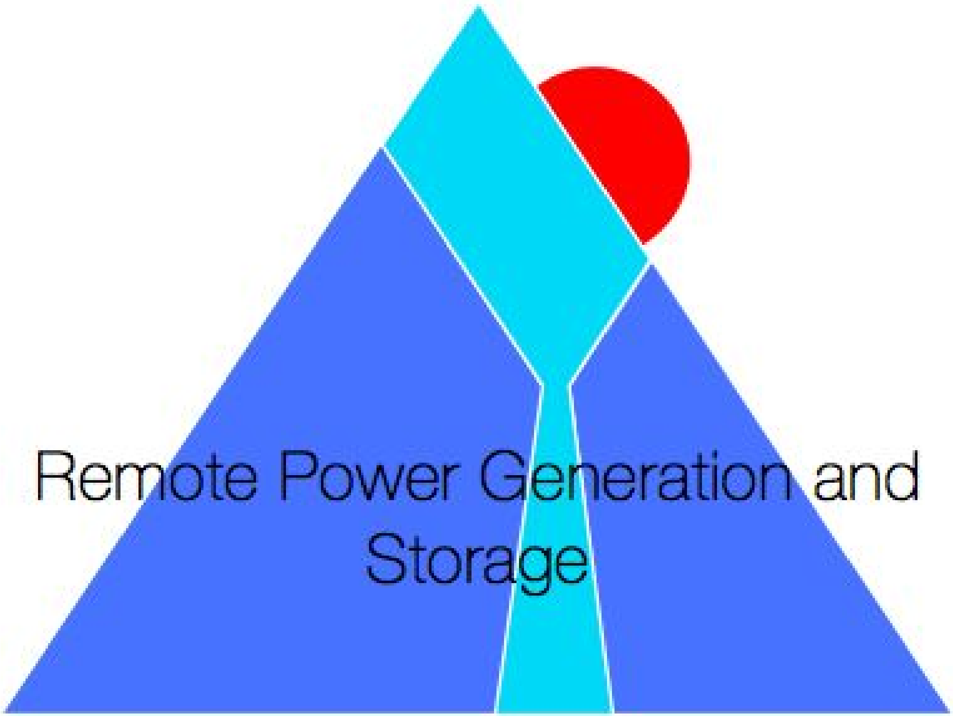
IGEN 330 Project Proposal:



By:

Rob Brodeur
Raj Gill
Liam Hilder
Tom Jiang
Atlas Kazemian
Mouayad Rassas
Andy Wang

INTEGRATED ENGINEERING

EXECUTIVE SUMMARY

RPGS (Remote Power Generation and Storage) is a project based in Vancouver that aims to provide sustainable power to communities lacking access to local power infrastructure. It is the brainchild of seven UBC Integrated Engineering students. The goal for the project is to have a working design by mid-April in 2018, and a product to be sold on the market within 3 years.

Electricity is a vital need for humans in the 21st century, and over a billion people in the world currently live their lives without electricity. RPGS aims to solve that problem by designing a portable device that can produce and store energy. The objective is to give users prolonged access to power without being connected to the national grid.

The target market is anyone with a need for off-the-grid power, whether they be rural villages in developing countries, organizations aiming to help provide that power in developing countries, or casual and recreational users. RPGS has a potential market of over a billion people, with 1.2 billion people in the world current lacking any access to electricity[1]. There is also a global renewable energy market worth hundreds of billions of dollars that can be tapped into, especially as consumers embrace the transition into renewable energy sources powering their daily lives.

RPGS intends to differentiate itself from its competitors by focusing on portability, price, and ease of use. Many renewable energy systems on the market are too difficult to set up or too expensive to buy for the everyday consumer. The product will be designed to easily operate and maintain while being affordable enough for use in communities under the poverty line.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1.0 INTRODUCTION

Many communities across the world do not have access to a reliable source of energy. The International Energy Agency estimates the number of people to be around 1.2 billion[1]. Figure 1 shows that a significant number of these people live in rural and underdeveloped areas. The level of people's access to energy can be correlated with their living conditions, and is a major driving force in economic growth [2]. Basic utilities like stoves and lights are unavailable to people living in these which has adverse effects on their health and education. Without education, children are unable to advance out of their socioeconomic level, constraining their opportunity to succeed and continuing the cycle of poverty[3]. Supporting worldwide efforts to bring energy to these communities would help them rise out of poverty.

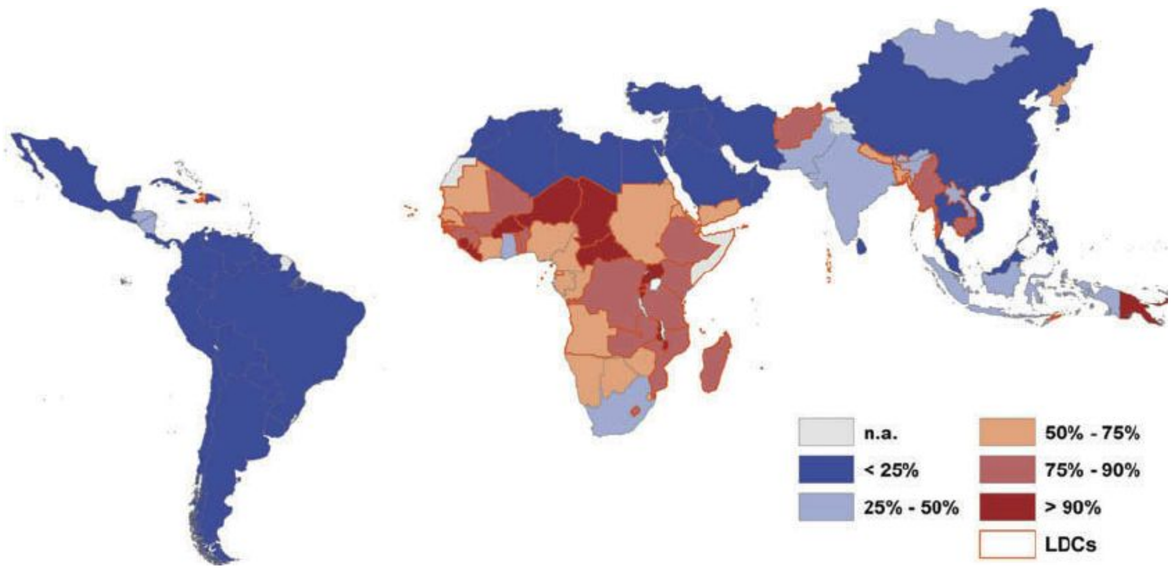


Figure 1.0: Percentage of people without power in developing nations

There are a few options available for people in these communities, and the majority of them lack the basic infrastructure necessary to facilitate power delivery. Local topography, natural disasters, or the geopolitical climate makes implementing permanent power solutions difficult if not impossible[4]. For people living in these areas, the lack of electricity is an issue that will not be solved by itself. Many residents live in very poor areas, making commercial solutions cost prohibitive. Diesel generators are an option but they are expensive to run and produce harmful emissions[5]. Maintenance is an issue in communities that lack the knowledge to repair these generators on their own, and it is difficult to obtain fuel and replacement parts.

Our team's proposed solution is to design a portable and durable power generation unit that people in these remote areas can use. The target users are people living in off-grid communities that need access to a cheap and reliable energy source. Our product will also be marketed towards non-profit organizations so they can distribute them to communities in need. Our motivation for this project came from two non-profit organizations: OLE - Nepal and ZOLCY, who donated 20 laptops for educational purposes to two villages in Dhading, Nepal. The goal presented to our group was to get the schools access to enough consistent power so that they could use the educational software on the laptops throughout the year. Our team decided to expand the goal of the project to developing a general power solution that would fulfill the needs of many communities across the globe.

2.0 NEEDS STATEMENT

To develop a system that is able to withstand harsh weather condition to safely generate and store energy in a cost effective and more environmentally adaptable manner than current products on the market.

3.0 QUANTITATIVE PROBLEM SPECIFICATIONS

Following the design process, our team set our design goals for our project. Table 1 summarizes both the primary and secondary quantitative problem specifications. Some of our specifications were taken from the original two villages in Dhading Nepal with the stipulation that our design be implementable in other communities across the globe as well. While, we have widened the scope of our project, the original two villages serve as good baseline communities.

Primary Specifications	**Secondary Specifications**
Provide at least 1.2kWh of power	At least 30% of parts locally sourceable
Waterproof in up to 18 000 mm (able to withstand heavy rain)	
	Fully recharge simple electronic devices in under 12hours
	Must weigh less than 30kg
	Accommodate the power demand for an additional 10 laptops
	Durable
	Easy to maintain

Table 1.0: Summary of Problem Specifications

3.1 PRIMARY SPECIFICATIONS

The primary function of the generator is to provide electricity. We developed the power specification by taking the average power consumption of a laptop, estimated to be 60W, and multiplying that by 20 laptops [6]. The result is an average power consumption of 1.2kW. The majority of residents in these communities do not have many electronic devices making this a reasonable specification.

The months of June to August, in Nepal, are known as monsoon season and as such the system should be waterproof up to 18000 mm, so that it can still function in these conditions. Waterproofing also makes the generator more durable as it is not sensitive to water damage and can be used in a wider variety of situations.

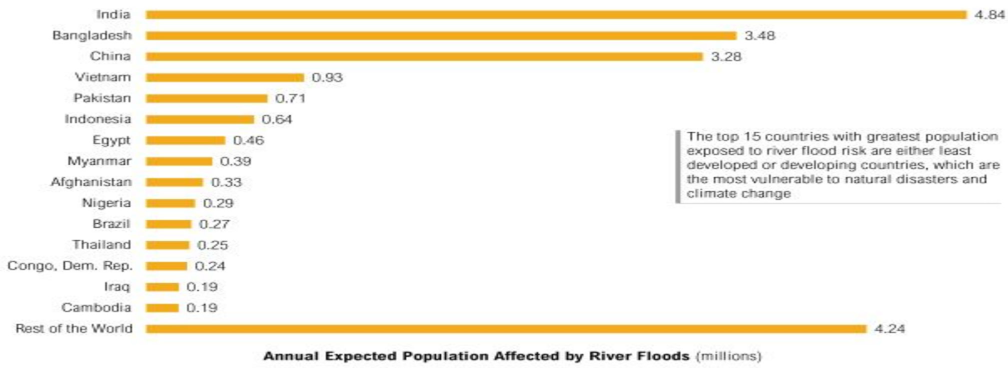


Figure 2.1: Top 15 Countries exposed to river flooding by population size

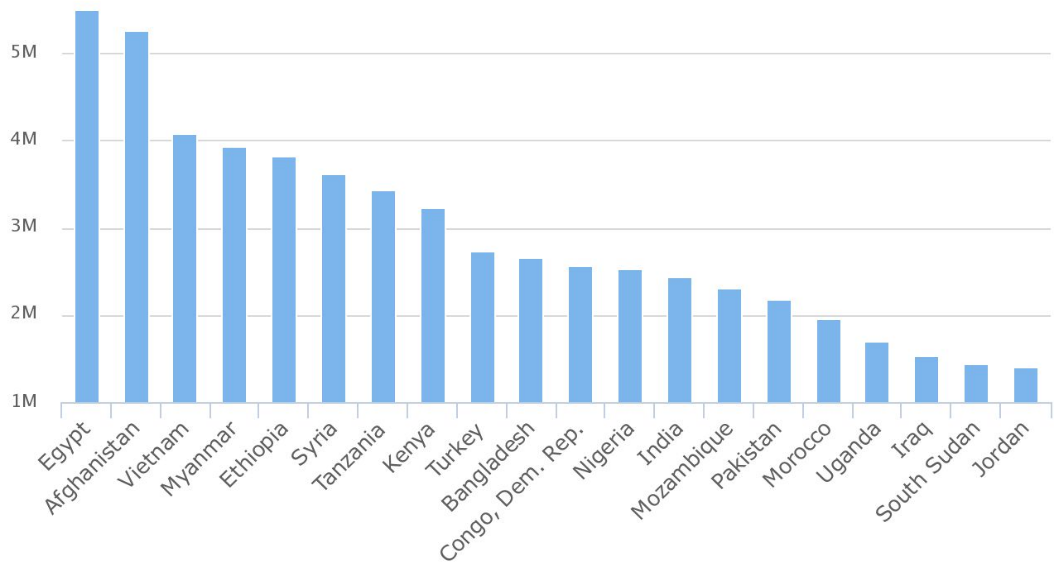


Figure 2.2: Top 25 Countries receiving foreign aid

As seen in Figure 2.1 and 2.2, 10 out of the top 15 countries affected by river flooding are also of the top 25 countries receiving global aid, which is important for a system targeted toward non-profit organizations.

The cost will remain under $500 to make it affordable. Our primary customers are non-profit organizations whose end users are well below the poverty line and cannot afford an expensive product. Commercial power solutions costs thousands on average so this makes our productive more competitive against them. Having a low cost also makes our product more attractive to private buyers like camping enthusiasts.

3.2 SECONDARY SPECIFICATIONS

It is difficult to source spare parts in these remote communities. Therefore, our team would like our system to be composed of at least 30% of locally available parts. The design should allow users to make easily make repairs on site with common materials instead of having to ship parts across the globe.

The major means of travel for people in isolated villages is walking, therefore, the part of the system that needs to be transported should be limited to a weight of 30kg. This is to ensure it can be carried by on foot due to the lack of roads.

Like any other product, it is important to remember the scalability of the product, and as such we want our system to be able to handle the increased power demand of an additional 10 laptops to account for increased power demand that villages our system is used in will inevitably face.

The charging part of the system must be able to fully recharge the batteries of simple electronic devices (ie. cell phone and laptops) within 12 hours, or overnight, to account for daily use of said electronic devices.

Durability is measured in the life span of the product. Our team specified that the whole system function for a minimum of 5 years. Accessibility to these remote communities is difficult and by designing a system with a long lifespan, NPO’s will only need to deliver the product once in awhile.

4.0 ANTICIPATED CHALLENGES

One immediate challenge for our group is identifying the scope of our project. Since the original goal was presented to us for two specific villages, initially it was hard to think of solutions that would work outside of this used case. We have identified this issue as a group and have pivoted our focus to developing a more general product, but it is an issue we must be constantly vigilant about going forward.

The durability of our generator is critical for it to function in areas that have poor conditions. We anticipate that this will be a challenge given the limited time and resources we have to test the operational lifespan of our product. We may have to overdesign certain components to ensure they reach our specifications. The complexity of our design must also be kept to a minimum to reduce the risk of a component failing. This lowers the options we can select for our design making it more difficult to create a suitable solution.

Another design challenge is ensuring our product can function year round. Adopting a solution that only works during part of the year is not enough, and we will have to incorporate multiple solutions while still maintaining simplicity. It must be able to be used and implemented regardless of geographical location and time of year, which means it will need to be very adaptable to a variety of environments.

5.0 REFERENCES

[1] About energy access. (2017). Retrieved October 14, 2017, from https://www.iea.org/topics/energypoverty/

[2] Lavelle, M. (2013, May 30). Five Surprising Facts About Energy Poverty. Retrieved October 17, 2017, from http://news.nationalgeographic.com/news/energy/2013/05/130529-surprising-facts-about-energy-poverty/

[3] 2015, M. 2., 2015, M. 8., & 2014, J. 2. (2017, February 27). The Issues Affecting Global Poverty: Energy. Retrieved October 17, 2017, from https://www.one.org/us/issues/energy/

[4] Zahnd, A. (2006). *Renewable Energy Village Power Systems for Remote and Impoverished Himalayan Villages in Nepal*. [ebook] Montana: Jonesport. Available at: https://www.udc.edu/docs/cere/Zahnd.pdf [Accessed 14 Oct. 2017].

[5] Energy Overview of Canada's Remote Communities, Sigma Engineering Ltd, 1985, https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/2013-118_en.pdf

[6] Stone, D. (2017). *Laptop Vs. PC Power Consumption*. [online] Smallbusiness.chron.com. Available at: http://smallbusiness.chron.com/laptop-vs-pc-power-consumption-79347.html [Accessed 17 Oct. 2017].