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MAIN CHALLENGES OF OFFSHORE WIND

Investment and Operational Costs

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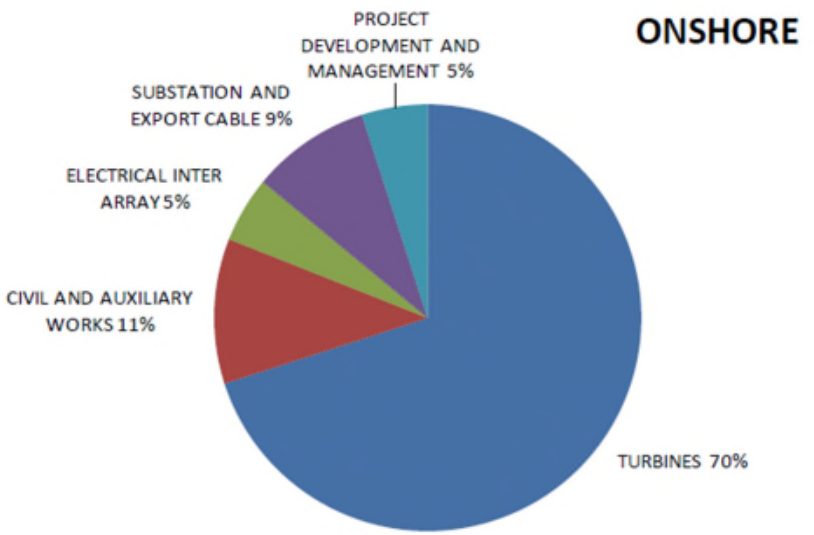
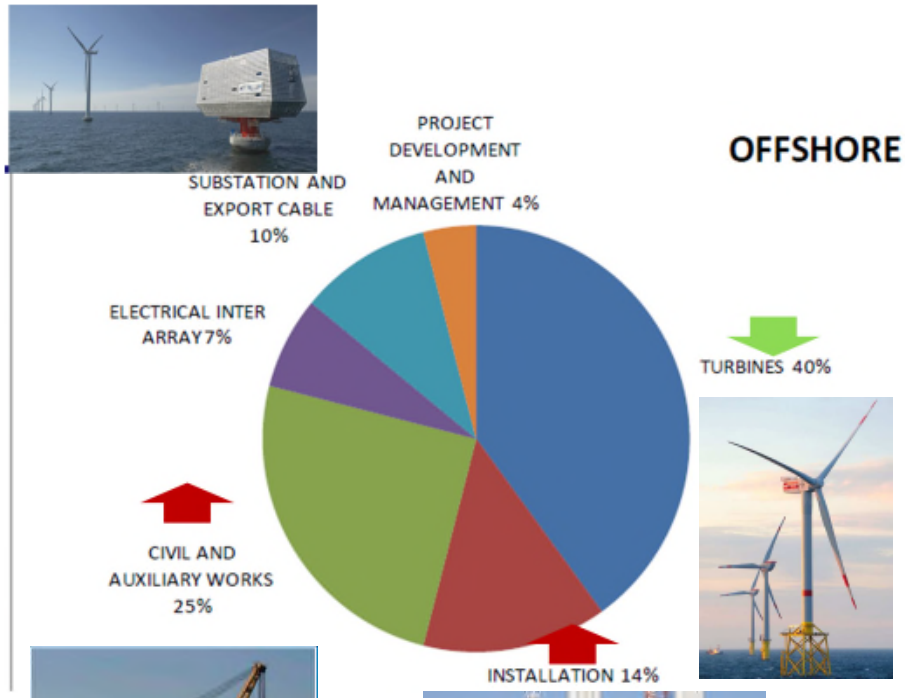
Onshore vs Offshore

Different cost breakdown and risk allocation





Multicontracting strategy is most common approach in Offshore to manage risk and get costs down

Higher Capex and Opex than onshore, but also higher capacity factors

Cost Profile during project phases

Duration of Offshore Projects require economic and regulatory stability

A typical project requires around 8-10 years, first 4-6 to reach FID

	Development	Pre FID	ID Approval	Post FID	Construction
Definition	Permitting process after exclusivity granted	Project design		Closing of contracts and construction kick-off	Offshore facilities construction
Main Activities	• Environmental and site studies (Resource, geophys, constraints, etc) • Consenting ***Reaching certainty on the development viability***	• Detailed engineering, geotechnical studies, etc. • Tendering ***Reaching a final project design, ready to allocate contracts***		• Contracts closing • Main supplies manufacturing • Launch of construction of onshore facilities	• Offshore installation
Timing	2,5 / 3,5 years *	1,5 / 2,5 years *		2 years *	2 years *

+ potential pre-FID commitments to secure long lead items or slots: HVDC, vessels,…

1%-1,5%	***5%***	*3,5%-4%*	***95%***

Most of the CAPEX will be committed post Final Investment Decission however relevant commitments will have to be incurred pre FID at risk

Cost of Energy. Drivers

Strong focus on CAPEX reduction. Many elements of the wind farm contribute to this

$$LCOE = \frac{I_0 + \sum_{t=1}^{n} \frac{A_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{M_{el}}{(1+i)^t}}$$

LCOE	Levelised cost of energy in $Euro_{2012}$/MWh
I_0	Capital expenditure in Euro
A_t	Annual operating costs in Euro in year t
M_{el}	Produced electricity in the corresponding year in MWh
i	Weighted average cost of capital in %
n	Operational lifetime (20 years)
t	Individual year of lifetime (1, 2, …n)

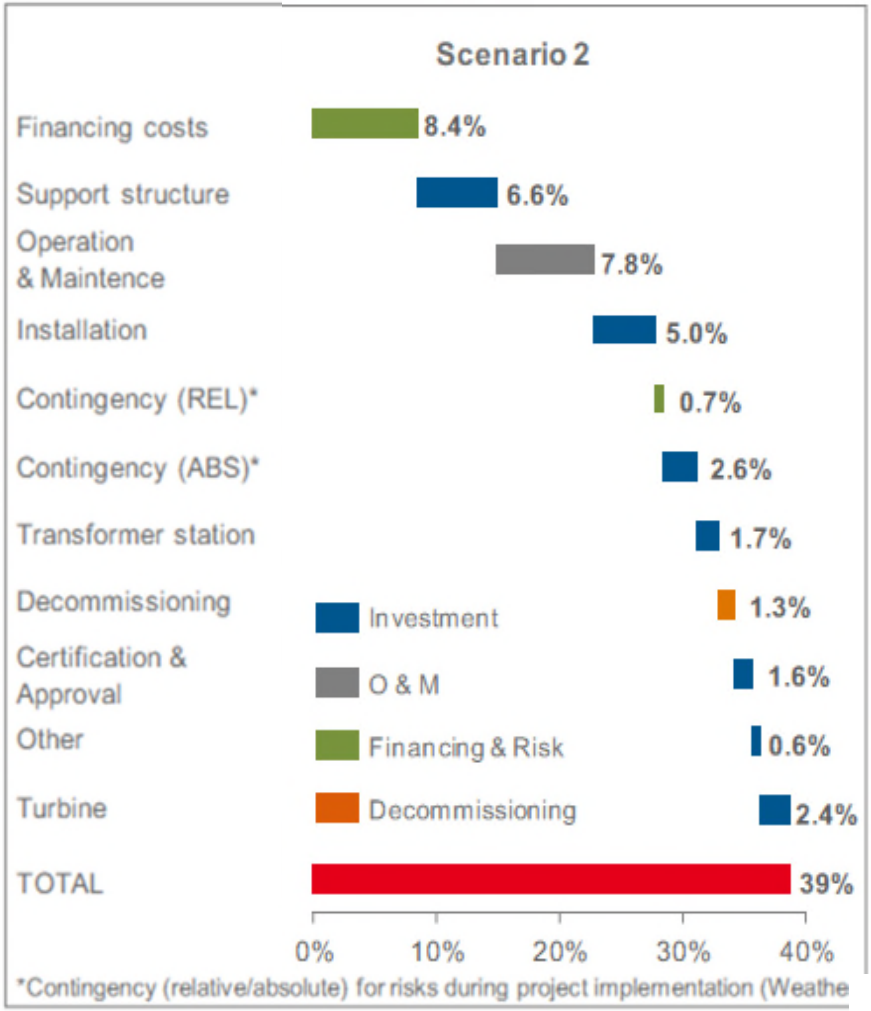
- **CAPEX:** WTGs, structures, electrical infrastructure, installation, risk approach, site conditions,...
- **OPEX:** Site conditions, access systems, reliability, standardisation, mantainability, logistics,…
- **Produced electricity:** Availability, access systems, turbine efficiency, reliability of production estimations
- **Life time:** Design standards
- **Cost of Capital:** Risk profile and perception, financial environment, share of equity,…

There are other factors like energy Production, OPEX and Risk that contribute significantly to CoE

How to achieve targets

35% Cost reduction by 2020 is achievable

Site selection	• Physically and environmentally suitable • Good location for grid and logistics
Technology selection	• Bringing forward the next generation • Reliability, efficiency, durability
Standardisation	• Learning and optimisation • Risk reduction and efficiency
Industrialisation	• Economies of scale • Improved competition



Source: [Prognos / Fichtner]

Volume of projects and market visibility will be crucial

Iberdrola experience and approach to reduce CoE

West of Duddon
400 MW. UK. 2013-2014

- **Standard** Round 2 project on monopiles
- **WTGs**. Increased rotor size
- **Structures**. Standardization of foundations
- **Logistics**. Development of an offshore specific port area increasing installation efficiency and certainty.
- **Logistics**. Use of new generation vessels for foundation installation and WTG installation.

Wikinger.
400 MW. GER. 2016-2017

- **WTG.** Use of upper range of existing turbine size
- Early WTG selection to allow time to **value engineer** the project and optimize BOP.
- Selection of a **Jacket Structure** solution that may become one of the common structures for large scale developments in deep waters

East Anglia ONE
1,2GW. UK. 2017-2019

- **New WTG developments** from 5 to 8 MW under consideration.
- **Standardization** 40 m deep structures.
- **Large scale** wind farms **O&M strategy.**
- **HVDC** export technology under consideration.
- First step towards further and deeper offshore **industrialization**