

# Tidal Technologies

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# Today's presentation

- Tidal energy resource
- Technologies for extraction
- Comparison with wind energy
- Issues of introducing a new technology into the marine environment
- Costs and the future



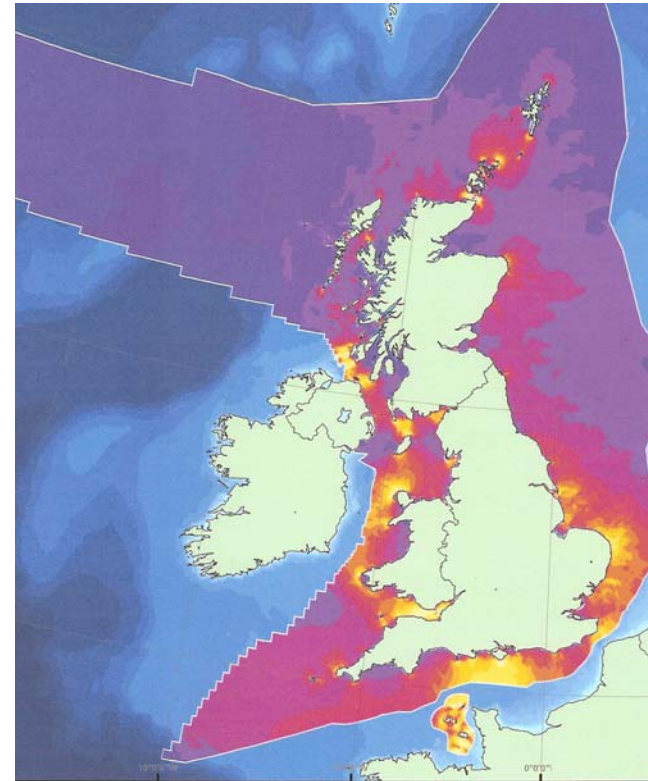
# Tidal Energy

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



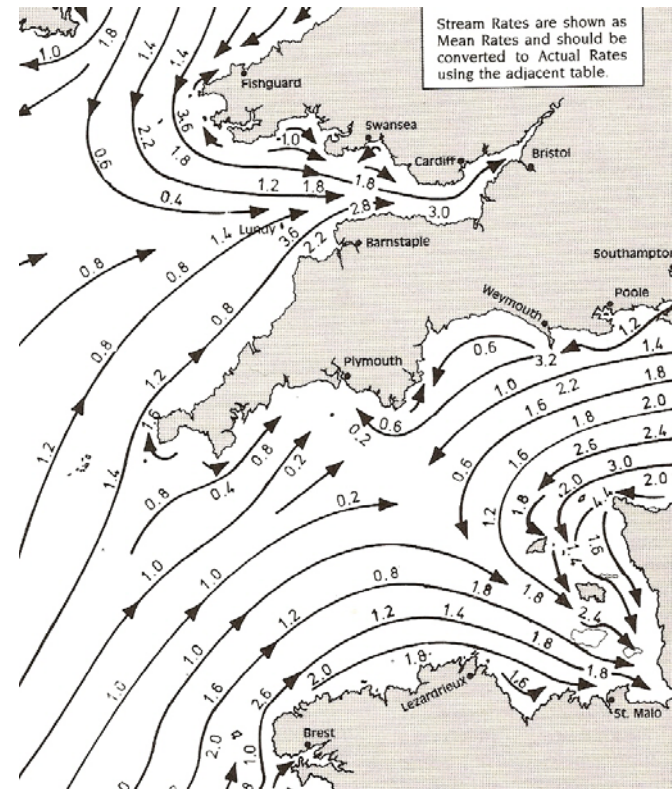
# UK Tidal Stream Resource

- 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



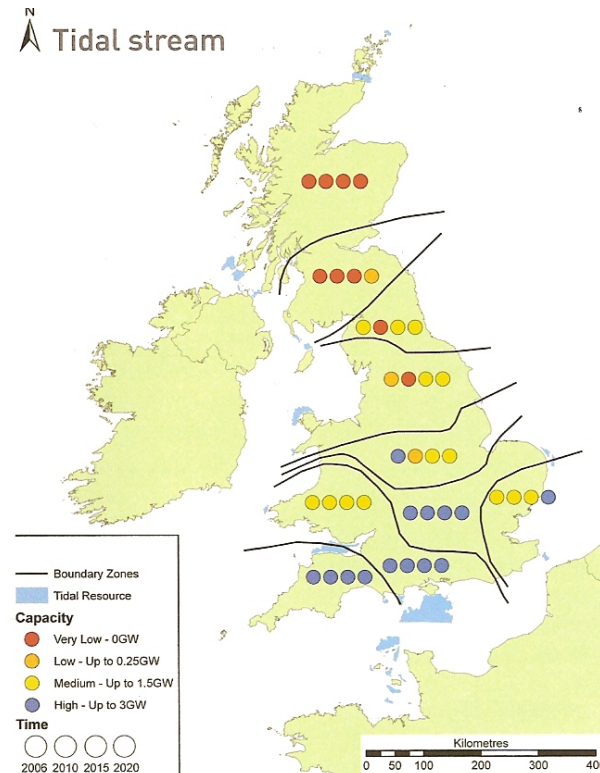
# Tidal Stream Resource in the Bristol Channel

- Maximum tidal rate 5-6 knots (2.5 – 3 m/s)
- Close to centres of population – the end users of electricity



# Grid Connection Issues

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



# Tidal Stream Generators

- The system consists of:
  - Prime mover (rotor or oscillating foil)
  - Foundations (fix to the seabed)
  - Powertrain (gearbox and generator)
  - Power take-off system (electrical power, control system and cable to grid)





# Horizontal Axis Turbines

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





# Seaflow Project

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



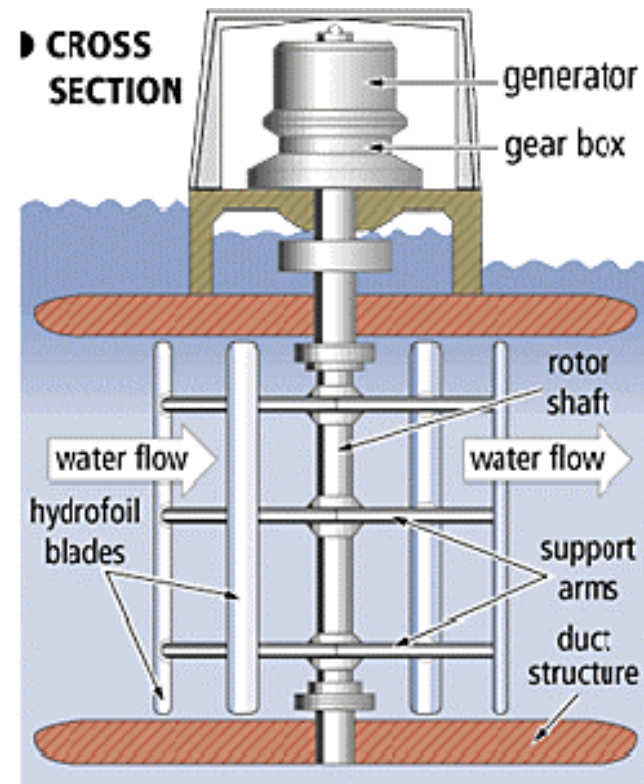
# Seaflow Maintenance

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



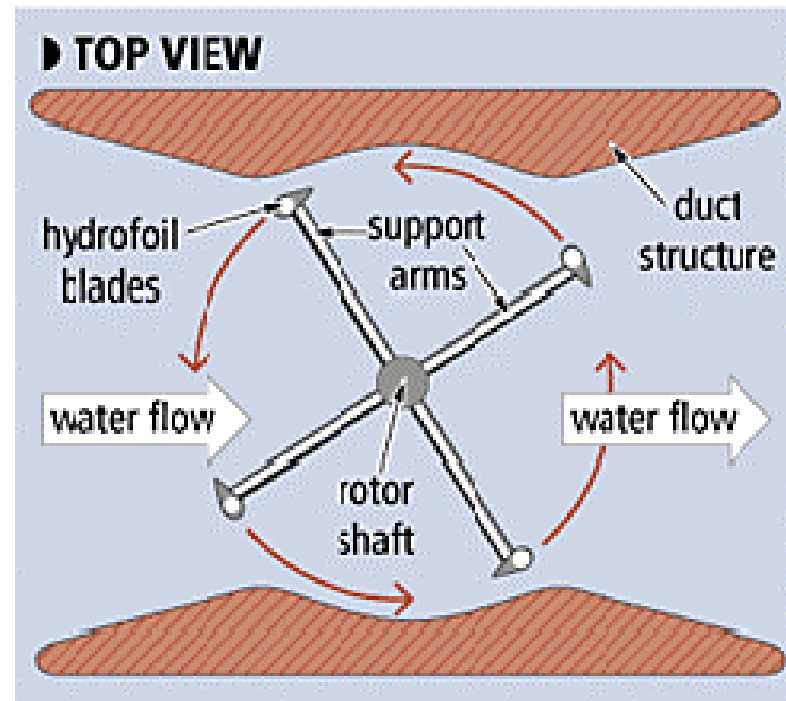
# Vertical Axis Turbine

- Concrete base on sea floor
- Design for shallow water
- Generator and gearbox above water



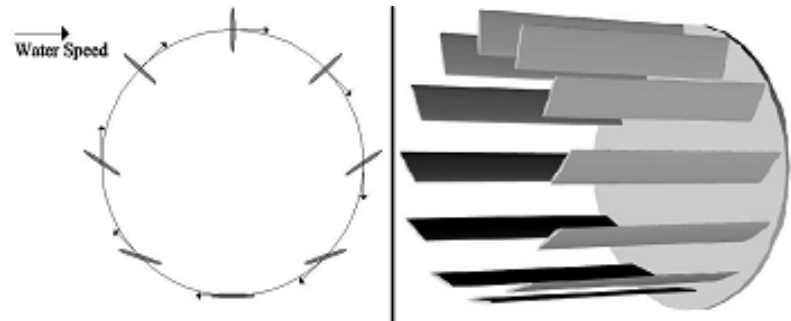
# Vertical Axis Turbine

- Blades generate hydrodynamic lift
- Unidirectional rotation on ebb and flow of tide
- Duct directs flow through the rotor



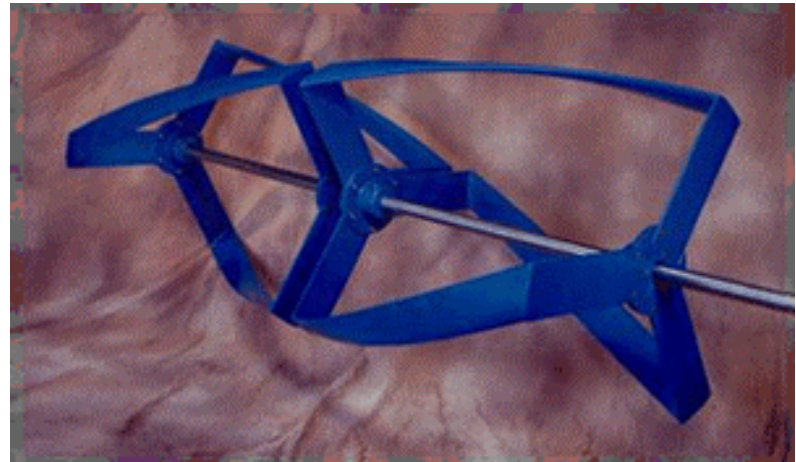
# Cycloidal Turbine

- Paddle wheel with articulating blades
- One blade is broadside to the flow, the opposite blade is feathered
- Insensitive to flow direction



# Helical Turbine

- Tidal stream flows across the rotor
- Direction of rotation depends on the blade orientation, not the flow direction





# Tidal Stream 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



# Tidal Stream versus Wind

- Advantages:
  - High energy density because water is 830 times denser than air
  - Predictable energy resource and capture
  - Predictable energy schedule (reduced intermittency)
  - Low visual impact



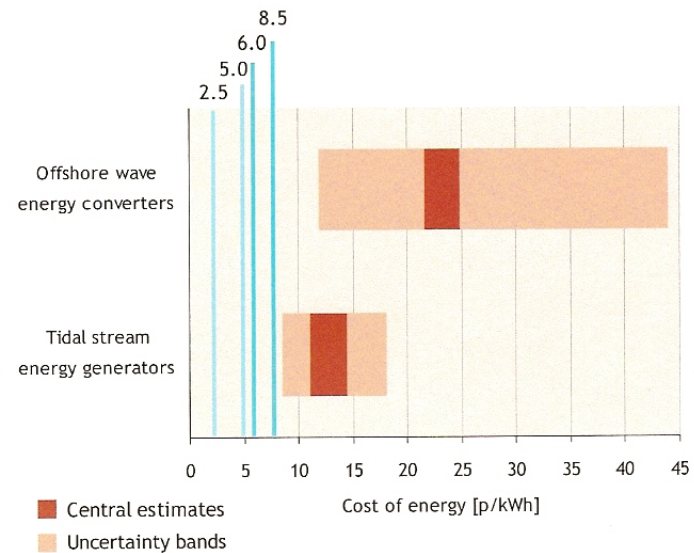
# Issues to be resolved

- 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)



# Estimated Costs Today

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

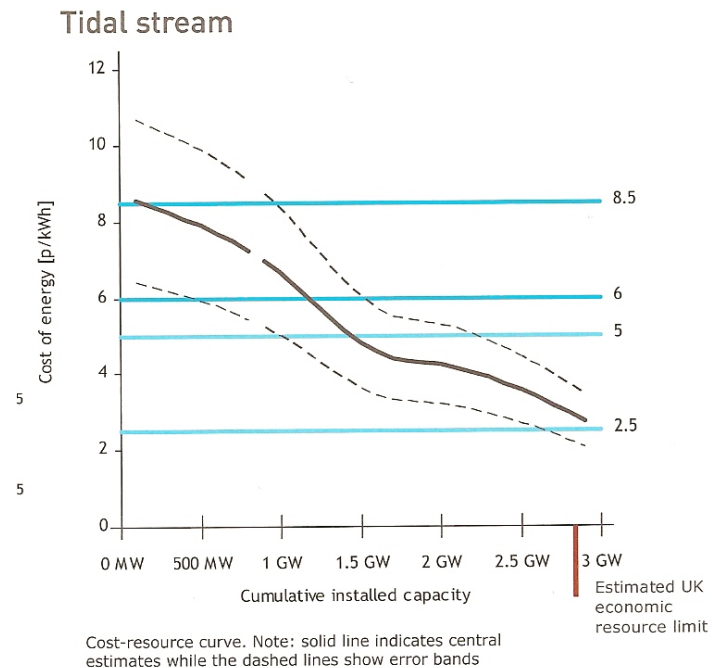


7 Ocean Power Technologies website: [www.oceanpowertechnologies.com](http://www.oceanpowertechnologies.com)



# 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



# The Future?

- UK is world leader in tidal technologies
- Existing skills in offshore sector
- New industry for domestic and export markets
- Worldwide revenue £20-60 billion

