

The Potential for Low Carbon Energy from the Sea

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Today's presentation

- Government targets for electricity generation mix
- The marine energy resource
- Technologies for extraction
- Comparison with wind energy
- Issues of introducing a new technology into the marine environment



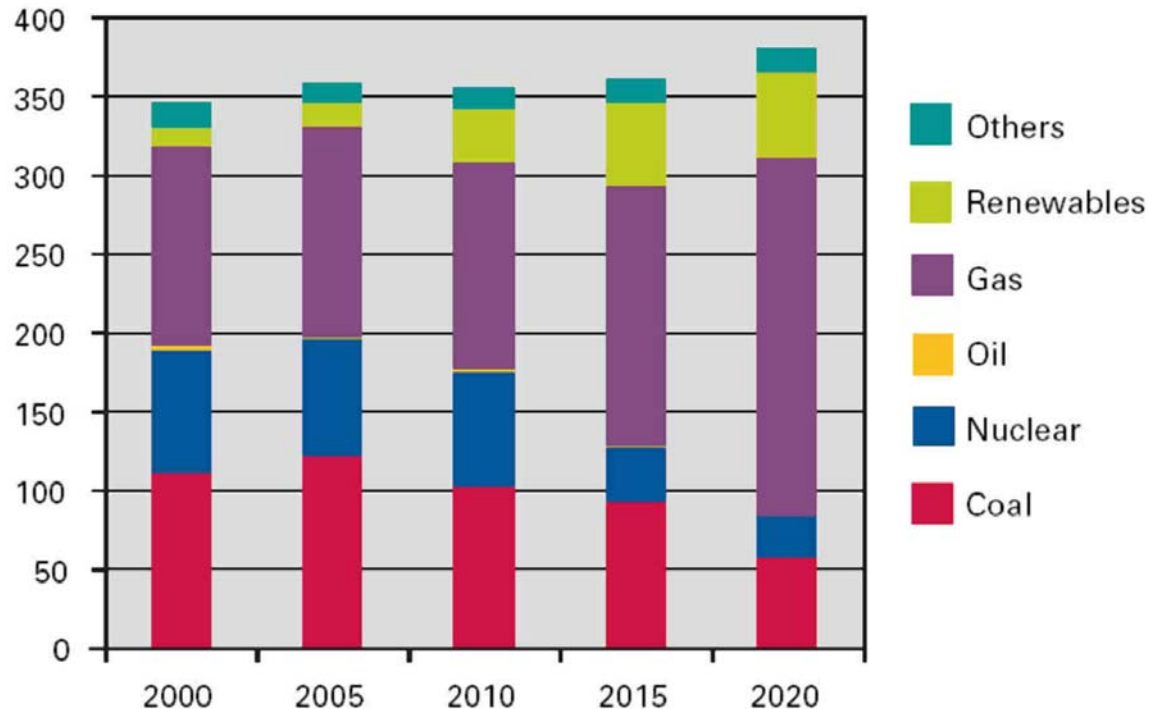
Government Targets

- Every kWh of electricity generated by renewable sources saves 0.44 kg of carbon emissions
- Targets for energy mix:
 - 10% renewables by 2010
 - 15% renewables by 2015
 - “Aspiration” of 20% by 2020



Sources of Electricity Supply

TeraWatt hour



Sources of Marine Energy

- Tidal Power
- Wave Power
- Ocean Thermal Energy
- Salinity Gradients

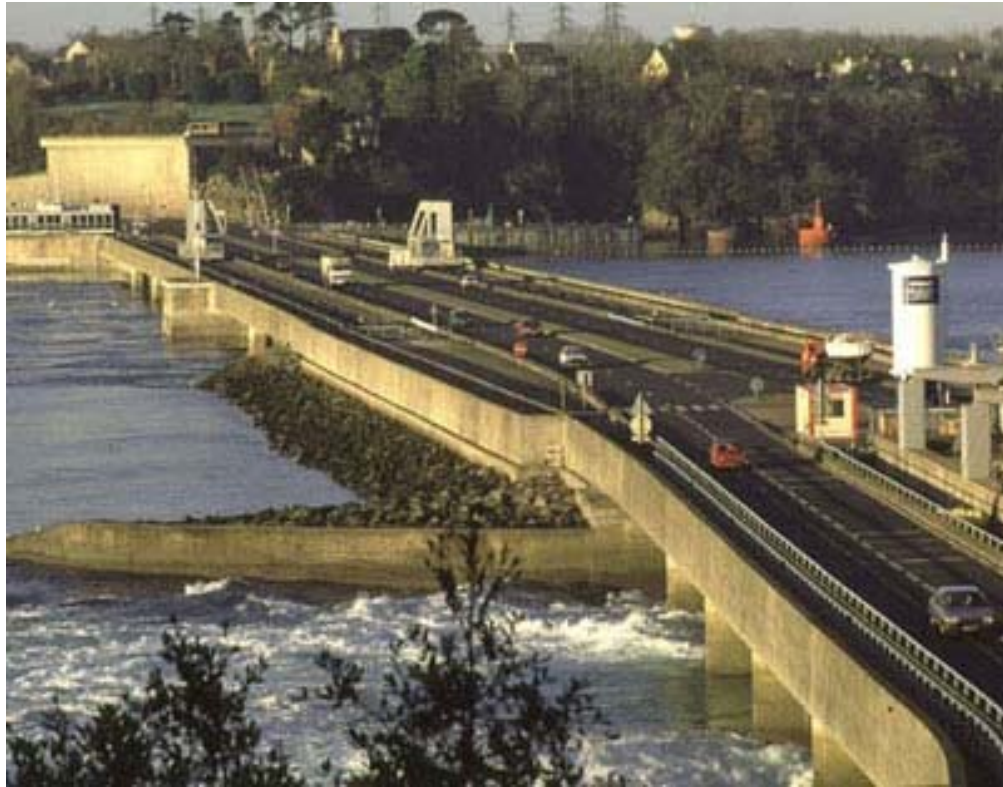


Tidal Energy

- The “pull” of the moon (and sun) on oceanic waters causes:
 - Tidal height changes
 - Tidal flows of water



La Rance Tidal Barrage



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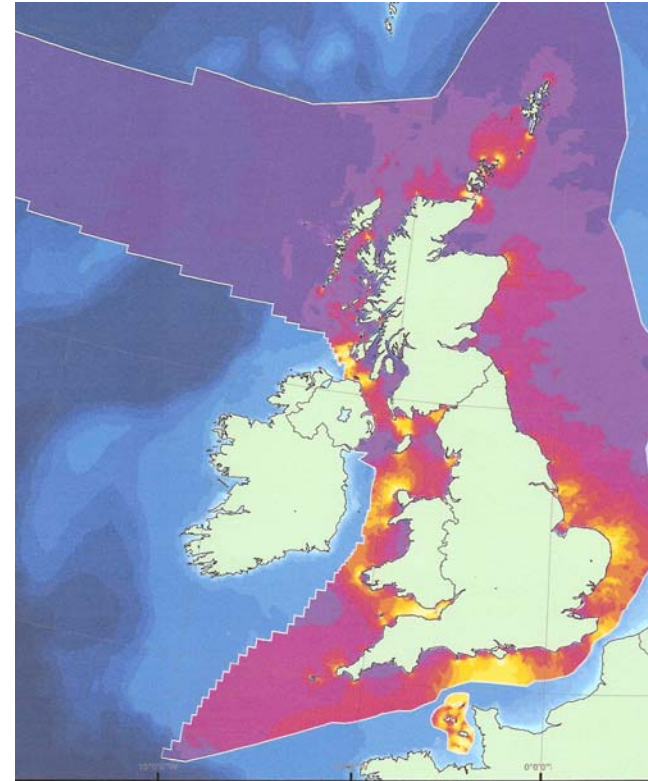
Tidal Barrages

- Capture 100% available energy
- But there are significant disadvantages
 - Upstream sedimentation
 - Downstream coastal erosion
 - Water quality issues
 - Enormous energy cost of construction



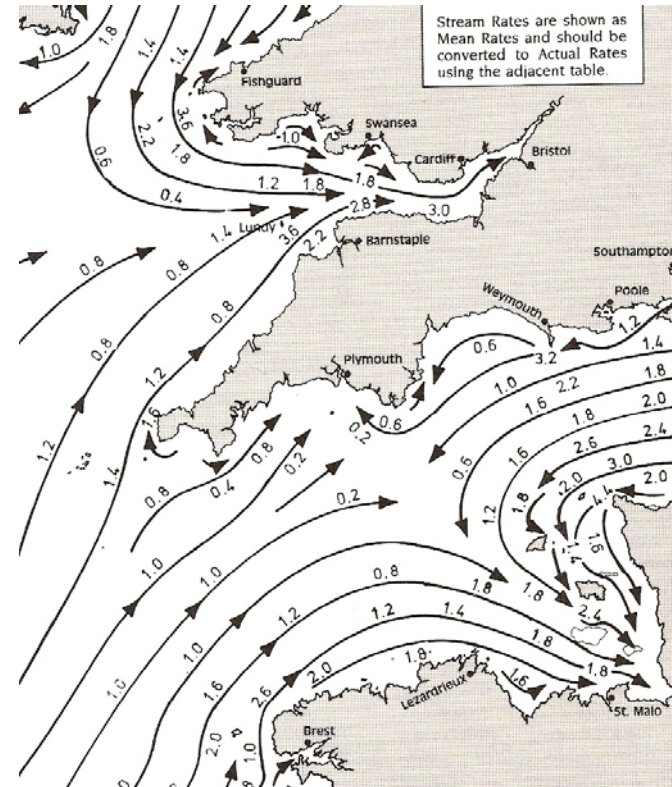
UK Tidal Stream Resource

- 50% of Europe's resource
- 10-15% of global resource
- 12 TWh / year exploitable now
- In long term, 3-5% of current UK energy demand



Tidal Stream Resource in SW England and Channel Islands

- Maximum tidal rate 7-8 knots (3.5 – 4 m/s)
- Close to centres of population – the end users of electricity



Horizontal Axis Turbines

- Similar to a wind turbine
- Mounted on:
 - Seabed
 - Pile
 - Under floating raft



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Seaflow Project

- 300 kW axial turbine
- Commercial-scale tidal generator
- Installed off Lynmouth, Devon in 2003
- £3.4m project



Seaflow Maintenance

- 11m rotor mounted on a collar round the pile
- Collar and rotor are raised for routine maintenance



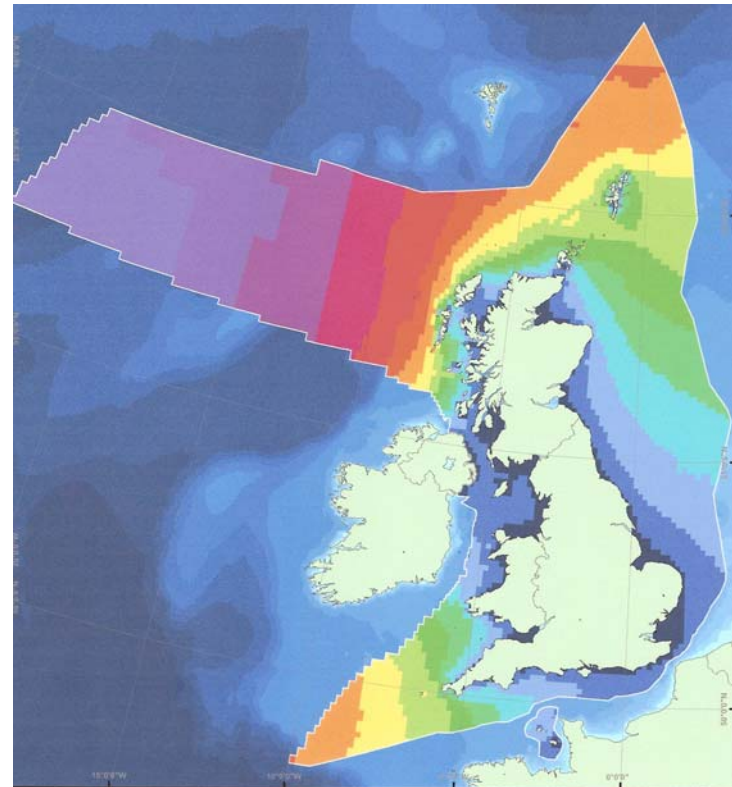
Wave Power

- Concentrated form of solar energy
- Solar power 100 W per square metre
- Wave power 70 kW per metre of crest length



UK Wave Energy Resource

- 35% of Europe's resource
- Less location-dependant than tidal resource
- In long term, 10-15% of current UK energy demand



Wave Energy Converters

- Oscillating water column (OREcon)
- Over-topping device
- Hinged flap device
- Buoyant moored device



Pelamis - buoyant moored device



Pelamis at Sea

- 750 kW machine tested in Orkney
- 2.25 MW wave farm off north coast of Portugal
- Will supply 1,500 households



Marine Energy versus Wind

- Technical challenges :
 - Deployment and maintenance are difficult
 - The marine environment is corrosive and hydrodynamic forces are high
 - Equipment (e.g.cables, gearboxes) must be waterproof



Marine Energy versus Wind

- Advantages:
 - High energy density because water is 830 times denser than air
 - More predictable energy resource and capture
 - Tidal has a totally predictable energy schedule (reduced intermittency)
 - Low visual impact



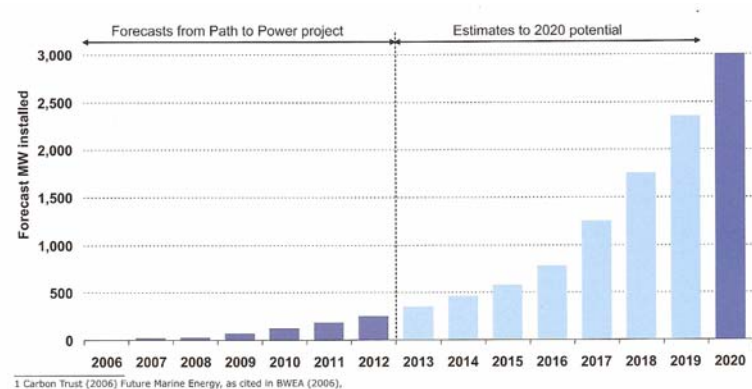
Issues to be resolved

- Environmental impacts
 - Effects on flow and sediment transfer
 - Impacts on marine life and ecosystems
- Conflicts with other users of the sea
 - Commercial shipping and leisure craft
 - Fishing
 - Dredging
 - Special areas of conservation (Marine SACs)



The Future?

- 50% of the population in SE England live within 10 km of the coast
- Small scale marine energy generators for waterside developments?



Thank you for listening

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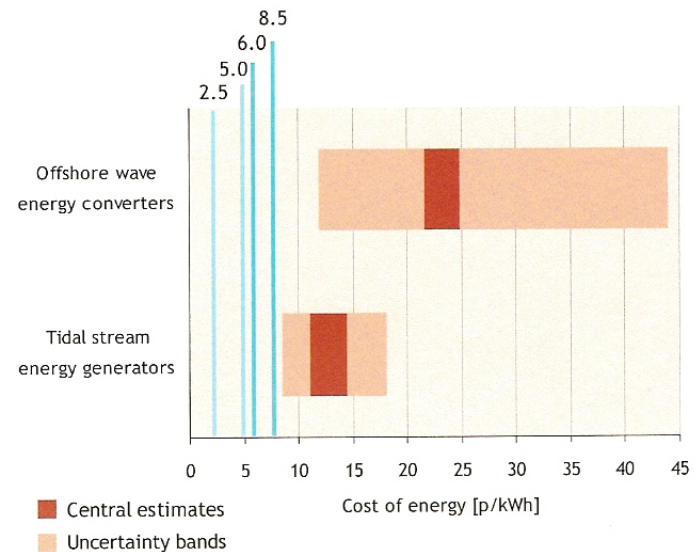
www.r-e-a.net



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Estimated Costs Today

- High capital expenditure
- High maintenance costs
- Energy resource is free
- Accounted for in estimated cost of 12-15 p/kWh

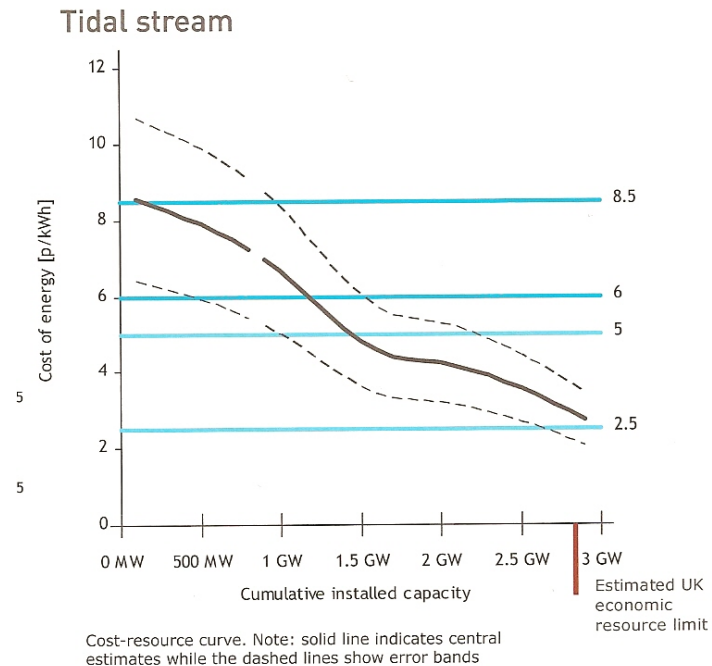


7 Ocean Power Technologies website: www.oceanpowertechnologies.com



Cost Reduction Scenarios

- Comparison with wind energy
- 1980 - 2004
 - Installed capacity increased from ~5MW to 50GW
 - Cost of electricity reduced from 20 to 5 Euros / kWh



Grid Connection Issues

- Grid capacity in Scotland is limited
- Transmission and distribution networks in the South West have spare capacity

