

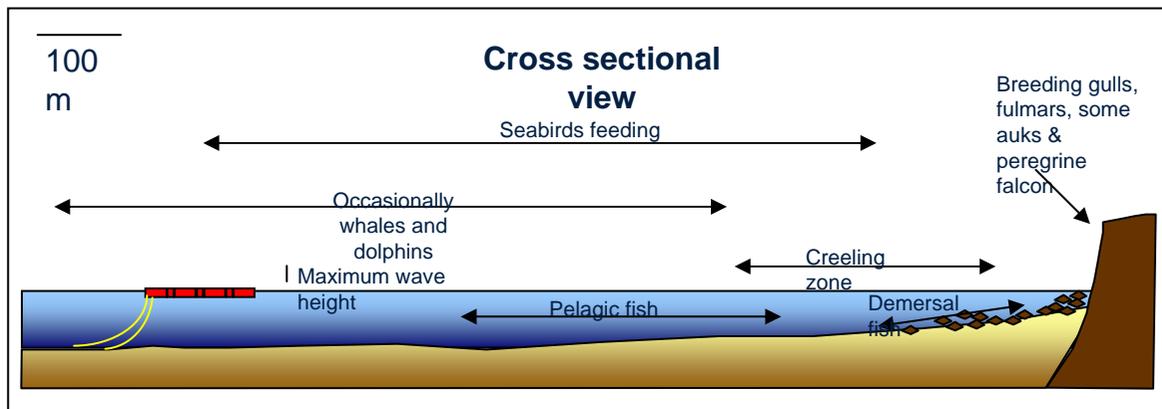
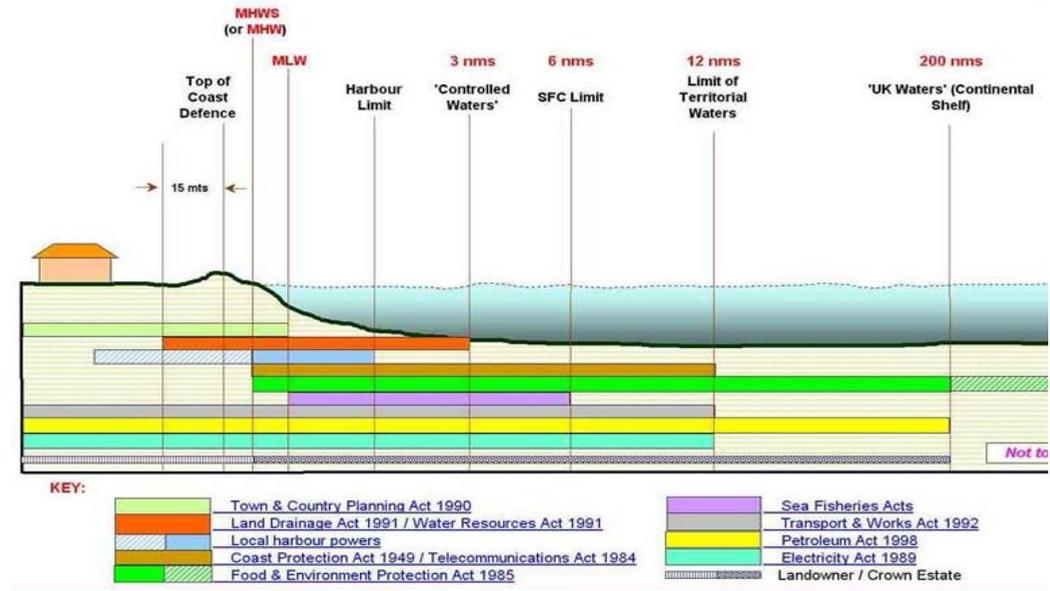
OCEAN POWER DELIVERY LTD

Environmental considerations Max Carcas, Business Development Director



Areas to consider

- Environmental aspects
- Permitting aspects
- Stakeholder involvement



Areas to consider

- Land
- Seabed
- Installation activities
- Visual/audible
- Wave energy abstraction
- Navigation, shipping & spatial
- Fishing
- Operational activities
- Marine life
- Pollution risk
- Social impacts
- Positive benefits



Land

- Substation
- Overhead lines
- Buried cables
- Cable markers
- Lighting
- Land access
- Communications



Substation at EMEC, Orkney

SUBMARINE CABLE INSTALLATION



SUBMARINE CABLE POST-INSTALLATION







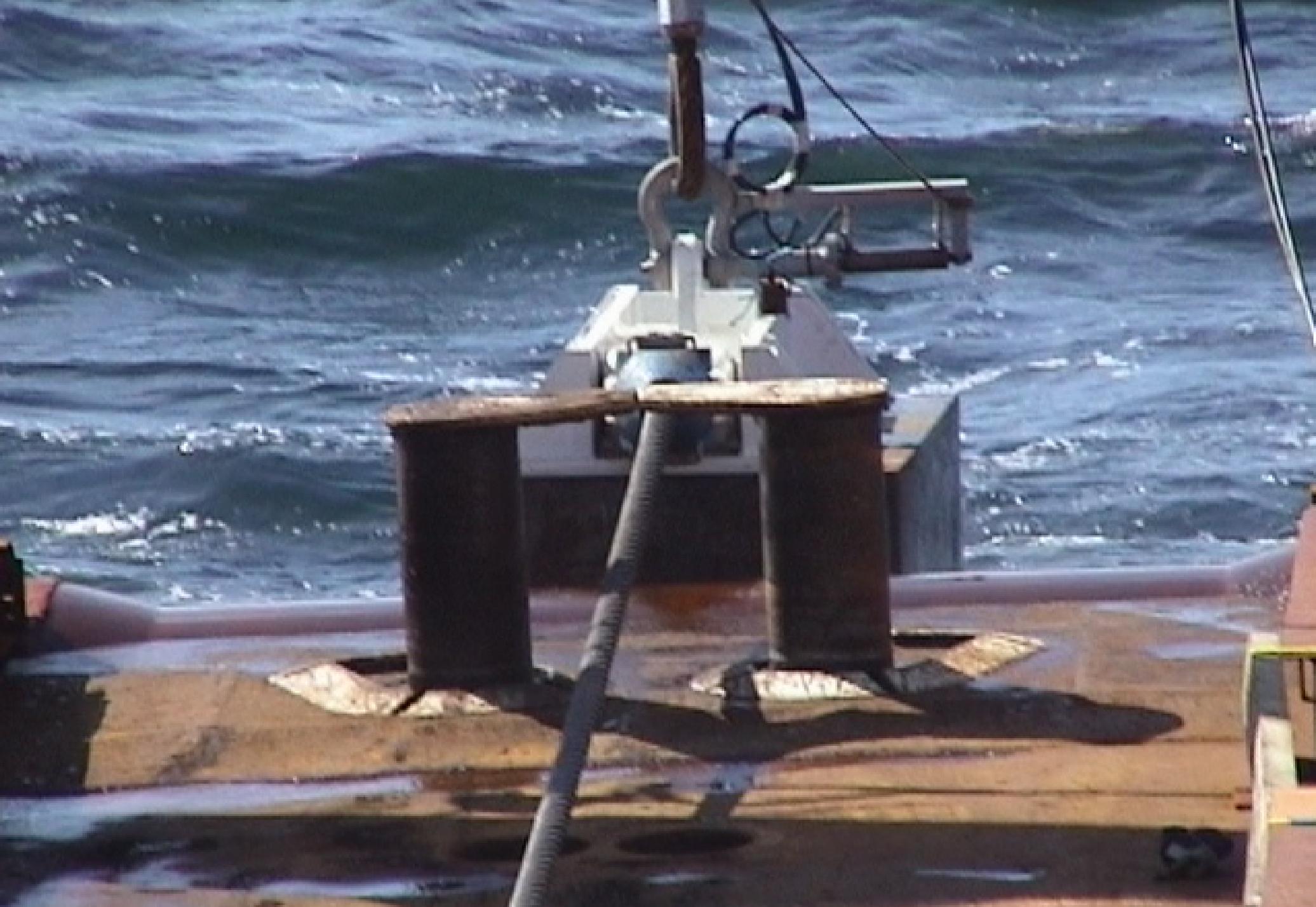
Seabed + installation activities

- Submarine cable
 - Buried
 - Drilled
 - Surface laid
 - Armoured
- Mooring attachments
 - Clump weights
 - Anchors
 - Piles
- Installation activities









An underwater photograph showing a portion of a ship's hull. The hull is dark and appears to be made of metal. A large, orange, cylindrical object is attached to the hull, extending diagonally across the frame. The water is dark and murky, with some light reflecting off the hull and the object. The overall scene is dimly lit, typical of an underwater environment.

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BAL MORAL



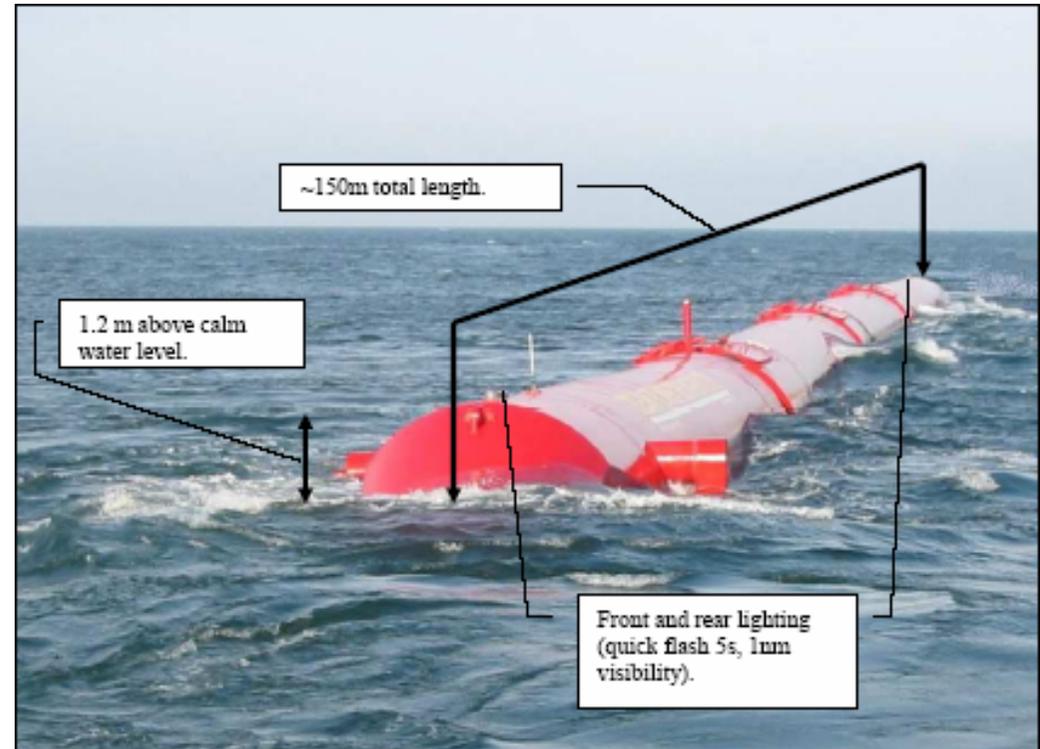
Visual/ audible

■ Visual

- Distance offshore
- Height of land
- Height of machine
- Wave height

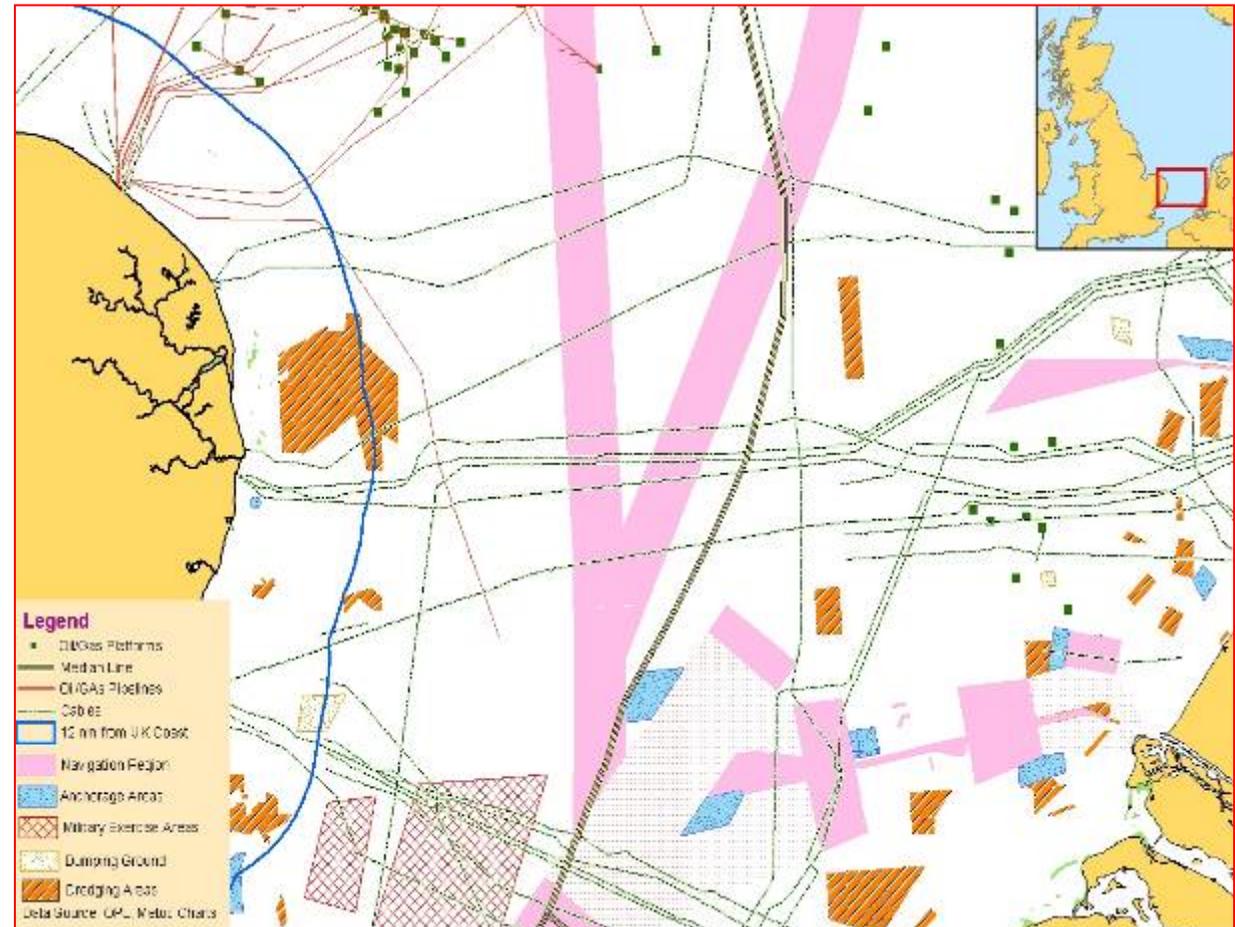
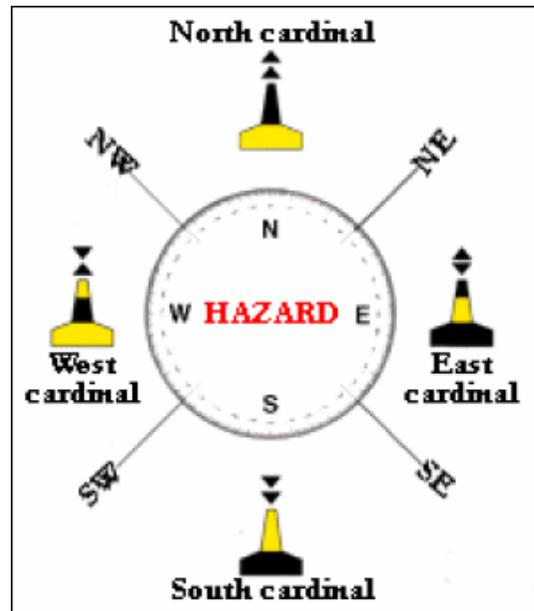
■ Audible

- Close proximity
- Shoreline
- Frequency



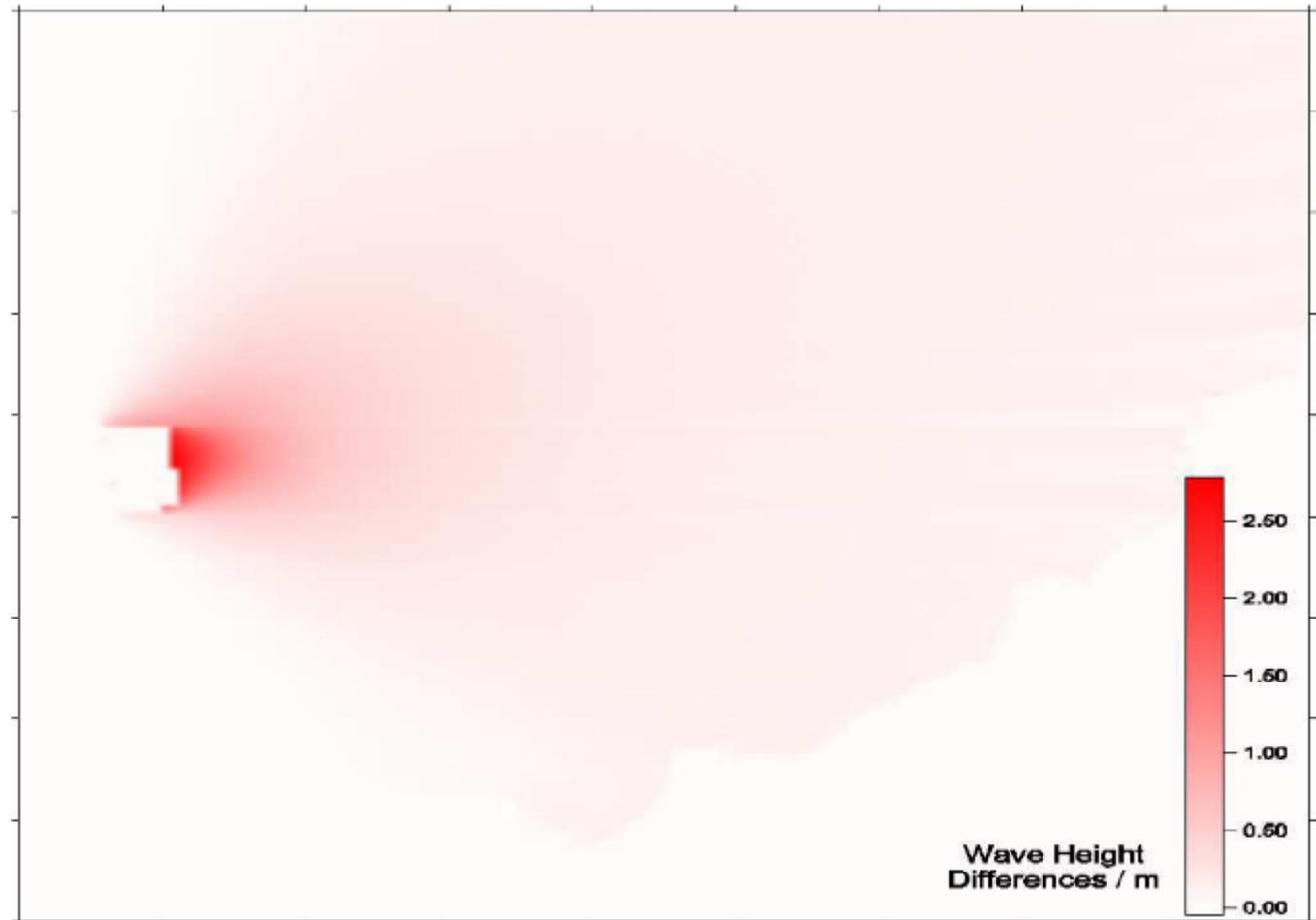
Navigation, Shipping & Spatial requirements

- Careful site selection
- Marked on charts
- Notices to mariners
- Navigational markers, radar reflectors + lights



Wave energy abstraction

- Average energy reduction 10% immediately behind farm
- Reduction in wave energy at coastline negligible
- Most sedimentation change and erosion occurs in extreme waves
- Pelamis absorbs <1% energy in extreme waves
- Important to engage with surfing community



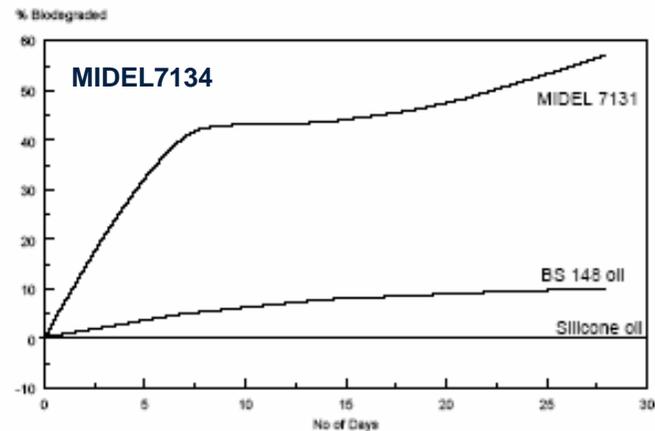
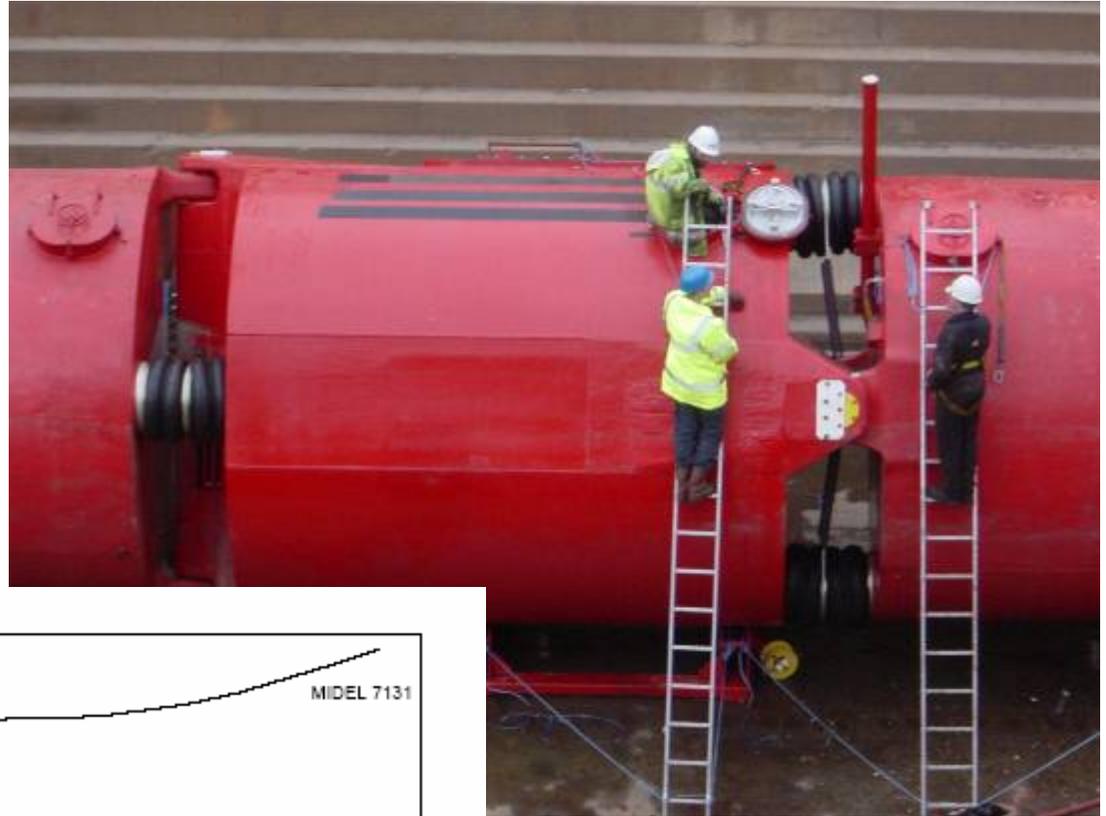
Example of wave height reduction from 100% absorber (eg island – not Pelamis wave farm)

Pollution risk

- Use of environmentally benign fluids
- No greases, oils or lubricants in contact with sea (eg of ships)
- Containment
- Double/triple sealing
- Seaworthiness – naval architecture
- Insurance

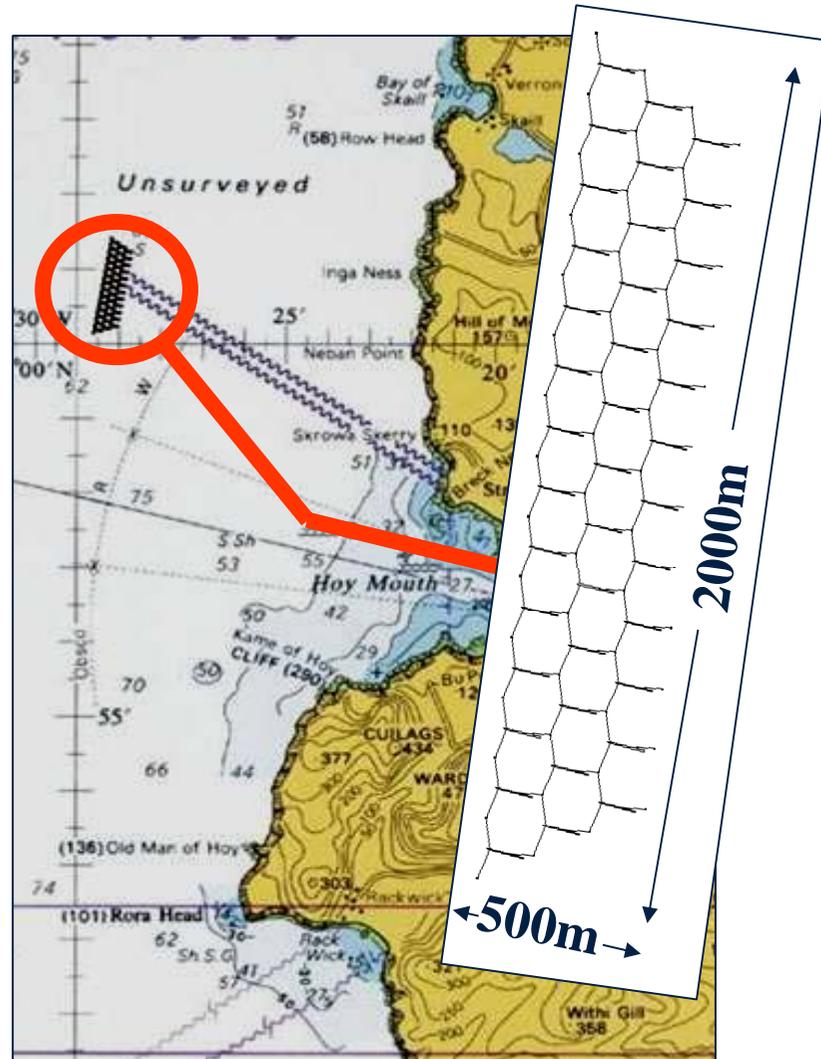


BIOHYD-SE



Fishing/ recreational use/ marine life

- Area of sea unavailable for fishing or recreational use
- Low area requirement (30MW < 1km²)
- Careful site selection to avoid important areas
- Potential benefits in aquaculture regeneration (no take zones)



Operational activites – Production

Power module fabrication



Power module assembly



Main tube fabrication



Main tube fit-out



Main tube fabrication



Final assembly and launch



Operational activities – Operation and Maintenance

Installation & recovery



Multi cat O&M vessel



Operations & maintenance



O&M shore facility



Marine life

- Bio-fouling – machine moves with water not through water like a vessel => anti-fouling generally not required on structure
- Impressed current anti-fouling system for hydraulic fluid cooling pipework (contained within module envelope to protect against damage)
- Mooring yoke (20m water depth) may require some anti-fouling



Environmental Assessment – worst case

Key	Negative			None	Positive		
	Major	Moderate	Minor		Minor	Moderate	Major

	Wildlife	Habitats	Energy	Sea users	Local community	Landscape	Wider community	Wastes
Wash-out of harbour	-	-	-	-	-	-	-	Exhausts & bilges, paint drips, debris in dock
Wash at sea	noise	-	-	Obstacle to shipping	-	-	-	Exhausts & bilges
Shipping at sea	noise	-	-	Obstacle to shipping	-	-	-	Exhausts & bilges
Temporary docking	noise	Disturbance to seabed	-	Obstacle to dive boats	Harbour dues Servicing work	Use of pier	-	Seepage water
Marine site operations	Noise & antifouling	-	-	-	Local servicing needs	level of activity on pier	-	Exhausts & bilges
Altered water turbidity	Noise	Disturbance to seabed	-	Interference with creeling	-	Boat will attract attention	-	Exhausts & bilges
Proposed water turbidity	Noise	-	-	Interference with creeling	-	Boat will attract attention	-	Exhausts & bilges
Mooring device	-	Disturbance to seabed	-	Debris	-	-	-	Waste cable
Structural hook-up	Attraction for fish	-	-	-	-	-	-	-
Navigation marking	-	-	-	Assistance to navigation	-	Will enhance visibility	-	Waste cable
Operation of vice	Noise attraction for fish	-	Absorption of wave energy	Obstacle to shipping & fishing	Point of interest, adds to renewables credibility	Visibility	Validation of important technology	-
Performance monitoring	-	-	-	-	Confidence in future for investment and jobs	-	Validation of important technology	-
Environmental monitoring	Sampling losses	-	-	-	Local benefits	Demonstration of visibility	Validation of important technology	-
Routine recovery	Noise	-	-	Obstacle to shipping	Service opportunity	Passing operation	-	Exhausts & bilges
Planned recovery	Noise	-	-	Obstacle to shipping	Service opportunity	Passing operation	-	Exhausts & bilges
Working and/or mooring	-	Disturbance to seabed/coast	-	Obstacle to shipping	Service opportunity	Passing operation	-	Seepage water
Maintenance	-	-	-	May fill berth	Service opportunity, noise, odour, reduced access to pier	Temporary operation on pier	-	Removal of fouling, paints, hydraulic oil, scrap metal
Hoisting	-	-	-	Obstacle to shipping	Service opportunity	Passing operation	-	-
Mooring maintenance	-	Seabed disturbance	-	-	Service opportunity	Passing operation	-	Waste cable
Material recovery	Noise	-	-	Obstacle to shipping	Service opportunity	Passing operation	-	Exhausts & bilges
Mooring recovery	Turbidity	Seabed disturbance	-	Removal of obstacle	Service opportunity	Passing operation	-	Waste cables
Commissioning	-	-	-	-	Service opportunity	-	Museum piece	Scrap metal, sand, hydraulic oil etc
Disposal of wastes	Litter or debris	Litter or debris	--	Debris	Service opportunity, litter	Avoid litter	Off Orkney disposal ?	Reuse, recycle, reduce then licensed disposal
Delivery of supplies	-	-	-	-	Service opportunity	-	Service opportunity	Packaging
Supply of services	-	-	-	-	Service opportunity	-	Service opportunity	-
Facilities for visitors	-	Vegetation damage	-	Boat trips	Service opportunity, increased visitors to unusual areas	Suitability of interpretation	-	Litter
Communication	-	-	-	-	Service opportunity	-	Need info	Recycled paper
Management	-	-	-	-	Service opportunity	-	-	Office efficiency
Emergency response	-	Access to shore from land	-	Help from & obstacle to others	Reputation for area, service opportunity	Temporary operation	Reputation of technology	Sand, hydraulic oil, scrap metal, cables and ropes
Security	-	-	-	Easy access to site	Eyes and ears	-	-	-
	Wildlife	Habitats	Energy	Sea users	Local community	Landscape	Wider community	Wastes

Environmental Assessment – best practice

Key	Negative			None	Positive		
	Major	Moderate	Minor		Minor	Moderate	Major

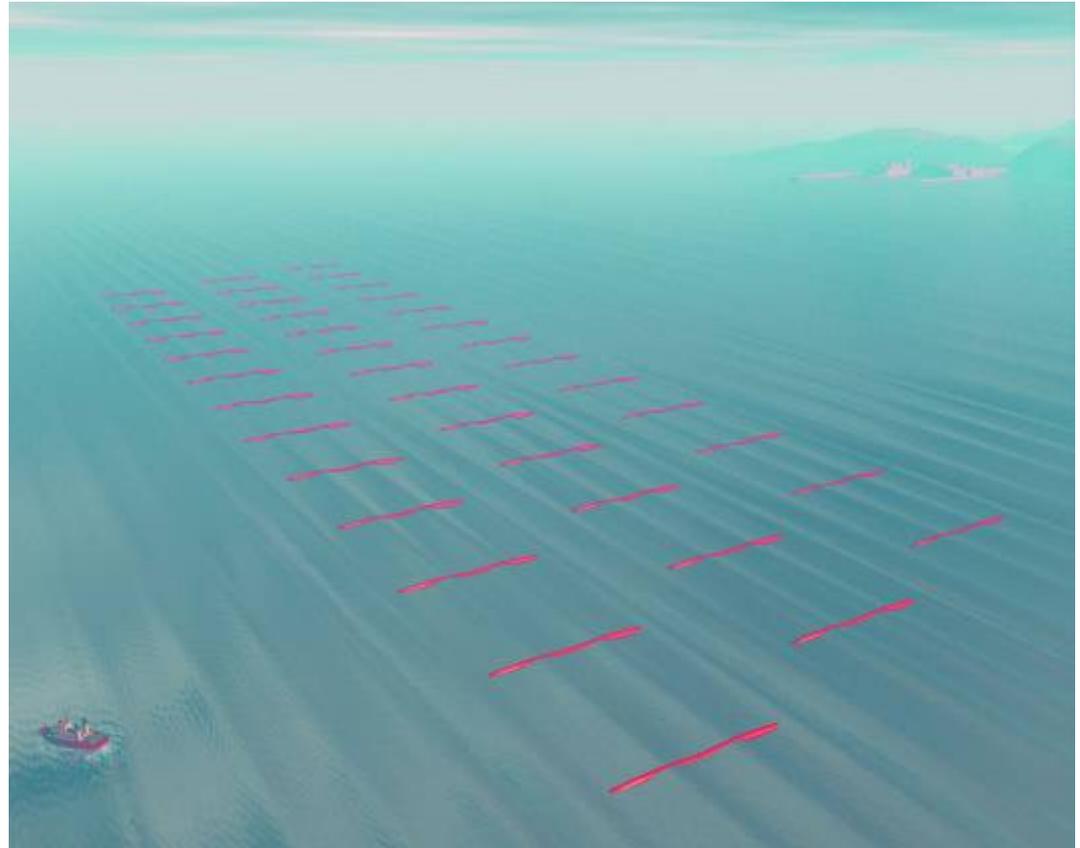
	Wildlife	Habitats	Energy	Sea users	Local community	Landscape	Wider community	Wastes
-out of our	-	-	-	-	-	-	-	Exhausts & bilges, paint drips, debris in dock
at sea	-	-	-	None	-	-	-	Exhausts & bilges
ing at sea	insignificant noise	-	-	None	-	-	-	Exhausts & bilges
porary ring	insignificant noise	None	-	Obstacle to dive boats	Harbour dues Servicing work	Not noticed	-	Seepage water
r-site arations	insignificant noise	-	-	-	Local servicing needs	Not noticed	-	Exhausts & bilges
tered water dby	insignificant noise	None	-	None	-	Not noticed	-	Exhausts & bilges
sed water dby	insignificant noise	-	-	None	-	Not noticed	-	Exhausts & bilges
ring device	-	Disturbance to seabed	-	None	-	-	-	Safe disposal
trical hook-up	Attraction for fish	-	-	-	-	-	-	-
tion marking	-	-	-	Assistance to navigation	-	Will enhance visibility	-	Safe disposal
ration of ce	insignificant noise attraction for fish	-	Determined to be insignificant	Obstacle to shipping& fishing	Point of interest, adds to renewables credibility	Point of interest	Validation of important technology	-
ormance itoring	-	-	-	-	Confidence in future for investment and jobs	-	Validation of important technology	-
ronmental itoring	No harm	-	-	-	Local benefits	Demonstration of visibility	Validation of important technology	-
tine recovery	insignificant noise	-	-	None	Service opportunity	Not noticed	-	Exhausts & bilges
lanned very	insignificant noise	-	-	None	Service opportunity	Not noticed	-	Exhausts & bilges
king and/or ing	-	Disturbance to seabed/coast	-	Obstacle to dive boats	Service opportunity	Not noticed	-	Safe disposal
tenance	-	-	-	Obstacle to dive boats	Service opportunity, noise, odour reduced access to pier	Not noticed	-	Safe disposal
aunching	-	-	-	None	Service opportunity	Not noticed	-	-
ring tenance	-	None	-	-	Service opportunity	Not noticed	-	Safe disposal
l recovery	insignificant noise	-	-	None	Service opportunity	Not noticed	-	Exhausts & bilges
ring recovery	Turbidity	Seabed disturbance	-	Removal of obstacle	Service opportunity	Not noticed	-	Safe disposal
ommissioning	-	-	-	-	Service opportunity	-	Museum piece	Safe disposal
osal of es	None created	None created	-	None	Service opportunity, litter	None	Safely undertaken	Safe disposal
very of lies	-	-	-	-	Service opportunity	-	Service opportunity	Safe disposal
oly of ces	-	-	-	-	Service opportunity	-	Service opportunity	-
ilities for ors	-	Visitor facilities on roadside and in town	-	Boat trips	Service opportunity, increased visitors to unusual areas	Suitability of interpretation	-	None
munication	-	-	-	-	Service opportunity	-	Need info	Recycled paper
agement	-	-	-	-	Service opportunity	-	-	Best practice
rgency onse	-	None	-	None	Service opportunity	None	None	None
urity	-	-	-	Easy access to site	Eyes and ears	-	-	-
	Wildlife	Habitats	Energy	Sea users	Local community	Landscape	Wider community	Wastes

Positive benefits – local

- Each machine displaces 2,000 tonnes of CO₂ per annum (and other pollutants from conventional generation)
- A 30MW wave farm would displace 80,000 tonnes of CO₂
- UK potential 25m tonnes of CO₂ per annum

- Job potential for experienced marine operators in operations and maintenance

- Public engagement vital!



Global energy policy context – the big picture

Environmental:

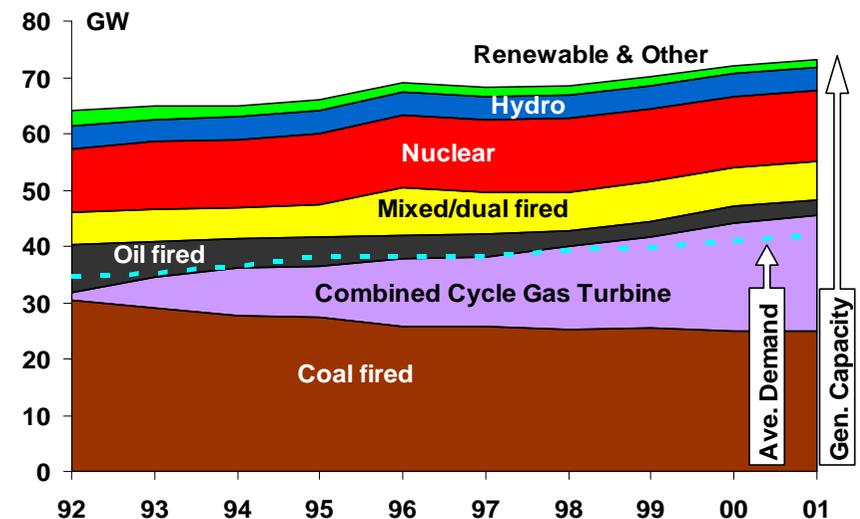
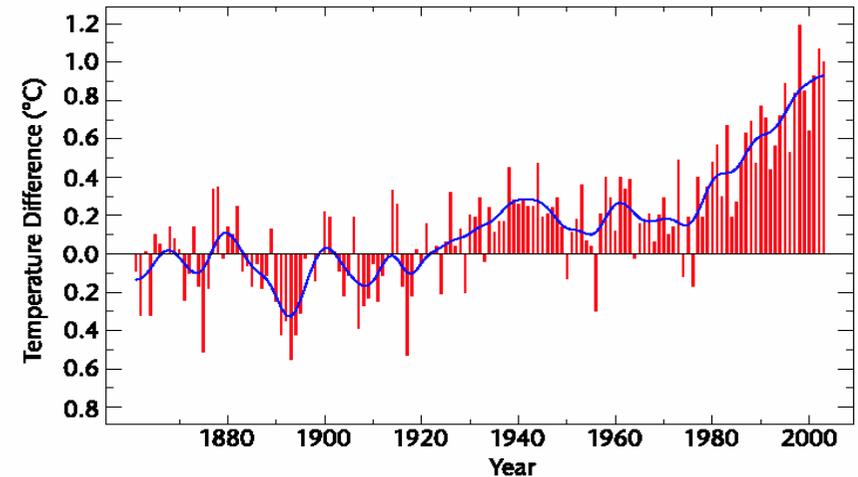
- Climate change, unprecedented rises in carbon dioxide and temperature in short time

Socio-economic:

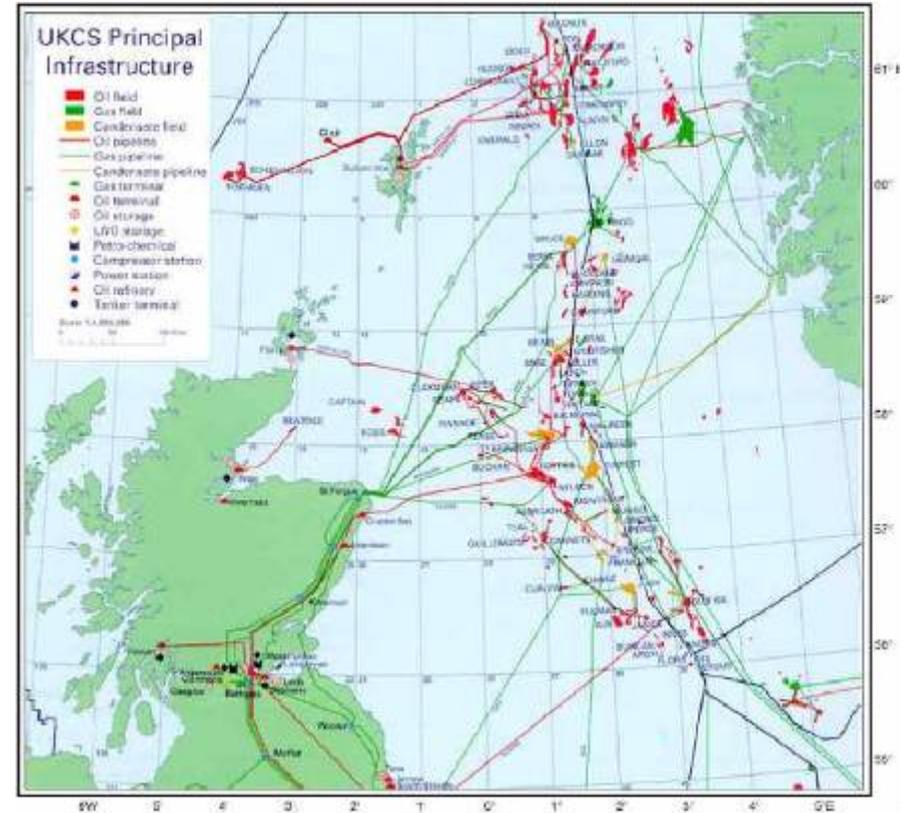
- Job potential
- Cost effective energy production

Security of supply:

- Electricity demand continuing to rise
- Existing power plants reaching end of life
- UK now net importer of gas, 50% imports by 2010, 80% by 2020



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UKCS oil and gas: millions of years to deposit but only 15-30 years left!