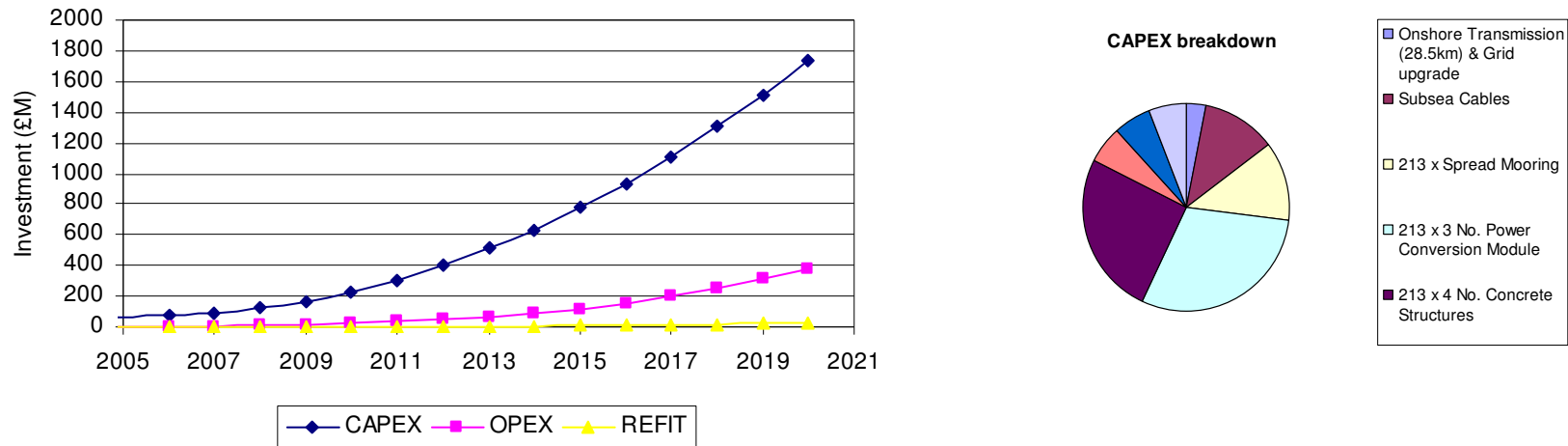


HSE, Fugro (2001)

Input to Macro-Economic Model



- Forecast installation rate to 2020

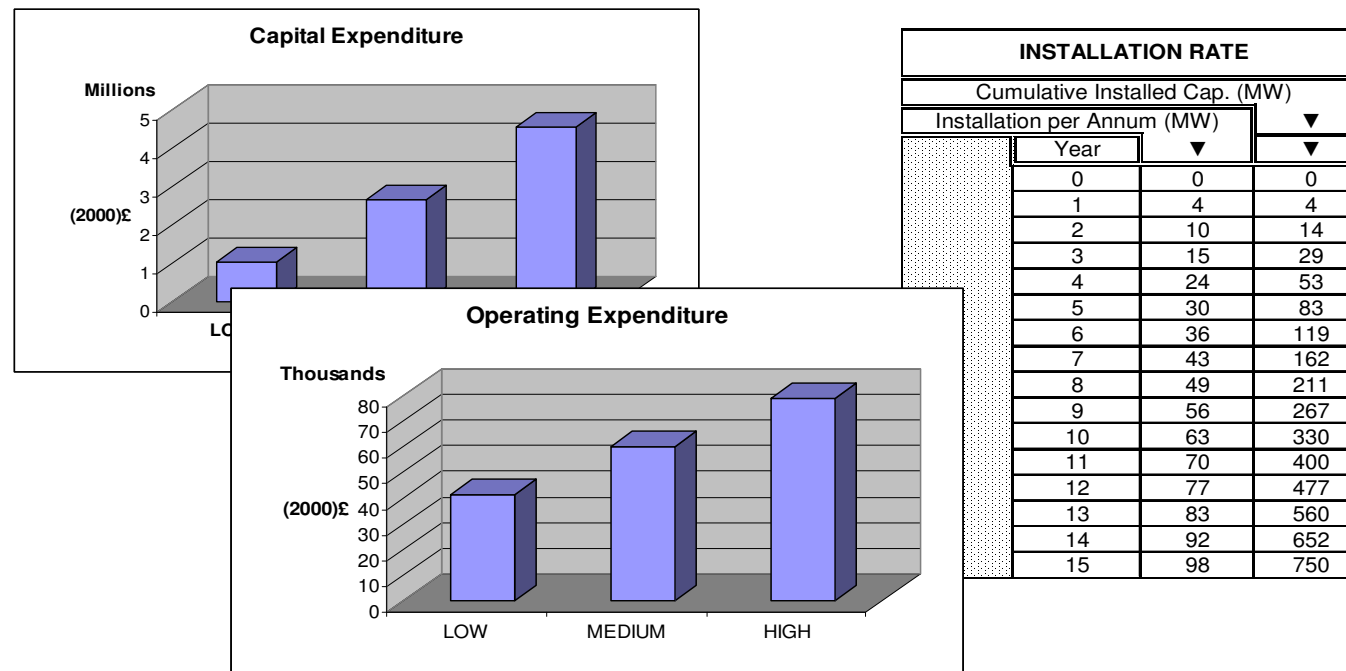


- 3GW of wave power installed by 2020
 - Supply up to 20% of Scottish Demand (Boehme *et al.*, 06)
 - Cost breakdown based on published data for OPD Pelamis at generic site (Previsic *et al.*, 2005)



Input to Macro-Economic Model

- 750MW of tidal power installed by 2020



Cost breakdown based on published data from BBV & MCT (UK) and EPRI (N. America)



Economic Model Approaches (2)

Data Envelopment Analysis

- Identify producer that minimises inputs to attain output(s)
- Technology selection for manufacturing processes
 - Kouja (1995), Shang & Seuyoshi (1995)
 - Environmental impact of electric power generators
 - Ramanathan (2000)
 - Economic efficiency of alternative generating technologies:
 - Criswell & Thompson (1996)
 - Widely used for evaluating performance of schools, universities, hospitals and commercial firms.
 - Johnes (2004)



Economic Model Approaches (2)

Marine energy scheme inputs:

- Quantities of site infrastructure
- Site to shore transmission
- Installation & maintenance time
- Incident energy

Economic Model Approaches (2)



Comparative approach:

- Considers economic efficiency of alternative producers
- Independent of 'expert' or future cost estimates
- Produces ranking for multiple outputs
- Rank technology & site options by 'technical efficiency'



Seeds for the Future

The foundations for:

- An unbiased method for selecting technologies which economically exploit the available resource.
 - inc. Location, Technology and Macro-economics
- Selection of economically efficient technology for a site
 - Identify technologies for further R&D
- Sensitivity of design ranking to macro-economic criteria
 - job creation, GDP, generating portfolio variance