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How to increase project value using Lidar

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Abstract

Lidar (Light detection and ranging) is a mature remote sensing technology used to measure wind speed and direction. Real world data from Lidar deployments at wind farms demonstrates that a Lidar measurement campaign can lead to increased energy yield along with significant reductions in energy yield uncertainty, and reductions in maintenance costs.

The associated impact on project valuation and access to financing has been quantified through the construction of a financial model for a generic UK offshore 250MW wind farm. Realistic inputs and assumptions based on SgurrEnergy's extensive industry experience were used.

Objectives

Two cases were considered: i) deploying both Lidar and a conventional offshore meteorological (met) mast, and ii) using a met mast only.

The key ways in which the use of Lidar may improve the financial performance of a project are as follows:

1. Improved wind farm design, leading to increased energy yield.
2. More appropriate selection of wind turbine.
3. Increased energy yield arising from improved operating strategy and controls, reducing yaw misalignment and reducing wake impacts.
4. Reduction in energy yield uncertainty, leading to improved access to finance.
5. Maintenance cost reduction arising from reduced loads.
6. Improved power curve testing techniques and reduced power curve testing costs
7. Continued risk mitigation throughout the project life.
8. Significantly improved contractual position with accurate specification of site wind regime, and accurate measurement of power curve for a large proportion of the turbines at low cost.

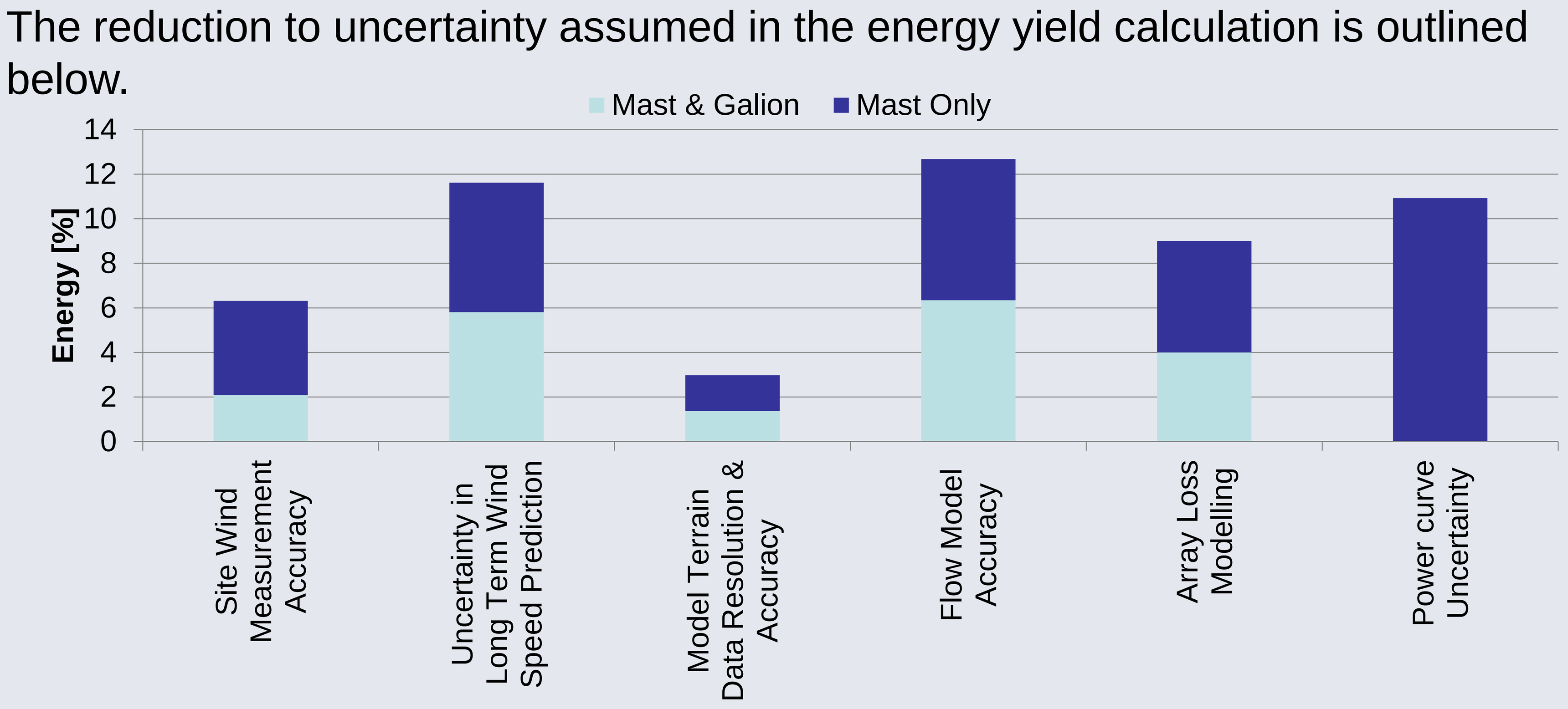
It is important to take a robust approach to analysis of this type, and where appropriate to apply a degree of conservatism. The following assumptions were used for the financial modelling:

1. An increase to the predicted median energy yield (P50) of 1% due to a better understanding of the wind regime, more appropriate turbine choice and more efficient layout.
2. An increase to the predicted 10^{th} percentile energy yield (P90) of 2.64% due to a reduction in uncertainty associated with vertical wind speed extrapolation and power curve performance. Reduced uncertainty causes an increase to the P90 for a given P50. Reduced uncertainty therefore enables developers to raise more finance, retaining more equity, and increases the internal rate of return (IRR) on the developer's equity investment.

Methodology

The predicted energy yield is a major source of uncertainty for a wind farm project, and if the uncertainty associated with the project reduces, this enhances the financial prospects of the project and enables developers to raise more finance and therefore retain more equity than would otherwise be the case.

The reduction to uncertainty assumed in the energy yield calculation is outlined below.



The key energy yield assumptions driving the results were as follows:

	Met mast only	Lidar & met mast
P50 (MWh/Annum)	1,073,100	1,083,831
P90 (MWh/Annum)	918,340	942,610

Results

Key Results of Lidar Financial Modelling		
	Met mast only	Lidar & met mast
% of Capex Financed by Debt	83.0%	85.5%
Debt Financing Amount	£843m	£869m
Equity Financing Amount	£173m	£148m
Project NPV (20 year, nom, post tax)	£100m	£112m
Project IRR (20 year, nom, post tax)	11.5%	11.7%
Equity IRR (20 year, nom, post tax)	23.7%	26.9%

The deployment of a Lidar at the site with a conventional 90m met mast allowed the P50 to increase from 1,073GWh to 1,084GWh, and the P90 to increase from 918GWh to 943GWh. This resulted in an increase in leverage from 83% to 85.5%, which equated to a reduction in equity required of around £25M and in increase in equity IRR from 24% to 27%.

A full description of the modelling methodology, assumptions and implications can be found in the *Galion Lidar Offshore Financial Model Briefing Paper* produced by SgurrEnergy.

Conclusions

The financial modelling of the above points using real world data demonstrated that the deployment of Lidar resulted in an increase to the P90 and P50 energy yields.

The increase to P90 will improve access to finance, which in turn will increase equity IRR. The increase in P50 would increase the valuation of the project and the return on the developer's investment.

For a 250MW offshore wind farm these improvements equate to £12m in value and 3.2% in equity IRR.

Lidar allows direct measurement of wind speed around the site and thereby accurate determination of areas of highest productivity (which can be significant even in the offshore environment), no-go areas of high shear and/or turbulence, and optimum hub-height. This results in a better optimised design with higher energy yield, IRR and NPV.

Understanding the character of wind flow, specifically any anomalies, enables improved operating strategy and control strategy to reduce loads and increase yield, for example through a reduction to yaw misalignment and active wake management.

Maintenance costs will reduce under an improved wind farm operating and control strategy. Production can be curtailed under wind flow conditions causing excessive loads.

Some additional benefits of Lidar were not modelled but nevertheless are significant:

By measuring (using Lidar), understanding and specifying the fullest possible set of information on the site's wind characteristics, the turbine supplier can be directly informed about the conditions the turbines must work under. This ensures that the design is robust and appropriate, and the OEM takes full responsibility, strengthening the contractual position of the owner.

Power curve tests using Lidar can be used to quantify the benefit of performance enhancement upgrades and understand performance in a range of real world conditions. The use of a Lidar deployment reduces the cost of these activities by a factor of 100 compared to a fixed met mast and therefore allows power curve validation at a large proportion of turbines on the farm thus improving the contractual position of the owner.

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