Development of Offshore Wind Farm and basic wind power turbines

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Abstract

The leading generation of power in the 20th century shows the second phase in the form of offshore wind power. The development of offshore wind farm took a huge leap in the 21st century as major countries started investing in this huge field. This paper will review the development of offshore wind farm and different types of turbines used over the years as well as will show the current capacity of world to generate wind power..

Keywords: *offshore wind farm, onshore wind farm, turbines*

Introduction

The energy crisis and environmental pollution have forced the government and the people to look for alternatives of energy. The world is in constant look for more and more sustainable energy methods, like it has developed in the past such as solar, wind. Tidal, geothermal, etc. Out of all these energy sources, the most promising and most abundant source of power generation in which the world is investing is Wind Energy. The Global Wind Energy Council (GWEC) released its *Global Wind Report: Annual Market Update* today, showing a maturing industry successfully competing in the marketplace, even against heavily subsidized traditional power generation technologies. More than 52GW of clean, emissions-free wind power was added in 2017, bringing total installations to 539 GW globally. With new records set in Europe, India and in the offshore sector, annual markets will resume rapid growth after 2018. [1]

The wind energy sector which is growing in such a huge space is one of the major attractions of investors and firms all around the world. The wind energy sector can be basically developed through onshore wind farms or offshore wind farms. The onshore wind farm started developing in the early 80s of the 19th century and thus were seen as the prominent methods of energy generation. But it had certain set of problems which were seen in the future such as noise pollution, available of large land areas for installations, obstructing view of natural landscapes etc. Thus the new developing system, offshore wind turbine, was seen without any demerits of the onshore wind farms except of high cost of installations, which are constantly being optimized by the development of major technology giants.

Status of offshore wind energy development

The offshore wind energy sector is constantly growing, reaching new heights each year as well as showing growth in different parts of the world.

A small study below shows the growth percentage of different countries till 2017 in the offshore wind power generation.

OVERALL POWER GENERATION:

A historical record of 4,331 MW of new offshore wind power was installed across nine markets globally in 2017. This represents an increase of 95% on the 2016 market. Overall, there are now 18,814MW of installed offshore wind capacity in 17 markets around the world.

At the end of 2017, nearly 84% (15,780MW) of all offshore installations were located in the waters off the coast of eleven European countries. The remaining 16% is located largely in China, followed by Vietnam, Japan, South Korea, the United States and Taiwan.

LARGE MARKETS:

The UK is the world's largest offshore wind market and accounts for just over 36% of installed capacity, followed by Germany in the second spot with 28.5%. China comes third in the global offshore rankings with just under 15%. Denmark now accounts for 6.8%, the Netherlands 5.9%, Belgium 4.7% and Sweden 1.1%. Other markets including Vietnam, Finland, Japan, South Korea, the US, Ireland, Taiwan, Spain, Norway and France make up the balance of the market.

SPREAD OF PLANS:

The spread of the offshore industry beyond its northern European home to North America, East Asia, India and elsewhere has begun. The first US offshore wind farm came online in 2016, China's offshore wind industry has finally taken off, and Taiwan has an ambitious programme lined up. The number of countries planning pilot projects or full-scale development of commercial-scale offshore wind farms is rapidly growing; the latest newcomers wanting to enter the sector are in Australia, Brazil and Turkey [2].

A statistical graph shows below the global cumulative offshore wind capacity:

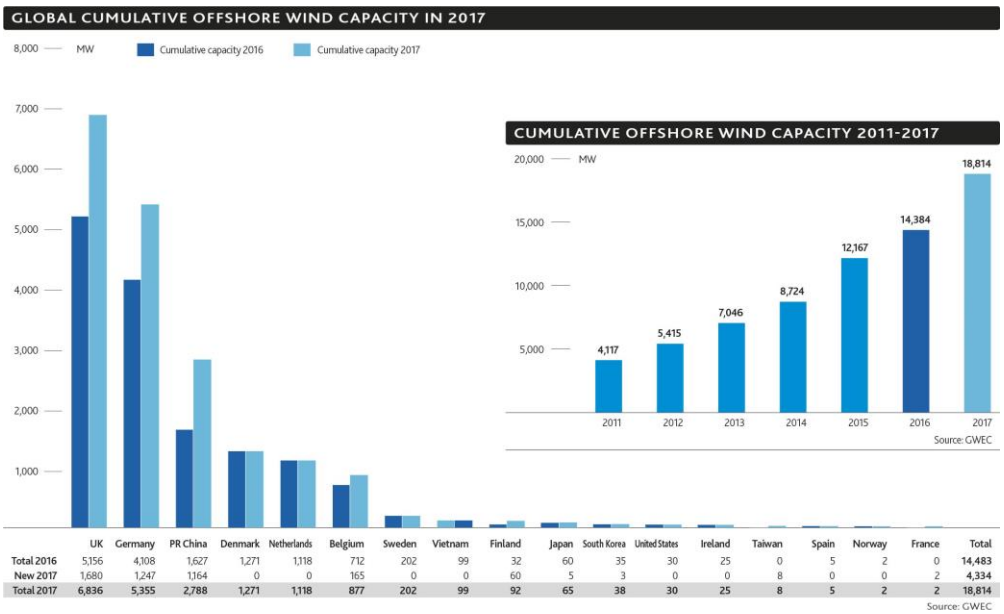

Fig 1 [3]

Types of offshore wind turbine

Floating wind turbine:

A **floating wind turbine** is an offshore wind turbine mounted on a floating structure that allows the turbine to generate electricity in water depths where fixed-foundation turbines are not feasible.[6]

One of the most exciting emerging technical advances for the wind industry is the development of floating wind turbine platforms. With a number of advantages over conventional offshore wind, floating wind turbine concepts have spawned from start ups worldwide and at least three different designs are being actively tested off the coast of Portugal, Norway, and the United Kingdom. These prototypes are still early stage, far from mass production and commercialization, but are gaining attention and earning investment dollars.[4]

A picture of france first wind farm with floating turbine

Fig 2[5]

Vertical Axis Wind Turbine:

A **vertical-axis wind turbines** (**VAWT**) is a type of **wind turbine** where the main rotor shaft is set transverse to the **wind** (but not necessarily **vertically**) while the main components are located at the base of the **turbine**. This arrangement allows the generator and gearbox to be located close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind which removes the need for wind-sensing and orientation mechanisms.[7][8]

A diagram of VAWT:

Fig 3[9]

Current capacity of the world:
The world is growing fast in the process of developing wind energy and every year certain councils publish various statistics based on current scenario. Some of those statistics are shown below with the help of bar graphs and pictures.

GLOBAL INSTALLED WIND POWER CAPACITY (MW) – REGIONAL DISTRIBUTION

		End of 2016	New 2017	Total 2017
AFRICA & MIDDLE EAST	South Africa	1,473	621	2,094
	Egypt	810	-	810
	Morocco	787	-	787
	Ethiopia	324	-	324
	Tunisia	245	-	245
	Jordan	119	-	119
	Other[1]	159	-	159
	Total	**3,917**	**621**	**4,538**
ASIA	PR China*	168,732	19,500	188,232

	India	28,700	4,148	32,848
	Japan	3,230	177	3,400
	South Korea	1,031	106	1,136
	Pakistan	592	200	792
	Taiwan	682	10	692
	Thailand*	430	218	648
	Philippines	427	-	427
	Vietnam	159	38	197
	Mongolia	50	50	100
	Other[2]	70	–	70
	Total	**204,104**	**24,447**	**228,542**
EUROPE	Germany	50,019	6,581	56,132
	Spain	23,075	96	23,170
	UK	14,602	4,270	18,872
	France	12,065	1,694	13,759
	Italy	9,227	252	9,479
	Turkey	6,091	766	6,857
	Sweden	6,494	197	6,691
	Poland	6,355	41	6,397
	Denmark	5,230	342	5,476
	Portugal	5,316	–	5,316
	Netherlands	4,328	81	4,341
	Ireland	2,701	426	3,127
	Romania	4,328	5	3,029
	Belgium	2,378	467	2,843
	Austria	2,632	196	2,828
	Rest of Europe[3]	8,354	1,432	9,778
	Total Europe	**161,891**	**16,845**	**178,096**
	of which EU-28[4]	154,279	15,680	169,319
LATIN AMERICA & CARIBBEAN				
	Brazil*	10,741	2,022	12,763
	Chile	1,424	116	1,540
	Uruguay	1,210	295	1,505
	Costa Rica	319	59	378
	Panama	270	–	270
	Peru	243	–	243
	Argentina	204	24	228
	Honduras	180	45	225
	Dominican Republic	135	–	135
	Caribbean[5]	200	18	218
	Others[6]	386	–	386
	Total	**15,312**	**2,578**	**17,891**
NORTH AMERICA	USA	82,060	7,017	89,077
	Canada	11,898	341	12,239
	Mexico	3,527	478	4,005
	Total	**97,485**	**7,836**	**105,321**
PACIFIC REGION	Australia	4,312	245	4,557
	New Zealand	623	–	623
	Pacific Islands	13	–	13

Total	**4,948**		**244.9**	**5,193**
World total	**487,657**	**52,573**	**539,581**	

Source:GWEC

1 *Algeria, Cape Verde, Iran, Israel, Kenya, Libya, Mozambique, Nigeria*
2 *Azerbaijan, Bangladesh, Sri Lanka*
3 *Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Faroe Islands, FYROM, Hungary, Iceland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Romania, Russia, Switzerland, Slovakia, Slovenia, Ukraine.*
4 *Austria, Belgium, Bulgaria, Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK*
5 *Caribbean:Aruba, Bonaire, Curacao, Cuba, Dominica, Guadalupe,Jamaica, Martinica, Granada, St. Kitts and Nevis 6 Bolivia, Colombia, Ecuador, Guatemala, Nicaragua, Venezuela*

*Note: Project decommissioning of approximately 648 MW and rounding affect the final sums * Provisional Number*

Fig 4[10]

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