FLOATING RENEWABLE ENERGY ASSETS

FLOW is a relatively new concept when compared to tidal, but one that could open up vast opportunity to increase global renewable energy production. To help understand more about the risks and opportunities, integrated spoke with Michael Hook and Frank Rose from Strainstall, a world leader in developing innovative monitoring solutions that enhance the safety and performance of assets, including for the oil, gas and renewable energy sectors.

The UK tops the world ranking of countries producing offshore renewable energy with an installed capacity of 8.3GW (source: 2019 International Renewable Energy Agency Statistics). The Department for Business, Energy and Industrial Strategy said in March 2019 that offshore wind's share of electricity rose from 1% in 2010 to 6% in 2017, and it is expected to hit 10% next year.

There is probably a good reason, the UK has a relatively shallow foreshore of less than 50m which is perfect for fixed-bottom platforms that up to now have been the prevailing offshore windfarm installation method. But now floating offshore assets, both wind and tidal, are starting to emerge from the pre-commercial (R&D) stage in readiness to scale up to commercial production levels.

NEW OPPORTUNITIES

Going further away from the shoreline is going to enable operators to access stronger and more reliable wind resources. According to a report by Wind Europe in June 2017 up to 80% of potential offshore wind sites globally are in waters more than 60m deep. And it's widely suggested that the floating wind market is potentially eight times bigger than the fixed offshore wind market.

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Country/Region	Share of offshore wind resource in +60m depth	Potential for floating wind capacity
Europe	80%	4,000 GW
USA	60%	2,450 GW
Japan	80%	500 GW
Taiwan	-	90 GW

Source: Wind Europe Floating Offshore Wind Vision Statement, June 2017

Moving into deeper waters away from the shoreline – or especially expanding in ocean-bordering locations such as the US or Asia, which have steeply shelving foreshores and in some cases high seismic risk – floating platforms are the only cost-effective way of proceeding. And they present some equally compelling construction cost and environmental benefits due to the less-invasive nature of the installation.

In October 2017 the world's first floating offshore windfarm started delivering electricity to the Scottish grid. Hywind is located about 15 miles from Peterhead in Aberdeenshire, Scotland and is positioned in water depths of up to 129m.

LEANING ON THE OIL AND GAS EXPERIENCE

As floating offshore wind emerges, it is leaning heavily on the experience, knowhow and supply chains available from the more mature oil and gas sector. Some of the most advanced development in floating offshore wind is coming from oil and gas producers themselves; with a view to gaining carbon credits and diversifying their own production mix while at the same time leveraging their existing knowledge and delivery infrastructure.

Norwegian oil and gas producer Equinor (previously known as Statoil) is perhaps the best-known example. Not only do they own a 75% stake in Hywind, their Hywind Tampen project is expected to be operational by the end of 2022. Located in 260-300m water depths this floating offshore wind farm will provide 35 percent of the annual power demand of Snorre A and B and Gullfaks A, B and C oil and gas platforms. This will help to optimise the output from the oil and gas assets – i.e. use less of their own recovered oil and gas in production – as well as offset their carbon output.

ASSET LOAD MEASUREMENT AND MONITORING

Even for an oil and gas giant, though, resilience and efficiency are key factors in developing successful wind assets. Even though floating wind, and to a lesser extent, tidal, lean on established offshore design concepts including examples such as semi-sub technology proven in oil and gas, their different use raises questions about fatigue and performance, for example the higher centre of gravity and thrust created by the turbines.

The machinery needs to be able to withstand whatever the waves and weather can throw at it. And weather patterns, wind strength, storm surges and wave sizes are becoming less predictable. What starts out as a location with a maximum 1-in-50 wave of 14 metres may turn out to be a lot more aggressive in 20 years' time than the developers are anticipating now.

On the efficiency side, offshore renewable machinery (fixed or floating) is complex, expensive, and typically designed for up to 20 year lifecycles. If anything, cost is even more of a driver for renewable development than it was for oil and gas, due to the demands of levelized cost of energy (LCOE) – an economic assessment of the average cost of building and operating an asset divided by its total energy output over its lifetime.

Against this background, asset load measurement and monitoring equipment has a vital role to play in protecting the structural integrity of offshore assets – whether platforms, turbines, sub-stations, mooring lines or other machinery. Tools such as strain gauges (sensors which convert mechanical forces into measurable electrical signal data), often used in Load Cells, monitor fatigue and performance over the entire design lifecycle of the assets and are typically used to assess a number of different loads, including mooring loads. The output is a complex data configuration, including environmental, oceanographic, their correlations to mooring line tensions and other measures.

In the pre-commercial phase renewable developers naturally and deliberately put a lot of emphasis on this monitoring process; mainly because it has commercial value. By validating design loads against actual loads before you start commercial production, you might be able to value-engineer in the commercial stage (e.g. reducing steel could cut capital expenditure and as a secondary benefit potentially reduce operational costs). Or, as has also happened in oil and gas, monitoring tools can sometimes justify life extensions for assets which have borne a lighter load in production than they were designed for.

The load monitoring tools are designed for the entire lifecycle not just the development phase – so they can be used – but there are still questions whether they will. In oil and gas it would be unthinkable for mooring loads not to be closely monitored in production, especially given the risk of environmental catastrophe that could ensue from a break. But could cost pressure prompt renewable producers to consider scaling down monitoring once they've scaled up production?

KEY RISKS

Value-engineering decisions taken with the objective of bringing down LCOE might have broader risk implications. We can all appreciate the risk of a turbine or even the sub-station becoming disconnected due to failure of the mooring system, but perhaps the failure of one mooring system could damage multiple assets and cause a more catastrophic property damage and supply interruption incident - especially as floating assets move into more aggressive wind and tidal locations.

A good example is off the West Coast of Ireland and a project known as AFLOWT (Accelerating market uptake of FLoating Offshore Wind Technology), which is designed to demonstrate the survivability and cost-competitiveness of floating offshore wind technology. Funded by the EU's Interreg North West Europe programme to accelerate uptake of floating offshore wind, it aims by 2022 to have a full-scale floating wind turbine deployed for testing. The seas off the west coast have some of the strongest wind resources in the world with waves of 14m or more not being unusual.

Being further offshore and in challenging conditions brings many other cost and risk challenges, not least asset maintenance. Getting to the offshore assets and then the health and safety risks involved in checking equipment. Like other engineering machinery, asset measurement and monitoring systems are being digitised. This is going to enable remote monitoring that will help reduce some of these risks and costs.

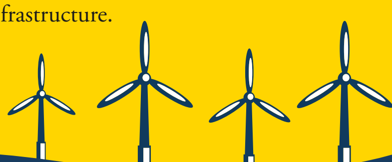
Illustration © Equinor

DATA

Digitisation, also, brings other benefits and is opening up broader data discussions. So far there has been little data sharing by renewable producers, due mainly to its proprietorial value at this early stage of the industry's development. The progress of oil and gas was undoubtedly accelerated by wide data sharing. The same could eventually be achieved in renewables, with more widespread use of the output from monitoring tools. It's a question that will undoubtedly continue to be debated.

FINAL THOUGHTS

Insurance represents a major cost for renewable energy operators. Close and effective asset monitoring and measurement can help to reduce key risks and could become even more important as assets move into more challenging sea and weather conditions. In the end, though, the national energy security argument is perhaps the most compelling argument of all. As renewable energy becomes a more important part of the supply mix, countries will need to be sure of the security and reliability from there offshore wind assets. If they are closely monitored that can help control downtimes and reduce or eliminate risk to the primary energy infrastructure.



BENEFITS OF ASSET MONITORING

1. SAFETY
ASSURING SAFE OPERATIONS BY ENSURING ASSET PERFORMANCE

2. DOWNTIME COST
MITIGATING RISK OF NON-PRODUCTIVE TIME BY PREDICTING ISSUES BEFORE THEY HAPPEN

3. CAPITAL EFFICIENCY
IMPROVE THE CHANCES OF ASSET LIFE EXTENSION

4. ACCESSIBILITY
OPEN THE DOOR TO NEW INACCESSIBLE SITES

5. DATA
CONTINUAL IMPROVEMENT WITH DATA INSIGHTS

ABOUT **STRAINSTALL**

Strainstall is a world leader in the development of innovative monitoring solutions that enhance the safety and performance of assets. Drawing on more than 50 years' experience, they develop and apply innovative technology, including load, strain and stress measuring techniques, within a wide range of sectors including marine, offshore, civil engineering, nuclear and aerospace. Their systems are proven to perform year on year in hostile and hazardous environments.

Strainstall has been part of James Fisher and Sons plc since 2006. James Fisher is a leading provider of specialist services to the marine, oil and gas and other high assurance industries worldwide.

Strainstall

MEET **MICHAEL HOOK**

Michael is responsible for the development and growth of the Strainstall range of surface and subsea load monitoring and instrumentation equipment for use within the renewable sector with a focus on Floating Offshore Wind, Wave & Tidal.
Prior to joining Strainstall in January 2019 he was General Manager of Sustainable Marine Energy Limited, a turnkey supplier of integrated tidal energy generation systems.

MEET **FRANK ROSE**

Frank's background is in Marine Technology, Mechanical and Electrical Engineering, including CFD, FEA and Naval Architecture. His main areas of responsibility have included bid preparation, engineering design, materials specification, bid management, cost control, reporting and planning, commissioning and offshore installation.

Michael Hook

Frank Rose