PROJECT ONE: MILESTONE 1 – COVER PAGE

Team Number: 57

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Mary Butrus	butrusm
Tiana Rhule	rhulet
Abyan Jaigirdar	jaigia1
Firas Elayan	elayanf

MILESTONE 1 (STAGE 0) – PRE-PROJECT RESEARCH MEMO

Team Number: 57

You should have already completed this task individually prior to Design Studio 3.

1. Copy-and-paste each team member's pre-project research memo on the following pages (1 team member per page)
   → Be sure to indicate each team member's Name and MacID

We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their Pre-Project Research Memo with the **Milestone One Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone One Team Worksheets** document allows you to readily access your team member's work
  - This will be especially helpful when completing ***Stage 1*** of the milestone

Team Number: 57

Please list Team Member that is submitting the memo.

Full Name: Firas Elayan	MacID: elayanf

Copy-and-paste the pre-project research memo for one team member in the space below

Due to our enormous annual consumption of oil, it is estimated that the world could run out of oil in as little as 5 decades.[1] By the time it leaves us, it would have caused nearly irreversible damage to the planet's environment as well as dangerous alterations to global climates. As a result of this, many countries around the world have displayed exponentially increasing interest in renewable resources, particularly wind energy. Several countries are looking to utilize their strong winds in order to generate electricity that could power towns and even cities. In fact, wind energy is the fastest growing renewable source of energy, with predictions that it will play a colossal role in the generation of electricity in a few decades. The rapid development of wind turbine technology has led to many offshore wind projects beginning which are aimed at replacing fossil fuels by a great amount.[2]

Building a wind turbine is not as simple as attaching 3 large blades to an even larger rod. Many factors must be taken into consideration when designing a wind turbine and even a wind turbine blade. Exactly how these factors affect the design of the wind turbine depends on the scenario. It is up to the designer to assess the situation and then come up with a suitable design. The climate of the location where the turbine is to be built is a factor that affects the design of the turbine. Some places, for example, receive more aggressive winds than others, and so strength and stiffness must be taken into consideration. The conditions of the location that the turbine is being built on are also a relevant factor. Another factor is the effect that wind turbines can have on their surroundings. Although wind turbines are quite helpful for the environment, they can negatively affect nearby communities in a few ways, such as causing noise and blocking views which can make it sort of a nuisance.[3]

Copy the references below (use IEEE format)

[1] "When will fossil fuels run out?", Ecotricity [Online]. Available: https://www.ecotricity.co.uk/our-green-energy/energy-independence/the-end-of-fossil-fuels#:~:text=Globally%2C%20we%20currently%20consume%20the,in%20just%20over%2053%20years. [Accessed: September 24, 2020]

[2] X. Sun and D. Huang and G Wu, "The current state of offshore wind energy technology development", ScienceDirect [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0360544212001685#:~:text=Wind%20power%20has%20been%20the,in%20electricity%20generation%20in%202050. [Accessed: September 24, 2020].

[3] J.F. Manwell, J.G. McGowan and A.L. Rogers, *Wind Energy Explained – Theory, Design and Application.* John Wiley & Sons Ltd, 2002.

Team Number: 57

Please list Team Member that is submitting the memo.

Full Name: Tiana Rhule	MacID: rhulet

Copy-and-paste the pre-project research memo for one team member in the space below

Introduction:

The purpose of a wind turbine is to convert kinetic energy into usable electrical power through mechanical energy. There are two different kinds of turbines, vertical axis turbines and horizontal axis turbines, horizontal axis turbines are the most common. Many early civilizations have used the power of wind to provide innovative solutions to common problems much before electricity existed. According to S. Santoso, the "first documented electricity-generating wind turbine was for battery charging" in 1887, the development of electric power generating technologies has advanced much further since then [1]. In the 1930's wind generated electricity was used for farms without grid connection to the US [1]. More currently, wind turbines for electricity are used for commercial purposes to power large machines. Large-scale modern wind turbines have become more relevant over the past few decades as countries consider renewable energy technologies [1]. Most modern turbines are equipped with technologies that allow them to adjust and prevent damage caused by environmental effects. Such as features that control and adjust the operation of the turbine under normal circumstances and during an emergency.

Design factors:

Wind speeds vary over time, this is because climate is forever changing, along with the wind. This includes turbulence, which is the short-term variation of wind speed. Wind speed can also vary in a spatial aspect, such that the speed at the top of the rotor can be greater than those at the bottom. Typically, the higher the height of the turbine the greater the wind speed and the lower the turbulence intensity. The tower height and blade length are proportional to the generation capacity of the turbine. Thus, the larger the dimensions the greater capacity the wind turbine has. There is no theoretical design that could possibly extract all energy from the wind. This is important when it comes to designing an optimal wind device [2].

Copy the references below (use IEEE format)

[1] Surya Santoso, Ph.D.; H. Wayne Beaty, *Standard Handbook for Electrical Engineers, Seventeenth Edition.* New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto: McGraw-Hill Education, 2018.

[2] Francis M. Vanek, Ph.D.; Louis D. Albright, Ph.D.; Largus T. Angenent, Ph.D., *Energy Systems Engineering: Evaluation and Implementation, Third Edition.* New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto: McGraw-Hill Education, 2016.

Team Number: 57

Please list Team Member that is submitting the memo.

Full Name: Mary Butrus	MacID: butrusm

Introduction:

Wind power has been the quickest developing type of sustainable power source throughout the previous scarcely any years [1]. As indicated by Intergovernmental Panel on Climate Change (IPCC) report, 80% of the world's energy supply could emerge out of sustainable sources by 2050 and wind energy will assume a significant part in power age in 2050 [1]. In the developing business sector for wind energy and the restricted accessible space inland, the advancement of seaward wind farms become increasingly significant [1]. With a quick advancement of innovation, the seaward wind power ventures have become a pattern in numerous nations like Europe now [1].

Design factors:

Wind turbines are designed to maximise the rotary wing radius to maximize power output [2]. Larger blades allow the turbine to capture more of the mechanical energy of the wind by moving more air through rotors [2]. However, larger blades require more room and better win speeds to control [2]. As a general rule, turbines are spaced out at four times the rotor diameter [2]. This distance is important to avoid interference between turbines, which decreases the power output [2]. When it comes to the design of the blades there are many things to take into consideration. It is good to note that wind turbine edges produce lift with their curved shape [3]. The side with the foremost curve produces low air pressure, whereas at the same time, high-pressure air underneath powers on the other side of the blade-shaped aerofoil [3]. The net result could be a lifting drive opposite to the organization of the flow of the air over the turbine’s blade [3]. The point here is to design the rotor blade in such a way as to form the proper sum of rotor blade lift and thrust, creating ideal deceleration of the air and thus resulting in blade efficiency [3].

[1] Sun, D. Huang, and G. Wu, "The current state of offshore wind energy technology development," *Energy*, 30-Mar-2012. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0360544212001685#:~:text=Wind power has been the,in electricity generation in 2050. [Accessed: 24-Sep-2020].

[2] Alison Campbell, and others, "Wind power," *Wind power - Energy Education*. [Online]. Available: https://energyeducation.ca/encyclopedia/Wind_power#:~:text=The three main factors that,than having occasional high winds. [Accessed: 24-Sep-2020].

[3] Meg Jenkins,"Wind Turbine Blade Design Optimization with SimScale: Blog," *SimScale*, 07-Nov-2019. [Online]. Available: https://www.simscale.com/blog/2019/09/wind-turbine-blade-design/. [Accessed: 24-Sep-2020].

Team Number: 57

Please list Team Member that is submitting the memo.

Full Name: Abyan Jaigirdar	MacID: jaigia1

Introduction:

In recent years, wind energy has become one of the most economical renewable energy technologies [1]. Not only do they provide a stable source of energy [1] but wind energy can successfully compete with conventional energy production [3]. Many countries have considerable wind resources, which have still been harnessed [1]. There are benefits to using wind energy such as it does not produce greenhouse gases and that they are flexible to increasing demand, so you are able to add more turbines to a wind farm [1].

Design Factors:

The first step in designing a wind turbine is to determine what it will be its purpose [2, pg.249]. For example, wind turbines that are meant for remote communities will have a different design from wind turbines that will be used for producing power supply to large utility networks [2]. The application will play a factor in choosing "the size of the turbine, the type of generator it has, the method of control, and how it is to be installed and operated" [2]. For example, wind turbines for utility power will tend to be as large as practical. Currently, these turbines have power ratings in the "range of 500 to 1500 kW, with rotor diameters in the range of 38 to 61 metres" [2]. These machines are usually installed in groups or wind farms and may be able to utilize developed infrastructure for installation, operation and maintenance [2]. You also need to consider things such as the rigidity of the blade, is it flexible or stiff? Lower speed turbines are usually stiffer whereas lighter, faster turbines have blades that are more flexible [2, pg. 320]. Also, the number of blades can play a factor. Most modern turbines have 3 blades since it has an advantage when considering "the polar moment of inertia with respect to yawing is constant" [2]

Copy the references below (use IEEE format)

[1] "Wind Energy," *Wind Energy - Introduction*. [Online]. Available: https://energypedia.info/wiki/Wind_Energy_-_Introduction. [Accessed: 22-Sep-2020].

[2] J. F. Manwell, M. G. J. G., and A. L. Rogers, "Wind Turbine Design," in *Wind energy explained*, Chichester: John Wiley & Sons, 2002.

*If you are in a team of 5, please copy and paste the above on a new page

MILESTONE 1 (STAGE 1) – INITIAL PROBLEM STATEMENT

Team Number: 57

Stage 1: Initial Problem Statement:

What is your first draft of the problem statement? Keep it brief and to the point. One or two sentences should be enough. **For initial problem statement you should be focusing on main function(s) of wind turbine.**

To design a turbine that optimizes the wind speed to convert into effective electrical energy.

MILESTONE 1 (STAGE 3) – REFINED OBJECTIVE TREES

Team Number: 57

For each engineering scenario, you will be submitting a modified/revised objective tree agreed upon by the group. Each branch of objective trees should have a minimum of 3 layers. This can be hand-drawn or done on a computer.

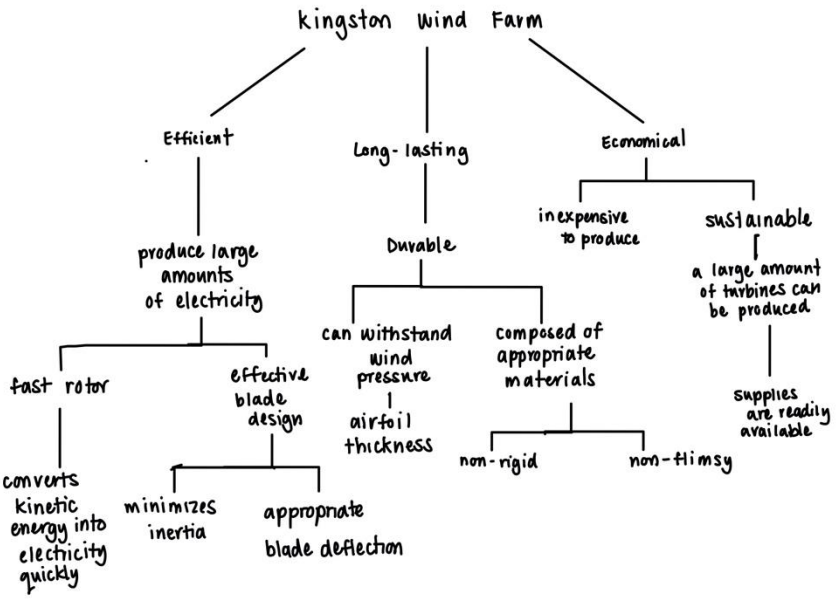
Engineering Scenario #1

The title of the scenario

Renewable Energy for a Large Population

Team objective tree diagram for scenario #1

Please have a copy of refined and finalized team objective tree for scenario #1.



Team Number: 57

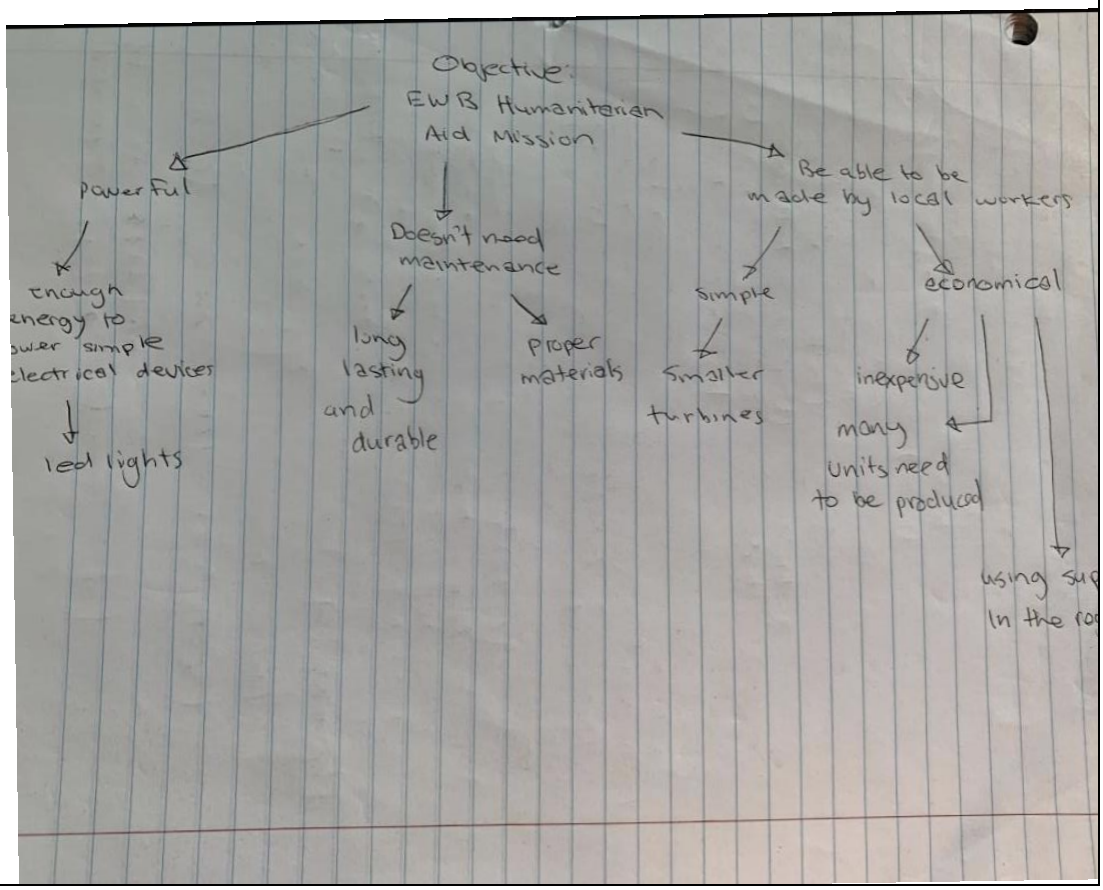
Engineering Scenario #2

The title of the scenario

EWB Humanitarian Aid Mission

Team objective tree diagram for scenario #2

Please have a copy of refined and finalized team objective tree for scenario #2.



Team Number: 57

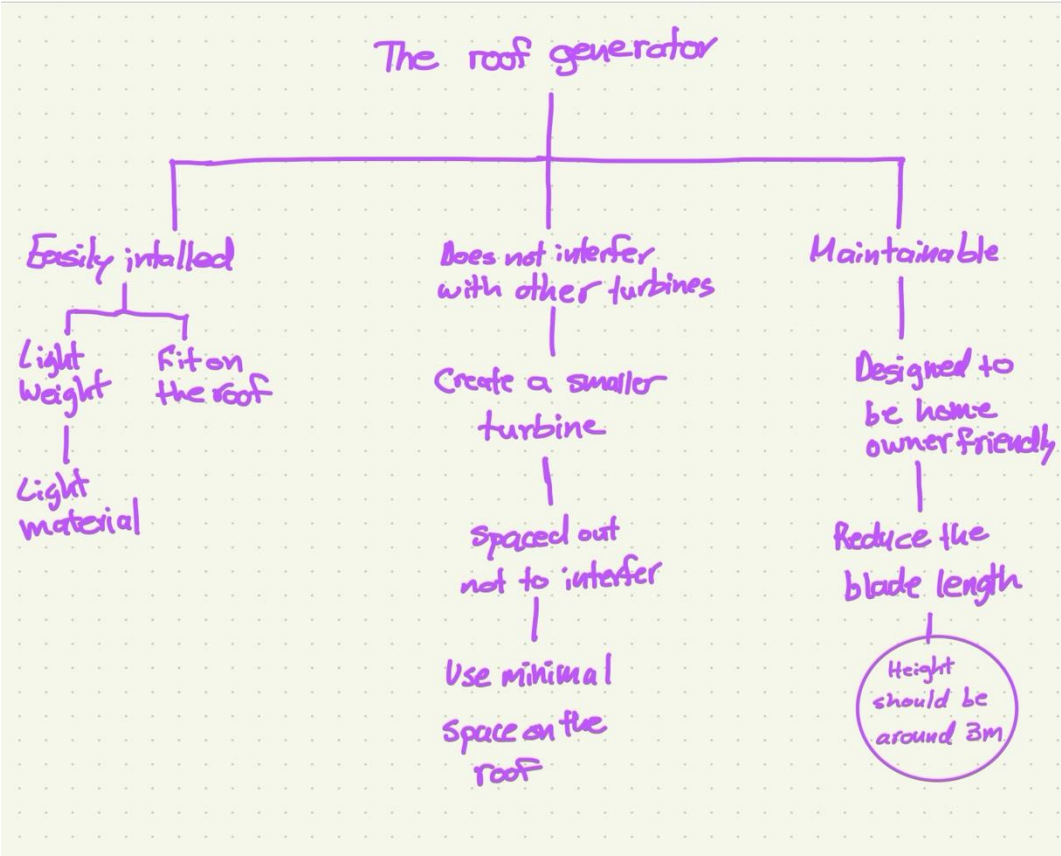
Engineering Scenario #3

The title of the scenario

The Roof Generator

Team objective tree diagram for scenario #3

Please have a copy of refined and finalized team objective tree for scenario #3.



Team Number: 57

Engineering Scenario #4

The title of the scenario

A Pioneer in Clean Energy

Team objective tree diagram for scenario #4

Please have a copy of refined and finalized team objective tree for scenario #4.