energy technologies institute

www.eti.co.uk

Floating Foundations for Offshore Wind

Society of Maritime Industries

February 2017

ETI10 TEN YEARS OF INNOVATION 2007—2017

What is the ETI?

- The ETI is a public-private partnership between global energy and engineering companies and the UK Government.
- Targeted development, demonstration and de-risking of new technologies for affordable and secure energy
- Shared risk

ETI members

bp
CATERPILLAR®
EDF ENERGY
Rolls-Royce
Shell
Department for Business, Energy & Industrial Strategy
EPSRC Pioneering research and skills
Innovate UK

ETI programme associate

HITACHI Inspire the Next

The Low Carbon Energy 2050 “opening team”

- Demand management
- Nuclear
- Fossil fuel, with carbon capture and storage
  - Including gas
- Biomass, with carbon capture and storage
- Offshore Wind

Provided all technology options are available

Offshore Wind has the potential to be cost competitive with lowest cost low carbon generation

Offshore Wind has the potential to be cost competitive with lowest cost low carbon generation

- Bigger, better turbines
- With bigger, more efficient blades
- Installed more cheaply
- With improved, system, cost of energy
- Accessing better wind resource
- Benefitting from volume economics
- With clear returns for stakeholders
- Ability to test new innovation quickly

What are the disruptive technologies going to be?

Floating is not about going far offshore: it is about making best use of good wind resources close enough to shore to deliver attractive LCOE

- Our studies showed that to deliver lowest cost offshore wind we needed to access:
  - High wind speed site
  - Close enough to shore to
    - Be maintainable from a shore base
    - Avoid HVDC transmission
    - Reduce farm to shore transmission losses
- To do that we need a range of foundation types to cover 0m to 100m water depth.
- That involves developing cost effective foundation types suitable for >30m

Floating wind: Benefits and concerns

Benefits

- Potential for competitive cost of energy
- Access to areas of higher wind speed
- Production line approach
- Harbour build and tow out.
  - Maximise work shore side, reducing impact of weather and offshore working
  - Only works for some concepts
- May reduce requirement for specialist ships
- Existing demonstrators have performed well

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Concerns

- Needs demonstrators to build investor confidence
- Higher winds are linked with more severe sea state
- Technology route not clear
- Technology and operational issues not well understood
- May require specialist ships
- Constraints from competing use of deeper water
  - Shipping, fishing, military

Several concepts around

Concrete caisson
Ideol

Spar Buoy
Hy-Wind

Semi-sub
Windfloat

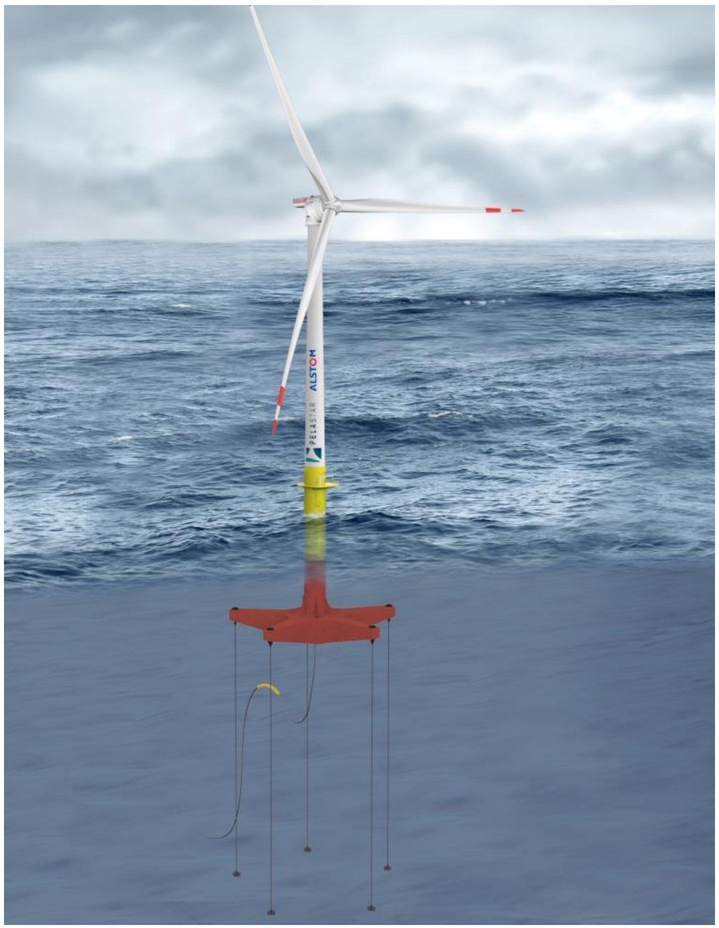
TLP
Pelestar

Other concepts and variations exist

Several floating wind approaches

- Spar Buoy
  - Hywind
  - Demonstrated off Norway
  - Developing Hywind Wind Farm in Buchan Deep, NE Scotland
  - Needs deeper water than most of UK waters
  - Need to reduce material use (steel) to be competitive
- Semi-submersible
  - Wind Float
  - Demonstrated off Portugal
  - Need to reduce material use (steel) to be competitive
- Concrete barges
  - Eg Ideol
  - Cheaper material, closer to being competitive
- Tension Leg Platform
  - Glosten TLP
  - Potentially a light hull; with higher vertical load mooring
  - Could provide very attractive energy costs

Floating Offshore Wind System FEED study



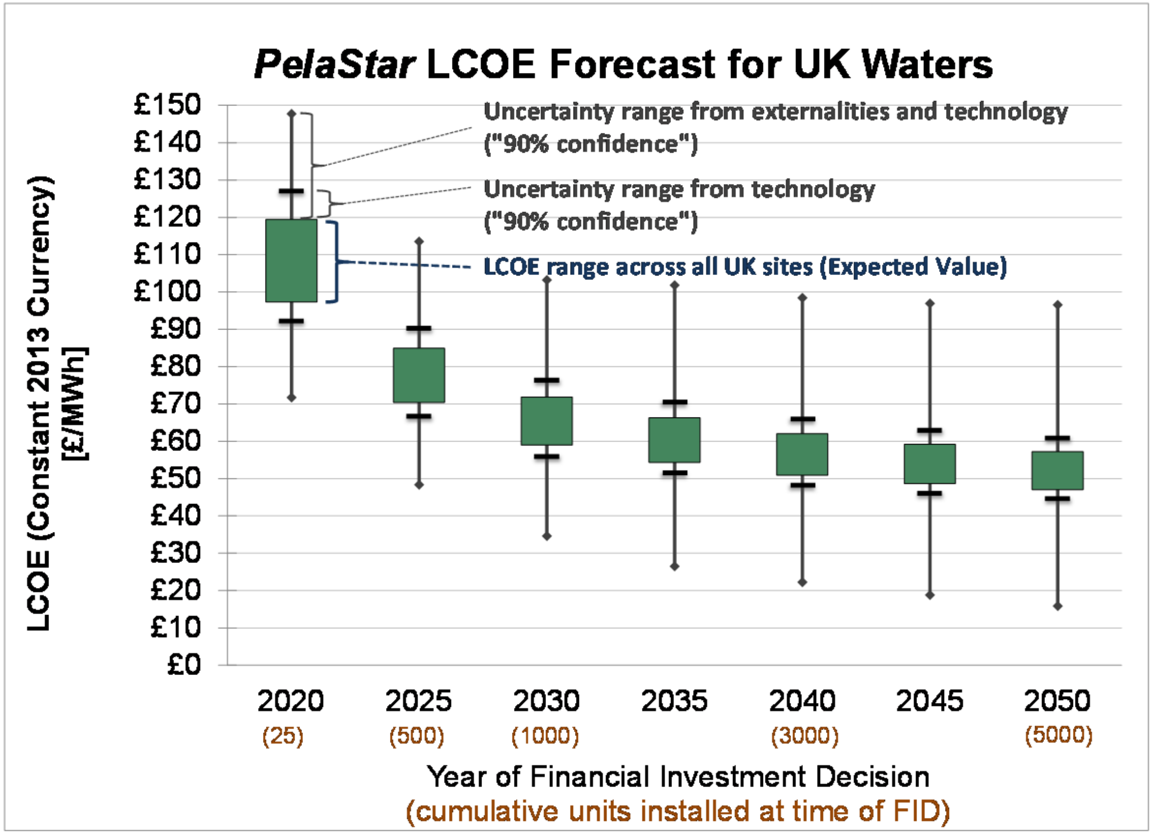
- Front End Engineering Design (FEED study)
  - TLP approach
    - Best “additionality for ETI”
  - Led by Glosten Associates
  - Alstom 6MW turbine
  - Contracts signed February 2013
  - 12 month project
  - Design site: Wave Hub, off NW coast of Cornwall

Glosten's PelaStar TLP Technology

- Lightweight Steel Hull
- Synthetic Tendons
- Production line approach, with Quay-side Turbine Assembly
- Efficient Farm Layout
- Potential for an attractive cost of energy
    - Enough for Offshore Wind to be part of the 2050 opening line up

The FEED study drew on the expertise of highly credible organisations

The TLP FEED study indicates that a TLP solution could be very attractive for UK (and other) waters

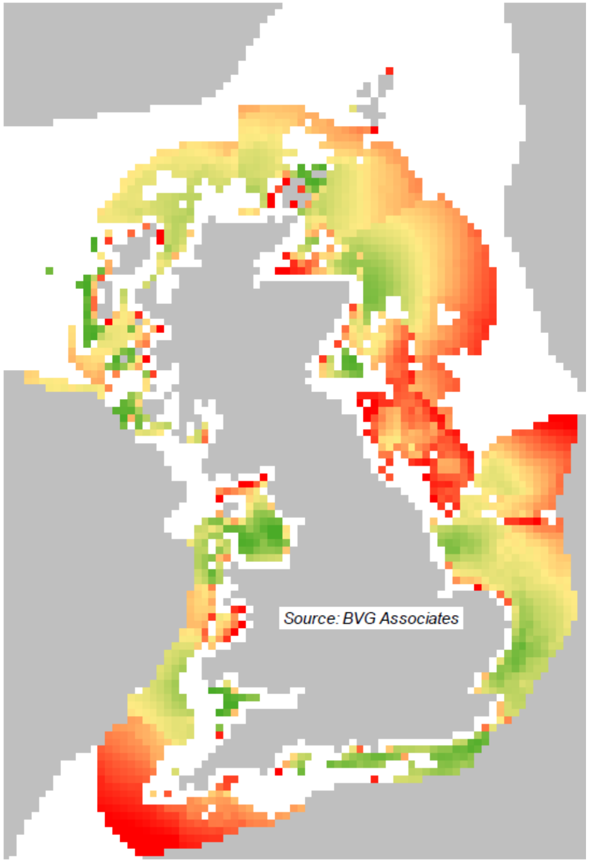


Actual deployment likely to be 5+ years longer than shown in this graph

A paper on the UK cost study is available at www.eti.co.uk

Based on our insights, how much floating wind could there be by 2050?

- If 40GW of offshore wind is deployed by 2050, between 8 and 16GW could be TLP based floating offshore wind
- Scottish & Welsh waters are particularly well suited to TLP technology
- English sites are less suited to TLP
  - Other floating technologies may suit English waters
  - Shallower water means fixed foundations more attractive
- Floating could be ready for mass deployment in late 2020s



Conclusions

- Offshore Wind has a significant role to play in the UK 2050 energy mix
  - Provides proven capability if other technology deployment is constrained
- Potential to deliver costs competitive with lowest cost form of low carbon generation
- Deployment of 8 to 16 GW of floating wind (if 2050 total is 40GW) could make economic sense for the UK
- The larger the UK deployment of offshore wind, the more important floating wind will become

Questions?

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