Technologies for Marine Energy Extraction

Stephanie Merry

Renewable Energy Association

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Today's presentation

- Government and EU targets for electricity generation mix
- The marine energy resource
- Technologies for extraction
- Comparison with wind energy
- Marine environmental issues
- Opportunities for offshore industry

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Government Targets

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

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EU Target for Renewable Energy

- On 8th March 2007, Europe's leaders set a binding target for the EU energy supply of 20% renewables by 2020
- With the UK's wind and marine resources, we should accept a greater burden of the share

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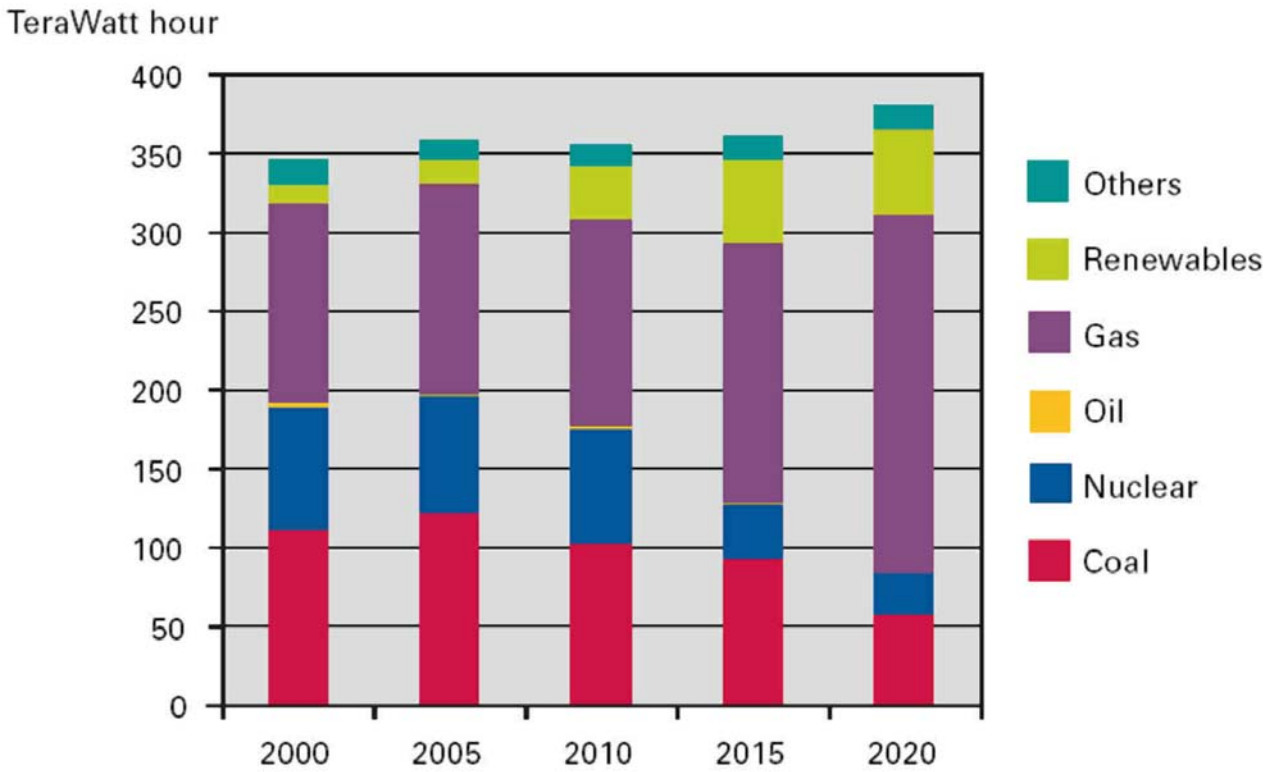
Sources of Electricity Supply



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Sources of Marine Energy

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

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Tidal Energy

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

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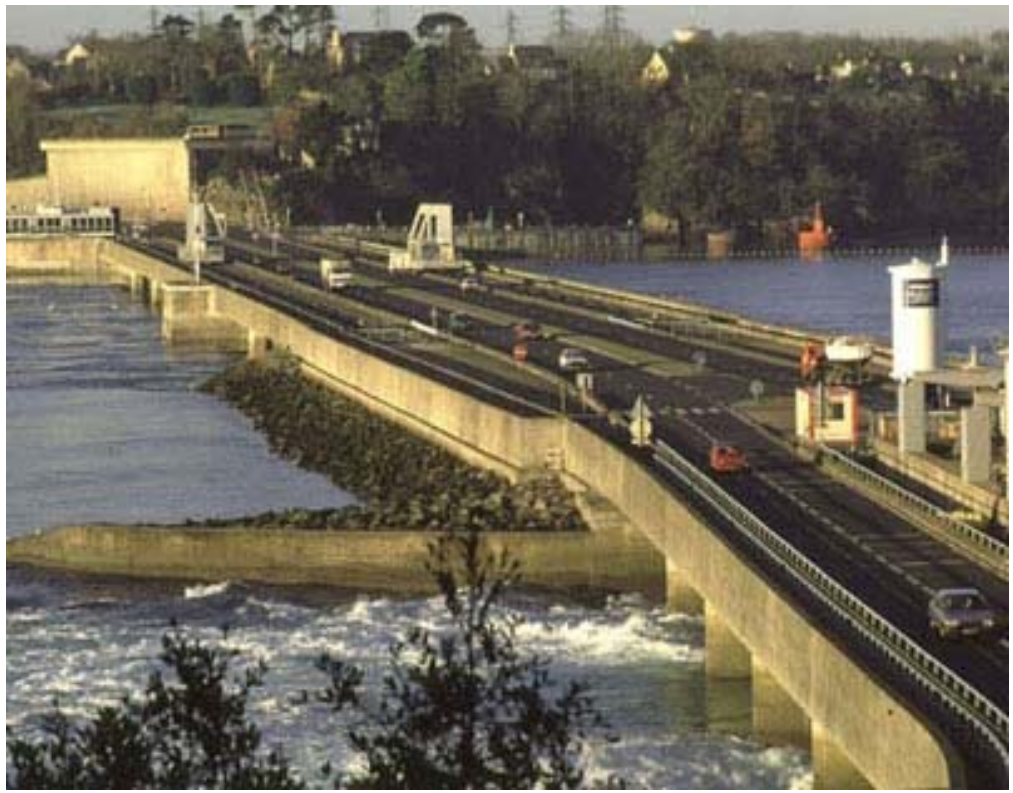
La Rance Tidal Barrage



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Tidal Barrages

- Capture much of the available energy
- But there are significant disadvantages
  - Sedimentation and coastal erosion
  - Change to tidal regime
  - “Peaky” generation output
  - Water quality issues
  - Enormous energy cost of construction

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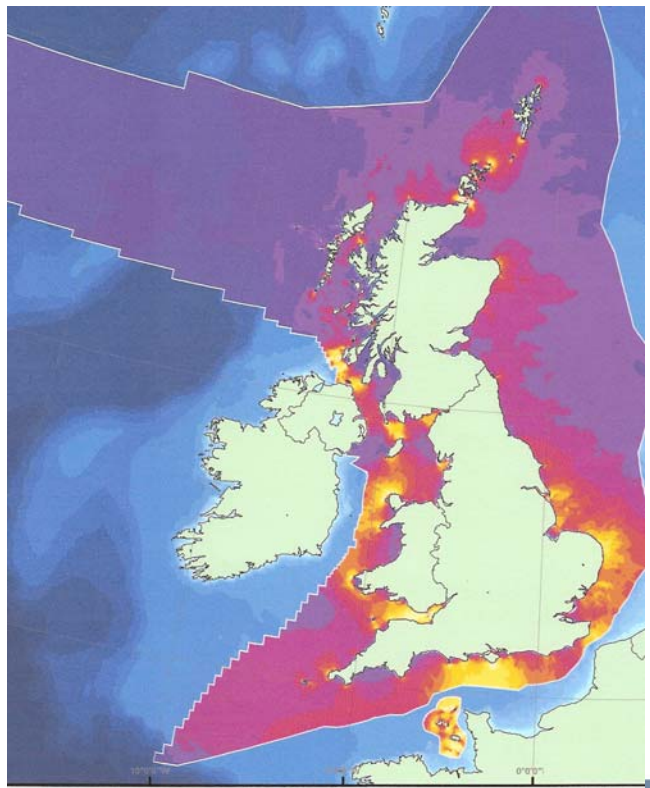
UK Tidal Stream Resource

- 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



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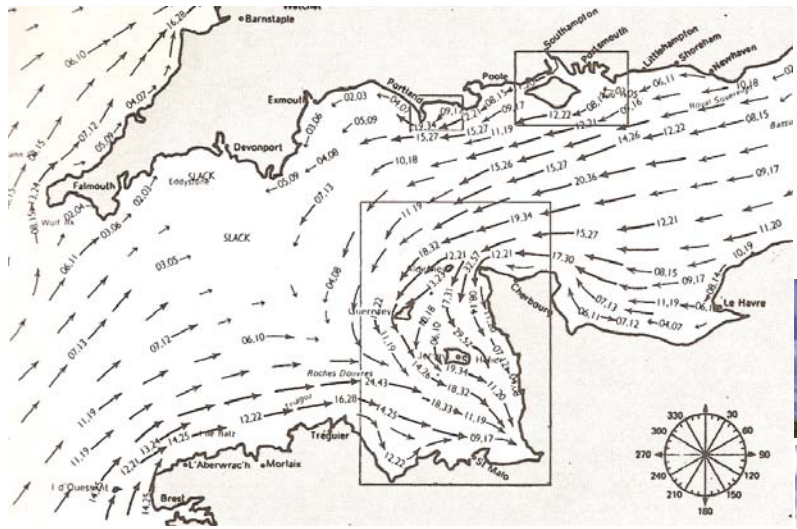
Tidal Stream Resource in the Western Channel

- Maximum tidal rate 7-8 knots (3.5 – 4 m/s)
- Further strong resource in the Dover Straits
- Close to centres of population



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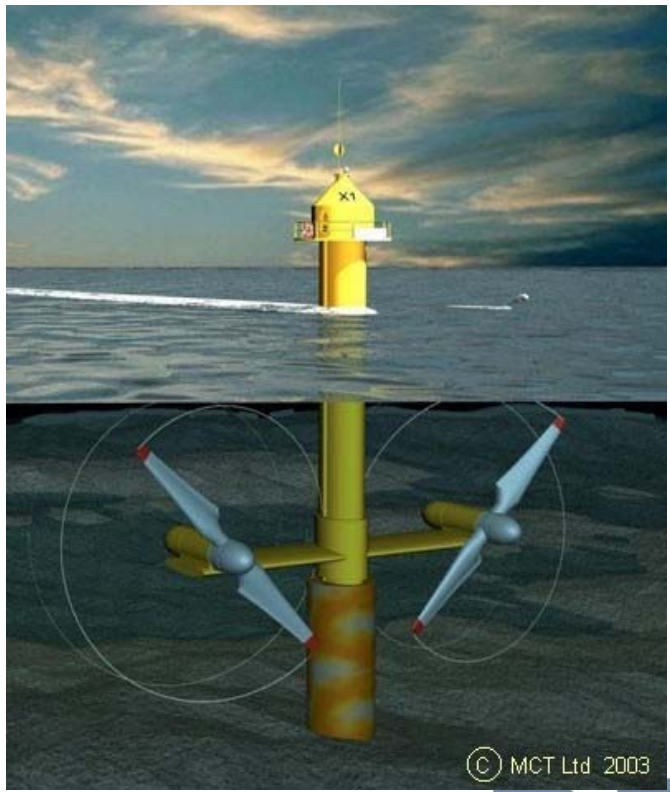
Horizontal Axis Turbines

- 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

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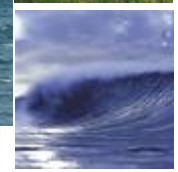
Seaflow Maintenance

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



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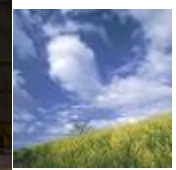
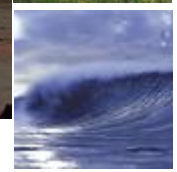
Seagen Project

- 1 MW demonstrator in Strangford Lough
- Pile-mounted with twin rotors on cross-arm
- Grid-connected
- Installation commences August 2007





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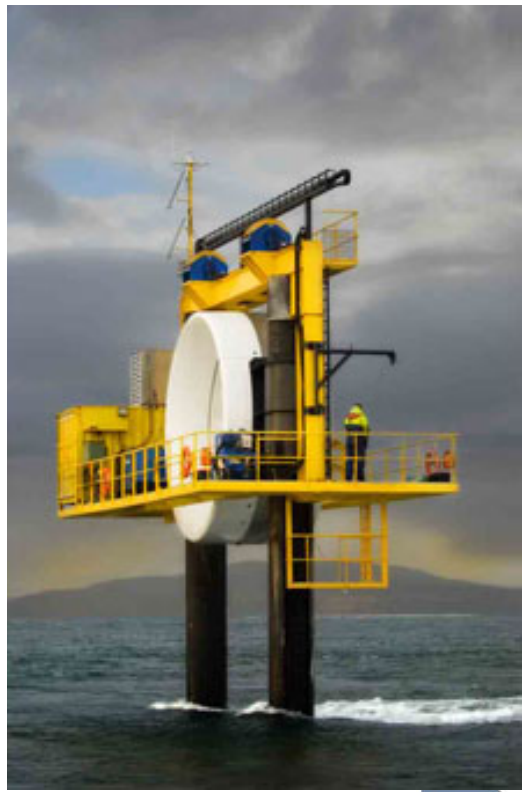
Open Hydro Tidal Turbine

- Installed at the European Marine Energy Centre, Jan 2007
- 250 kW, open-centre turbine with permanent magnet generator in rim.



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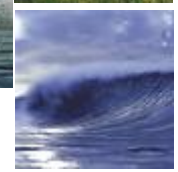
Wave Power

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



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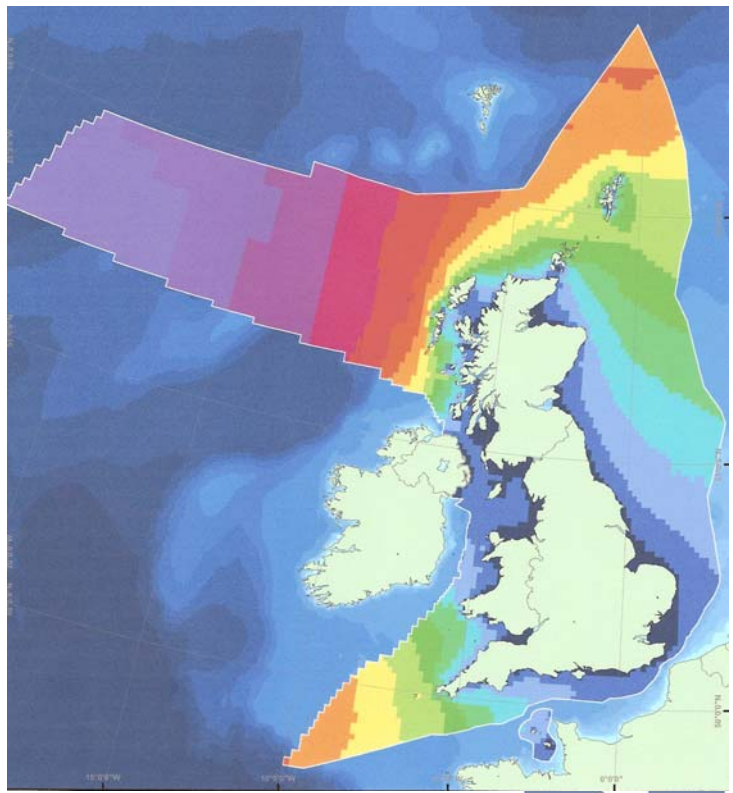
UK Wave Energy Resource

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



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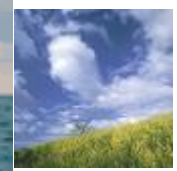
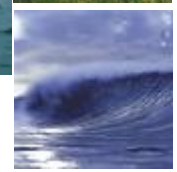
Wave Energy Converters

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





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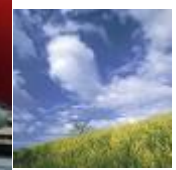
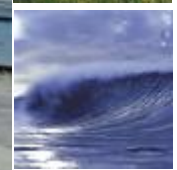
Pelamis - buoyant moored device





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Pelamis at Sea

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

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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

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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

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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)

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Opportunities for Marine Industry

- Component fabrication
- Materials, coatings and corrosion protection
- Underwater cables and seals
- Installation and maintenance
- Environmental monitoring

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Thank you for listening

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