VERTICAL WIND TURBINE

Gorlov

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Contents

Introduction

Egypt is a net exporter of crude oil and natural gas, however, the combination of increasing consumption and declining production has led to a decline in natural gas exports since 2009, as the government started to divert natural gas supplies from exports, in order to satisfy domestic demand, eventually turning the country into a natural gas importer since 2015

Egypt's Production of Different Energy Sources during the 2000s in Ktoe

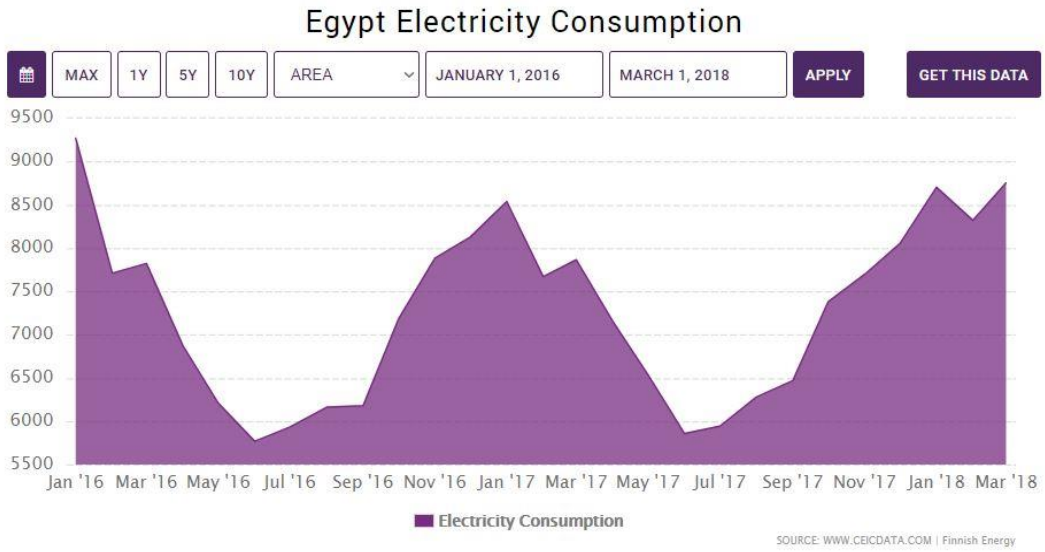
	2000	2005	2012	2013	2014	2015	2016	2017
Coal	20	14	0	0	0	0	0	0
Crude Oil	33189	30111	32142	29537	32825	33210	30835	31885
Natural gas	18555	35901	54839	50143	39084	34763	34763	35362
Electricity from Fossil Fuels	5302	8211	12250	12250	13431	14355	14514	14679
Hydro Electricity	1260	1087	1112	1113	1188	1155	1171	1187
Electricity from Renewables	12	47	139	139	145	137	150	165
Refinery/Oil Products	23449	28561	24754	21836	25348	25676	26357	270565

Electricity Access

According to the U.S. Central Intelligence Agency (CIA)'s 2018 report, only around 300,000 people of the whole Egyptian population is currently without access to electricity.

Introduction

Egypt's Electricity Consumption data was reported at 12,277.000 kWh in Mar 2018. This records an increase from the previous number of 11,612.000 kWh for Feb 2018. Egypt's Electricity Consumption data is updated monthly, averaging 8,565.000 kWh from Jan 1997 to Mar 2018, with 255 observations. The data reached an all-time high of 39,385.000 kWh in Sep 2012 and a record low of 3,737.230 kWh in Feb 1997. Egypt's Electricity Consumption data remains active status in CEIC and is reported by Ministry of Electricity and Energy. The data is categorized under Global Database's Egypt.



The cost of energy from municipal power grids keeps going up, and the importance of maintaining a healthy environment grows every day. Egypt intends to supply 20 percent of generated electricity from renewable sources by 2022, with wind providing 12 percent, Hydro power 5.8 percent, and Solar 2.2 percent. On the other hand, construction organizations and people in general seek efficient ways of providing energy and there is major concern for engineering companies around world of Utilizing the Renewable Energy with small scale making it suitable for buildings roofs, gardens and other properties.

Introduction

Wind Energy Vs Solar Energy

	WIND TURBINES	SOLAR PANELS
Driving Source	Wind energy, works all day	Sunlight, works during daylight only
Surface Area (For 5KW Power Production)	As (Circle) =0.7 m^2	As (Rectangle) = 55 m^2
Environmental Effect	Neither have toxic materials nor producing pollutants	Large amount of fossil fuels & toxic materials like the PVC & glues are used in the manufacture of the cells and the waste cause disposal problems

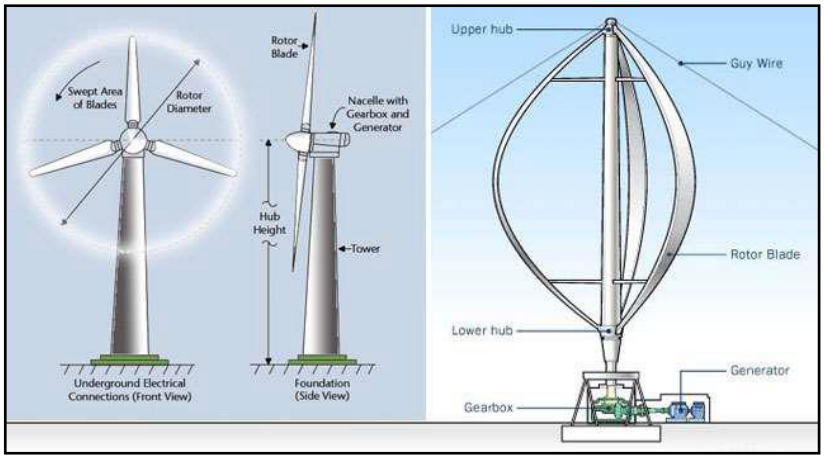
Overall Net Benefits

	Wind	Solar
Avoided Emissions	$284,526	$185,338
Avoided Energy Cost	$98,925	$67,732
Avoided Capacity Cost	$70,482	$46,425
Fixed Cost Incurred	$-162,687	$-181,434
Other Costs (Periodic O&M)	$-7,755	$-4,713
Total Net Benefits /MW/Year	$283,311	$113,349

Introduction

Vertical Vs Horizontal WT

A wind turbine generator can have a vertical or horizontal rotation axis. A vertical-axis wind turbine is advantageous for installation in city centers because it is not affected by the direction of the wind as much as a horizontal-axis wind power generator.



It is easy to maintain because it does not need complicated structure such as yawing devices.

Gorlov Wind Turbine

Our prototype design is a Darrieus turbine with its blades canted into a helix, this type is called Gorlov. With our prototype and since the wind pulls each blade around on both the windward and leeward sides of the turbine, this feature spreads the torque evenly over the entire revolution, thus preventing destructive pulsations.

PROJECT
Objectives

Our goal is to optimize a small scale wind turbine based on the range of power that would run all day on wind energy available. Achieving the optimum design to reach the maximum use of wind, our design is according to Gorlov type which produces a higher lift force than the drag force which is highly required to ensure the continuity of blade rotation. This design also overcomes that challenge of changing the angle of attack and the change of momentum decreasing stresses generated on the blades. The length of our design is about 1.3 meters. Our Prototype can be installed on a rooftop of a house where wind is conveniently continuous to generate necessary power to feed the house's appliances.

With our prototype we'll be participating in the International Wind Turbine Design Contest IWTC organized by Hanze University of Applied Sciences in the Netherlands and hopefully win the IWTC 2019.

PROJECT Procedure

Work Flow

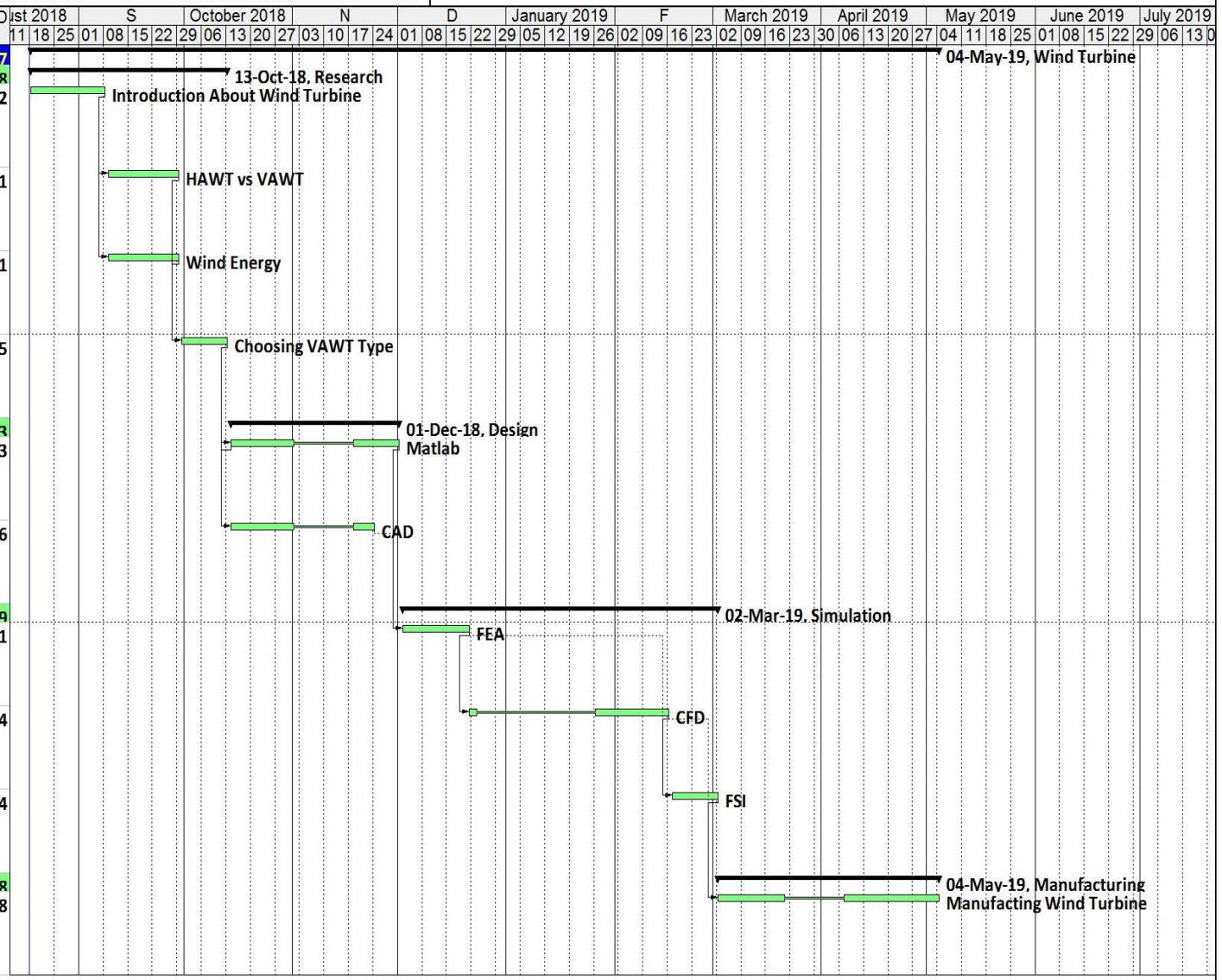
	Process	Description
1	Determining Range of Power	500~700 Watts
2	Design Process	Selection of primary dimensions and set of materials that could be used during manufacturing
3	Simulation Process	1. Using The Finite Element Method to run a structural analyses 2. Using Computational Fluid Dynamics (CFD) to analyze aerodynamic forces
4	Finalizing Dimensions	Selection of Final Dimensions
5	Final Selection of Materials	Selection of Final Materials
6	Manufacturing Process	Using 3D printing to achieve the maximum accuracy of blade manufacture
7	Testing	Test is run in a wind tunnel to calculate the output power

ALEXANDRIA UNIVERSITY
FACULTY OF ENGINEERING
Mechanical Engineering Department
Hydraulic Machines and Fluid Mechanics Branch.

جامعة الإسكندرية
كلية الهندسة
قسم الهندسة الميكانيكية
شعبة الآلات الهيدروليكية و ميكانيكا الموائع

Wind Turbine

Activity Name	Start	Finish	D
Wind Turbine	18-Aug-18	04-May-19	217
Research	18-Aug-18	13-Oct-18	58
Introduction About Wind Turbine	18-Aug-18	08-Sep-18	22
HAWT vs VAWT	09-Sep-18	29-Sep-18	21
Wind Energy	09-Sep-18	29-Sep-18	21
Choosing VAWT Type	30-Sep-18	13-Oct-18	15
Design	14-Oct-18	01-Dec-18	33
Matlab	14-Oct-18*	01-Dec-18	33
CAD	14-Oct-18*	24-Nov-18	26
Simulation	02-Dec-18	02-Mar-19	79
FEA	02-Dec-18	21-Dec-18	21
CFD	21-Dec-18	16-Feb-19	44
FSI	17-Feb-19	02-Mar-19	14
Manufacturing	02-Mar-19	04-May-19	48
Manufacting Wind Turbine	02-Mar-19'	04-May-19	48



PROJECT SCHEDULE

Budget & Cost Analysis

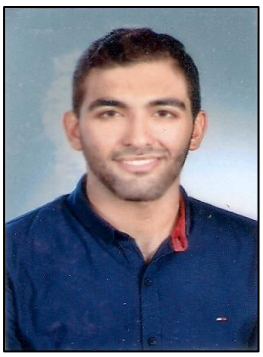
Manufactured Components						
Component	Quantity	Specification	Manufacturing Process	Purpose	Price per Unit in EGP	Total price in EGP
Blade	3	-Material: ABS -Weight: 750 gm	-3d Printing -Costs 9 EGP/gm	3D printing to Achieve its twisting design to reach our Optimum Design.	9785	29355
Tower	1	-Material: Stainless Steel -Weight: 10.92 Kg	Machining Costs 180 EGP/ Kg At Abou Eldordar	Transferring the Mechanical power to the foundation where the Generator	1965.6	1965.6
Tower Arms	3	-Material: Stainless Steel -Weight: 5.35 Kg	Machining Costs 180 EGP/ Kg At Abou Eldordar	Holding the Blades and overcoming the stresses	963	2889
Bought Components						
Component	Quantity	Specification	Buying Process	Purpose	Price per Unit in EGP	Total price in EGP
Bearing	4	Single Row Deep Groove Ball Bearings (KOYO6252)	From Abou Eldordar	Necessary for Rotation mission and Preventing Friction	375	1500
Brake	1	Dynamic Braking Resistor	Online Store: Alibaba	To Control the blades during the high wind speed	895.85	895.85
Gearbox	1	Step up speed multiplier rotator gearbox variator	Online Store: Alibaba	Adjusting the speed of the tower to the needed speed for the generator	3583.40	3583.40
Generator	1	Model E3 2-48/60 3000 rpm Max Power: 2880 Watt	Online Store: Sincro Compny	Converting the Mechanical power into Electrical Output power	5376	5376

Additional Costs	
Accessories	5000 EGP
Spares	25000 EGP

Travelling Expenses for the Competition at Hanze University				
Ticket price	Total Tickets price	Destination	Outbound	Return
£666 = 15131.17 EGP	£4,661= 105748.60 EGP	Groningen, Netherlands	Wed, 19 Jun 2019	Sun, 30 Jun 2019

Total Expenses	
Total Price Excluding Travelling Expenses	75,564.85 EGP
Total Price Including Travelling Expenses	181,313.45 EGP

TEAM MEMBERS



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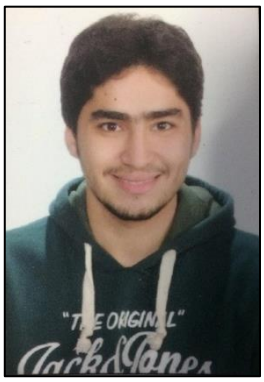

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PROPOSAL SIGN-OFF

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