

Feasibility of Using Wind Turbine Blades Structure as Artificial Reef

Behzad Rahnema Falavarjani

Gotland University, Department of Energy Technology

rahnema.b@gmail.com, Tel:0098-311 2675272, Cell: 0098-913 302 9428

Summary:

The Global Wind Energy Council annual market statistics published on February 2012, show that the wind industry installed just over 41,000 MW of new clean, reliable wind power in 2011, bringing the total installed capacity globally to more than 238,000 MW at the end of last year. [1] European wind power has recorded an average annual market growth of 15.6% from 1995, with a cumulative capacity of 94 GW in 2011.[2] Corresponding to the growth of wind turbine industries, wind turbine blades are also growing fast in both size and number. The problem that now arises is how to dispose of the blades at the end of their lifecycle. There are currently three available methods considering disposing blades as waste materials: Landfill, incineration and recycling.

Based on environmental, economical and technological concerns these three methods are not completely applicable for blades considering the different materials uses in their structures. [3]

In order to promoting of artificial reefs in fishery and coastal management, this paper considers blade material as a positive resource for the environment and introduces an alternative way of disposal using as artificial reef structure in the sea.

The feasibility of applying wind turbine blades as artificial reefs can have a major effect on worldwide development of wind power regarding creation of specific relation between wind power management and coastal management.

Key words: Wind Turbine Blade, Disposing methods, Artificial reefs.

Introduction

During the past decade, wind power industry has remarkable growth in Europe. The total installed power capacity in the EU has increased dramatically from 2% in 2000 to 9.6% in 2010. In 2011 this capacity has increased surprisingly to 21.4% with around 11% growth compare with previous year. [2]

According to growth of wind power industry, wind turbine blades are also growing fast in both size and numbers. Available methods and researches consider blade as a waste material after its life cycle, which is about 20-25 years after their production, and try to apply different methods to dispose them.

Possibility of using wind turbine blade as a positive resource for environment and applying these massive products as artificial reef in the sea would make a significant change from their manufacturing and production process through their disposal methods.

Artificial Reef

An artificial reef is a submerged structure deliberately placed on the seabed to mimic some functions of a natural reef such as protecting, regenerating, concentrating and/or enhancing population of living marine resources. [4]

The main purpose for placement of artificial reefs on the sea bed is to increase marine biodiversity, improve fish stock and develop tourism industry.

Placement of artificial reefs in the EU requires special attention and concern for different guidelines, conventions and protocols. In recent years, most of the countries start to use artificial reefs for different purposes. [5]

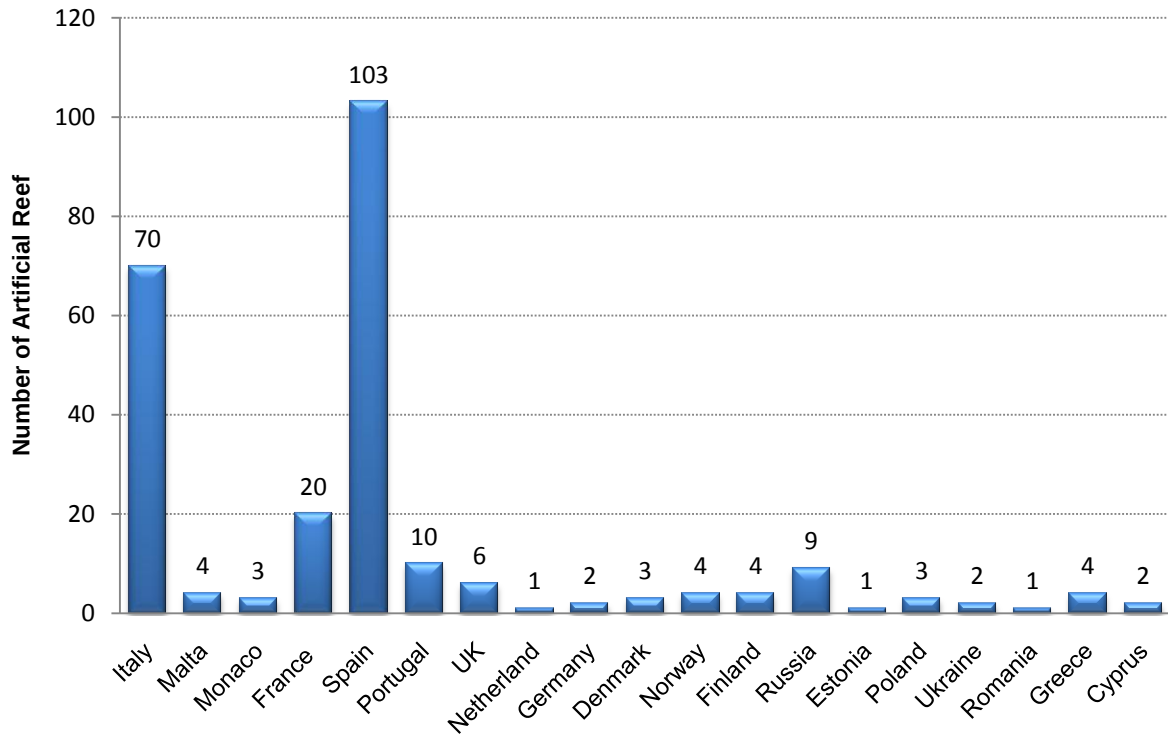


Figure 1 artificial reef in the EU [5]

Offshore wind turbine foundations are already well-known as artificial reef structures. According to the growth of wind power in different part of Europe, the expected amount of blade material which will be on hand in next decade is a considerable subject for deliberation.

Estimation of expected amount of blade material

Size of wind turbine blades has a direct relation with power capacity of wind turbine. Based on growing the share of wind energy, to meet the 2020 goal in Europe, the size of wind turbine blades are also growing incessantly. Figure 2 shows the annual amount of wind power installation from 1995 to 2011 in GW. [2]

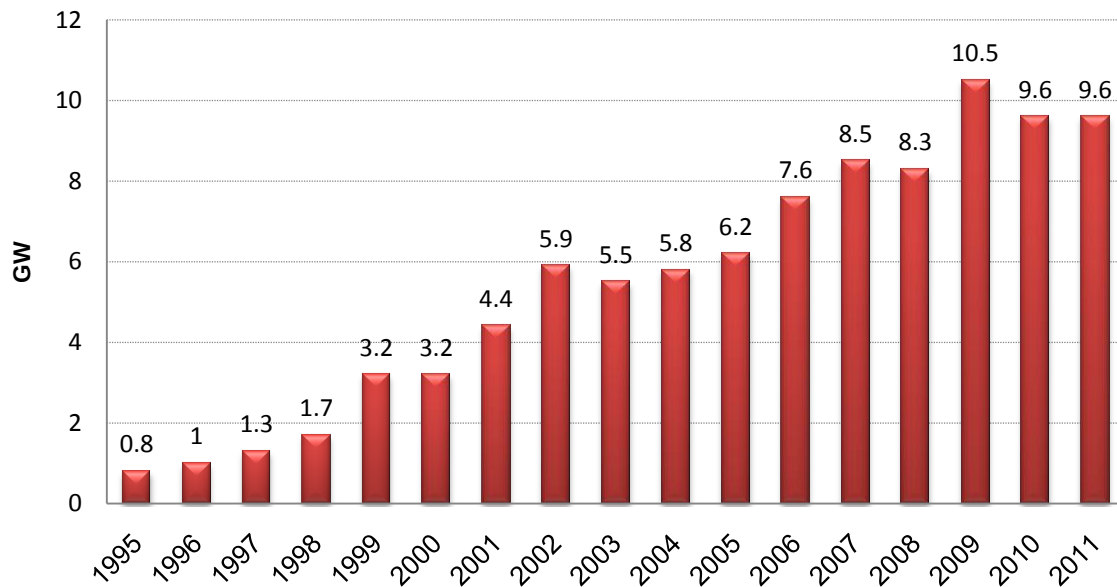


Figure 2 Annual Wind Power Installations in the EU [2]

A rough estimation suggested by Prof. Dr. Henning Albers state that for each KW installed wind power 10 Kg blade material is used. Based on this estimation, it is expected to have around 940,000 tons of blade material in 2036 just in Europe. Figure 2 shows the expected cumulative amount of blade material available after their life cycle. [6]

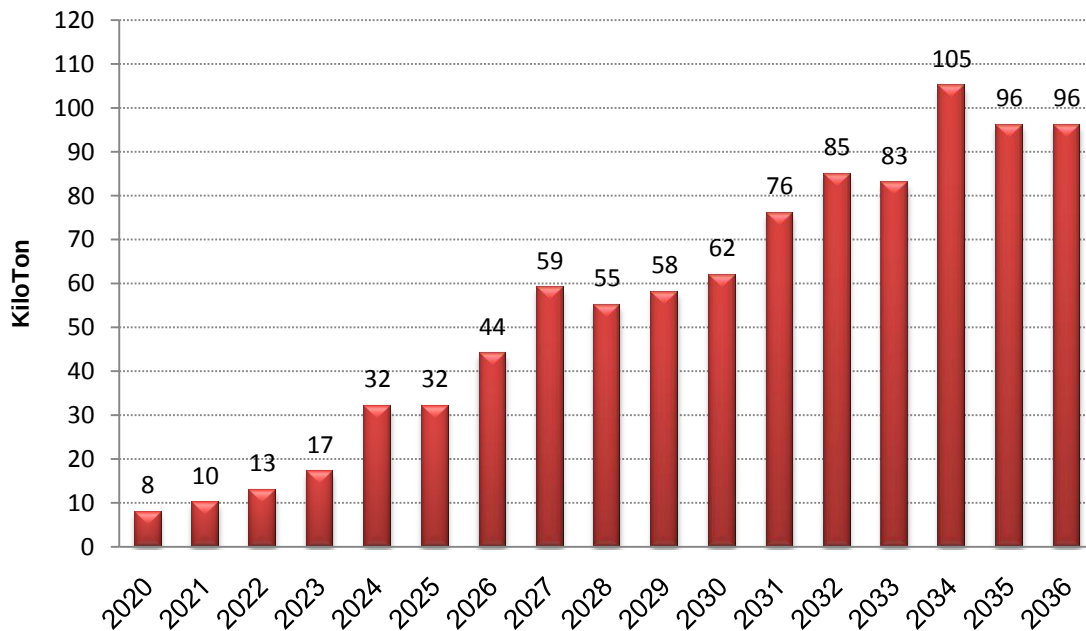


Figure 3 Expected Annual Amount of Wind Turbine Blade Material in the EU [6]

Available methods consider these amounts of blade material as a waste material and try to recycle or reuse them after their life cycle. Throughout these attempts, there is just a successful process regarding incineration of wind turbine blade [10], but according to the growth of wind power and consequently blade size, this method is not completely applicable from technical and economical aspects.

Application of wind turbine blade as artificial reef

Wind turbine blade can be used as resource after their lifecycle by applying them as artificial reef structures in the sea. It will be impressive to use blade materials as a habitat for marine life for both wind power developers and fishing companies. It can be also important factor in social acceptant issues.

There are several considerations which should be taken in to account regarding using wind turbine blade as artificial reefs:

- *Structure*

It has been proven that the significant contribution of fish abundances, community composition, diversity and biological productivity on artificial reefs, mainly based on enhancement of shelter availability and their structural complexity. Depend on variety of sizes; wind turbine blade with their hollow structures can create a safe environment for fishes, larvae, roes, algae. [7]

To get positive effect on fish abundance, the scale of artificial reef should match the size of marine population. Depending on artificial reef design and purposes it might be vital to change the structure of blades, for example, cutting the tip of blades or making some holes in different part of them.

Applying small changes in blade structure is based on artificial reef purposes and the ways of using them in different water depth for different marine types. Placing the artificial reefs is costly and logistically difficult.[8] Hence, changing blade structure (creating holes, cutting down and crushing) is critical issue and needs to have spatial planning for constriction and deployment in the water base on technical and economical factors.

- *Material*

Wind turbine blades are made of Glass Fiber Plastic materials which inert materials, meaning they do not have any chemical reaction with the seawater. Moreover, these plastic materials are absolutely solid and do not have any chemical leakage in the sea. They also do not contain any hazardous materials, like radioactive materials or heavy metals.

Ability of attraction of marine life like food availability is the major concern regarding blade materials. In fact, wind turbine blades should provide food for fish through epibiota, such as algae, hydroids, bryozoans, bivalves, corals, and mobile invertebrates associated with the sessile biota. [7]

- *Suitability*

This project should be done by monitoring the effects of the reefs on marine environment in short, medium and long term process. The monitoring should be considering environmental effect of reefs. If a reef does not meets its objectives or have a negative effects on environment and marine life should be dismantle and remove from sea bed. Removing project can be as complex as placing, and it is depend on position of reef and bathymetric characteristic of sea bed. [9] Size and complexity of blades structure is another factor in fish assemblage. On the large reefs, species should be less likely to go extinct from accidental events than on small reefs, and thus larger reefs should have more species. [7] According to the size of blades in offshore wind farms, they can meet this objective and also they can provide a suitable shelter for different marine life.

- *Durability and stability*

Regarding the fact that it takes some years for reef to be colonized by biological communities, reefs should be stable and durable in different weather conditions to achieve the main objectives. Therefore, weight of blades are one the important factors to make reefs. As rule of thumb, it is suggested that the weight of the reef should be at least double that of the specific gravity of seawater, or, otherwise, the structure should be anchored to sea bed. [9]

Conclusion

This feasibility study promotes using wind turbine blades as a habitat for marine life after their life cycle. Offshore wind turbine blades are much more suitable for this propose regarding transportation issue and also their large scale dimensions.

For ever growing blades, available methods of disposing is not fully applicable (or appropriate) but still there is a number of blind spot using blade as artificial reef in the sea. Subjects like responsibility, acceptance, permissions and monitoring during the process should be taken in to account by future studies. There is also a lack of experimental experience in this field meaning insufficient evidence related to technical possibility of this procedure.

References

1. GWEC 2011: *Global Wind Statistics 2011*
2. Wind in Power, *European Statistics*, February 2012
3. Rahnama Falavarjani Behzad, *Reduction of Environmental Impact Effect of Disposing wind Turbine Blade*, Master Thesis, Gotland University, Wind Power department, 2011
4. OSPAR COMMISSION, *OSPAR Guidelines on artificial reefs in relation to living marine resources*.
5. Fabi Gianna et al, *Overview on artificial reefs in Europe*, 2010
6. Albers H., Greiner S., Bremen Hochschule, *Recycling of Wind Turbine Rotor Blades - Fact or Fiction?*, Institut für Umwelt und Biotechnik H. Seifert, U. Kühne, Hochschule Bremerhaven, Institut für Windenergie, DEWI MAGAZIN NO. 34, FEBRUARY 2009
7. Wilhelmsson Dan, *Aspect of offshore renewable energy and the alterations of marine habitats*, Department of Zoology Stockholm University, 2009
8. Seaman, W. Sprague, L.M., 1991. Artificial habitat practices in aquatic systems. In: Seaman, W., Sprague, L.M. (Eds.), *Artificial Habitats for Marine and Freshwater Fisheries*. Academic Press, Inc., San Diego, California 92101, pp. 1–27.
9. London protocol. 2nd Meeting 19 . 23 May 2008 Agenda item 5, *Development of guidance for the placement of artificial reefs*, scientific group of the London convention - 31st Meeting;
10. E. Schmidl, S. Hinrichs; Holcim (Deutschland) AG, *Geocycle Provides Sustainable Recycling of Rotor Blades in Cement Plant*.