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

Team Number: 26

This is an individual deliverable and should be submitted by each team member **prior** to Design Studio 3.

→ Complete your pre-project research memo on the following page

At the beginning of Design Studio 3, we will be asking that you copy-and-paste the Pre-Project Research Memo below into **Milestone One Team 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

Please list Team Member that is submitting the memo.

Full Name:	MacID:
Sana Khan	Khans288

Summary of wind turbine blade technology and potential design considerations.

Each individual research memo should be ***no more than one page***, excluding references.

Introduction:

Wind turbines are a renewable energy source widely used around the world. They take wind energy and convert it to electrical energy through the use of aerodynamic force. Modern wind turbines have been very reliable and cost effective [1]. They have become larger in size over the last few decades, allowing them to be more efficient and produce a larger quantity of energy. They are designing lighter, sturdier, and performance optimizing parts for wind turbines through advanced technology and research while continuing to improve materials, location, and structure of the turbines [5].

Design factors:

There are many factors that need to be considered when engineering wind turbines. The location of the generator should be closer to the ground allowing there to be easy access to service [2]. Some generators have been built at the top causing many issues with servicing [2]. Many companies producing wind turbines have built them out of steel due to their sturdiness to withstand strong winds as well as their strength to hold the blades in place [4]. However, this may not be the ultimate choice of material for blades. Many companies are looking into using different composites such as carbon-fiber and glass-fiber for the blades [7]. They are temperature-moisture resistant (meaning that they won't corrode and get ruined in moisture or humidity) and provide improved fatigue resistance. Furthermore, this material provides high stiffness and low density and is cost effective which is good for budgeting [7]. Obviously, for the turbine to generate energy it needs large amounts of wind which is why it is built very high up. However, the structure cannot be compromised and needs to be built more thicker and stronger to prevent swaying and movement during strong winds and storms [2]. Wind turbines should contain some braking system where the blades stop spinning just in case winds get too strong to prevent breaking/bending of the blades or over working the generator and causing electrical issues [2]. The location of the wind turbine is very important. Many factors need to be considered such as the weather patterns of the area (snowy, rainy, stormy). This branches off into considering what material should be used to keep the turbines lasting for a long time. For example, using the right metal to construct base and blades so that they don't corrode in rainy/snowy weather or using sturdy metal that won't bend or sway in strong winds. Wind patterns (direction of wind) needs to be considered as well to understand whether or not the wind turbines will thrive in that area. So, if wind only blows north east, positioning the turbine at an angle where the wind optimizes the turning of the blades. In terms of design, there should be three blades because they help keep the angular momentum constant so that the blades can rotate smoothly [3]. They should be constructed thinly to prevent drag and in a curved shape to allow better access for air flow and performance. So, when 1 blade is up 2 are down to promote momentum to keep the blades spinning. Narrow blades give good torque from the wide part of the blade and reduces drag at the fast-moving tip to be able to maximize efficiency and produce the most energy by converting larger than 40% of the wind energy to electricity [6]. Overall there are many designs, structural, and location factors that need to be taken into consideration when trying to make energy efficient, low cost wind turbines that provide a large amount of energy for society.

References (adhere to IEEE notation)

***references do not count toward word count / page limit

[1] "How Do Wind Turbines Work?" Energy Efficiency & Renewable Energy [Online]. Available: https://www.energy.gov/eere/wind/how-do-wind-turbines-work. [Accessed: September 26, 2020]

[2] K. Miller-Wilson, "Design of a Wind Turbine." lovetoknow [Online]. Available: https://greenliving.lovetoknow.com/Design_of_a_Wind_Turbine. [Accessed: September 26, 2020]

[3]. L. Villazon, "Why do wind turbines have three blades?" Science Focus: The Home of BBC Science Focus Magazine [Online]. Available: https://www.sciencefocus.com/science/why-do-wind-turbines-have-three-blades/. [Accessed: September 26, 2020]

[4] M. Froese, "How are blade materials and manufacturing changing to keep up with larger turbines." Windpower Engineering & Development [Online]. Available: https://www.windpowerengineering.com/blade-materials-manufacturing-changing-keep-larger-turbines/. [Accessed: September 26, 2020]

[5] "Next-Generation Wind Technology." Energy Efficiency & Renewable Energy [Online]. Available: https://www.energy.gov/eere/next-generation-wind-technology#:~:text=Modern%20wind%20turbines%20are%20increasingly,averaging%202.15%20MW%20of%20capacity [Accessed: September 26, 2020]

[6] "Wind Turbine Blade Design, Flat or Curved." Alternative Energy Tutorials [Online]. Available: https://www.alternative-energy-tutorials.com/energy-articles/wind-turbine-blade-design.html [Accessed: September 26, 2020]

[7] Z. Khaled, Z. Soraya, and Z. Adel. *Fatigue strength prediction in composite materials of wind turbine blades under dry-wet conditions: An artificial neural network approach.* Sage Publications, Ltd., 2016

MILESTONE 1 (STAGE 1) – INITIAL PROBLEM STATEMENT

Please complete this worksheet in your corresponding team document.

MILESTONE 1 (STAGE 2) – PRELIMINARY OBJECTIVE TREE

Team Number: 26

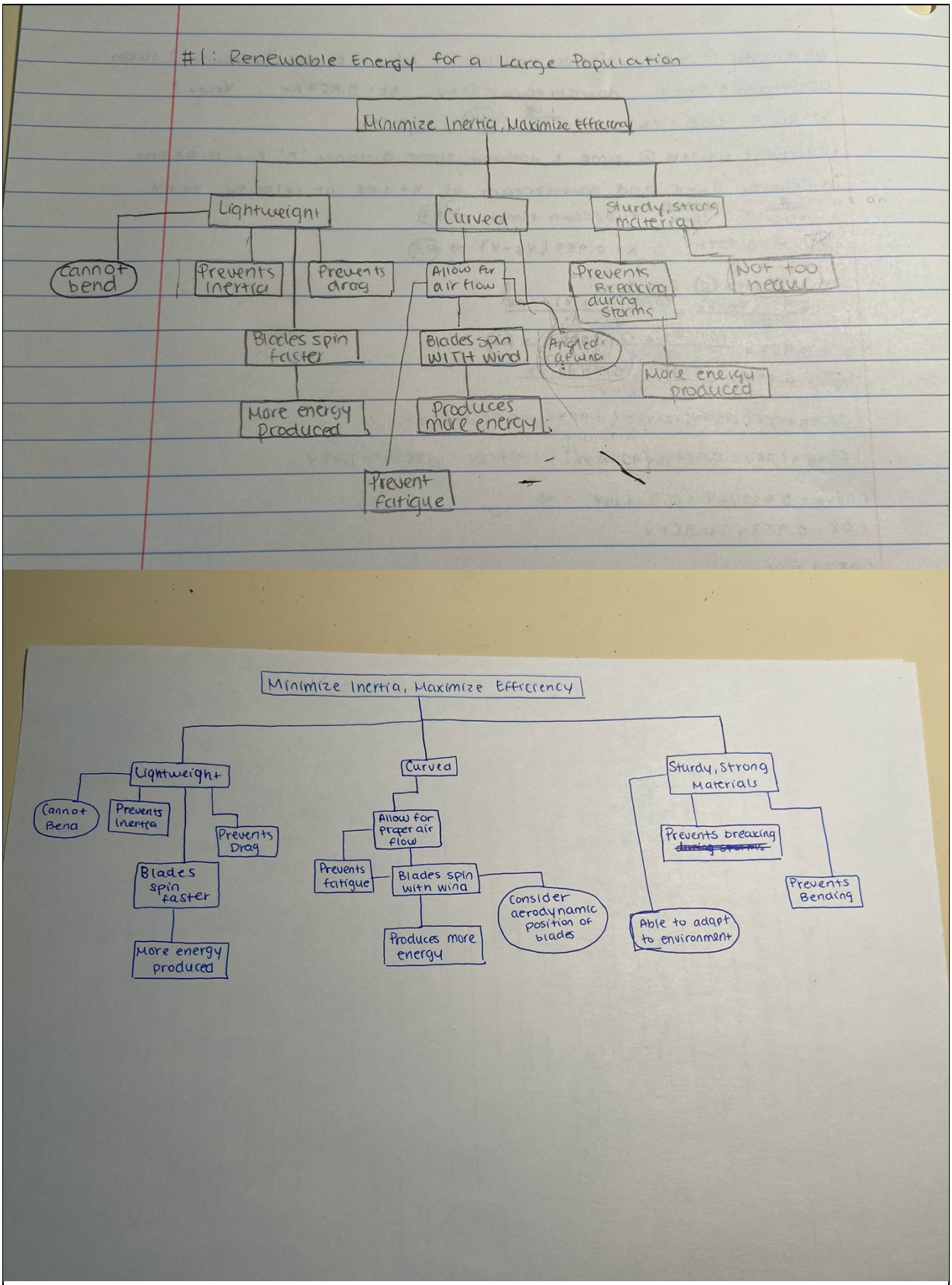
This is an individual deliverable each team member will complete ***during*** Design Studio 3.

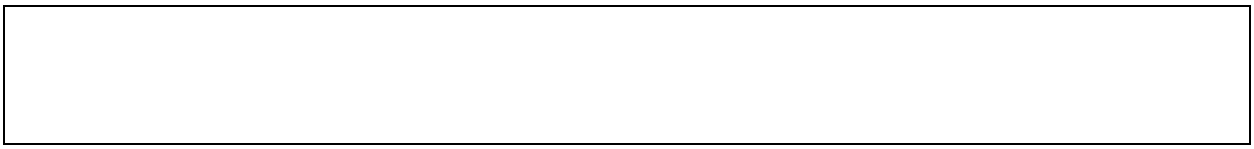
→ Review the 4 different engineering scenarios outlined in the Project 1 module

→ The Project **Manager** will assign each team member one scenario

→ Complete a preliminary objective tree for your assigned scenario on the following page

Name: Sana Khan	MacID: khans288
Engineering Scenario #: 1	
Enter title of assigned scenario Renewable Energy for a Large Population	
Insert individual preliminary objective tree diagram for assigned scenario in the space below	


#1: Renewable Energy for a Large Population
Minimize Inertia, Maximize Efficiency
Lightweight
Curved
Sturdy, strong material
Cannot bend
Prevents inertia
Prevents drag
Allow for air flow
Prevents Breaking during storms
Not too heavy
Blades spin faster
Blades spin WITH wind
Angled/ afoil
More energy produced
More energy produced
Produces more energy
Prevent fatigue
Minimize Inertia, Maximize Efficiency
Lightweight
Curved
Sturdy, Strong Materials
Cannot Bend
Prevents Inertia
Prevents Drag
Allow for proper air flow
Prevents breaking during storms
Blades spin faster
Prevents fatigue
Blades spin with wind
Consider aerodynamic position of blades
Prevents Bending
More energy produced
Produces more energy
Able to adapt to environment



MILESTONE 1 (STAGE 3) – REFINED OBJECTIVE TREE

Please complete this worksheet in your corresponding team document.