Floating wind - Risk analysis towards bankability

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Floating wind - Risk analysis towards bankability

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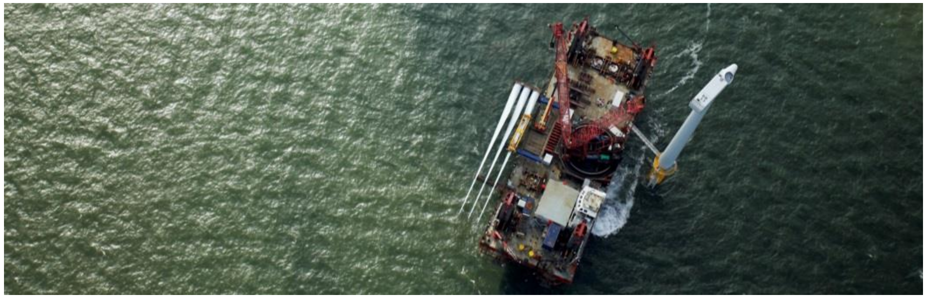


1. Green Giraffe – The renewable energy finance specialist

We get deals done

Deep roots in renewable energy finance

- Launched in 2010 by experienced finance specialists with a **strong and proven track record** in renewable energy
- 60+ professionals with offices in Hamburg (Germany), London (UK), Paris (France) and Utrecht (the Netherlands)
- Multi-disciplinary skill set including **project & structured finance, contract management, M&A, and legal** expertise

High quality, specialised advisory services

- Focus on projects where we can actually add value
- We can provide a holistic approach and are able to include sector-specific tasks in addition to traditional debt or equity advisory (such as contracting, strategic advisory and development services)
- Widening geographical reach with a burgeoning presence in the Americas and Africa in addition to Europe
- Priority given to **getting the deal done!**

Close to **EUR 15 billion** funding raised for renewable energy projects in **7 years**

60+ professionals in **4 countries**

Involved in over **80 renewable energy projects** with a capacity of more than **18 GW**

1. Green Giraffe – What we can do for you

Proven track record in closing deals and maximising value for our clients and their projects

What Green Giraffe brings to the table

- Specialised expertise in **fund raising and financial structuring**, project development and contracting for complex transactions
- **Credibility in the equity markets** through a strong and proven track record in buy/sell side advisory and brokerage in the wind and solar industry
- An **extensive and first class network with investors, contractors, banks, advisors and intermediaries** in the renewable energy market
- The lessons we have already learned will enable you to optimize the development process and **avoid costly mistakes and delays**
- We are deeply **committed** to the success of our clients and we offer you **highly competitive fee structures** including **success oriented schemes**

Strategic advisory

- Corporate strategy advisory and market intelligence
- Technology and project bankability assessment
- Business plan analysis, financial modelling and valuation

Debt and equity raising and structuring

- Detailed financial analysis and valuation
- Fully structured packages to banks or potential investors
- Commercial negotiations with investors or banks
- For greenfield or brownfield projects

Assistance in project development and contracting

- Support in early project development (business plan, tariff tenders, permit process)
- Project- and sponsor-specific contracting services
- Support in negotiation (or review) of commercial terms, e.g. EPC warranties, availability levels, etc.

1. Principle Power – Globalizing offshore wind

An innovative technology and services provider to the offshore wind industry

Presence worldwide

- All disciplines in house: engineering and operations
- Offices in California, France and Portugal

Strong industry backing

Shareholders

edp, REPSOL, A.SILVA MATOS, PORTUGAL VENTURES

Partners

eit KIC InnoEnergy, Shell

A proven technology

Successful 5 years full life cycle demonstration

- 2 MW Vestas turbine injected 17 GWh in to the grid
- Operational until 12 m waves, survived 17 m waves

Pre-commercial projects

In progress

- Portugal: WFA (2019)
- France: Gulf du Lion (2020)

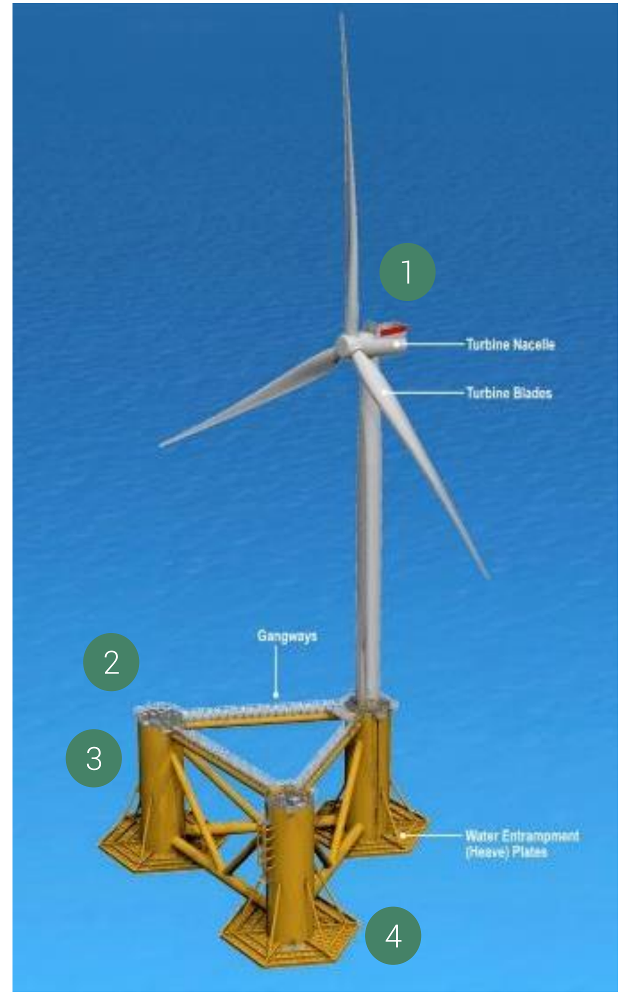
Commercial developments

- USA: CA, HI, North East
- Asia: Taiwan, Korea, Japan
- EU: France, UK, Portugal

1. The WindFloat technology

Risk analysis considers unique features of the WindFloat

1. Turbine agnostic
2. Hull trim system 'Active ballast system'
3. Water ballast (operational draft)
4. Heave plates (dynamic response)



Cost

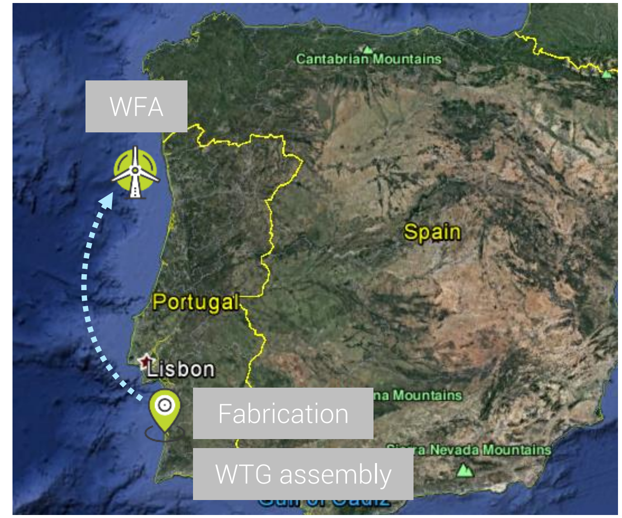
- Light structure
- Serial production
- Onshore commissioning
- Low cost vessels

Risk

- Widely available vessels
- Limited offshore work
- Onshore large correctives
- Lower weather risk

1. The WindFloat Atlantic project

Risk analysis leverages WindFloat Atlantic project experience



Overview

- Location: 20 km off the coast of Viana do Castelo (PT) in 100 m water depth
- Turbines: 3 x MHI Vestas V164
- Construction: same shipyards as for WF1, WTG installation at quayside in Sines
- ABS Certification: design (25 years lifetime), construction and installation

First non-recourse financed floating offshore wind project

- Equity closed at end of 2015 with major international players
- The WindFloat Atlantic project in Portugal (25 MW) delivered under a traditional non-recourse financing structure
  - EIB: InnovFin program
  - EKF: Denmark's export credit agency
  - Commercial banks
- Term sheets approved, project in advanced stage of due diligence

1. Collaboration between Green Giraffe and Principle Power

Risk analysis of the WindFloat technology

Background of the collaboration

- The parties shared a mutual interest in assessing development, construction and operational risks associated with the WindFloat technology
- Technology providers need funds to advance the deployment of their technologies, thus the interaction with the financiers is crucial for the floating offshore wind sector to reach commercial utility scale
- A key aspect of commercialisation of floating offshore wind is to ensure that investors and lenders understand the risks involved with this technology and obtain comfort that such risks can be managed

A risk assessment case study to serve as a functional model

- Objectives of the joint rehearsal
  - Model a hypothetical commercial floating offshore wind farm (same technology as WFA)
  - Produce a project risk register that considers development and technology risks specific of the floating technology
  - For each risk, estimate the probability of occurrence and cost impact
  - Assess the mitigation solutions which can be adept to control the project risks
  - Estimate feasible requirements for contingency funding

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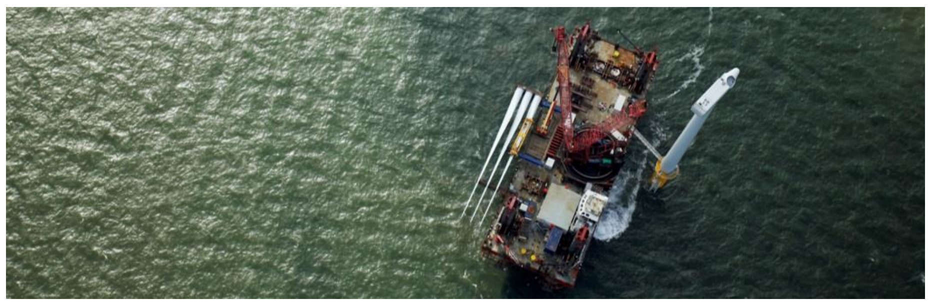
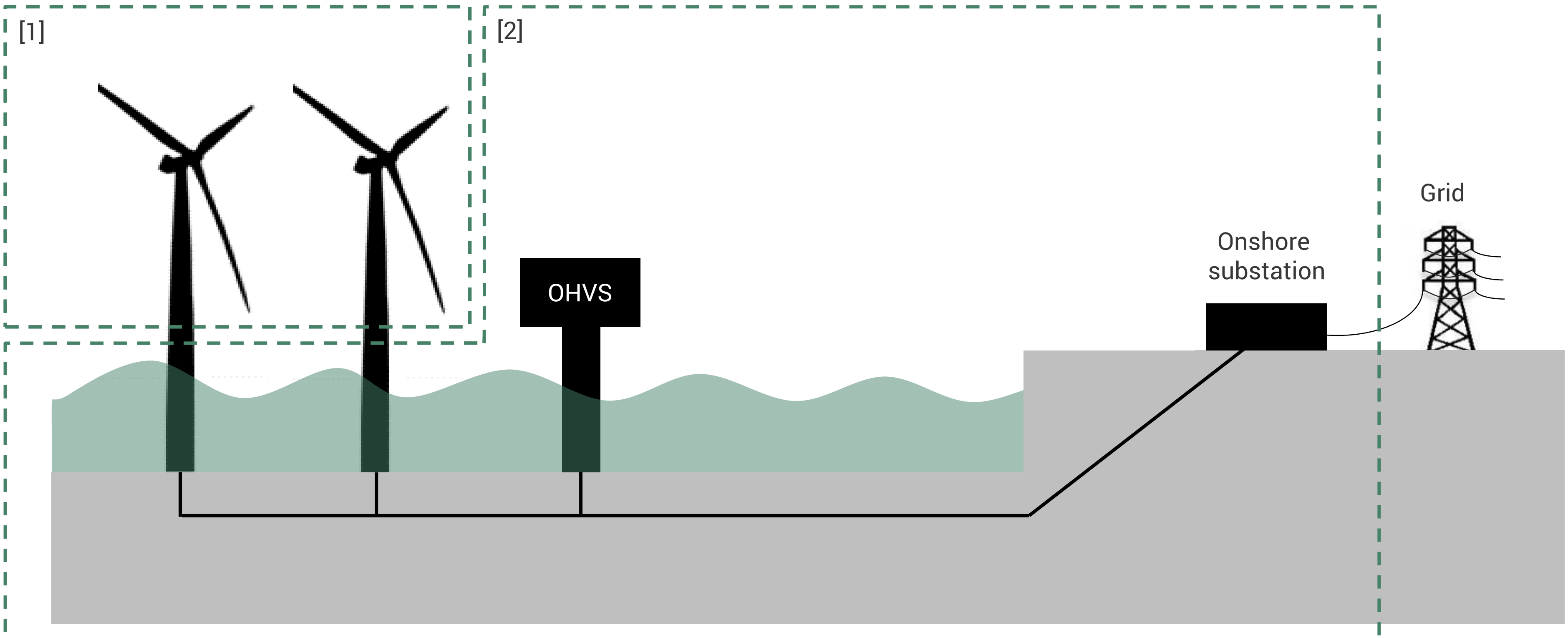


2. Approach to risk management

Contractual structuring

The traditional offshore wind contracting strategies with bottom-fixed farms

- Current preference for very low number of contracts (3 of fewer)
- With pricing based on fixed lump sum contracts

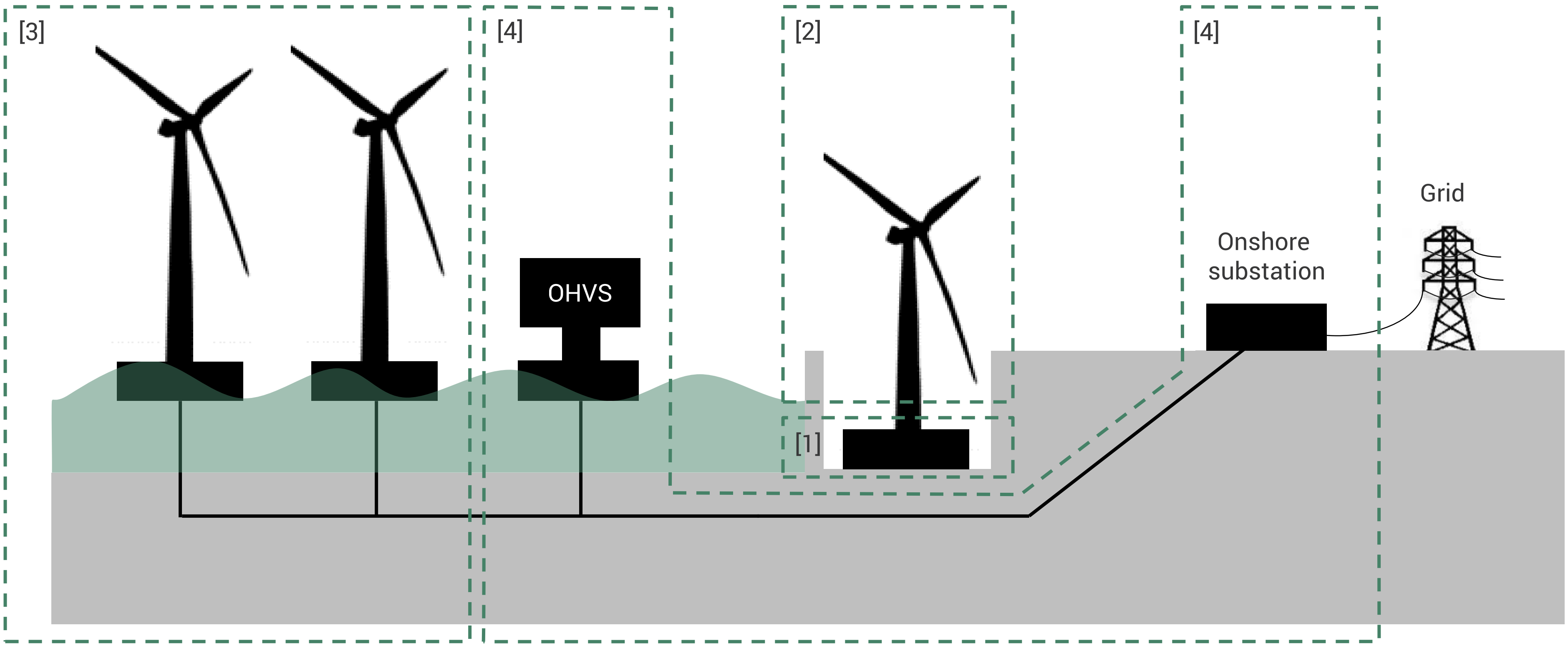


2. Approach to risk management

Contractual structuring of floating offshore wind

Built on the bottom-fixed offshore wind experience with a few technology specific adjustments

- Scope divided between four contract lots: [1]. foundations, [2]. WTGs, [3]. offshore services, [4]. export system
- With pricing based on fixed lump sum contracts



2. Approach to risk management

Risk allocation and interface are key

Interaction between floating technology and turbine to be developed in an integrated way

- Design certified by a reputable classification society
- Project acquires a license from the floating technology provider and fabricator takes responsibility for its realization
- Weather risk borne by the contractors or priced into the base case contingency funding
- Construction schedule contractually supported by liquidated damages high enough to compensate the loss for the project as a consequence of being delayed
- Absolute liability caps high enough to cover for liquidated damages that compensate the loss for the project as a consequence of being sued

Turbines and foundations service agreement (15 years), lease agreements with Marshalling and service harbours (20 years)

- Maintenance of floating foundations synchronized as much as possible with WTGs (minor repairs on site as for conventional technology), with large correctives (major up tower repairs) to be performed at quay side with land based crane
- Turbine supplier to warrant availability of turbines excluding carve outs (e.g. accessibility due to adverse weather, turbine out of operational envelope in heel angle and accelerations - floating motion dissimilar to design)
- Turbine supplier to warrant the power curve minus the uncertainty of the measured power output during the DNP and the impact of the floating motion (being detrimental or beneficial to the power curve)

Technical and contractual interfaces need to be well identified and carefully managed

2. Approach to risk management

Model a hypothetical commercial floating offshore wind farm

Assumptions

- Permitting in place and Environmental Impact Assessment (EIA) approved
- Grid access arranged (onshore substation, corridor for export cable, PPA)
- Support mechanism awarded (Contract for Difference)
- Pre-completion revenues considered per array of floating wind turbines (i.e. 3 arrays = 3 CfD starting dates)
- Conservative construction schedule, based on a P90 weather scenario
- Regulation of works via industry standards for health and safety assessment and environmental management system
- Insurance package: construction and operations all risks, delay in start up, third party liability and business interruption (to cover only external events, not internal ones such flaw in the design, etc.)

Uncertainties

- Wind measurement and extrapolation (FLiDAR sustained by correlation from met mast)
- Interannual wind variation
- Wake modelling (both general and specific to floating)
- Power curve uncertainty, including floating motion
- Plant availabilities (WTG, floating foundation, offshore substation, grid)

The project contingency funding is defined on the basis of

- Qualitative and quantitative risk register (full detailing)
- Project uncertainties (estimate)
- Major delay scenarios (preliminary analysis)

2. Risk analysis

Risks have been captured for each package via sector experts and group workshops

The risk register allows for listing and reporting, providing a complete overview of the project exposure

- Each risk has been assessed in terms of
  - Causes and consequences
  - Probability of occurrence (min, max)
  - Present cost impact (min, most likely, max)
  - Mitigation solution and target cost impact (post mitigation)
- The risk register includes a Quantitative Risk Assessment (QRA) that facilitates the calculation of project contingency funding

Monte Carlo simulation methodology to size contingency funding

- The Monte Carlo simulation is considered the best practice approach to quantify the cost of risks associated with complex projects and to estimate contingency funding
- Multiple iterations are generated, each being a unique and deterministic scenario, characterised by the same risks defined in the risk register and representing a potential outcome of the project
- These multiple resolutions are then used to generate a single probabilistic function that defines the project total risk exposure
- From this function probability levels (i.e. P50, P75, P90, P99) can be determined

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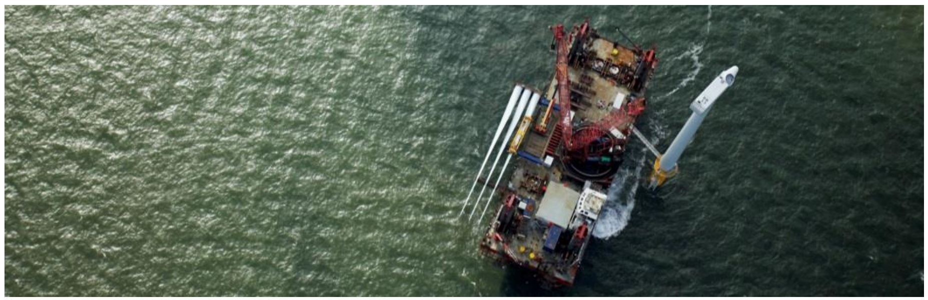


3. Risk register highlights

Design and certification

Risk control starts with design process

- Design standards are adapted from the Oil & Gas and conventional offshore wind sectors, verified through long track record in both industries
- Turbine supplier defines WTG performance criteria (e.g. accelerations, heel angle)
- Floating technology provider designs foundation to keep WTG within operational & extremes envelope
  - WTG supplier collaboration is central to define requirements and confirm acceptability of performance
- WindFloat technology adapted to turbine specifications and site conditions
- Full system simulation according to standards with software validated with performance data from WF1
- Classification society (e.g. DNV GL, ABS, BV, ClassNK) reviews and confirms that design process complies with all performance objectives

Risks	Mitigation solutions
• Certification process delay (design interface WTG-FOU)	• FID after design approved for construction
• Production underperformance (defective design)	• Early and full involvement of WTG supplier
• Component damage / excessive wear / catastrophic failure	• Certification review of entire design process

3. Risk register highlights

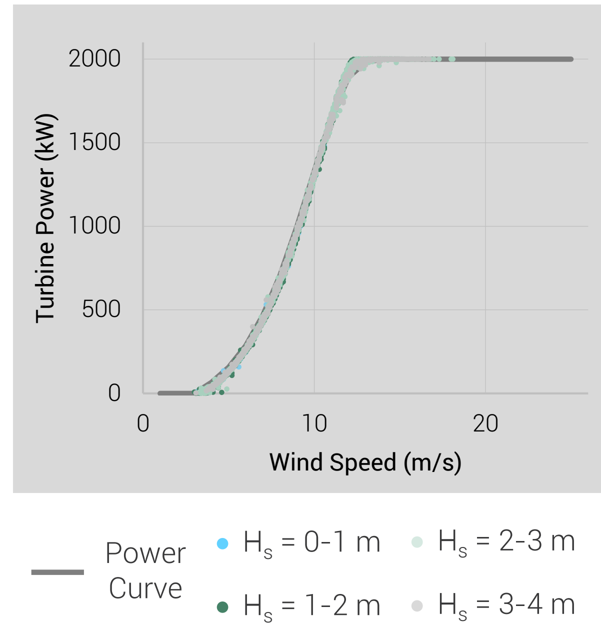
Turbine performance

WF1 track record confirms turbine performance

- Full scale 2 MW turbine for 5 years in operation
- No power losses or negative effect on turbine performance
- High system availability (excluding grid issues)
- Inspection at decommissioning confirmed healthy turbine, sold for re-use

Contracting of supply and servicing of turbines influences risk exposure

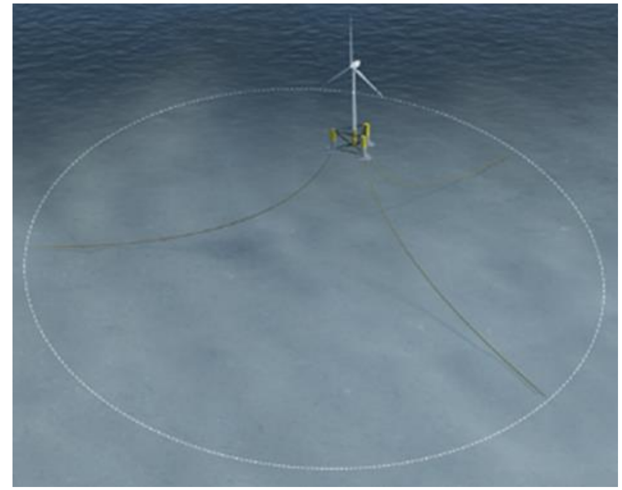
- Choice of an experienced turbine supplier (WFA project: MHI Vestas V164)
- Essential TSA and SAA/SMA items critical to bankability



Risks	Mitigation solutions
• Turbine-floating foundation interface	• WTG & FOU long term service agreements
• Availability or production penalties	• WTG & FOU component warranties, availability guarantees
• Component damage / excessive wear	• WTG power curve guarantee

3. Risk register highlights

Mooring scheme and seabed interface



Provides interface between floating wind turbine and seabed

- Function to provide station keeping (not stability) - Windfloat technology
- Designed according to standards with safety factors, in conjunction with geophysical and geotechnical campaign
- Catenary configuration with low pre-tension to reduce vessel requirements
- Anchors embedded in advance, mooring lines pre-tensioned before hook up of floating wind turbine

Off the shelf components with proven track record

- Drag embedment anchors from maritime industry, mooring lines from Oil & Gas
- Proven connectors allow simple hook-up/disconnect of floating wind turbines

Risks	Mitigation solutions
• Seabed geotechnical conditions not as expected • Mooring system deficiency • Component damage / excessive wear / catastrophic failure	• Effective project management and planning, due diligence • Seabed campaigns according to best practices • Independent certification (design, fabrication, installation)

3. Risk register highlights

Foundation fabrication and assembly

Design robustness tested in extreme met-ocean conditions

- 5-year inspection of WF1 platform showed no structural damage
- Significant track record in use of steel for floating Oil & Gas platforms and conventional offshore wind
- Fabrication quality enforced through monitoring by classification society, strict acceptance criteria and long term platform warranty

Commercial project requires serial production

- Facility investment needed to serialize aspects of fabrication
- Leverage on existing supply chain for sub-components fabrication
- Careful planning and conservative scheduling to reach target volumes

Risks

- Schedule delay, knock on effect
- Cost overruns (e.g. steel price, exchange rate, loss in PCR)
- Component damage / excessive wear / catastrophic failure

Mitigation solutions

- Effective project management and planning, due diligence
- Counter party analysis of suppliers and contractors
- Independent certification (design, fabrication, installation)

3. Risk register highlights

Electrical infrastructure

Inter-array and export cables

- Dynamic cables available (e.g. 66 kV inter-array cables at WFA project)
- Proven track record in the Oil & Gas sector at medium & high voltages
- PPI patented solution for dis/re-connection of individual turbines from array cables to enable large correctives maintenance at quay side

Floating offshore substation

- No technical barriers to locate high voltage equipment on a floating platform (long history of powering applications in the Oil & Gas sector)
- Engineering required to achieve design for commercial scale substation
- Several certified suppliers available for top side, platform to follow principles of floating foundation for turbine (i.e. meet top side requirements)

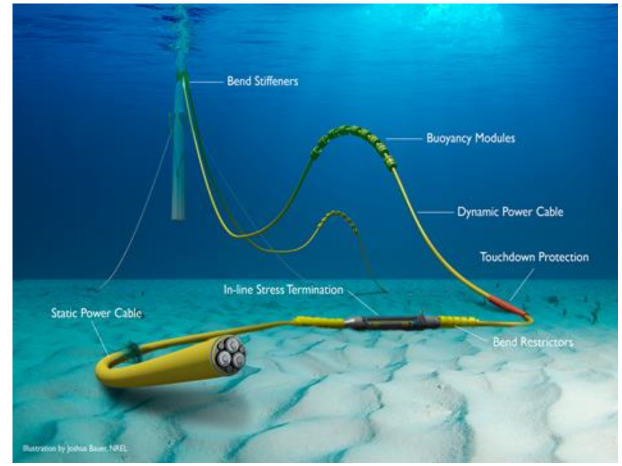


Illustration by NREL (US Department of Energy)

Risks

- Dynamic cables performance (design or mechanical)
- Interface issues between IAC and WTG
- Floating substation cost overruns and performance

Mitigation solutions

- Effective project management and planning, due diligence
- Counter party analysis and early engagement of suppliers
- Extra cable sections and spare ancillary equipment

3. Risk register highlights

Turbine assembly and offshore installation

Straightforward sequencing of activities

1. Pre-laid in advance: anchors embedded and proof tested at design load, mooring lines wet stored
2. Turbines installed on floating foundations at quayside by land based crane
3. Floating wind turbine towed to site by standard offshore tug boats and hooked up to pre-installed mooring lines
4. Inter-array cables laid and connected to floating wind turbines

Low sensitivity to weather – all assembly activities land based (including lifting)

- Only commissioning done offshore, hook up most sensitive activity (Hs < 2.5 m)
- Low commercial implications if adverse weather (vessels EUR 15-30 k/day)

Risks	Mitigation solutions
• Schedule delay (e.g. late delivery, adverse weather)	• Effective project management and planning, due diligence
• Contractors interfacing (WTG, fabricator, offshore party)	• Counter party analysis of contractors
• Cost overruns (e.g. fuel cost, exchange rate, loss in PCR)	• Conservative schedule, including delay scenario analysis

3. Risk register highlights

Operations, maintenance and decommissioning

Scheduled maintenance and minor corrective repairs

- Same approach as for conventional offshore wind farms
- Access through CTV, SOV or helicopter - validated by WF1
- Turbine minor repairs on site with on board crane

Large correctives maintenance

- Mooring scheme and inter-array cables designed for disconnection of individual turbines
- Large correctives (major up tower repairs) to be performed at quay side with land based crane
- Floating wind turbines to be towed with local tug boats - procedure validated through successful decommissioning of WF1

Risks

- WTG & FOU availabilities, adverse weather (accessibility)
- Failure predictability (e.g. damage, wear, corrosion rate)
- Unavailability of infrastructure for large correctives

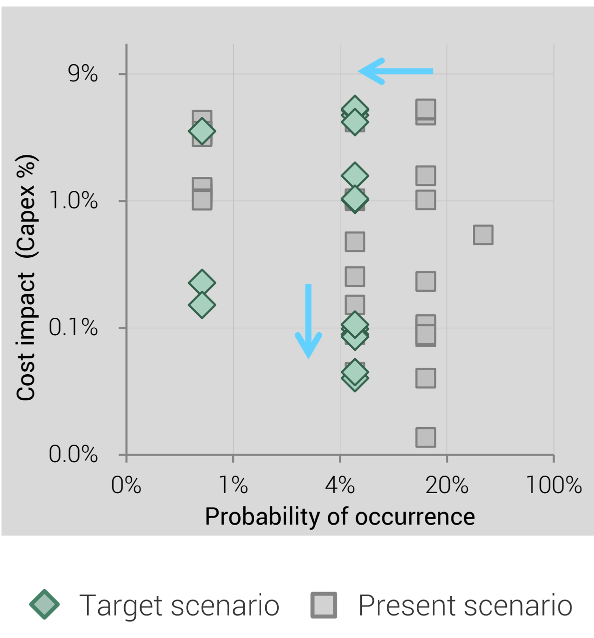
Mitigation solutions

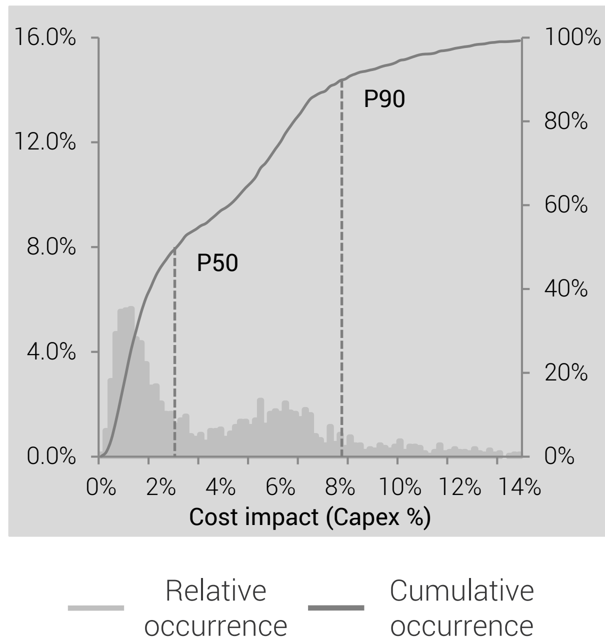
- WTG & FOU long term service agreements with spare parts
- Farm access strategy to protect cables and mooring lines
- Options for large correctives (quay side, land crane)

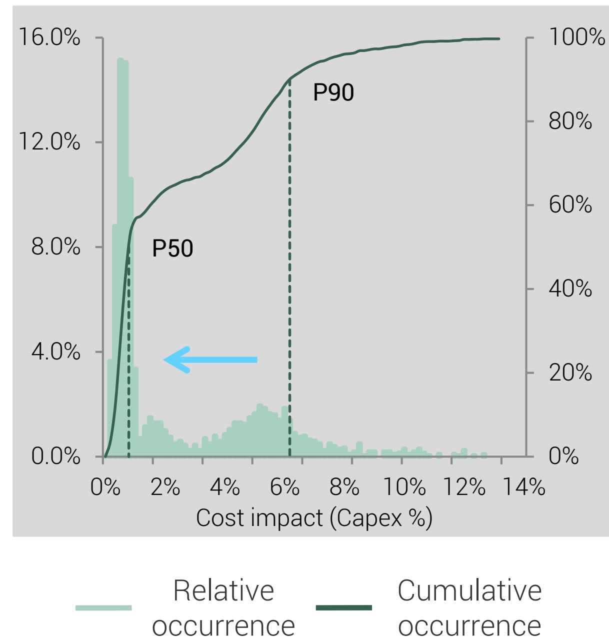
3. Further risk analysis outcomes

The qualitative and quantitative evaluation of risks

Risk mapping	Present risk exposure	Target risk exposure
The risk are mitigated through technical and contractual solutions	Estimate of most likely contingency around 2% of Capex with P90 of 8%	The mitigation solutions optimize the total project risk exposure







Project financing is about risk analysis: making risks visible & measurable and mitigating them

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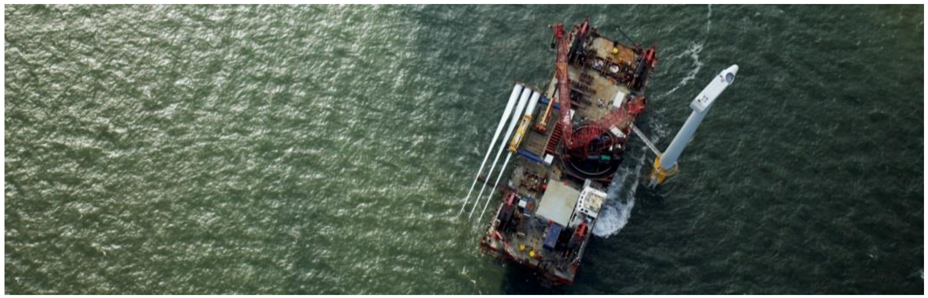


4. How projects are financed

"Balance sheet" (equity) vs "non-recourse" (debt)

Large projects are typically developed through a stand alone project company

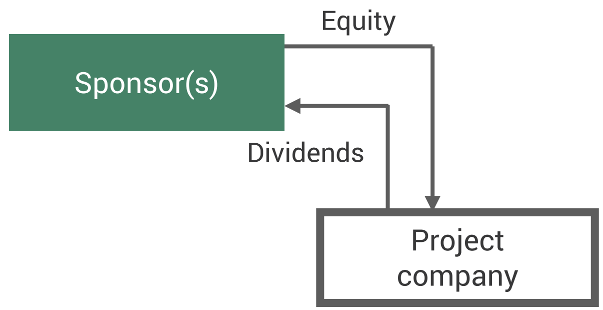
- Owned by the project investors
- With its own revenues & balance sheet and thus the ability to raise debt on its own merits

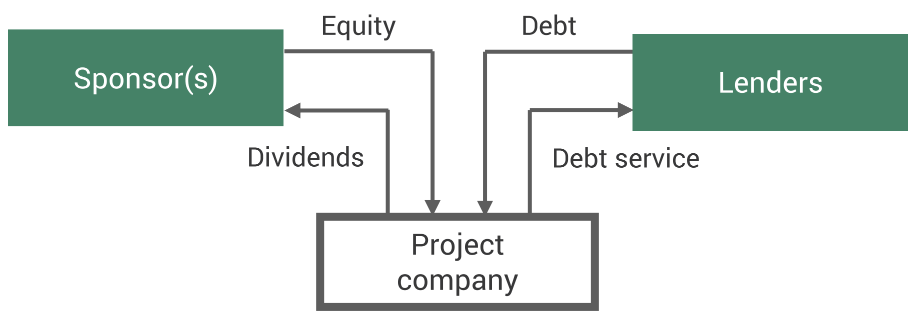
There are only two discrete sources of funding

- By the owners (directly via equity or shareholder loans, or indirectly via guarantees)
- By banks without recourse to the equity investors – this is "project finance"

The way a project is funded will have a material impact on how it deals with contractors

- In a project finance deal, you need to deal with the senior lenders' requirements!
- Tax, accounting, consolidation and rating issues





All parties have a direct incentive to understand who will be funding the project

4. Equity providers for offshore wind – the different profiles

Investors and appetite for risk

Investor	Perm.	Dev.	Constr.	Ops.	Notes	PF
Utility	Yes	Yes	Yes	Yes	A proven solution. Requires good cooperation to manage projects jointly as few are willing to take passive stakes. Many are "full"	If possible
IPP	Yes	Yes	Yes	Yes	Developers experienced in offshore wind, from European pioneers (PNE, wpd) to global IPPs (NPI, Deepwater). Flexible and pragmatic	Yes
Private equity	Some	Yes	Yes	No	Require high returns and typically either involvement in dev. phase and/or aggressive long term assumptions. Control & exit are issues	Yes
Municipal utility	No	Maybe	Some	Yes	Have small but strong balance sheets. Can be part owners. Slow decision process. Stringent risk requirements. Required IRR is low	Probably
Sovereign wealth funds	No	Maybe	Some	Yes	Require simple contracting structure, long term O&M agreements and controlling partner. Masdar took on construction risk	Not necessarily
Infra funds	No	No	Maybe	Yes	A large universe of potentially interested parties. Most still require construction risk mitigation and long term O&M agreements	Probably
Corporations	No	No	Maybe	Yes	Invest to hedge power price risk or for strategic/marketing reasons. Happy (or require) to be minority shareholder strategic investor	Not necessarily
Pension funds	No	No	Maybe	Yes	Generally do not like construction risk. Some have shown interest to step in at FC (done on Butendiek). Need long term O&M agreements	Not necessarily
Contractors	No	Maybe	Yes	No	Are taking stakes or providing subordinated vendor loans to secure project pipeline. Often need a clear perspective on exit after COD	Not necessarily

4. Equity providers for floating offshore wind

Limited appetite for early deals

Industrial investors will dominate the early projects

- Utilities interested to test a new market segment
- IPPs looking for the "next new thing" – some private equity players might have the same approach
- Small developers – if they can find the early development equity

Strong political support required

- Outright investment subsidies required for early projects (demonstrators and early commercial projects)
- This will be needed in addition to the specific tariff likely to be required for such projects
- EU programmes (via EIB or otherwise) can contribute

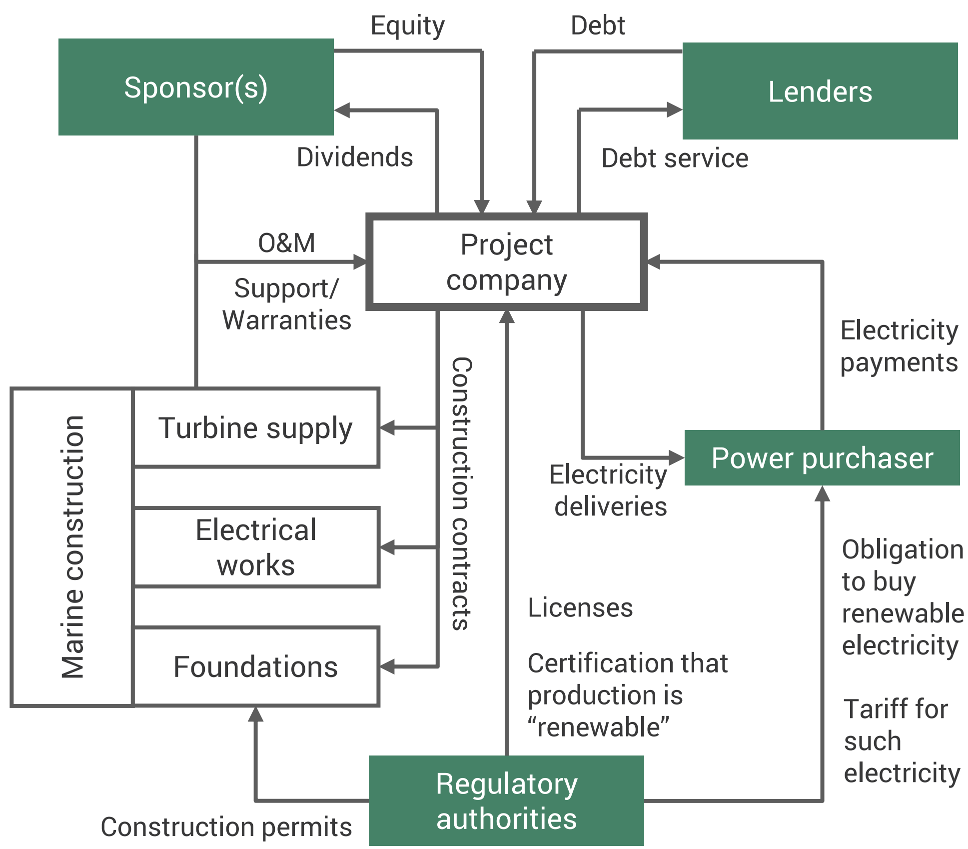
With the early demonstrators in the water for years, investors are actively looking at the sector

4. Debt for offshore wind

Offshore wind transactions are always heavily contracted

Major contracts include:

- Permits, licenses, authorisations, etc…
- Construction/supply contracts
- Electricity sales contracts (and, if applicable, green certificates / RO contracts)
- O&M contracts
- Financing documents



Offshore wind is a quintessential example of a comprehensive contractual structure

4. Offshore wind project finance – the early deals (1/2)

Early deals – 4 transactions around the financial crisis

Q7 (also known as Princes Amalia) (2006, the Netherlands, 120 MW, Vestas V80, EUR 219 M financing)

- The very first deal – set a number of precedents (debt sizing principles, multi-contract construction risk taken via heavy due diligence and contingent funding, 10-year O&M package)
- 3 MLAs, 3 additional banks, plus key support from EKF

C-Power phase 1 (2007, Belgium, 30 MW, Repower 5M, EUR 126 M financing)

- Consolidation deal – a more aggressive version of the Q7 structure (longer tenor, some merchant risk)
- 1 MLA, 3 additional banks, no multilateral

Belwind phase 1 (2009, Belgium, 165 MW, Vestas V90, EUR 544 M financing)

- First deal post-financial crisis – allowed to confirm that the early structures were sound (construction risk, some merchant risk) while increasing the size thanks to heavy multilateral involvement
- 3 MLAs, EIB and EKF, no syndication – heralded the "club deal" period

Boreas (2009, UK, 194 MW offshore, Siemens 3.6-107, GBP 340 M financing)

- First UK deal, with a large number of banks (14 altogether)
- No construction risk, but funding under the UK ROC regime, with some merchant risk

4. Offshore wind project finance – the early deals (2/2)

Early deals – pioneers and precedent-setting, but with a small number of players

Successful structures – and really non-recourse!

- DD + contingency mechanism structure to bear construction risk validated in subsequent deals
- Construction risk with multi-contract structure validated and repeated
- Repeated with several different turbines, sponsors and regulatory regimes
- All early projects built within agreed budget and timetable, and now operating to full satisfaction

A fairly small number of players involved

- Only a small number of institutions actually took construction risk
- Heavy reliance on a small number of multilaterals (EKF, EIB)
- The same advisors and people in almost every deal

A difficult market context

- No syndication market for what are fairly large deals – thus a need for "everybody" on each deal
- Lack of precedents at a time banks were retreating to favoured clients and familiar risks

4. Debt for floating – what will be possible

Debt could be raised for the first commercial projects

The players

- By necessity, public financing institutions such as BPI, EIB and EKF will need to play a strong role
- Some commercial banks should be willing to finance early projects with the right parties and structure

The terms

- The early deals will naturally have conservative debt terms compared to traditional offshore wind
- A key requirement will be to have lower leverage (50:50 or 60:40 would be a more reasonable target for early projects)
- Pricing will be above offshore wind, but likely not by much (50-100 bps premium)

The other requirements

- Specific due diligence will be required on the items which are new to lenders
- Availability guarantees from the right parties (commitment of the floater provider to be discussed extensively)
- Ample contingency budget, both for construction and for maintenance
- Focus on transparency, availability of track record, and strength of industrial counterparties

Debt terms will not be aggressive, but should still help investors

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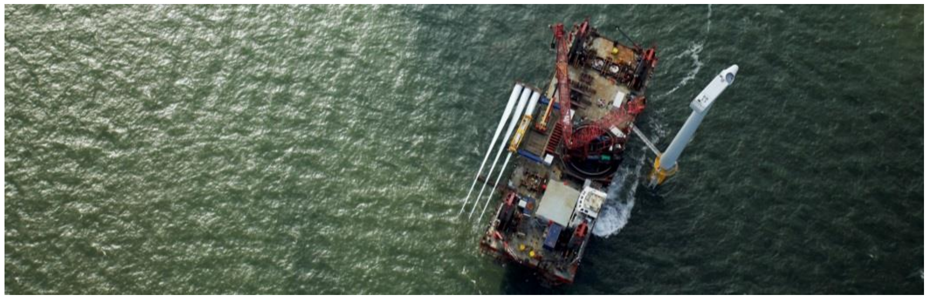


5. Conclusion

Funding is available for the pioneers, but will be subject to strict conditions

The most advanced technologies will be the first to be financed

- Those with full scale demonstrators already installed, and with a satisfactory operating track-record
- Project sponsors will need to make the effort and take the time to educate financiers on this young technology
- Terms will be guided by market precedents, to the extent they are applicable

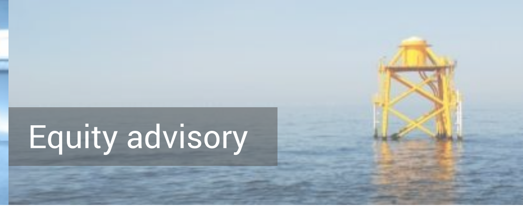
Extensive due diligence and contractual requirements

- Transparency regarding the technology is critical
- Technical advisors trusted by the financiers should be involved early
- Thorough risk assessment and management process are paramount
- The contractual structure should be adapted on the corporate strength of the technology providers
- Specific focus on the experience of the supply chain and development team

Different players for different stages

- Venture capital for technology development financing
- Private equity and developers for early projects
- Infrastructure funds and PF banks for larger projects

Floating wind can raise financing if it targets the right financiers and meets their requirements



Green Giraffe

The renewable energy financial advisors

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green-giraffe.eu