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Brazilian's Southeast Wind Power Analysis for an Offshore Wind Farm Implementation to Local Petroleum Activities Energy Supply

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Abstract

The world has changed dramatically over the last 200 years, and in the last few decades scientists have been looking for ways to produce energy without adverse side-effects. Even an offshore platform is not immune from the polluting effects of fossil fuels, which get its needs also from gas turbine generators. As alternative, we are proposing an offshore wind energy generator farm, for supply the needs of the offshore petroleum platform, replacing the gas turbine generator with a clean and renewable alternative. This paper will present a case of study of the potential of a wind power generator to supply for the Campo's and Santos' Basin in Brazil.

Methodology

First, a bibliography study will be done, analysing what has been done till now in these countries for avoid the potential of the installation of wind power generators in stead to replace a not clean one used. Also, the information of gas turbine generators will be focused. In a second step, references from many countries which are nowadays investing technology and studies to develop kind of the some presented objective will be verified, such as from Denmark, Portugal, Norway, Germany, UK, etc. So, with a concrete bases about the possibilities, and summarising these studies with the wind potential we have in the Brazilian's coast, a best place will be suggested for installing a wind power generator farm, so that energy could be supplied for the Brazilians' Campos and Santos Basin, with the major distribution efficiency.

Introduction

Since years, Brazilian is known as a great potential of wind power. Its geometry and the continental location of the country are also positive task that contribute to get the most efficiency of the wind current coming to the South America continent. Strongly can be emphasized that the north coast and the southeast coast from Brazil are the most privileged area [2], where the wind velocity can range from 6m/s to about 7m/s or in some cases 8m/s, what can be also observed through the figure 1, a study done by the Center of Electrical Energy, 2007. Observing now a study of the Middle and South Brazilian's wind potential, provided by the Brazilian's Wind Energy Association (figure 2), 2008, a good comparison can be checked, showing as well how high is the potential of the southeast coast [3], with an average of wind velocity of about 7m/s.

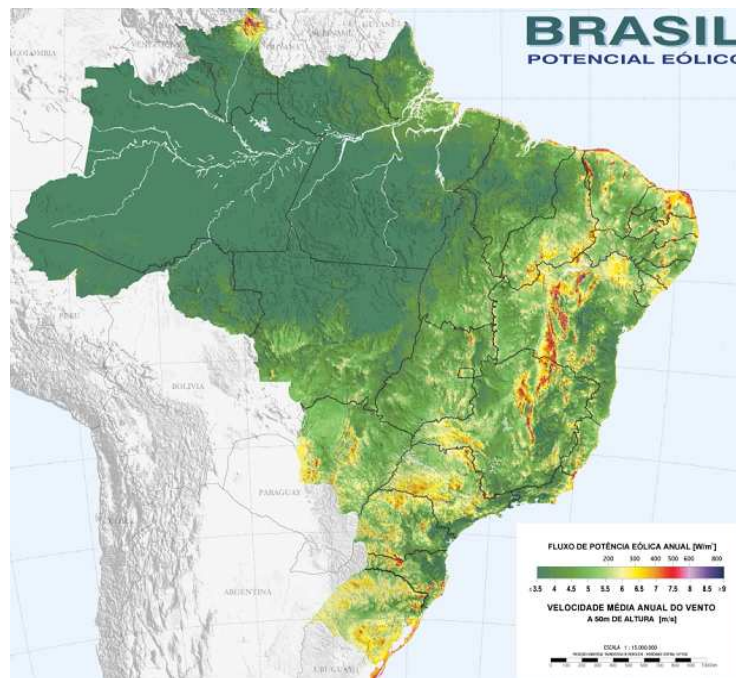


Figure 1. Brazilian's wind power distribution. [2]

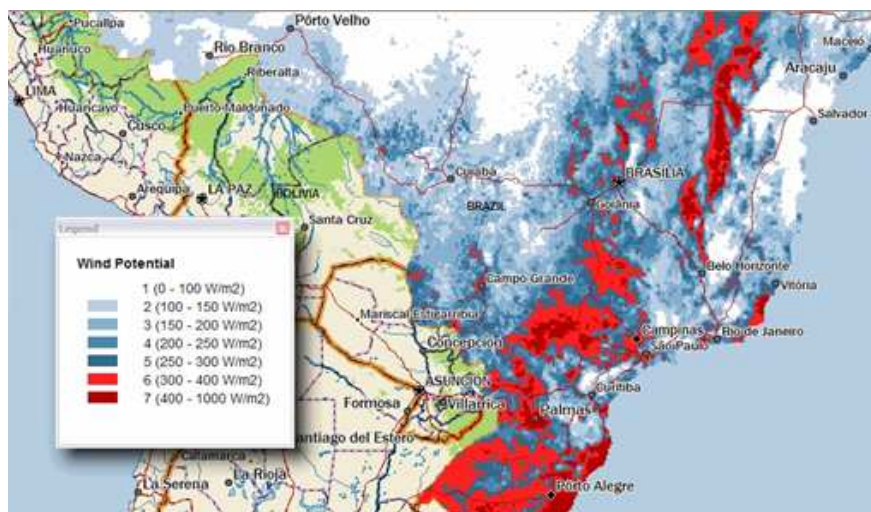


Figure 2. Middle to South Brazilian's wind potential. [3]

Very important in wind velocities analysis, is to verify how it is changed along the year periods, what can be observed by the figure 3, a selecting of specific pictures from from the Center of Electrical Energy database.

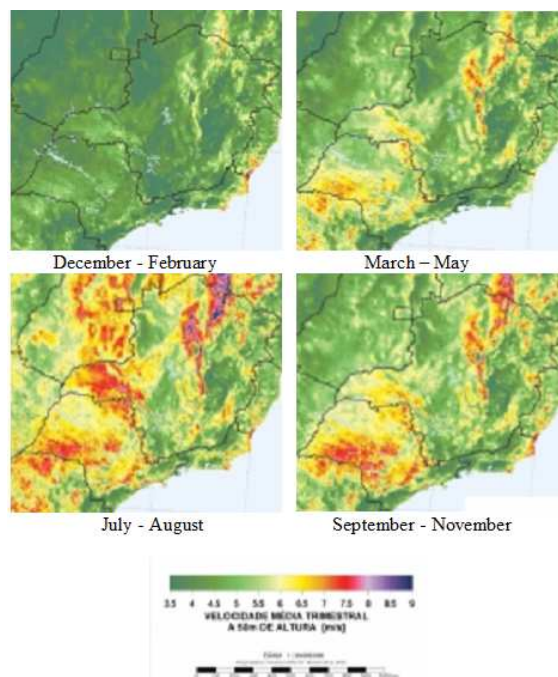


Figure 3. Seasonal distribution of wind potentiality of Southeast Brazilians'. [2]

2. Wind potential of Cabo Frio's coast and the Brazilian's petroleum basins

The region of the state Rio de Janeiro comprehends an area around a really famous city, Cabo Frio, which is pointed with a red circle by the figure 3. From its geographic location and the petroleum basins distribution in the Brazilian's coast [5], which is showed by the figure 4, could be also said that it is exactly situated between the Santos and Campos Basin. This last, pointed as well with a red circle in the figure 4.



Figure 3. Cabo Frio city and comprehended potential area. [4]



Figure 4. Brazilian's coast petroleum basins distributions. [5]

3. Blocks and Platforms distribution along Santos and Campos Basin and wind farm potential area selection

The Santos and Campos Basin in Brazil are the owner of the major national petroleum reserves, and in a no late future, will be the major national petroleum producers. Each basin has a variable distribution of blocks (Figure 5), which are situated in differential depth distribution area along the Brazilian's southeast coast.

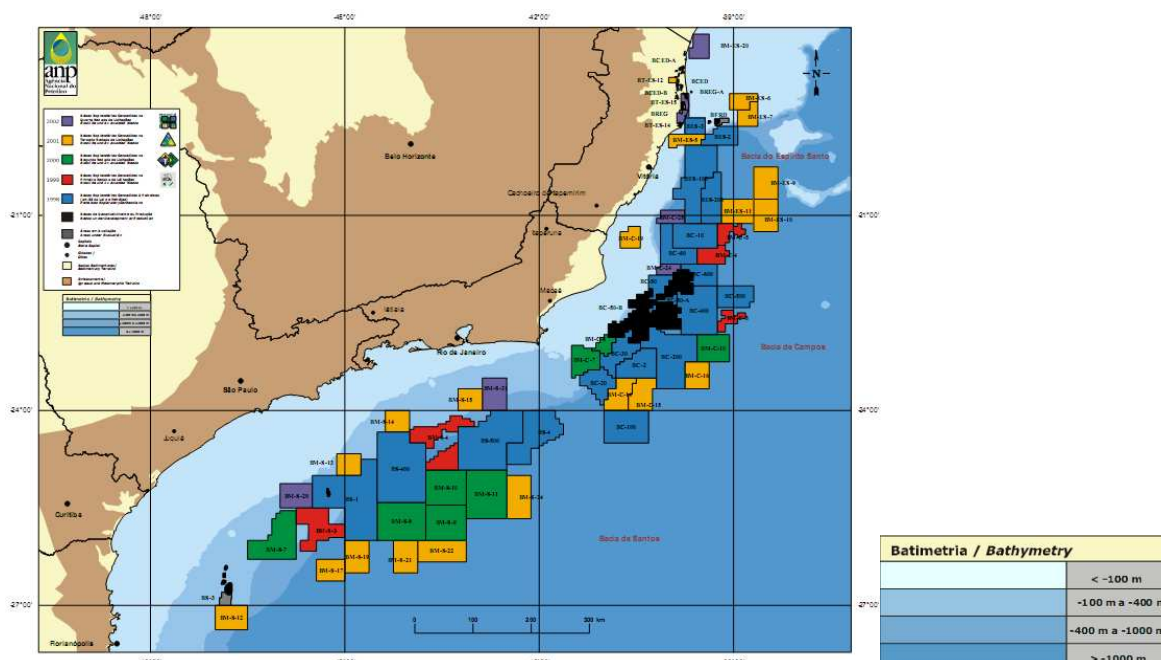


Figure 5. Distribution of the Santos Basin (left) and Campos Basin (right). [1]

Can be also noted, that an area of the Cabo Frio's coast between the both basins is not included in the blocks distribution (Figure 6), so that could be still used for another purpose, such as a offshore wind farm, the presented paper proposal. After calculations considering the figure proportion

of the figure 5 and the grey selected area showed by the figure 6, the total result gotten is an amount of about 5508km² (108km x 51km).

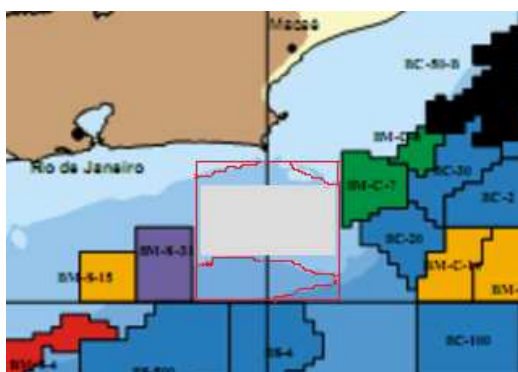


Figure 6. Potential wind power area selection between Santos and Campos basin.

For a platforms analysis, in the table 1 and in the table 2, can be seen a briefly description of the platforms situated in the Campos and Santos Basin [6]. Also, can be noted that the platforms systems, such as FPSO (Floating Production, Storage and Offloading), semi-submersible and fixed, are somehow in a proportional way distributed.

Table 1 – Platforms of the Campos Basin. [6]

Name	Type	Depth (m)	Wells (production/injection)	Oil Production (10 ³ bbl/d)	Gas Production (10 ³ m ³ /d)	Capacity of Storage (10 ³ bbl)
ESPF	FPSO	800	8 / 10	100	2500	1700
FPSO-RJ	FPSO	1350	5 / 4	100	2500	1600
FPSO-FLU	FPSO	800	9 / 6	80	61	1200
P-31	FPSO	330	23 / 0	200	2900	1760
P-33	FPSO	780	6 / 2	63	1500	2000
P-35	FPSO	850	06 / 12	130	3000	1500
P-37	FPSO	905	17 / 12	180	4600	1600
FPSO-BR	FPSO	1290	9 / 3	100	1800	1600
FPSO-MLS	FPSO	1200	6 / 5	100	2300	1600
P-43	FPSO	800	20 / 14	150	6000	2000
P-48	FPSO	1040	13 / 8	150	6000	2000
P-50	FPSO	1240	17 / 15	180	6000	1700
P-34	FPSO	1250	4 / 0	60	600	300
P-7	semi-submersible	207	15 / 0	56	900	-
P-8	semi-submersible	423	16 / 0	60	1600	-
P-9	semi-submersible	220	10 / 0	38	550	-
P-12	semi-submersible	100	22 / 0	35	900	-

P-15	semi-submersible	243	7 / 0	37	480	-
P-18	semi-submersible	910	25 / 0	100	1950	-
P-19	semi-submersible	770	19 / 0	100	2800	-
P-20	semi-submersible	620	7 / 0	60	1000	-
P-25	semi-submersible	575	20 / 0	100	3000	-
P-26	semi-submersible	990	20 / 0	100	2800	-
P-27	semi-submersible	533	7 / 0	50	1800	-
P-40	semi-submersible	1080	x	x	6	-
PCH-1	Fixed	117	11 / 0	44	2000	-
PNA-1	Fixed	145	28	40	3000	-
PNA-2	Fixed	170	27	28	60	-
PGP-1	Fixed	121	25 / 0	200	2550	-
PGP-1	Fixed	101	19 / 0	120	650	-
PCP-1	Fixed	86	28 / 0	16,8	-	-
PCP-2	Fixed	87	19 / 0	9,95	-	-
PVM-2	Fixed	101	16 / 0	5,5	-	-
PVM-3	Fixed	101	13 / 0	2,9	-	-
PCE-1	Fixed	116	36 / 0	60	1600	-
PPM-1	Fixed	115	33 / 0	80	2100	-
PCP-3	fixed	90	14 / 0	15	70000	-

Table 2 – Platforms of the Santos Basin. [6]

Name	Type	Depth (m)	Wells (production/injection)	Oil Production (10 ³ bbl/d)	Gas Production (10 ³ m ³ /d)	Capacity of Storage (10 ³ bbl)
SS-11	semi-submersible	152	2 / 0	20	-	-
PMLZ-1	fixed	131	6 / 0	5	2500	-

From the table 1 and figure 5, the Campos Basin is composed of 13 (thirteen) FPSO, 12 (twelve) semi-submersible, and 12 (twelve) fixed platforms, with a total of 37 (thirty-seven) platforms and 28 (twenty-eight) blocks. And from the table 2 and figure 5, the Santos Basin is composed of 1 (one) semi-submersible and 1 (one) fixed platforms, with a total of 2 platforms and 24 blocks.

4. Total Energy required to be supplied in Campos and Santos Basin

How could be noted, in the Campo Basin exist a minimum of one platform for existed block, 37 (thirty-seven) platforms and 28 (twenty-eight) blocks. Considering these facts for the Santos Basin, a necessity of a minimum of 24 (twenty-four) platforms are avoided, what will be run no late in 2012 [6]. Considering nowadays the necessity of about 100MW of supplied energy for keep a platforms working, what are normally done through 4 (four) gas turbine generators, this fact could be extrapolated for all the platforms existed in these basins.

So, with a macro and simplified calculation, multiplying 100MW for the total platforms, considering 1 (one) per block, total of 52, reaches a result of 5.200MW energy or about 5,2GW to be supplied. Considering now the fact that just the energy supply for fixed platforms could be replaced, and considering also the proportion distribution of fixed platforms existed in the Campos Basin moulded for the Santos Basin and the actual information of platforms implementations [6], resulting in 8 platforms for the Santos Basin, a total of 20 platforms fixed platforms are avoided.

Following the same meaning as before, multiplying 100MW for the total fixed platforms, 20 (twenty), give a result of a total 2,0GW to be supplied.

5. Results and Conclusion

Analysing the potential of the wind on the Brazilians coast distribution, can be seen that a strong wind can be get as well near the city Cabo Frio, from the state Rio de Janeiro, In the southeast of Brazil. These data are also true for a seasonal consideration. Not just a coincidence, but a highly significant opportunity, is the fact that can be observed through the potential of the coast of the city Cabo Frio. It stays exactly in an area between the Santo's and Campo's Brazilians' Basin. These facts, from a macro analysis, enhance the positive validation of offshore park for wind power generators. After avoiding the area expected to be used, the energy transmitting needs and the energy required from the platforms and no less important, its construction, considerable results can be given, for its possibilities of implementation. No less important is the fact that the European countries are still developing a strongly emphasised studies about the offshore wind farms technology, and the consideration of every offshore wind farms capacity followed of each project costs, gives a good overview of the required project cost of a offshore wind farm implementation on the Cabo Frio's coast. From this analysis, an emphasised research could be developed, to give the opportunity to show how implement full a project like this comes to be.

6. Acknowledgements

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