Summary of Offshore Wind – Preliminary Feasibility

About the document

This document has been prepared by the Renewable Energy Team as a high level summary of the Xodus report into offshore wind feasibility. As such it uses direct extracts from the main report in some places and paraphrases the report in others. This summary provides the key information, but for a fuller understanding of the work and findings please refer to the relevant section of the full report.

Introduction

In August 2015 the States of Guernsey, acting through Commerce and Employment's Renewable Energy Team ("RET") and Guernsey Electricity Limited ("GEL") signed a collaboration agreement to undertake a joint feasibility project to understand the potential implications of a circa 30MW offshore wind farm and identify the next steps of data required to further a potential project.

It was identified that there was a significant amount of work to fulfil the identified work streams that would require external expertise.

Based on a competitive tender process, Xodus (see www.xodusgroup.com) were appointed as the consultant to deliver work. The consultancy work began in November 2015 and was completed in June 2016.

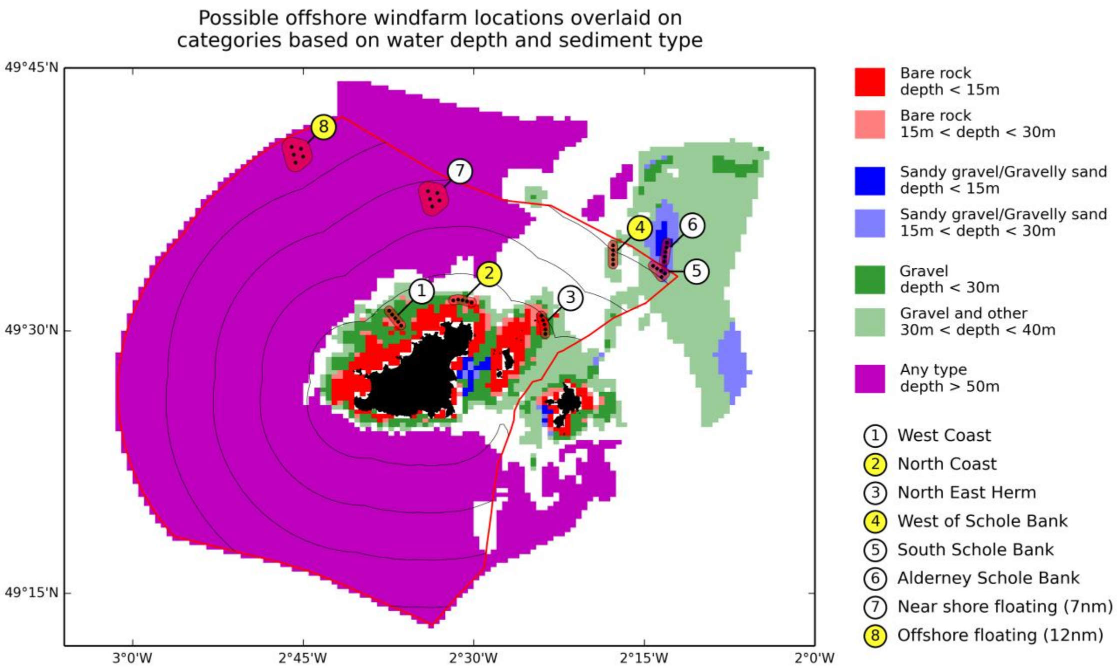
The project was managed by RET, with workstreams split between RET and GEL based on best fit. Regular calls were held with RET, GEL and Xodus to monitor progress. RET and GEL were involved to ensure the work was done appropriately and that learning could be gained.

The full report is available to download from www.guernseyrenewableenergy.com.

Findings

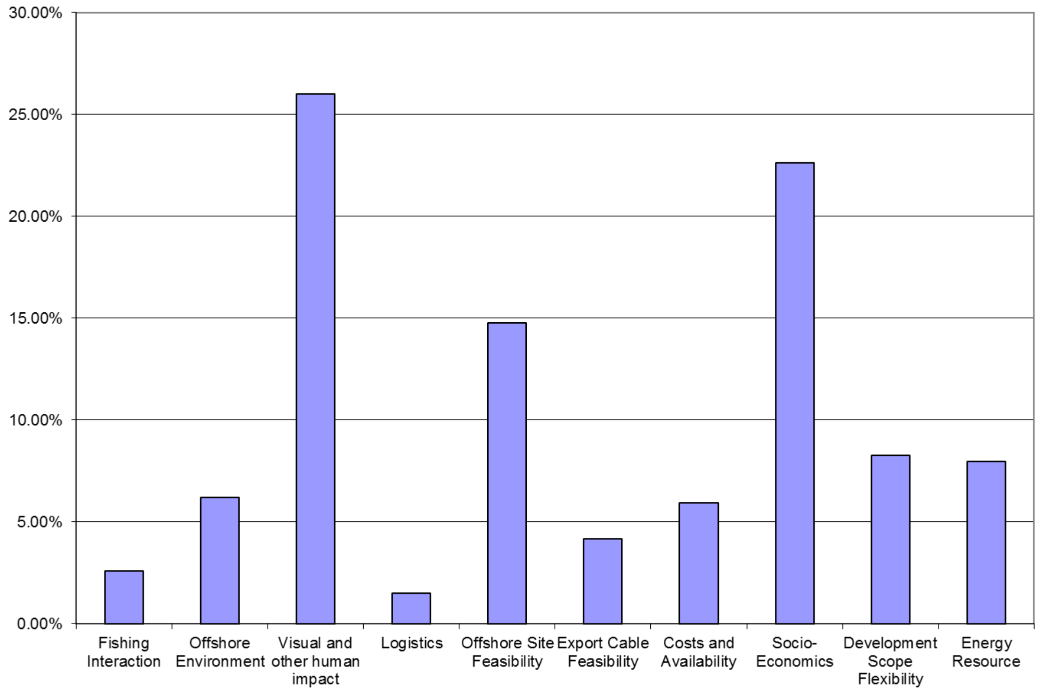
This section summarises the findings of each of the work streams identified before and during the tender process.

Site Selection



The overall study looked at 3 distinct areas, near to shore (less than 3 miles from the coast), around the Schole Bank, and far offshore (floating).

Based on a “Value, Decision, Risk Management” (“VDRM”) tool developed and utilised by the consultant, utilising the drivers and weightings shown below, the far offshore site was identified as most favourable (its low visual impact being a major factor).



Wind and Wave Data Analysis

The table below summarises the conclusions and recommendations for data gathering.

Recommendation	**Timeframe**	**Reasoning**	**Importance for the project**
Employ LIDAR at Chouet *Estimated cost: £140k*	Minimum two years	Required for engineering and resource assessment	High
Identify additional wind monitor site: *Minimal cost*	Minimum 2 years	Correction for land influence.	Medium
LIDAR at additional site *Estimated cost: £160k*	Minimum 2 years	As above	Medium
Monitor LIDAR technology *Minimal cost*	Ongoing	Scanning LIDAR may become more affordable.	Medium
Scope wave buoy *Minimal cost*	Ongoing	A wave buoy to the north would be of use	High
Deploy wave buoy *Estimated cost: £60k*	Minimum one year	An important input to the design basis	High
Review metocean data *Estimated cost: £5k*	Minimum two years	e.g. water levels and currents	High
Engage with potential partners on modelling *Minimal cost*	Ongoing	Further modelling will very likely be needed	Low
Compare wind correction methods: *Estimated cost: £10k*	Ongoing	The best practice should be determined.	Medium

Concept Outline

The structures used and layout of the array would be very site dependant. This study looked at 3 distinct sites, 1 using either gravity base or drilled piles, 1 using jacket piles and one using floating.

Cable landfall would be along the north coast.

Operation and Maintenance + Turbine availability

Unplanned failures are far hard to allow for but were estimated with the knowledge of other projects the consultant has worked on.
Turbines almost certainly exhibited failure rate profiles with high failure rates during the "burn in" period followed by several years of stability before entering the "burn out" phase at the end of the economic life.

- A central estimate for turbine availability of around 91% has been derived, but with significant sensitivities.

	Schole Bank (fixed foundation)	**West of Schole Bank (fixed foundation)**	**Floating sites**
Standard simulations	91.4%	90.1%	90.9%
Pessimistic lead times for repair vessels	84.3%	83.2%	84.7%
Improved failure rates	94.4%	93.8%	94.3%

Overall turbine availability estimates for three wind farm sites. An allowance of 2 visits/year of 8 hours down time is also included to capture scheduled maintenance.

Risk and Opportunity

A full risk/opportunity register has been completed for continuous assessment. The high risks following mitigation, and the good opportunities are outlined in the tables below.

ID	Risk description	Likelihood	Impact	Risk	Consequence	Category	Mitigating actions	Contingency	Comments	Likelihood	Impact	Risk
		Pre-mitigation								Post-mitigation		
1	Ongoing volatile energy market and/or low cost of oil or alternatives	5	5	H	Difficult to plan and design value adding project	Political	Introduce flexibility where possible. Have a long term low carbon energy policy incorporating security of supply.	Introduce/maintain flexibility in alternative solutions for electricty supply.	Residual risk depends on policy statements.	4	5	H
3	Small scale and first of a kind in Guernsey waters makes project unattractive to the industry	4	5	H	Lack of interest in supply chain, and no economies of scale drive up costs	Financial	Consider pilot project or collaboration with larger projects. Early engagement with key suppliers. Establish robust permitting pathway.	Prepare for higher costs and give preference to technical solutions that favour small scale.	Residual risk depends on progress of nearby fixed and floating projects and potential of collaboration.	3	5	H
8	Lack of detailed information from supply chain	4	5	H	High risk of cost overruns or cancelling a feasible project	Financial (technical)	Make project look attractive and real (even 1 GW projects have this problem!). Consider pilot stage technology and strategic partnering.	Maintain options.	Risk could be reduced if successful with strategic partnerships.	3	5	H
10	Not obtaining seabed rights from the Crown	3	5	H	Unlikely to find suitable site within 3nm limit.	Political	Keep the pressure on to maintain schedule.	Introduce/maintain flexibility in alternative solutions for electricty supply.	To be reviewed at an early stage. Other risks could be generated depending on agreements.	3	5	H
10b	Not obtaining territorial seas 3nm to 12nm	3	5	H	No Guernsey project	Political	Keep the pressure on to maintain schedule.	Introduce/maintain flexibility in alternative solutions for electricty supply.	To be reviewed at an early stage. Other risks could be generated depending on agreements.	3	5	H

ID	Opportunity description	Likelihood	Impact	Opportunity	Consequence	Category	Development actions	Contingency	Comments	Likelihood	Impact	Opportunity
		Pre-								Post-		
1	Security (with diversity of supply) - lower reliance on imported energy	3	4	G	Less reliance on imports and long cables	Political	Progress the project with a focus on reliability and consider energy storage	Consider altnernative ways of achieving security of supply	Consider network integration requirements. Focus on storage.	4	4	G
2	Fixed price or certainty of energy price	4	3	G	Price will be fairly constant for the life of the project.	Political	Establish acceptable price and scale and design project accordingly. Consider a phased development.	Consider altnernative ways of achieving price certainty.		4	4	G
3	Lower carbon emissions than oil	5	3	G	Lower carbon emissions. Especially important given COP 21 Agreement on climate change. Improves Guernsey's international reputation and relationships.	Political	Establish the importance of lower carbon emissions	Consider low carbon inter-connectors		5	4	G
4	Reduced CAPEX of replacing diesel generating equipment	3	3	F	Reduction in net cost of project	Financial	Detailed planning of capacity management	Don't factor in the cost reduction when assessing project	Some diesel generation could be reduced.	4	3	G
6	Large scale commercial export	1	5	F	Very large scale project	Financial and political	Establish if commercially viable (via French or UK subsidy) and seek public interest.	Progress appropriate scale project	The likelihood of this could incease if France develops projects nearby.	2	5	G
7	Additional cable connection to Alderney from the project (assuming FAB link goes ahead)	3	3	F	Increased redundancy and potential import/export	Political	Promote advantages of security of supply, price stability and less diesel backup.	Continue project without the extra cable link.	Need to establish the viability of connecting into the FAB link HVDC system. It could be a showstopper.	3	4	G
10	Floating wind centre of excellence - adding a test site using project infrastructure	2	4	F	Increased local business activity an international reputation.	Financial	Consider during the design process and inform the public of the potential.	Consider in parallel to the project.		3	4	G
12	Creation of a marine reserve/protected area in an exclusion zone	4	3	G	Excluding large fishing vessels benefits the marine environment.	Political	Promote advantages of potential improved angling (as seen on other wind projects) and overall benefits to marine environment.	Establish exclusion zone requirements during construction and operation for both floating and fixed foundation options at an early stage.	Most likely for floating project that will probably require an exclusion zone during operation.	4	3	G
14	Local vessel use during construction and O&M	4	3	G	Local business opportunities and skills development	Financial	Supply chain engagement and education	Prepare to use other vessels	The impact could grow if France develops other projects locally.	4	3	G
16	Harbour use during construction and O&M	4	3	G	Local business opportunities (sufficiently small scale not to impact tourism)	Financial	Supply chain engagement and education	Consider alteratives at an early stage	The impact could grow if France develops other projects locally.	4	3	G
19	Partnering with French offshore wind developers.	3	4	G	Benefit from economies of scale and use of Guernsey as a logistics hub.	Financial	Early discussions with French developers and the French Dept. of Renewable Energy (considering both fixed and floating projects and their 2030 targets).	Consider in parallel to the project.	Waters very near and to the west of Guernsey are considered favourable for floating wind by the French authorities.	3	4	G

Socio Economic Assessment

The overwhelming conclusion was that any potential impacts would be very minor or negligible simply because of the small scale of the project, even though for a small island community it is a relatively large project. The main drivers for this project are diversity and security of electricity supply to Guernsey and reducing carbon emissions. There are unlikely to be any major negative socio-economic impacts other than the cost of energy may increase depending on the cost of imported energy.

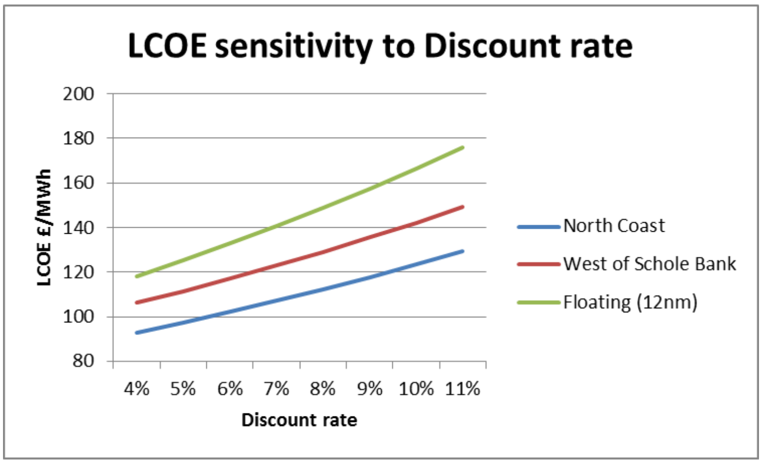
Creating significant local employment opportunities from a specialist project like Guernsey's is challenging and requires stakeholder alignment and commitment from authorities and the main project Sponsors and Developer, but some local employment would be anticipated.

Overall perhaps 30% to 40% of the project development spend could be Guernsey based with a total spend of the order £1-2 million over 3-5 years with some further local employment opportunities.

Economics Assessment

To assess the cost of electricity from different sites and design options we have created a Levelised Cost of Energy ("LCOE") model. LCOE is effectively the cost of energy generated by the project and is usually quoted in £/MWh.

A LCOE model for an offshore windfarm is a financial model created to assess different options on a consistent basis. It does this by calculating the energy price required to meet the target Internal Rate of Return ("IRR") required by the project funders. It takes into account the amount and timing of Capital Expenditure ("CAPEX"), Operational Expenditure ("OPEX") and decommissioning costs of the windfarm, as well as the amount and timing of electricity generated



	North Coast £/MWh	West of Schole Bank £/MWh	Floating (12nm) £/MWh
10% Target IRR	124	142	167
4% Target IRR	93	106	118

For the model it is assumed in the base case that the turbines will be installed during 2020 and decommissioned during 2040, as although projects often have a design life of 25 years there is limited experience of long-term operation of offshore windfarms.

- There is a large degree of uncertainty about LCOE at this stage of the project due to:
  - Only limited site information being available
  - Lack of detailed design for the project
  - No supply chain engagement
  - Uncertainty about future commodity prices and exchange rates
- LCOE for the Floating option is expected to decrease as the technology matures, and could reduce below that of the West of Schole Bank option in the 2020s

Project Sponsors

Estimated LCOE is a potential show stopper and as such the highest priority should be given to minimising the cost. The lowest cost funding will be from funds raised by the States of Guernsey. As noted in the Project Economics study, the cost of funding has a significant impact on the LCOE for the electricity generated by the project. Therefore if the project is funded by the States of Guernsey as far as possible, the cost of electricity generated by the project will be reduced.

The highest cost of funding will be private sector investment in the development and consenting phase due to the high risk nature of this investment. In addition prior to any private sector investment in this phase, a complete regulatory and subsidy scheme will need to be in place to allow potential investors to assess the investment opportunity. Therefore if the development and consenting phase is funded by the States of Guernsey, the cost of electricity and potential delays would be reduced.

The potential impact on the cost of electricity is an increase in per unit cost roughly equivalent to that being proposed for a direct cable link to France.

Conclusions and Next Steps

Conclusions

- There are a range of technically feasible options to develop an offshore wind project off Guernsey.
- Developing a modest project, of the order 30MW, will achieve the fundamental objectives associated with energy diversification namely: security; price certainty; sustainability and lower carbon.
- The cost is higher than current French importation and on island generation
    - Funding from within Guernsey would minimise this cost.
    - Costs estimates are conservative – only 20, not 25 year, life, and based on today's prices, not forecasts.
- The lowest cost site is likely to be in the shallow waters off the North Coast (or any coastal site).
- Consider pursuing an extended wave and wind data gathering programme that could be relatively low cost but high value for the future.

Next Steps

RET are already working on some of these next steps, either as a result of the consultation or as work already in progress. In addition new steps have been highlighted that RET are looking to undertake.

Seabed and territorial seas – RET have been pushing other areas of the States of Guernsey for this work to be concluded for the last 3-4 years, it has implications not only for renewables but also fishing, connectivity and electricity infrastructure.

Metocean measurements – RET have had a wind mast up at Chouet since 2011 and have had a number of studies analyse the data. Next steps are to undertake LiDAR studies and factor in atmospheric issues.

Stakeholder engagement – RET are continuing to engage with the public as and when possible, including open day events and stakeholder groups. This will continue.

Economic assessment – RET have created and had verified the financial model used in this work, and will continue to monitor relevant industries and assumptions regularly to ensure it remains up to date.

Wave data – RET have previously looked into this work, however cost has been prohibitive. There is potential to tie into other E&I work (such as coastal defence) and to utilise RET's university contacts to reduce costs.