The Offshore Wind Challenge

Feargal Brennan

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UK Targets

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UK 2020 Target for Offshore Wind is approx 30GW;

Currently 4.7 GW installed in total;

Of this 1 GW is currently operational offshore;

1.5GW offshore currently under construction;

4.5GW consented or in planning;

30GW can be obtained from 6,000 5MW turbines

UK Offshore Wind

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Larger turbines = better Capex (£/MW)

Larger turbines = better Opex (p/kWh)

Average capital costs for offshore wind have doubled in the past 5 years (to £3.2m/MW)

Average expected operating costs have increased by approximately 65% over the same period (to £79k/MW/Anumn)

***Ernst & Young April 2009**

Why?

Among other reasons:

Limited supply base

Foundations (structures) and offshore operations not optimised

Design life is too short

We’re not alone…

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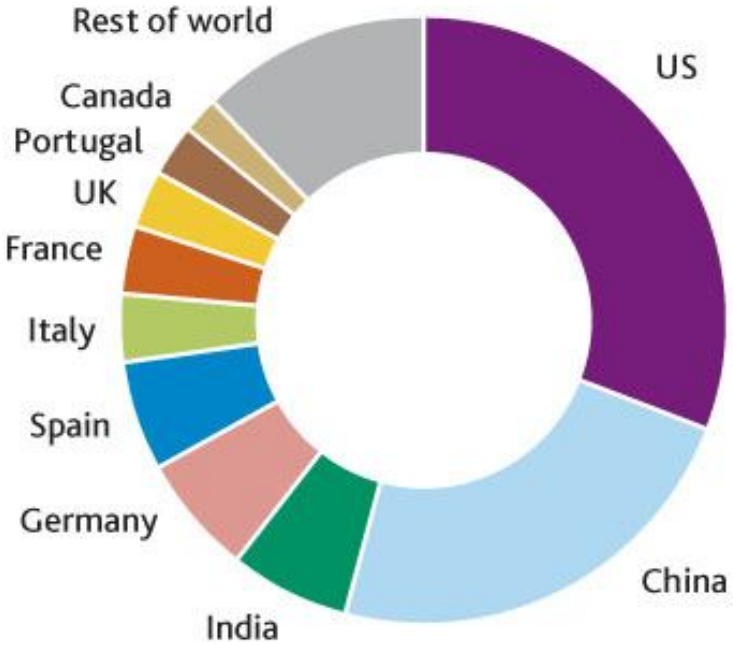
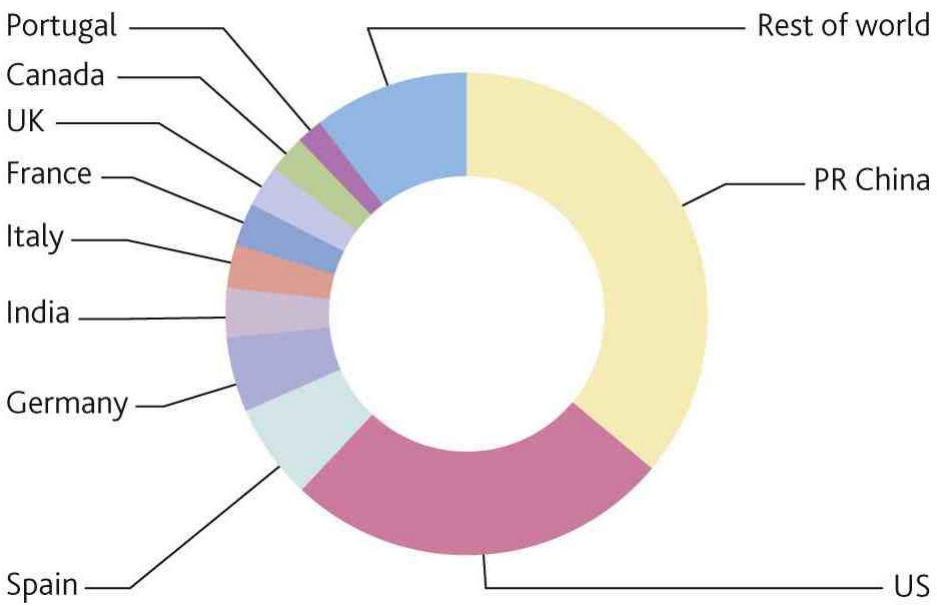
TOP 10 NEW CAPACITY 2008



	MW	%
USA	8,358	30.9
China	6,300	23.3
India	1,800	6.7
Germany	1,665	6.2
Spain	1,609	5.9
Italy	1,010	3.7
France	950	3.5
UK	836	3.1
Portugal	712	2.6
Canada	526	1.9
Rest of world	3,285	12.2
Total top 10	**23,766**	**87.8**
World total	**27,051**	**100.0**

Source: Global Wind Energy Council 2008.

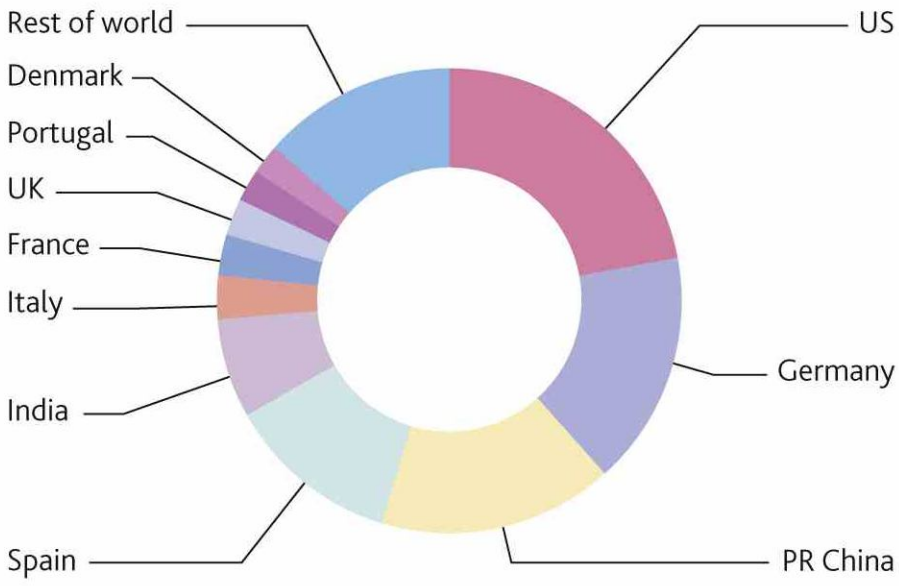
2009 Installed Capacity



	MW	%
PR China	13,803	36.0
US	9,996	26.1
Spain	2,459	6.4
Germany	1,917	5.0
India	1,271	3.3
Italy	1,114	2.9
France	1,088	2.8
UK	1,077	2.8
Canada	950	2.5
Portugal	673	1.8
Rest of world	3,994	10.4
Total top 10	**34,349**	**89.6**
World total	**38,343**	**100.0**

Source: Global Wind Energy Council 2009.

Total Installed Capacity



	MW	%
US	35,064	22.1
PR China	25,805	16.3
Germany	25,777	16.3
Spain	19,149	12.1
India	10,926	6.9
Italy	4,850	3.1
France	4,492	2.8
UK	4,051	2.6
Portugal	3,535	2.2
Denmark	3,465	2.2
Rest of world	21,391	13.5
Total top 10	**137,114**	**86.5**
World total	**158,505**	**100.0**

Source: Global Wind Energy Council 2009.

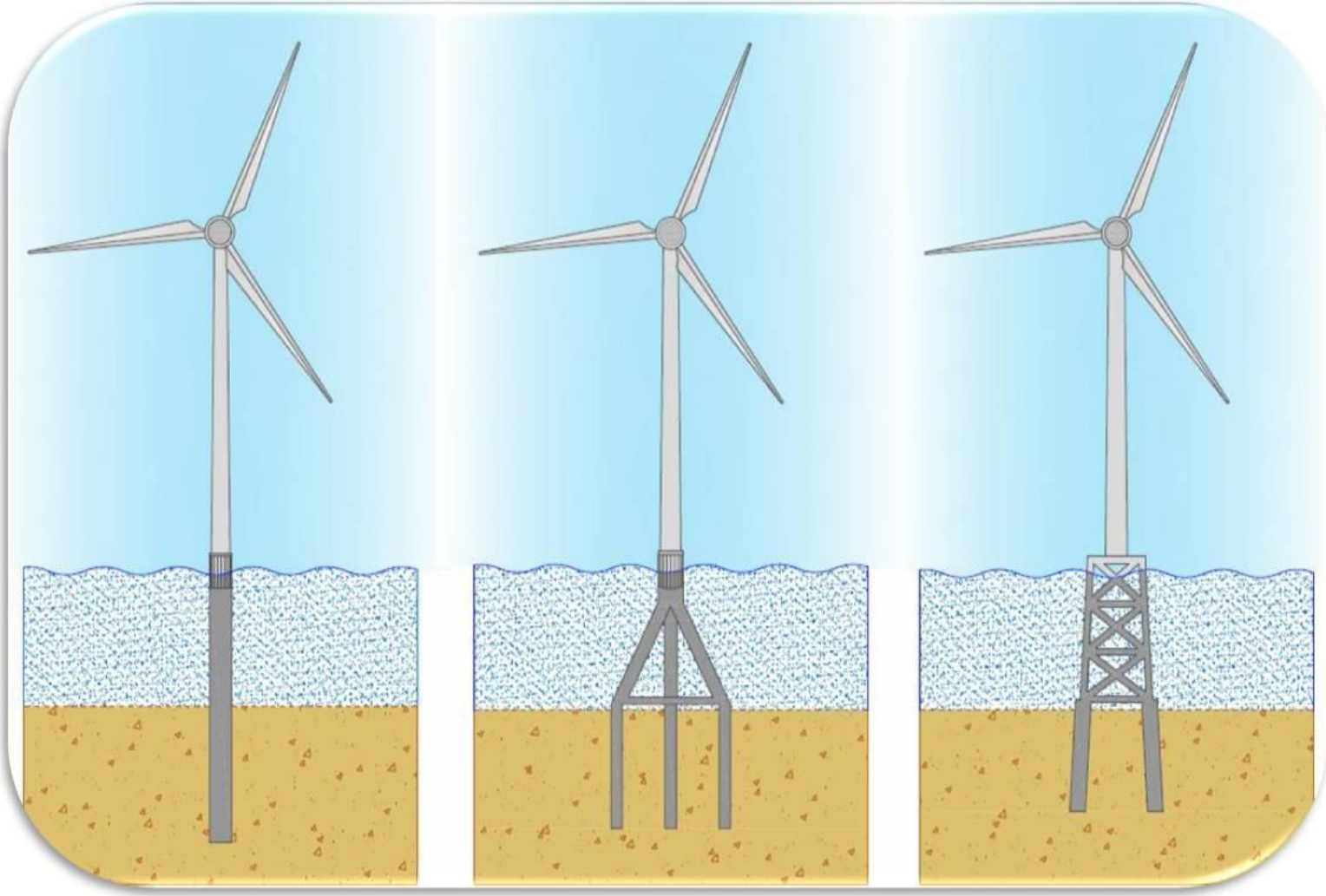
Offshore UK

Many of the “easy” sites have been built or are under construction/planning;

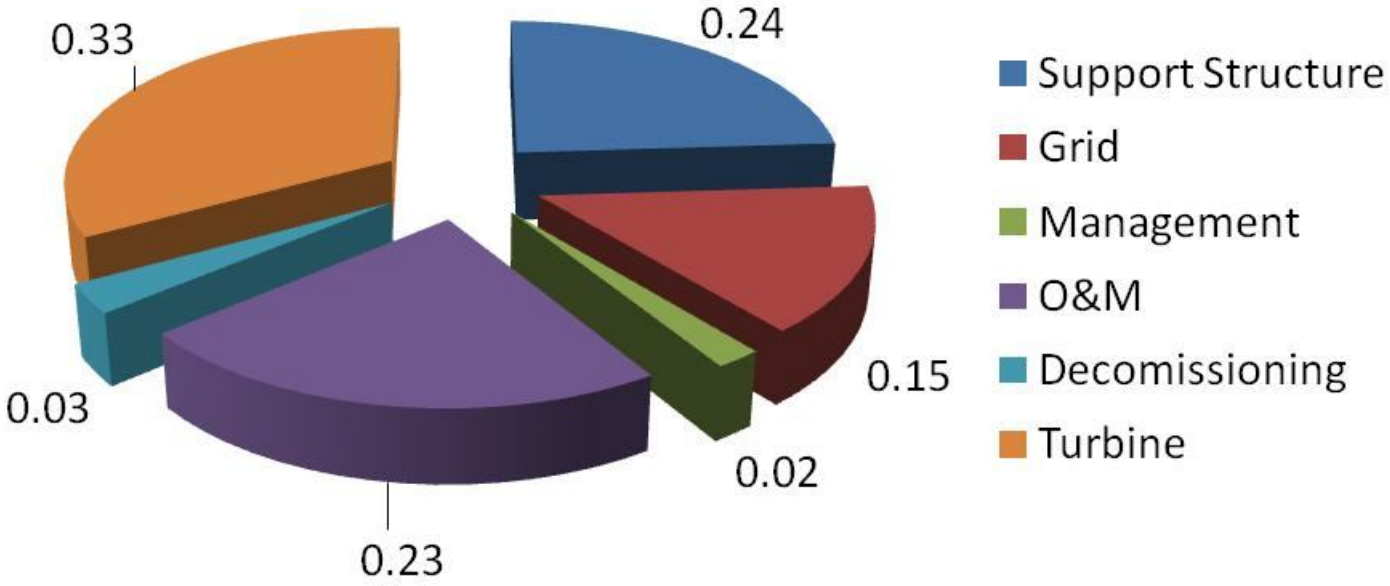
Water depths > 40m mean fixed support; structures become increasingly expensive with respect to water depth;

Floating foundations start to be economically attractive for water depths > 50 - 90m; a competitive solution at the shallower end of this range is very attractive.

Fixed Foundations

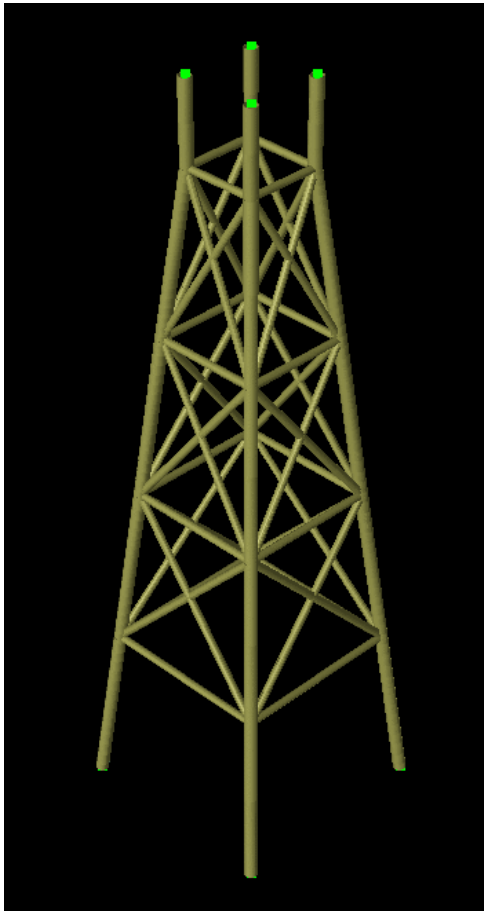


Life Cycle Cost



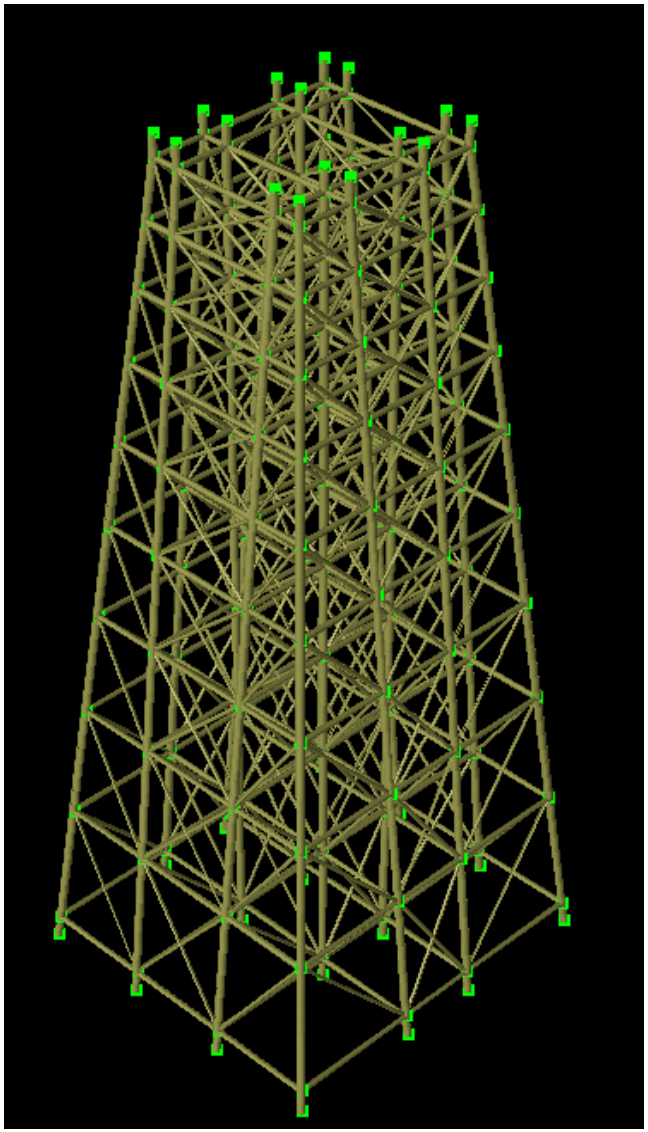
Cost breakdown for an offshore wind turbine 20 years [4]

Scaling Jackets



45 m depth Structure

125 m depth Structure



Failure rate is not the only important factor

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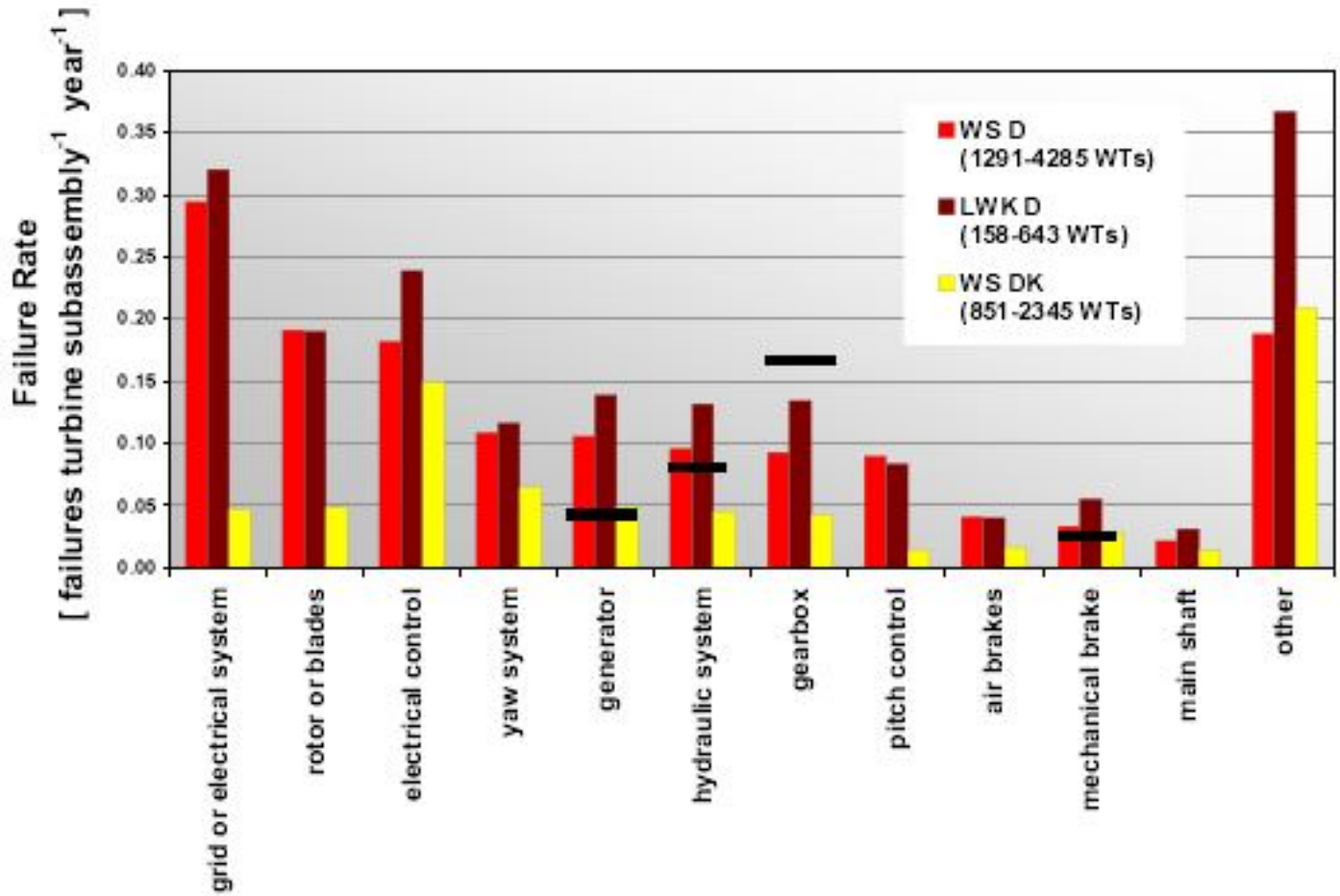
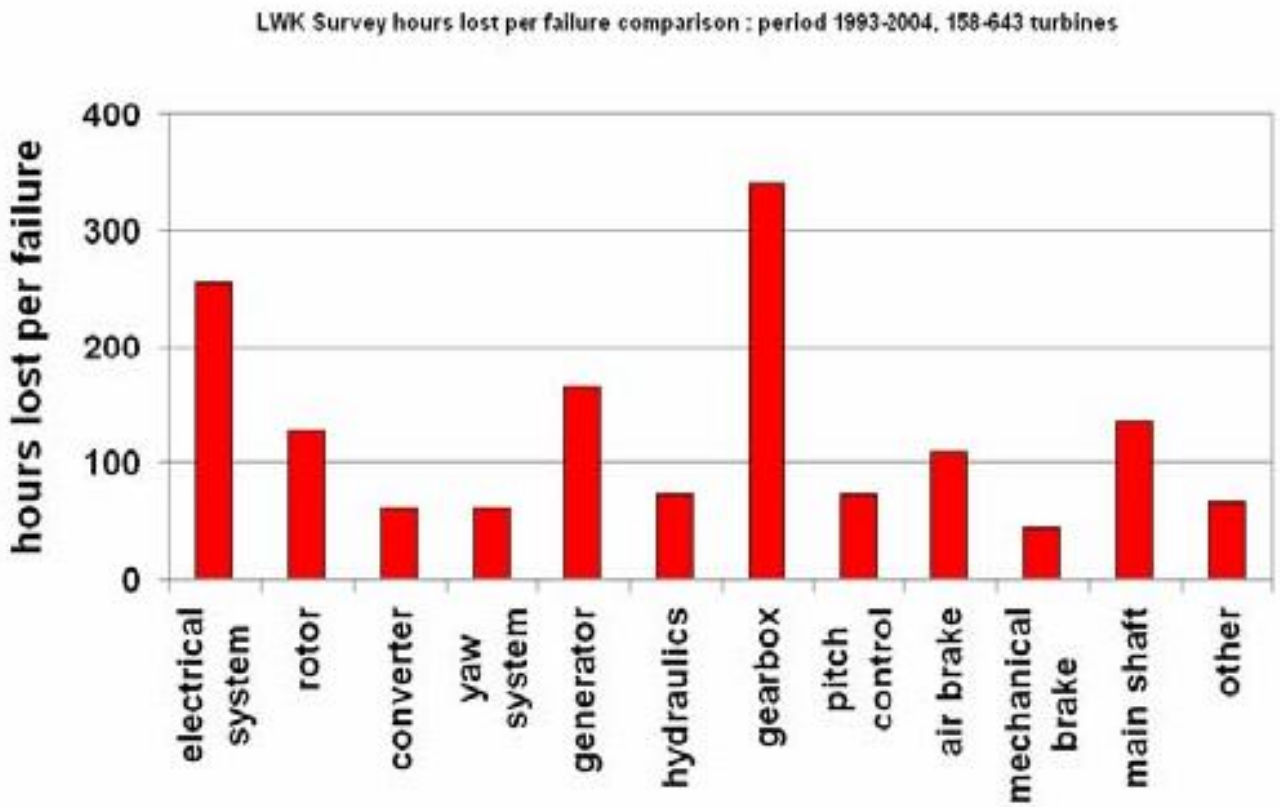
Travner et al 2007



Consequence of failure…

Travner et al 2007



Sandia

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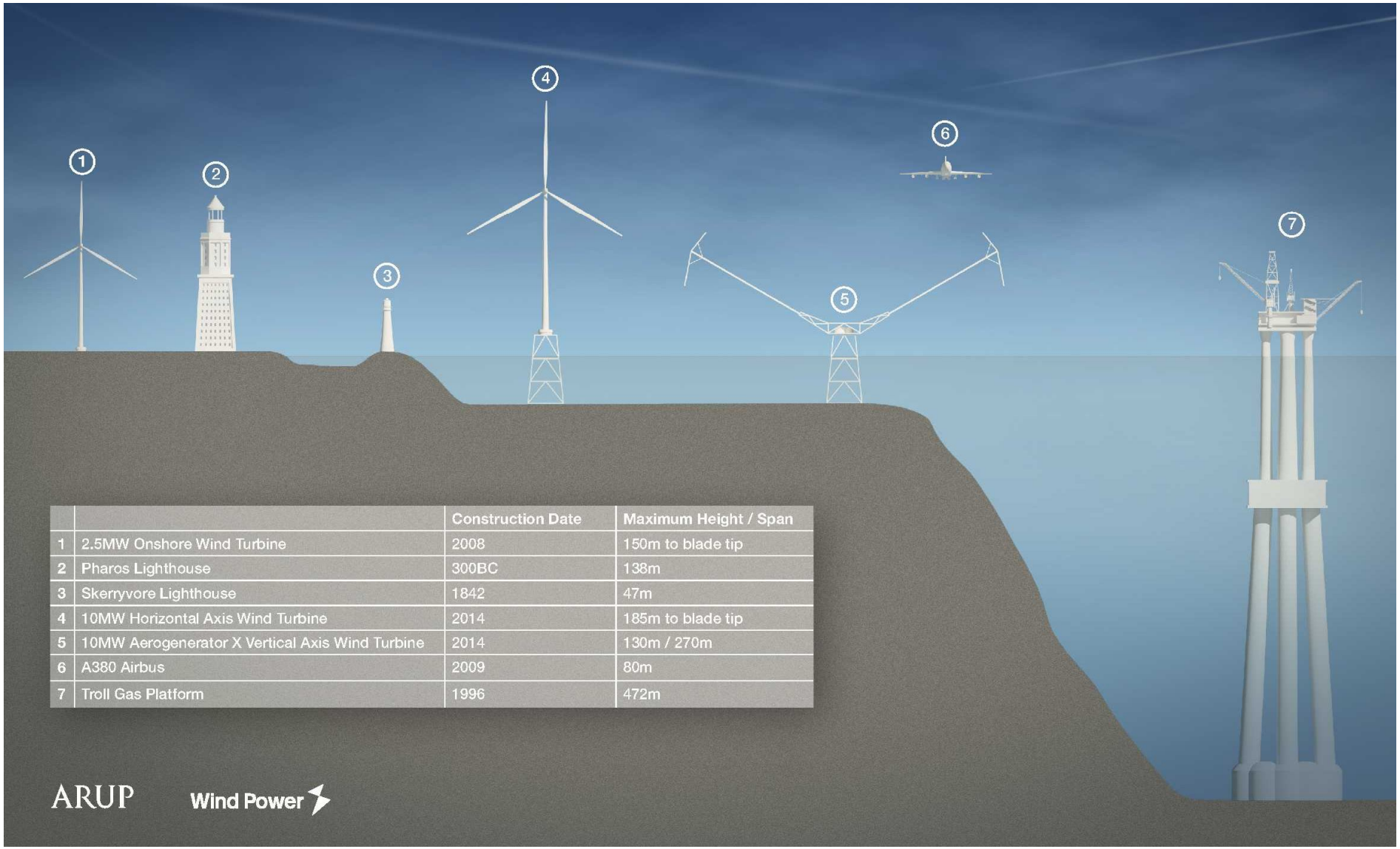
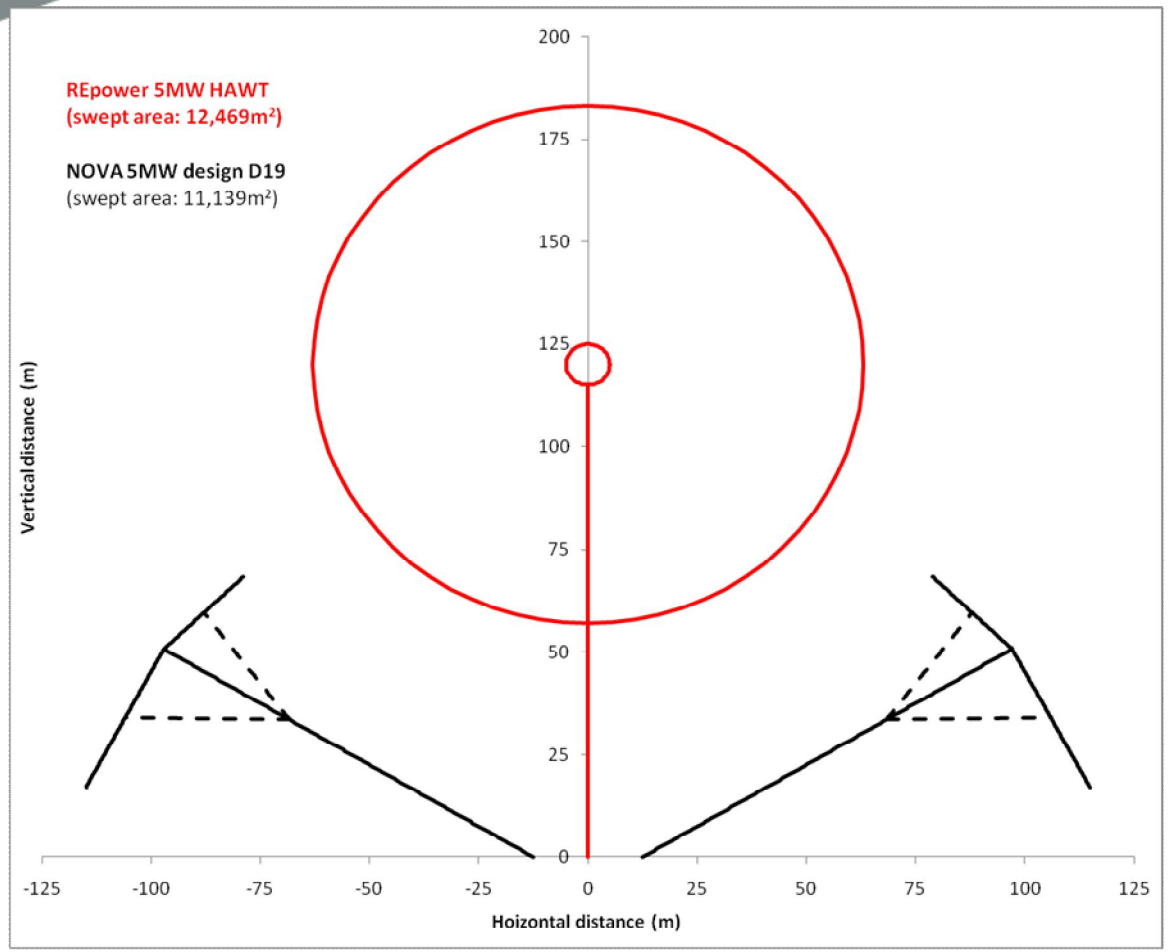


		Construction Date	Maximum Height / Span
1	2.5MW Onshore Wind Turbine	2008	150m to blade tip
2	Pharos Lighthouse	300BC	138m
3	Skerryvore Lighthouse	1842	47m
4	10MW Horizontal Axis Wind Turbine	2014	185m to blade tip
5	10MW Aerogenerator X Vertical Axis Wind Turbine	2014	130m / 270m
6	A380 Airbus	2009	80m
7	Troll Gas Platform	1996	472m

ARUP Wind Power

Comparative Sizes



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Summary & conclusions

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- Capex and Opex for Offshore are increasing
- Offshore wind is proving less reliable than predicted.
- Fixed foundations are prohibitively expensive in water depths greater than 50m.
- The solution is likely to lie in a purpose designed integrated offshore turbine that is not simply a marinisation of onshore machines