

UNIVERSITI TEKNOLOGI MARA

**DESIGN AND FABRICATION OF A
MODULAR WIND TURBINE**

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ABSTRACT

The project addressed the growing need for renewable energy solutions by focusing on the design and fabrication of a modular wind turbine system. Harnessing wind energy has become increasingly important in the transition towards sustainable energy sources. Existing wind turbine designs often lack scalability, adaptability, and cost-effectiveness, limiting their widespread adoption. Moreover, maintenance and component replacement can be challenging and costly, especially in harsh environmental conditions. The project has been conducted with a thorough analysis of existing wind turbine designs and their shortcomings. Computer-aided design (CAD) software is utilized to simulate and evaluate various prototypes, focusing on efficiency, durability, and scalability. The fabricated product is able to generate up 0.6 to 1 watt of power on a low wind speed (3-4m/s). The turbine WindyONE is able to produce a higher power generation given a high wind speed is available. This project has developed a scalable and adaptable modular wind turbine that is on par or exceed the existing wind turbine efficacy and efficiency while reducing maintenance costs and can be easily customized based on environmental factors and energy demands.

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CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Capable of generating thousand Terawatts of power across the entire globe, wind turbine has been one of the best renewable energy sources for its sustainability and scalability without negatively impacting the environment. Wind energy has been experiencing growth up from around less than 500 Gigawatts from 2017 until the end of 2022 and expected to be all the way up to 800 Gigawatts by the end of 2028 (onshore and offshore wind energy)[1]. This will result in the exponential growth in demands and production of wind turbine in the coming years.

Like all other sources of energy out there, wind turbine, especially the blades, is the most intensively stressed component and more likely to be damaged due to environmental factors[2]. These wind turbine is also prone to lightning strikes, especially in the winter region [3] that would causes this turbines rendered useless. The modern wind turbine is very susceptible to the environment and fatigue from the wear and tear despite all the system that has been put in place to combat this problem. In the event that these wind turbine goes down, disassembling and repairing the wind turbine could take several days[4], losing potential useful energy. This is where a wind turbine's modularity can help in reducing downtime while simultaneously increasing energy production and safety.

There's been multiple inventions that is not necessarily focusing on the downtime and transportation problem but it's design could be proven to helpful in the design of a modular wind turbine. One of it is the invention of multi rotor wind turbines that is aiming to significantly increase the production of electricity from wind energy[5]. Despite aiming for enhancing power generation, the multi rotor wind turbine is unexpectedly suitable for modular design as it reduces the original size of original wind turbine while dividing it into multiple parts, making it easy to assemble and disassemble.

The aim of this project is to design and fabricate a small-scale prototype of a modular wind turbine called WindyOne to prove that modularity of a wind turbine can potentially reduce the downtime when faced with damages and casualties, improve the effects of these wind turbines on the environment. Fabricating the prototype will include various manufacturing methods such as additive manufacturing, welding, and sheet metal forming.