Introduction

In September 2016 I took part in an Engineers Without Borders international volunteer placement, where the Douglas Bomford Trust supported my travel costs with a cheque of £250. This document aims to show what I was able to contribute and achieve during my time volunteering for WindAid Institute in Northern Peru. During my time there I successfully designed and build a prototype Internet of Things (IoT) Remote Monitor. This devices collects turbine performance generation data, user consumption data, and wind speed data, allowing us to for the first time track performance and having a basic alert system, for such things as low system battery level, high wind speeds. Since the 6 month placement, I have been asked to join the WindAid Institute team as staff, which I have gladly accepted to continue my work on the remote monitor and the support of other projects. I return in August 2017 to continue working there. Amongst many, one of the reasons I applied to volunteer on this placement was to improve my opportunities for employment, so thank you once again for your support.

Here are a collection of supporting photos you may find useful, feel free to use them.

Link to possible accompanying photos; CLICK HERE
Playa Blanca general photos: CLICK HERE

Background to WindAid Institute

WindAid institute serves an educational institute where volunteers from various stages of life make a donation to the program and volunteer for 1 month, learning to build a small off grid wind turbine. The final week the team visit a developing community in rural Peru to install this turbine giving a family electricity, perhaps for the first time. Or as WindAid's slogan "Light up a Life"

2.65 million people do not have access to electricity in Peru (8.8% of population *see notes for stats below). Over the past 10 years WindAid has been working in Peru, and to date has manufactured and installed 51 turbines, providing light to 710 people in many regions of Peru.

WindAid Institute employs 3 local engineers, and also supports part time apprentices currently studying and gaining workshop experience. Along with the regular monthly intake of international volunteers, supported by 4 international staff members.

WindAid has been working with one particular community for 5 years, a fishing community known as Playa Blanca in northern Peru in the district of Puira.

Beneficiary community: Playa Blanca

WindAid Institute came to Playa Blanca in early 2012 by accident, when one of the founders was visiting the area and spoke to the community about electricity and maybe electrifying the village. By the end of May 2012 they had installed a WindAid turbine in the school. The families told us they wanted turbines for individual homes too. After

unsuccessful attempts to partner with the municipality and another NGO, WindAid has been installing turbines and there are now 22 throughout the village (including one in the WindAid workshop), with plans to install up to 40.

The villagers have previously used kerosene, it was cheap but then could no longer be sourced and candles were expensive. In 2005, some villagers were able to purchase diesel generators but they are extremely expensive to run - 5 soles (£1.20) a day.

The municipality installed some solar panels in (September 2014). However there was no accompanying training in their use, so many ceased working. WindAid has been able to support those families a little in understanding how the panels work and there are now around a little more than half functioning in the village.

The wind turbine and associated equipment (wind turbine controller, DC lighting circuitry and USB mobile phone charger) is gifted to the family, on the agreement that the family pays into a community run maintenance fund of 30 nuevo soles (~£7.40). Previously on average families would spend 1 nuevo sol a day on candles, hence the figure of 30 nuevo soles a month was agreed.

The families use the energy for lights; charging mobile phones and batteries, some families also at an additional cost buy an inverter that allows them to use AC appliances such as radios TV's and fridges.

At the inception, a community group/committee (known as a directiva) was formed in Playa Blanca, it has various roles; president, secretary, treasurer, technician, education officer, and maintenance fee collector. This person collects the 30 neuvo soles a month, and the directiva as a whole act as a formal point of contact for the electrification programme. At the start of the electrification program there a raffle was held for all those community members that wanted a turbine, and that's the order of the waiting list WindAid are currently working through deploying turbines.

The relationship with the community is such that land was gifted to WindAid, in order to build a workshop facility in the community, where our teams can stay whilst deploying the wind turbines, and the hope is that local technicians will be involved in the manufacture process in the medium to long future.

During the process of installing turbines, the local government installed solar systems to houses separately from WindAid's efforts. It's hypothesised that the fact WindAid were installing renewable energy pushed the local mayor to install these solar systems. However a few years later, with no service or maintenance system in place, several of the systems are in various states of disrepair. It's hoped that having a specific technician role that community members improve their knowledge and can identify/ make repairs to some problems to avoid a similar situation.

Stats Notes

% Access to Electricity in Peru 91.2% (2012) - World Bank
8.8% of Peru do not have access to electricity
Population of Peru - 30.15 Million - World Bank
Hence Peruvians who do not have electricity = 8.8% of 30.15 Millions = 2.65 Million people

What I achieved during my time on placement

Wind Turbines

In 6 month placement, I was part of various volunteer teams that installed and commissioned 6 Wind Turbines with estimated 65 people directly benefiting from these systems.

September – Playa Blanca, Puira – 2 x 500Watt 1.7m diameter (1 family of 6 people, + WindAid workshop)
November – Pasto ruri, Ancash – 1 x 2.5kW turbine (Guiness record highest Wind turbine in the world, turbine was installed, but not functioning. Carried out maintenance and cable install for lighting and small power in the First Aid and Guide centre)
December – Playa Blanca, Puira – 1 x 500W 1.7m diameter. (1 family of 8)
January – Playa Blanca, Puira – 1 x 500W 1.7m diameter (1 family of 5)
February – Playa Blanca, Puira 1 x 500W 1.7m diameter (1 family of 6)
March – Los Angeles, La Libertad – 1 x 500W 1.7m diameter (school facility 2 rooms now have light and sockets for teacher to charge laptops)

Statistics Available

Through WindAid turbines (50 total), 710 Peruvians now have access to renewable electricity for light and small appliances.

Remote Monitor

Wind Aid now has a working prototype installed 17th May in a community known as Los Angeles, 2 hours from Trujillo. This unit sends averaged data such as generated and consumed power, battery voltage and wind speed to a website where the turbine can be monitored and analysed for performance anywhere in the world. You can see historical data here.

The unit has various modules;

1) Sensors; devices that measure a variable of interest, namely voltage, current and wind speed.

2) Microcontroller; we use an Arduino Uno which processes and collects these signals every second.

3) Field deployable PC; the data is collected and averaged by a Raspberry Pi, in the software 10 minute average data is compiled and also an internet connection to push the data to an internet page

4) 2G/3G Internet connection; a USB modem with a mobile phone sim card is used to connect to the internet

5) ‘Internet of Things’ platform where the data is collated on a cloud service, and can be presented visually using time based graphs. This platform also acts as our Alert system.

An alert system uses Twitter and tells us for example if the turbine system battery voltage is less than 11.5V this means the turbine isn't able to to up the communities daily usage. This will eventually lead to such a low battery level that the current 1.7m turbine would be unable to re-charge the battery. This early warning indication that we need to carry out an investigation, to improve system performance, or another possibility is its an indication to us that we need to perhaps retrain the community to ensure the turbine has an opportunity to recharge to system battery.

Personal Benefits from EWB placement

Personally benefit from learning a whole new skill set with microcontrollers, and small portable computers. Learnt to 'stand on the shoulders of giants' wealth of info available on this subject matter online, and to select parts that are suitable, adapt and implement for our purpose.

Constantly had to overcome seen and unforeseen problems. Improved my networking skills, reaching out to other engineers on other placements, current and past.

Level of Spanish has improved massively, working with non-English speakers, and engage with community members.

I have decided to continue working in international development, I have been offered a position within WindAid.

Future Plans and Projects

Community Workshop

WindAid hope to continue building their community workshop in Playa Blanca. The in-community workshop is pretty innovative in my opinion, makes the entire project more sustainable, empowers and trains local people. It is also planned to get a nominated technician will come and live in Trujillo with the volunteers and be part of that months team to build a turbine, gain hands on experience in the manufacture and assembly of a turbine.

WindAid have offered to compensate the technicians, matching their monthly salary so as their family is still provided for while they are away on the training course. With these provisions in place, it's still proving difficult to get the technicians to the WindAid workshop in Trujillo.

This to me highlights perfectly the difficulty of this kind of work and projects, most of the time the engineering aspect is the easy part. The interaction with humans is the key.

Remote Monitor

I return in August to continue the production of Remote Monitor will be rolled out, in addition there will be more further cost optimisation using smaller cheaper parts to reduce the cost base per unit, which is currently at US$206 hardware costs plus US$108 cost for one years data. Early design changes suggest reducing the hardware cost to around $150.

I will also continue my training program and documentation database, with the aim of two Peruvian engineers being capable of modifying, fault finding and building Remote Monitors.

The monitor has already highlighted that efficiency gains can be made, from 200W output, up to 400W output with some minor positioning changes between the rotor and the stator.. It’s expected that the monitor will be part of a factory acceptance test before the Turbines leave the workshop.