IRON AND STEEL INDUSTRY'S PERSPECTIVE FOR WIND POWER 20

PERSPECTIVA INDUSTRIEI METALURGICE PENTRU ELECTRICITATEA EOLIANĂ 20

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Abstract

Wind power gained an increasing attention during the last decades, although the motivation was not always the same. Currently, the support for wind power is grounded, mainly, on its low environmental impact due to the high potential and non-exhaustible pattern of resources along with little pollution during generation. By 2030 it is expected that a fifth of the power generated worldwide will be produced by wind power plants. Departing from these facts we question the outlook for one of the key industries for both energy production and environment. The growth of wind power will trigger a certain increase in steel industry's output, but this increase will not exceed the production capacity. Instead, such increase could bring in a contribution to improving the efficiency in iron and steel industry, although this surplus will not be able to produce a significant growth of the steel capacity utilisation ratio.

***Keywords*:** green economy, iron and steel industry, renewable energy sources, wind power

JEL CODES: L61, Q21, Q42

Rezumat

Electricitatea eoliană a câştigat un interes sporit în ultimele decenii chiar dacă motivaţia nu a fost întotdeauna aceeaşi. În prezent, susţinerea electricităţii eoliene este motivată, în principal, de impactul de mediu redus datorat potenţialului ridicat şi caracterului inepuizabil al resurselor, precum şi poluării reduse în timpul generării. Până în 2030 este aşteptat ca o cincime din electricitatea generată în lume să fie produsă de centralele eoliene. Plecând de aceste fapte, punem în discuţie una din industriile cheie atât pentru producţia de energie, cât şi pentru mediu. Creşterea generării de electricitate eoliană va determina o creştere a producţiei industriei metalurgice, dar această creştere nu va depăşi capacitatea de producţie. O astfel de creştere va contribui la creşterea eficienţei industriei energetice, deşi surplusul de producţie nu va putea produce o creşterea semnificativă a raportului de utilizare a capacităţii de producţie.

Cuvinte cheie: economie verde, industrie metalurgică, energie regenerabilă, electricitate eoliană

1. INTRODUCTION

The rush of renewable energy although not new and different in terms of motivation from one stage to another becomes a source of transformation that spreads over the entire economy creating opportunities for certain industries.

Renewable energy sources (RES) are promoted currently by their potential contribution to the alignment of greenhouse gas emission goals established as acceptable (Zamfir, 2012; Ioan, 2009). Various sources are envisaged and their combinations adapted to local context are considered key factors for the success of RES use.

Meanwhile power generation by using RES receives and outstanding support that resulted in a very high growth rate in this area (Bran et al., 2010). For instance, wind power growth rate in the last ten years record an annual mean of 30%, which is a very high rate compared with other industries (Zamfir and Popescu, 2011).

The development of the wind power is occurring by the use of turbines. Each turbine is made up by using between 131 and 316 tons of steel and each year there are erected around 25000 turbines. At what extent iron and steel industry could cover the production of turbines now it is of interest, but relatively easy to answer. On the other hand, the energy outlook for the next decades indicates a projection where wind power will climb to a contribution of 20% to meet power demand of 11.5 terawatts. In other terms, wind power generation should be much larger than it is today. What changes should occur and with what economic and social implications are to be expected in the iron and steel industry is the main question addressed by us. The answers will be developed as possibilities considering various expert opinions and energy and iron and steel industry data and outlook.

2. WIND POWER ROADMAP FOR THE NEXT DECADES

Power generation by wind turbines started in the 1970s. Since then a lot of progress was made and wind power plants with large fields of turbines become a common landscape in many regions such as China, US, Germany, Spain, India etc. (figure 1). The cumulative capacity of top ten countries reached 242.7 GW in December 2012, representing 86% of the global wind power capacity. Wind power's profile in a SWOT analysis framework is presented in table 1.

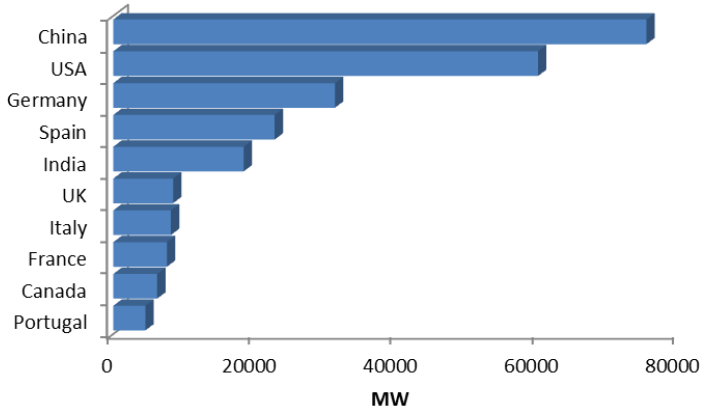

FIGURE 1 - TOP TEN CUMULATIVE INSTALLED CAPACITY (DECEMBER 2012)
Source: authors own representation using Global Wind Energy Council data

TABLE 1 - SWOT ANALYSIS OF WIND POWER

Strengths	Weaknesses	Opportunities	Threats
Non-exhaustible Huge potential resources No emission release during power generation Fast recovery of energy needed for turbine production (6-9 months) Easy recovery of materials by recycling	High rate of dispersion Discontinuity Localization – some regions have larger potential than others; areas with large potential are usually far away from large consumption areas Short life time of wind turbines (20-30 years)	Power generation Wind farms: combing agricultural production with power generation	Large consumption of materials, especially iron and steel Disruption of landscape Noise pollution Bird accidents

Source: authors

In the next decades the sector will continue to grow despite some important weaknesses. There are developed several scenarios that consider a variety of assumptions. These scenarios are:

- New policies scenario (International Energy Association): is based on the assessment of current directions and intensions in national and international energy and climate policy. Its assumptions comprise emission reduction targets adopted in Cancun (2010), commitments to renewable energy and efficiency, commitments of G8 or G20 governments;
- Moderate scenario (Global Wind Energy Outlook): takes into account all policy measures to support wind energy and the modest accomplishment of Cancun commitments;
- Advanced scenario: explores the extent to which wind industry could grow in the best case, but still well within the capacity of industry as it exists today and is likely to grow in the future. It assumes an unambiguous commitment to renewable energy and greenhouse gas emission reduction in line with industry recommendations, the political will to commit to appropriate policies and the stamina to respect them.

The results of these scenarios are summarized in table 2.

TABLE 2 - SCENARIOS OF WIND POWER GENERATION

Scenario	2015	2020	2030	2030 growth compared with 2012	
				Absolute	Relative (times)
New policies					
MW	397859	586729	917798	635211	3,2
TWh/a	976	1439	2412	1966	5,4
Moderate					
MW	425155	759349	1617444	1334857	5,7
TWh/a	1043	1863	4251	3805	9,5
Advanced					
MW	530945	11149919	2541135	2258548	8,0
TWh/a	1302	2821	6678	6232	15,0

Source: Green Peace and Global Wind Energy Council, 2012, p.11

The increases of wind power sector in twenty years are very important, this sector being three times larger than today even in the New policies scenario. Meanwhile, if ambitious energy and climate policy commitments are respected the growth summits to eight times the current wind power capacity.

The growth rates that will result in such evolution are less spectacular and will be lower than the current 28% calculated for the last fifteen years. In the Advanced scenario growth rates start below the historical average at 21%, increase until the middle of this decade and then decrease to 13% by 2020 and to 6% by 2030.The Moderate scenario starts with 19%, slightly decreasing to 11% in 2020 and 6% in 2030. The New policies scenario starts with 16%, followed by a drop to 6% in 2020 and a flat period until 2030 with 4% growth rate. Although the growth rates are going down as the size of cumulative market grows, small percentage increase will represent a large increase in capacity and power generation.

3. IRON AND STEEL INDUSTRIES PRODUCTION CAPACITY

3.1. Role of iron and steel for wind turbines

Wind turbines are complex machineries that comprise numerous components up to 8000 parts. All components of a wind turbine are steel dependent, up to 80% of the entire device being made out of steel (US Department for Energy, 2008). Figure 2 presents the sketch of a wind turbine highlighting the most important components presented below:

- Blades: 2-3, up to 30-50 m long, weighting 6.4-6.9 tons;

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- Controller: there is one in the nacelle and one at the base of the turbine. Its role is to monitor the turbine's condition and to control its movement;
- Gearbox: is present in many wind turbines in order to increase the rotational speed of the shaft that feeds into the generator.
- Generators: a single AC generator that converts the mechanical energy into electrical energy;
- Nacelle: houses the main components such as the controller, gearbox, generator and shafts;
- Rotor: includes the blades and the hub to which the blades are attached;
- Tower: tubular steel towers of 60-80 m consisting in three sections with various diameters.

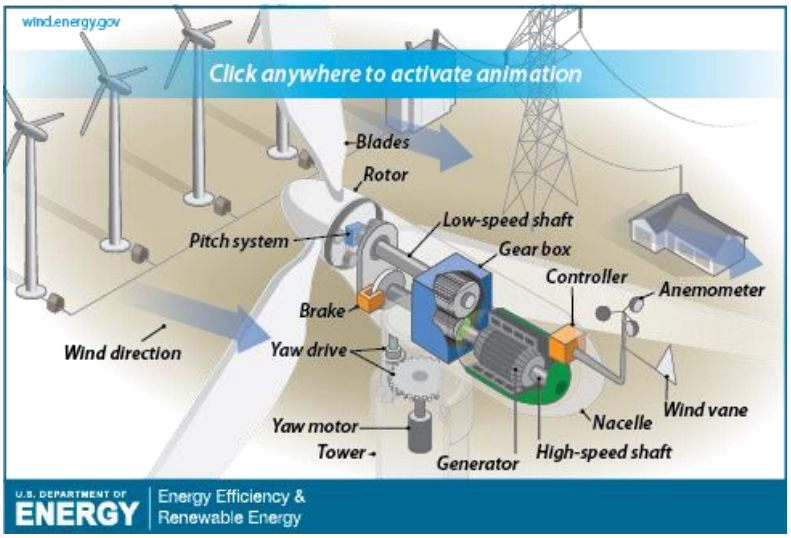

FIGURE 2 - COMPONENTS OF A WIND TURBINE
Source: US Department of Energy, 2008.

The structure of materials used for the fabrication of a wind turbine presented in table 3 indicates the high proportion of steel.

TABLE 3. WIND TURBINE RAW MATERIAL, % BY WEIGHT

	Concrete	Steel	Aluminum	Copper	Fiberglass	Adhesive	Core materials
1.5 MW							
Rotor							
Hub	0.0	100.0	0.0	0.0	0.0	0.0	
Blades	0.0	2.0	0.0	0.0	78.0	15.0	5.0
Nacelle							
Gearbox	0.0	96.0	2.0	2.0	0.0	0.0	0.0
Generator	0.0	65.0	0.0	35.0	0.0	0.0	0.0
Frame	0.0	85.0	9.0	3.0	3.0	0.0	0.0
Tower	2.0	98.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**1.3**	**89.1**	**0.8**	**1.6**	**5.8**	**1.1**	**0.4**

4 MW							
	Concrete	**Steel**	**Aluminum**	**Copper**	**Fiberglass**	**Adhesive**	**Core materials**
Rotor							
Hub	0.0	100.0	0.0	0.0	0.0	0.0	
Blades	0.0	2.0	0.0	0.0	78.0	15.0	5.0
Nacelle							
Gearbox	0.0	96.0	2.0	2.0	0.0	0.0	0.0
Generator	0.0	93.0	0.0	4.0	0.0	0.0	0.0
Frame	0.0	85.0	9.0	3.0	3.0	0.0	0.0
Tower	2.0	98.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**1.3**	**89.6**	**0.8**	**0.5**	**6.1**	**1.1**	**0.4**

Source: Strezinger, G., Svrcek, M. (2004). "Wind turbine development – Location of manufacturing activity: renewable energy policy project", Washington DC.

Most of the weight of a wind turbine is given by three major components: the tower, the nacelle, and the rotor, which are mostly made out of steel. The total weight of a wind turbine varies from 164 tons to 267 tons, out of which 127, respectively 227 tons represents steel. These figures demonstrate that wind power generation depends on the ability of iron and steel industry to provide the necessary devices. As long as the need of raw materials is regarded, the possibility to recycle almost entirely the components of the turbine after 20-30 years creates low supplementary pressure on exhaustible resources like iron ores. The most important challenge is related to iron and steel industry's production capacity.

3.2. Iron and steel production capacity

Iron and steel industry provides annually almost 2400 million tons of production (WSA, 2012) and faces a difficult period due to reduction of demand and structural changes occurring in China and India (Ernst & Young, 2013). Out of this, the crude steel production is of 1548 million tons (WSA, 2012). Currently the production capacity of this industry is used in proportion of 80% (figure 3) and it is not expected to exceed this level until 2014, rising to 83% in 2015/2016 (Ernst & Young, 2013).

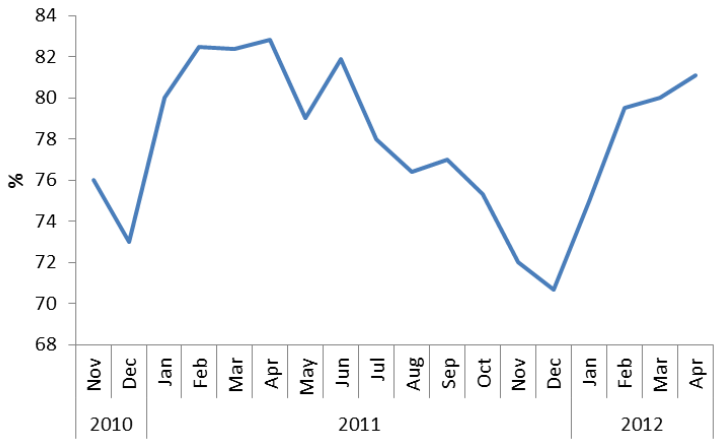

FIGURE 3 - STEEL CAPACITY UTILIZATION RATIO

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Source: WSA, 2010

Looking to the prediction of wind power generation, the additional wind turbines to be erected in various scenarios could represent an important stimulus for the steel demand (WSA, 2008). Nevertheless, the predicted growth rates do not leave room for optimism. Considering that currently in each year the number of functional wind turbines grows with 25000 and that the growth rate will be of 20% at the beginning of the period and 6% near 2030 it could be calculated the quantity of steel needed. This rises from around 5 million tons to almost 30 million tons. This represent a six times growth and could be interpreted as an important leap. Comparing with the industries production capacity it could be stated that this will not represent a restrain. On the contrary, wind power generation could only help the industry to improve its performance by a better use of its production capacity.

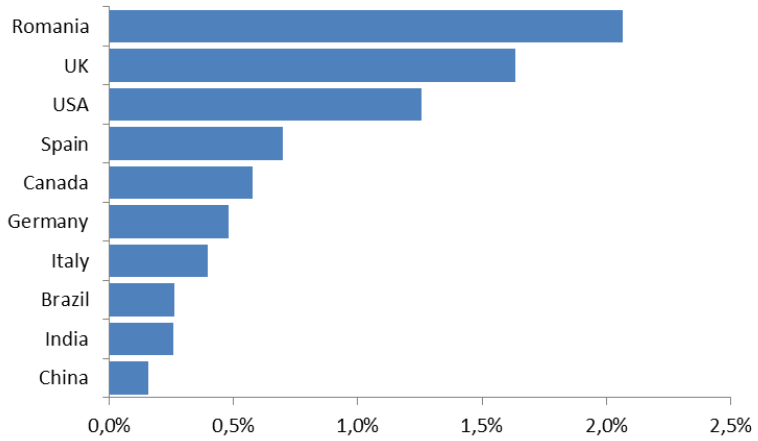

FIGURE 4 - PROPORTION OF STEEL NEEDED FOR WIND TURBINES IN TOTAL CRUDE STEEL PRODUCTION
Source: authors own representation using WSA and GWEC data

Looking to the crude steel production figures for top 10 new installed capacity countries it was calculated that the annual new installed capacity will require no more than 2% of the total crude steel production of these countries (figure 4).

CONCLUSIONS

Our analysis investigated the relation between wind power generation and one of its supporting industries, the iron and steel industry. In this respect we explored the wind power roadmap toward 2030 and compared it with the status and outlook of iron and steel production.

The upward trend of wind power generation is beyond doubt, regardless to the type of scenario considered. Nevertheless, the annual growth rates for new installed capacities will fall from around 20% to 11-13% around 2020 becoming flat at 6% toward 2030. Depending on their type, this means around

20 thousands win turbines per year to be produced, production that depends on the patterns of the iron and steel industry, since steel represents by weight the highest proportion among the materials used for the construction of a wind turbine.

Comparing the amount of steel needed for the wind turbine production and the production and production capacity of the iron and steel industry, it resulted that although the demand will increase, the size of this increase will not exceed the production capacity of the industry. On the contrary, wind turbine demand will not be able to significantly reduce the excess capacity of this industry, since it will trigger a 1-2% production growth, while the unused capacity varies between 20 and 30%. Another conclusion that could be drawn is that there is no restrain regarding the production of wind turbines for the next decades. Therefore improving the efficiency in this sector will require tackling other challenges such as localization that could bring a cost reduction of 10-20% and steel price that contribute with 74-82% to the capital cost of a wind farm (Qiu and Anadon, 2012).

REFERENCES

Bran, F., Stanef, R.M., Cretu, A.S. (2010). "Renewable resources in the 21st century. Business transformation through innovation and knowledge management: an academic perspective", in Proceedings of The 14th International Business Information Management Association Conference *Business Transformation through Innovation and Knowledge Management: An Academic Perspective*, Istanbul, vol.1-4, pp.1204-1217.

Ernst & Young (2013). "Global Steel 2013. A new world, a new strategy". Retrieved May, 28 from: http://www.ey.com/Publication/vwLUAssets/Global-Steel-Report-2013/$FILE/Global-Steel-Report-2013_ER0046.pdf.

GWEC & Green Peace (2012). "Global Wind Energy Outlook". Retrieved May, 28 from: http://www.gwec.net/wp-content/uploads/2012/11/GWEO_2012_lowRes.pdf.

Ioan, I. (2009). "Climate change risks. A sector approach with focus on iron and steel industry", *Metalurgia International*, vol.14, pp.134-137.

Qiu, Y., Anadon, L. (2012). "The price of wind power in China during its expansion: technology adoption, learning-by-doing, economies of scale, and manufacturing localization", *Energy Economics*, 34, pp.772-785.

Strezinger, G., Svrcek, M. (2004). "Wind turbine development – Location of manufacturing activity: renewable energy policy project", Washington DC.

US Department for Energy (2008). "20% Wind Energy by 2030. Increasing wind energy's contribution to US electricity supply". Retrieved March, 12 from: http://www.nrel.gov/docs/fy08osti/41869.pdf.

WSA (2008). "Advanced steel applications help to address climate change". Retrieved April, 23 from: http://www.worldsteel.org/dms/internetDocumentList/fact-sheets/Fact-sheet_Advanced-applications/document/Fact%20sheet_Advanced%20applications.pdf.

WSA (2012). "Crude steel production – December 2012". Retrieved March, 30 from: http://www.worldsteel.org/dms/internetDocumentList/statistics-archive/production-archive/steel-

PROCEEDINGS OF THE 9TH ADMINISTRATION AND PUBLIC MANAGEMENT INTERNATIONAL CONFERENCE
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Bucharest, June 17-18, 2013

archive/Crude-steel-production-December-2013/document/Crude%20steel%20production%20December%202012.pdf.

Zamfir, A. (2012). "Implementing regional renewable energy projects through public-private partnerships", *Business Excellence and Management,* vol. 2, no. 3, pp.77-84.

Zamfir, A., Popescu, R.I. (2011). "Promoting Renewable Energy – a Local Solution to Global Environmental Problems of Competitive Cities and Regions" in Přemysl Mácha and Tomáš Drobík (Eds.) *The Scale of Globalization. Global, Local, Individual. Think Globally, Act Locally, Change Individually in the 21stCentury (conference proceedings)*, *the 5th International Conference of Globalization,* University of Ostrava, Czech Republic, 8-9 September, pp. 379-387.