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Wind energy system in Ambocas-Ecuador: distributed generation and energy quality

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INTRODUCTION

The installation of a wind farm could be the optimal solution to solve the electricity quality problem in Ambocas area, Loja district (Ecuador). In the Altiplano Orense, where the area is placed, both quality of power supply and product quantity are deficient. Part of the problem is because the electrical bar of 69 kV in the Portovelo electrical substation, works actually with a voltage regulation of minus 12%. In addition, this last is about 60 km far from the National Transmission System (SNT). The area has a high energy consumption, both from industry as for residence. The primary demand is actually about 30 MW of power, but it is planned the construction of a new industrial pole to process minerals, with power demand of about 20 MW more. Thus, in a near future the actual problems with electricity quality will increase if do not generate electricity near the optimal charge point for the area, which includes cantons of Piñas, Portovelo, Atahulapa, and Zaruma. This will require the detailed study of permanent and dynamic energy consumption, including interconnection with the distribution station**[1]**.

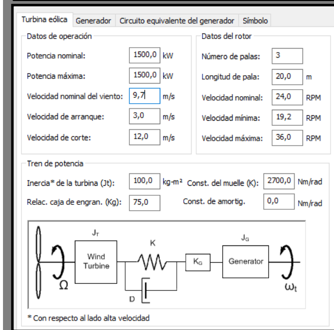
CONTENTS

1. Production of the WF: In Figure 1, where we present the estimated electrical energy production in the different months of the year as average, taking the wind data of the last 5 years. The annual production would be more than 52,000 MWh as obtained from the NREL-wind software simulation**[2]**, being the most productive months from June to September.

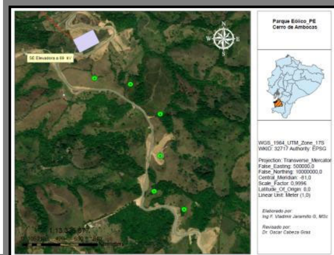
2. Connection of the WF: In Figure 2, To feed the national distribution system with the energy generated in the proposed WF, it is necessary a substation to elevate voltage from 34.5 to 69 kV (i.e., from 16 to 20 MVA) to evacuate the generated electricity through a three wires transmission line of approximately 12 km from the WF to the electrical substation of Portovelo. The planned transmission line will be made with 500 MCM ACAR aluminum conductor wire. Using the specialiced software CYME CYMDIST, we can simulate the interconnection impact knowing the current fluxes**[3]**. To do that, it is necessary to model the Power Electrical System (PES) of the Portovelo substation.

3. Economic analysis: In Figure 3, The total cost of the project is about 23.4 USD millions, while the estimated profits are about 5.26 USD millions per year.

[Turbine data to be input in the system]



[Windmills location in Cerro de Ambocas]



	Jan	Feb	Mar	Apr	May	Jun	Jul
Wind speed (m/s)	7.8	7.6	7.9	8.8	9.9	13.2	14.3
MWh/day	57,60	53,88	59,81	84,79	119,41	283,06	357,45
MWh/month	1.785,70	1.508,66	1.854,21	2.543,80	3.701,64	8.491,87	11.080,83

Aug	Sep	Oct	Nov	Dec	Average	Anual
13.8	13.0	7.7	5.8	6.8	**9.7**	
322,18	270,74	55,49	24,32	38,59	**143,94**	**52.560 MWh/year**
9.987,73	8.122,23	1.720,21	729,49	1.196,24	**4393,55**	

Figure 1. Wind Energy Production in kWh

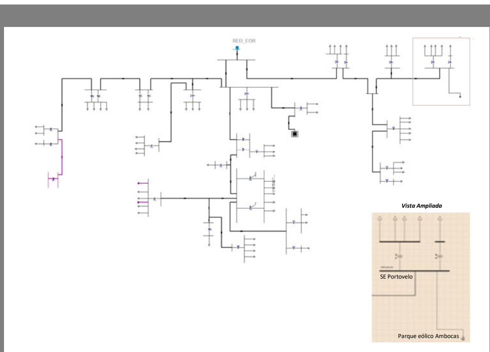


Figure 2. Power Electrical System of Portovelo substation

Description	Unity	Proyect
Installed Power	MW	10
Plant Factor	%	60
Wind Farm with all components	USD/KW	2,200
Substation connection	USD	1,200,000
Interconnection line	USD/Km	17,000
O&M variable	USD/MWh	17
O&M Fix	% investment	2.50
Energy market prize	USD/MWh	100
Emisions reduction certificate	USD	486.89

Figure 3. Costs and incomes of our project

RESULTS AND CONCLUSIONS

1. We have planned a wind farm, WF, of 10 MW composed by six mills with 1.5 MW power each near an existing road in Cerro de Ambocas. Loja (Ecuador). The capacity factor of the plant is 0.6. which represents the possibility of very high production compared with majority of similar wind farms all over the world.
2. The bar voltage level in the electrical substation improves due to the injection of energy directly to the substation, which means a much better electricity quality system, minimizing actual faults. The technical analysis shows that there is not any technical problem to install the WF.
3. In addition, a brief economical study of the project gives net benefits higher than 3.5 USD million per year on average before taxes. So, it is a very good business as well its environmental and social positive implications. This last conclusion due to the improve of the electrical service quality for homes and industries in the area.

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