Imperial College London

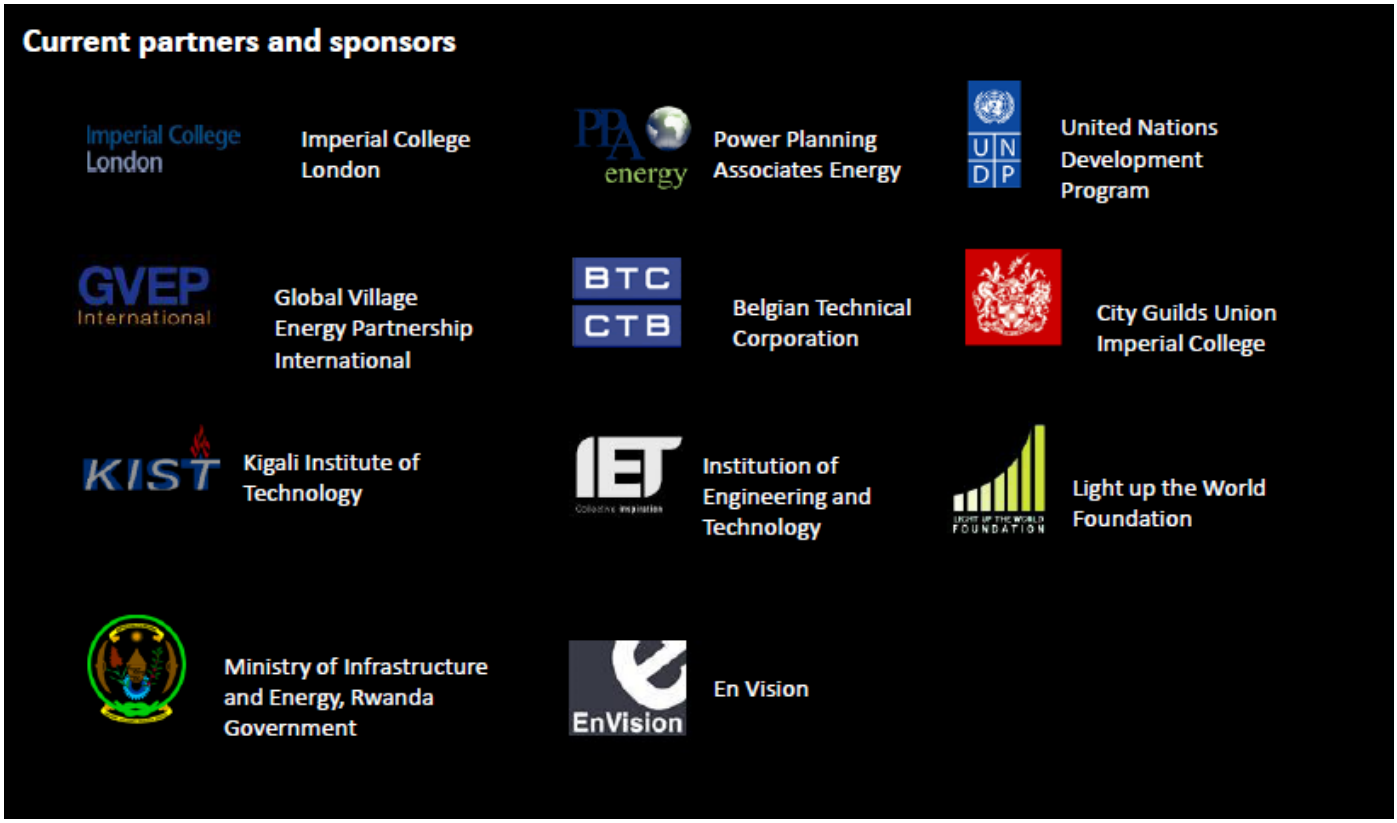
08 novembre 2009

AN EPIC JOURNEY TO THE HEART OF CENTRAL AFRICA

Authors

- Van Houcke Laurent
- Rybka Alexander

E.quinox would like to thank all its partners and members who have contributed actively to the successful implementation of the pilot Energy Kiosk in the rural community of Minazi, North Rwanda. Many people around the globe have spent money, time, or expertise in order to help us launch our society and increase our credibility within Imperial College and in Rwanda. The trust and support of all our stakeholders allowed us to convince and deal directly with Rwandan governmental representatives and local NGOs without which our project would not have passed the inception stage.



• EXPLORATION BOARD AT IMPERIAL COLLEGE

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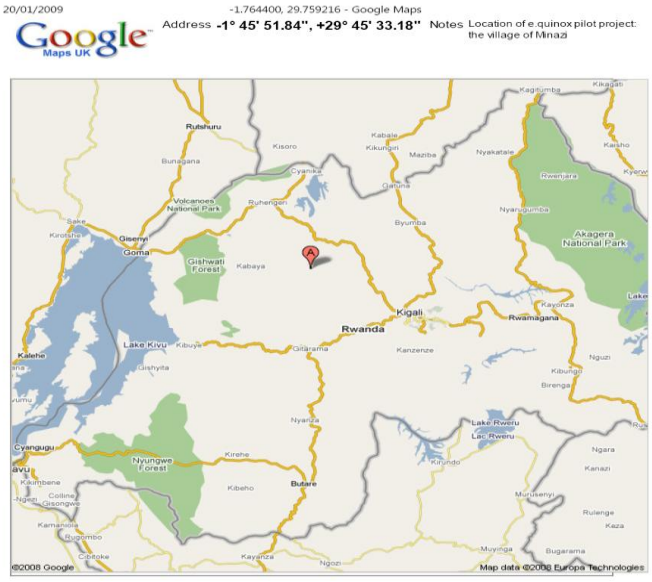
OVERVIEW

e.quinox is a student led organisation, with the charity status, born at Imperial College London in 2008. It aims to design, test, and implement sustainable and economically viable electrification solutions for rural Africa. In January 2009, four of e.quinox's members went on a survey trip to Rwandan to find a suitable location for our pilot project and gather the required socio-economic information about the local rural communities. Using this data the team was able to design a sizable and appropriate technical solution to provide electricity to villagers in rural Rwanda. By developing a sustainable and economically viable business plan we were able to raise the required funds for the electrical equipment and also to convince the Rwandan government to support us. E.quinox's main strength is our partnership with a local university and our strong collaboration with the Belgian Technical Cooperation and the Ministry of Infrastructure.

This report should give a good overview of the different aspects of our pilot project, from the technical design to the implementation stage.

AIMS AND OBJECTIVES

Our main aim was to give access to a clean, safe, and affordable source of energy to the sixty households of Minazi, a community at 2300m of altitude in the province of Gakenke Rwanda. We set out to design a suitable maintenance scheme to improve the longevity of the system by training local people and involving the local university students in the planning and implementation of our system. In parallel we hoped to strengthen our Rwandan partnerships and find funding for future projects.



PREPARATION

EQUIPMENT

- 400Wp of amorphous solar panels were airfreight to Rwanda
- 200m of cable was brought to Rwanda by the team
- 150 LEDs with plugs were brought to Rwandan by the team
- 60 battery boxes with low voltage circuitry were shipped to Rwanda
- 70 12Ah deep-cycle lead acid batteries were airfreight to Rwanda
- 1 data logger system with five sensors was brought to Rwanda.

There is a local clinic in a community 5km away from Minazi where basic care can be given. However for any serious injuries we will always try to reach the King Faisal Hospital in Kigali which is a two-hour drive away from Minazi. We will constantly have a jeep in the community as ambulances would not be able to access the village easily.

Hazard	Risk Likelihood	Consequence	Control measure
Weather			
General			• Our trip will take place during the dry season • Average temperature is 24°C
Sun	H	H	• Everyone will wear hat and sun glasses • Drink plenty of water
Lightning	M	H	• Hide in the energy kiosk which has a lightning rod
PV system			
Electric shock	L	H	• Live parts will be protected by casing or by circuit breakers. • The batteries will have a protection casing and people will not be able to access the terminals directly. • Safety guidelines will be given to people taking care of the system
Lighting	L	H	• Kiosk will be equipped with a lightning rod
Battery's gas intoxication	L	M	• Batteries will be placed in a well ventilated and isolated room in the kiosk. • Charge controllers will prevent batteries from producing gases if overcharged
Building the structure	M	H	• Civil engineering team will supervise any building activity. • The local district will provide us with trained builders who will carry out the tasks (i.e. building the roof). • The design of the kiosk will be validated by an approved UK civil engineer
Rural conditions			
Food/water poisoning	H	M	• Only bottled water will be drank • The food will be brought from Kigali and mostly packaged food will be bought
Malaria	L	H	• The risk of Malaria is low at 2300m above sea level. However each member will take anti-malaria tablets, use anti-mosquito spray and wear long sleeve shirts during the whole trip

Tension with community	L	M	• Our local team at the Kigali Institute of Science and Technology will always be there for any translation issue • We are under the protection of the local government and the local district authorities.
Personal Hygiene	L	L	• We will have access to the toilets in the authority building • A camping shower will be set up • A detailed personal equipment list will be made before departure
Sleeping	L	L	• We will be staying in tents next to the local authorities building
Animals	M	M	• The most dangerous animals in Rwanda are mosquitoes carrying malaria • However anti-insect spray will be used preventively
Electricity	M	L	• We will have a local diesel generator to power lights, cell phone chargers and cooking facilities.
Travelling			
Car accident	H	H	• Most of the time the group will be driven by a local driver from the Belgian Technical Corporation • Most of the expedition members have a driving licence and would be able to drive a vehicle in Rwanda
Getting lost	M	L	• We will have three mobile phone so that if we split in small group we'll be able to contact each other • Members will have to make sure the expedition leader knows where they are at all time
Moto accident	H	H	• The most common travelling method in Rwanda is to use moto-taxis which are cheap but dangerous. • We will try to avoid those as much as possible
Walking in the dark	M	M	• Members will try to travel in group of minimum three when travelling in the dark
Others			
Political unrests	L	H	• Rwanda has been stable since the end of the genocide. However we will be in contact with the Belgian and English embassy so that they can alert us if something is happening. • The Belgian Technical Corporation will be assisting closely our project and have a employee working in a village close by.

TECHNICAL

Our proposed solution to current energy problems in Mianzi is a solar power energy kiosk. This concept is based on grouping electricity production together so as to utilise the economies of scale and bring down the overall system price. The kiosk model also has added socio economic advantages which will be discussed later on. Figure 2 shows a general high level technical design of our system. We strongly believe that the energy kiosk could be the intermediate step for rural community to grow and hopefully, in a near future, have access to grid electricity.

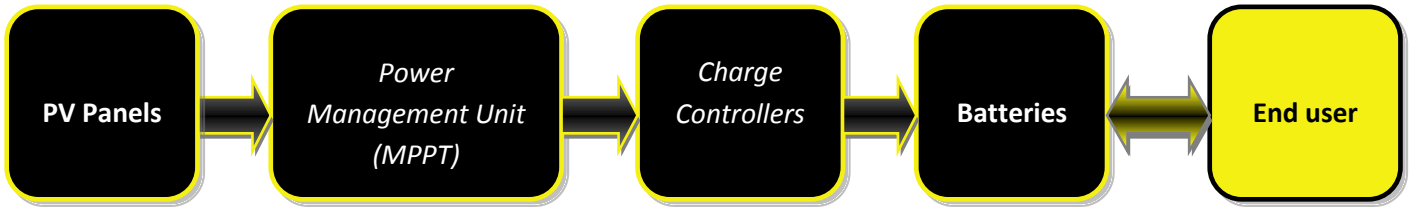


Figure 1: Kiosk High level design.

The PV panels will be the sole power supply. The maximum power point track inside the power management unit controls the I-V characteristic of the system and ensures that the highest amount of power is drawn from the PV panels. Should the maximum power not be required it is still important to dissipate any excess energy generated by the panels to prevent excess heat build up in the panels. Discharging the unused energy through the panels, in the best case scenario, will cause the panels to operate inefficiently, and at worst, can permanently damage them. The PMU also contains circuitry to dissipate energy that is not being used by the load (i.e. in a situation when the load power requirements are lower than the power available).

We are currently working with a design that incorporates a charge controller with every battery. This controller will also regulate the discharge of the battery and prevent it from being drained above a certain discharge depth. Having individual controllers is not only a cheaper option than individual low voltage disconnect switches, but also make maintenance simpler than using bulk chargers which carry a high investment.

The batteries will be charged in the kiosk and then rented out to the customer who can take them home. This model is based on existing customs where locals refill small bottles with Kerosene to run oil lamps in their homes. We will provide a casing to surround the battery for internal circuitry protection, which include a charge controller and battery terminal wiring. On the outside of the case, there will be three outlets for plugs available at the kiosk for the end user to insert to power LED lamps and mobile phone battery charger. The kiosk will provide all necessary appliances and replacement parts.

SYSTEM SIZING

Figure 3 below illustrates our system size. These specifications have been calculated using 3.5 peak sunshine hours per day and system losses of about 15%. The number of batteries in the system is larger than the number of homes as customers are not expected to wait for their battery to be recharged but will be given a fully charged one straight away. This implies some slack in the system. We are still conducting some research into a more accurate load definition using statistical models that predict the return rate and failure rate of the system. However since this is a

small scale version of our Energy Kiosk concept, the numbers below will not be affected significantly.

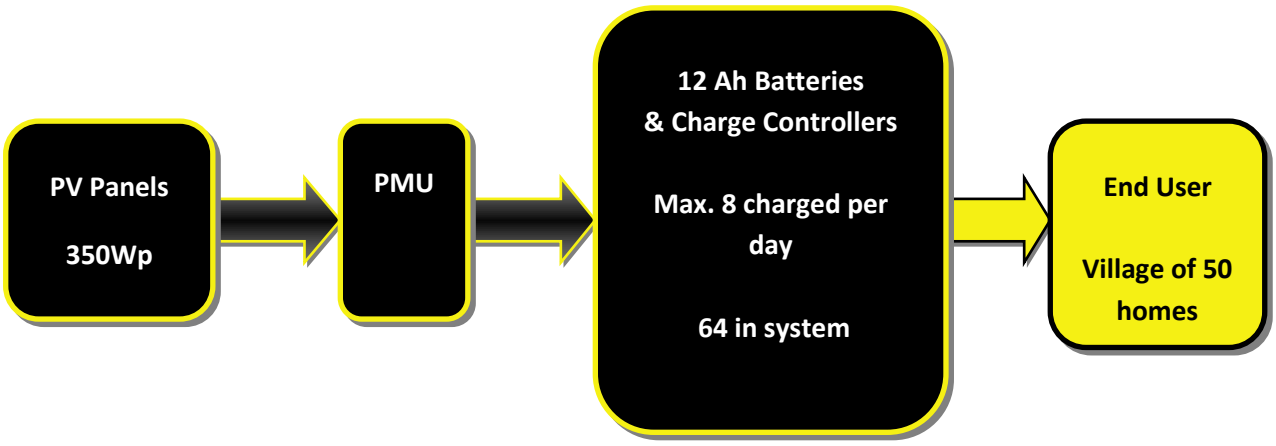


Figure 3: More detailed system design.

KIOSK BUILDING: STRUCTUAL DESIGN

e.quinox is currently finalising the design of the Mianzi Energy Kiosk. Here we present our concept, figure 4, and initial structural plans. The primary function of the kiosk design is to accommodate safely the electrical equipment including the PMU and batteries and provide a suitable space to conduct business between the shopkeeper and the end user. Under different circumstances another important feature would be to provide structural support for the solar panels on the roof of the building or elsewhere. In the case of Minazi this is not a problem as the kiosk will be located next to the new local government building. This building already has some solar panels in its roof for internal use only and we have been given permission to install our panels next to the existing ones. The area available is more than sufficient and well situated as it towers several meters above ground, providing excellent exposure to sunlight and additional security for the panels.

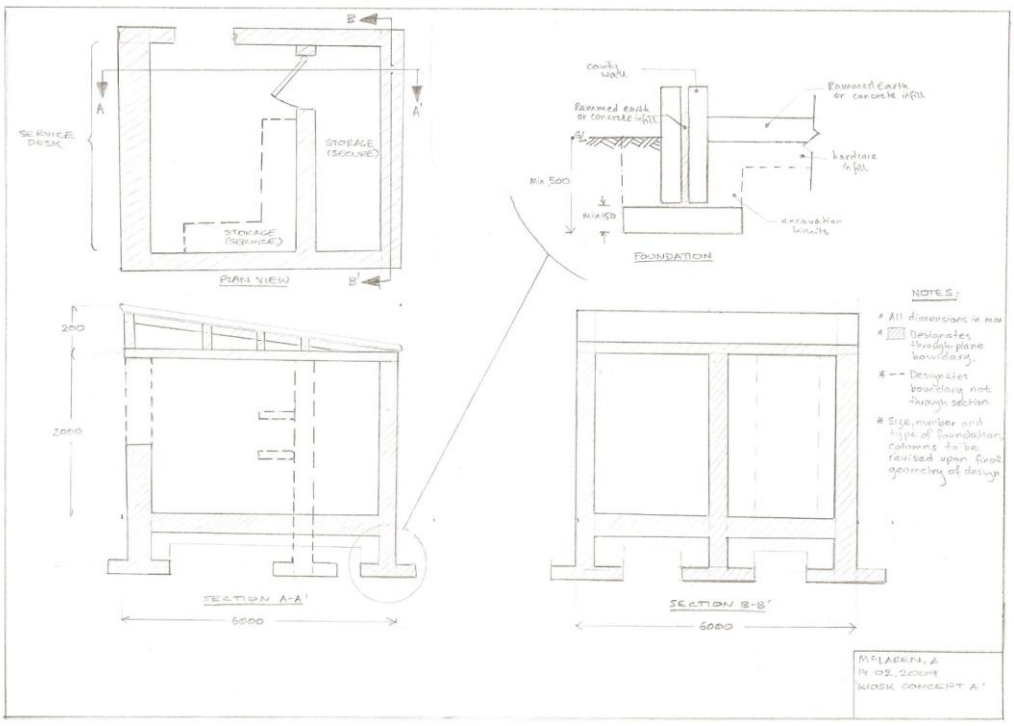


Figure 5: Basic design of kiosk.

GENERAL STAKEHOLDERS

To ensure the smooth running of the Energy Kiosk we recognise the importance of identifying all stakeholders and how they are related to each other. The most critical group for the running of the Energy Kiosk is the local population itself. Other stakeholders include: the shopkeeper of the kiosk, the local authorities and e.quinox. Each of the stakeholders has a distinctive interest in the running of the Energy Kiosk. In the following section the role of each stakeholder to the kiosk will be described.

Local population: It is expected that the core motivational driver for the population to move from petrochemical based lighting to electric lighting is price. Therefore, it is important to design the technical solution in such a manner that price for electric lighting per hour is lower to other forms of lighting. Furthermore, the local population will require that the system is reliable and safe. Therefore, the Energy Kiosk must have the capacity of meeting the demand of the community and also ensure that the shopkeeper is sufficiently trained to maintain the system.

Shopkeeper: It is important to ensure that the shopkeeper has an economical interest in the running of the Energy Kiosk. In this way it is more likely that the system is maintained properly and that the local population enjoy a good customer experience. This economical incentive will be based on a bonus system. The shopkeeper will have a basic salary and bonus based on the revenue generated from the kiosk. Hence it is in his interest to run the kiosk as a business and treat the equipment well so as not to accumulate a large maintenance deficit.

Local Authorities: The government of Rwanda recognises the need for the development in the energy sector to meet the objectivities of Vision2020. Therefore, any improvement in the area of rural electrification will provide the people of Rwanda a great sense of national pride and further strengthen the support for the government. The Energy Kiosk has the potential of improving the economical situation of many Rwandans and to provide them with a better quality of life. There are also significant advantages in the educational sector by installing electric lights in schools powered by 'Energy Kiosks' and giving children the possibility to study after dark.

e.quinox: It is in our interest to see that the quality of life has been improved by the system and that we have developed an affordable solution for most Rwandans living in rural communities. We would also like to see jobs being created around the support structure of the Energy Kiosk to further help the local economy. Furthermore, it is in our interest to ensure that our system is reliable and safe. Therefore, it is important from our perspective to ensure that a good level of training is given to the shopkeeper. Furthermore, it is also important to ensure that the local population is made aware of the benefits of the 'Energy Kiosks' and have the knowhow of handling the electric equipment they will be using in their homes.

We are a team of eight members of equinox from the electrical and electronic engineering department and the civil engineering department. We are all very good friends and have had many opportunities to work together. We are a very strong team as each member has specific skills useful for our expedition. Here is a list of the members:

Laurent Van Houcke (20), 3rd year electrical and electronic engineering

Expedition leader

Travel experience

2009 – Equinox's scouting trip to Rwanda
2008 - Hiked the GR 20, supposedly Europe hardest trek, for two weeks.
2007 - Hiked across Iceland for two weeks.
2007 - Independent travelling (backpacking) through Costa Rica, 5 weeks.

Relevant skills.

- I am currently one of the vice-chairs of e.quinox
- Consistently high performance in coursework and exams, first class in both first and second year.
- My native language is French which will enable me to communicate with people in Rwanda.
- 7 week placement in an engineering consulting firm
- Driving license

Christopher Hopper (21) 2nd year Electrical and Electronics Engineering

Treasurer

Travel experience

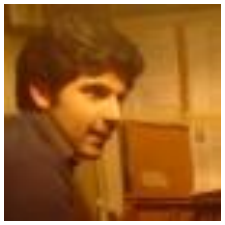
2006 - 6 weeks language course in Beijing, China
2007 - 4 weeks language course in Barcelona, Spain
2007 - 2 weeks language course in Málaga, Spain
2005 - Passed the french baccalauréat in La Rochelle, France
2004 - Stayed with a host family in La Rochelle, France; attended Lycée Jean Dautet, La Rochelle
Many other trips to different locations including Italy, France, Austria, Switzerland, USA, Canada and Turkey

Relevant Skills

- German (Mother tongue)
- English (fluent)
- French (fluent)

- Spanish (conversational)
- Mandarin (conversational basics)
- Driving license
- Achieved 69% in first year exams
- Vice-chair of e.quinox society and committee member of ICU Political Philosophy Society (PPS)
- Community service in the Dermatological Clinic of the University of Munich (Dermatologische Klink der Universität München (LMU))
- Committee member of the ICU Political Philosophy Society (PPS)

Mohammad Mansoor Hamayun (20), 3rd Year Electrical and Electronic Engineering



Travel Experience

- Hiking and fishing trip in Abisko, Sweden for one week.
- I have been to Are, Sweden a few times to engage in outdoor activities such as hiking and fishing
- During 9th grade I went with my school for a 4 day outdoor survival course (Vasterbotten, Sweden)
- During the summer of 2005 I travelled extensively in the northern areas of Pakistan and visited areas around Abbottabad, Pakistan and Muzaffarabad (Kashmir), Pakistan
- Extensive travel experience which has involved elements of outdoor activities (Sweden, Norway, Finland, Saudi Arabia, France, Switzerland, Germany, Pakistan etc.)

Relevant skills

- Currently involved in designing and building a cost-effective and robust solar power system aimed for rural communities
- 2008- Expecting a 1st class Degree based on previous 2 years of results
- 2008- Did a 10 week internship with Rolls-Royce Plc. within controls (accepted the offer for another internship for next summer)
- 2007- Did a one month internship with Mari Gas Company Ltd. In Islamabad, Pakistan (Good experience of working in a non-European country)
- 2007- Continued research work for the Department of Odontology, Umea University, Sweden.
- I have been involved in the e.quinox project from the very first day. For many months we have been looking into different designs and the social impacts of different technological and financial models on a community. Therefore, I think I am very well prepared to help towards fulfilling the aims of our January survey trip

Thomas Luth (20), 3rd year electrical and electronic engineering

Travel experience

- 2008, Independent trekking (camping) through Corsica, 2 weeks (including northern parts of the GR20)
- 2007, Independent travelling (backpacking) through Costa Rica, 5 weeks
- 2007, Independent trekking (camping) through Iceland, 2 weeks
- 2006, Treasurer of Himalayan expedition, trekking (part camping) through Ladakh region, high altitude(3.5km to 5km) for 5 weeks
- 2005, Independent trekking (camping) through Snowdonia & Brecon Beacons, including Gold DoE expedition (up to 5 days for each trip)
- Other misc. travelling and hiking trips before 2006 including. America (Grand canyon, Yellowstone), Australia (Kakadu national park, Blue mountains), Brazil, Spain, Portugal

Relevant skills

- 2008
  - Summer Placement in Electrical & Electronic Eng. Department, UROP
  - Field visit to FENIX project general Assembly and local machinery in Woking (micro grid development)
  - Achieved 1st in second year, (including power course)
  - Currently studying further power courses (transmission systems, power electronics)
  - 2nd year group project, design and build of a radio signal receiver (first class result)
  - 3rd year group project, currently in progress: design and build of a solar power system
- 2007
  - Achieved 1st in first year
  - Cheap radio design & build project (conventional radio, first class result)
  - Group project: design of PWM (pulse width modulator, first class result)
- Languages: German (mother tongue) , English (fluent), French (basics) & Spanish (conversational)
- Involved with e.quinox from the first day, hence know the requirements and technical aspects for a PV system very well.

Alexander McLaren (21), 3rd year Civil Engineering

Travel and Project Experience:

- Participated in Habitat for Humanity Projects in the Philippines (2003-2005) aiding the construction of mass housing for the poor.
- Participated in a corral reef conservation programme CAP-Oceans to build an artificial corral reef after extensive cyanide and dynamite fishing damaged the reef in Calatagan, Philippines.
- Aided in the restoration of a poorly maintained hospital in Puerto Galera, Mindoro, Philippines

Relevant Skills:

- Member of EWB Bursaries UK, and fund-raiser for a variety of construction-related aid programmes through my involvement with the senior council of Brent International School Philippines.
- Extensive exposure to many cultures and languages and can communicate across both potential barriers effectively.
- Speaks French, English and Spanish fluently.

Matthew Dayton (29), 3rd year electrical and electronic engineering

- 7 years of military training
- All military personnel, during boot-camp, are taught a broad range of
- Survival techniques. This includes emergency first aid, land navigation, evasion methods, and water survival techniques.
- Courses appropriately infused classroom methodology with realistic and stressful training scenarios.
- Expeditious attitude was founded while growing up in Seattle, USA, an outdoor-lovers paradise. During this time, he enjoyed rock-climbing, rigours hiking treks and camping.

Christopher Baker-Brian (21) 3rd year Electrical and Electronic Engineering

Travel experience

- 2004 and 2005 – Completed the Cheshire Hike, a demanding 50mile expedition over two days.
- 2007 – Completed the Duke of Edinburgh Gold Award
- 2007 – Tall Ships Expedition from Holland to Germany via Denmark for two weeks.
- Travel and Hiking Experience in Various European and North African countries, notably Switzerland, Tunisia and Spain.

Relevant Skills

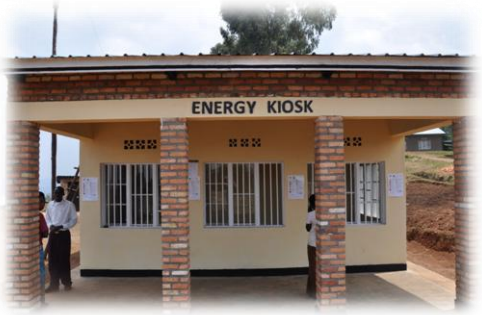
- University of London Men's 1st XI Hockey Captain 2007-2008
- Secretary for Imperial College Union's e.quinox Society
- Employed by Shell Global Solutions UK as a research technician during my gap year (Year in Industry Scheme 2005-2006) and also during my 1st year summer vacation (2007)
- Full Driving license – Qualified IC Union Minibus Driver
- Group project leader in first and second years
- Currently working towards a 1st Class Degree
- Awarded the RAE Electrical and Electronic Engineering, Best Technical Presentation Prize during my first year
- IET Jubilee Scholar 2006-2010
- Awarded the CGCA Activity Award for the department of Electronic and Electrical Engineering 2008
- English (Mother tongue)
- French (conversational)

Alexander Rybka (21) 3rd year Electrical and Electronic Engineering

Kejeh Ndubuisi (21) 3rd year Electrical and Electronic Engineering

FIRST ENERGY KIOSK

TECHNICAL



MICRO-FINANCING SCHEME

E.quinox decided, after having assessed the price structure for the use of the energy kiosk, that a way of financing the system for the local population was needed. Therefore a meeting with the local micro-financing institution CLECAM (*Caisse Locale d'Epargne et de Crédit Agricole Mutuel*) was organized. In this meeting the following terms and conditions were negotiated:

- Villagers can finance the e.quinox battery box and lighting solution with a loan from CLECAM
- The risk of this loan is taken by CLECAM
- CLECAM will charge the local population a monthly fee of 2.5% on the outstanding value of the loan.
- CLECAM will communicate closely with e.quinox to identify customers who are failing to pay their fees,
- If e.quinox receives the battery box back in a good condition, the customers will get their deposit back

This agreement was reached on Thursday the 24th of September.

DIARY

TUESDAY, 25TH OF AUGUST TO TUESDAY, 8TH OF SEPTEMBER

Team A travelled to Rwanda on the 25th of August and was welcomed at Kigali International Airport by the BTC. Team A's main goals were to make sure the equipment arrived safely in Kigali before the arrival of team B, to organize the accommodation in Kigali and in Minazi, and finally to start assembling the battery boxes in collaboration with the KIST students. They faced severe delays and difficulties to take the equipment out of the airport's customs but with the help of the BTC and the Minstry of Infrastructure they managed to secure the equipment four days before team B arrived.

WEDNESDAY, 9TH OF SEPTMEBER TO WEDNESDAY, 16TH OF SEPTEMBER

Team B left on Wednesday the 9th of September from London Heathrow and arrived in Kigali the next day around lunchtime. The first three days were spent in Kigali, settling in and compiling an inventory of all goods that were shipped to Kigali. Meetings were held with the Belgian Technical Cooperation and students and academics from the Kigali Institute of Science and Technology. In these meetings the details timeline was developed.

A side from the organizational tasks, the group started the technical work, mainly concentrating on the assembly of the battery box. By Monday the 14th of October most of the preparatory tasks were finished, the battery boxes and lights were ready to be shipped to Minazi, the location of project implementation.

On Tuesday the 15th the first scouting team travelled to Minazi and inspected the construction of the energy kiosk and determined further technical specifications. On this occasion, all necessary equipment was transported to the village. The next day was spent by preparing for the first longer trip to the village, buying supplies and ensuring all camping equipment was in a good state.

THURSDAY, 17TH OF SEPTEMBER TO WEDNESDAY, 23RD OF SEPTEMBER

The team travelled out to Minazi on Thursday the 17th and after having orientated ourselves and when preparation of the accommodation (we were offered a low-standard house by the local nuns) was finished, the work on the energy kiosk started. In the next five days the following tasks were completed:

- Installation of all electrical equipment (metal frames for solar panels were produced, solar panels were mounted, in-house electrical equipment was installed)
- Training of the shopkeepers on technology and organizational issues, selection of shopkeepers
- Negotiations with the local authorities were held
- The kiosk was equipped with furniture

The team was supported by two students from the Kigali Institute of Technology, who helped communicating with the local population. On Tuesday the 22nd the team left again from Minazi. The next day in Kigali was used to buy all equipment that was still needed to finish the installation tasks.

THURSDAY, 24RH OF SEPTEMBER TO WEDNESDAY, 30TH OF SEPTEMBER

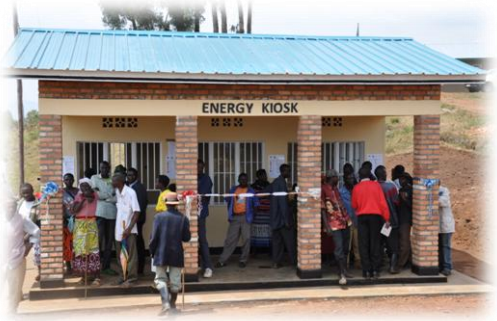
Thursday and Friday the team met with the Ministry of Infrastructure, the United Nations Development Program, the World Bank and other official bodies in Kigali. This was to organize the opening of the kiosk and to inform partners on the progress. Additionally a group travelled back to Minazi to meet with the Microfinance Institution CLECAM (*Caisse Locale d'Epargne et de CRÉDIT Agricole Mutuel*) to discuss terms for future customers. Also supplies for the second trip to Minazi were arranged. The weekend was taken off.

On Monday the 28th the team travelled back out to Minazi to finish all unfinished tasks before the official opening on the 30th of September. The tasks that were finished in these two days included:

- Re-Negotiation of pricing structure
- Further training of shopkeepers
- Further installations in kiosk were implemented, such as shelves and re-cabling of electrical equipment.

On the 30th of September the kiosk was officially opened in attendance of the Director for Energy f the Belgian Technical Cooperation, a government representative and the Representative of the local government. The ceremony was also attended by about 150 villagers.

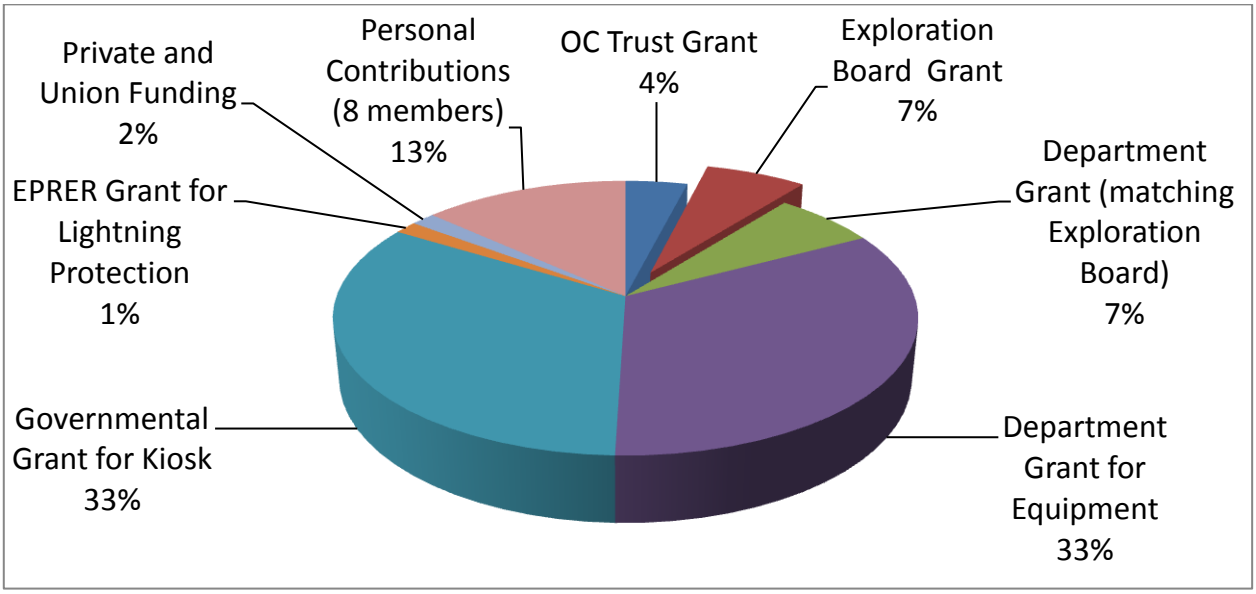
The team left Minazi on the 1st of October, taking part in an official dinner organized by the district of Gakenke (the area of implementation in Rwanda) to celebrate the success of the project. Departure from Kigali airport with destination London Heathrow was on the 2nd of October.



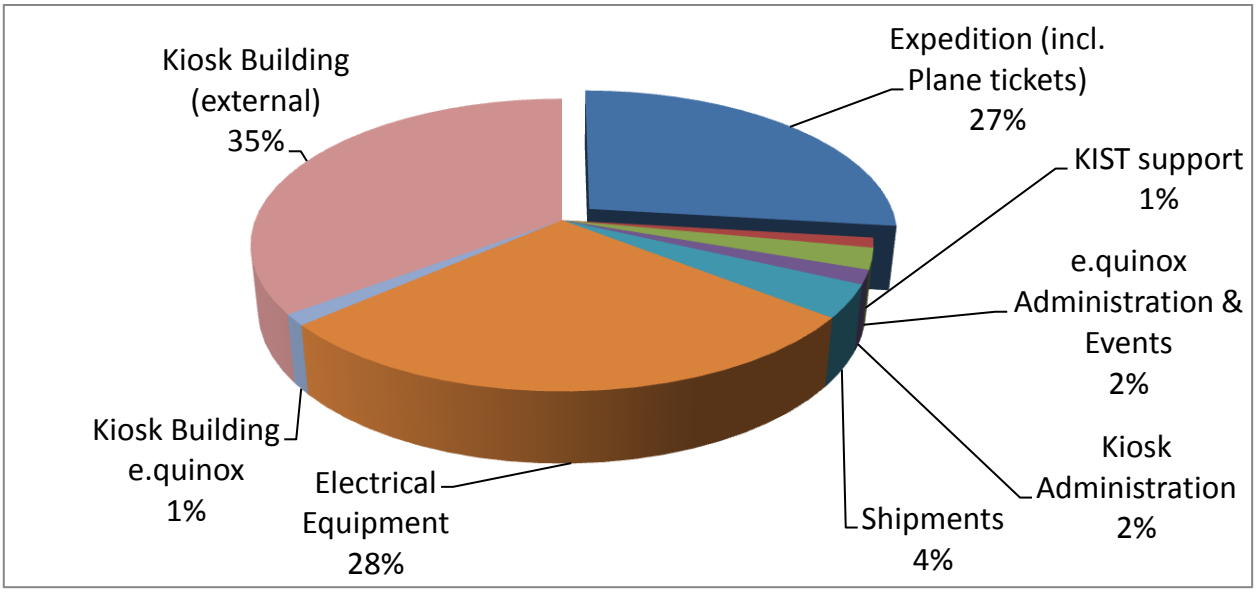
PROJECT BUDGET

The total of funds raised was 30,100GBP. Figure 1 shows a breakdown of the sources of funding, showing that the Exploration Board contributed 7% of the total value of the project. The gross of the funding came from the district of Gakenke in Rwanda for the building of the kiosk and from the department of Electrical and Electronic Engineering at Imperial College.

It is also worth noting, that the personal contribution paid by the trip members was significant, on average totaling in between £800 and £1000 for all expenses (some of which are private expenses and not included in this chart).



e.quinox expenditure for the pilot project 2009 is outlined in figure 2. The total expenses for the 2009 pilot project added up to around £29,700, the amount leftover will be kept for future projects. It can be seen, that the expenses for plane tickets, expedition equipment and a contribution towards living expenses for trip members added took up a great proportion of the e.quinox funds and the exploration board funding was spent on these expenses.



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This agreement was reached on Thursday the 24th of September.

OUTCOME AND FUTURE PLANS

The implementation of our pilot Energy Kiosk in Rwanda was an enriching and exciting opportunity for all e.quinox members who went on or prepared the trip in September 2009. We hope to have designed an appropriate technical solution, and a sustainable and economically viable business model for rural Rwanda. We will monitor the status (e.g. current output from the panels, solar radiation...) of our Energy Kiosk through our data logging system which sends us emails every morning at 3am. Furthermore, **four of our Rwandan e.quinox members from KIST have been employed by the Ministry of Infrastructure to carry on maintenance check up every two weeks**. They will report directly to us and the BTC so that we can twist our financing model to match optimally the customers' needs.

After the completion of our pilot project, our credibility as a student led organisation has increased drastically, allowing us to increase our workforce and secure potential funding from the BTC and the Ministry of Infrastructure for four to ten projects for next year. With our current and future members we will aim to implement four different Energy Kiosks in Rwanda in September 2010. Until then we will gather data from our first Energy Kiosk to improve our technology, financing model, and optimise customer's satisfaction and our system's economic viability. The two main tasks e.quinox will undertake this year are to increase its fundraising activities and develop the Energy Kiosk concept around different renewable sources of energy suitable for rural Rwanda such as hydro, biogas, grid-connected...

APPENDIX

SUPPORT LETTRE FROM THE MINISTER OF STATE IN CHARGE OF ENERGY AND WATER

REPUBLIC OF RWANDA

Kigali, on 07 JAN 2009
Ref n°.....

MINISTRY OF INFRASTRUCTURE
P.O Box 24, Kigali-Rwanda

TO WHOM IT MAY CONCERN

Reference: Installation of a Solar Kiosk Pilot Project in Rwanda

The Rwandan Government is currently working on increasing access to modern forms of energy especially for its rural population. So far only 5% of the Rwandan population is connected to the national electricity grid and even though the Government targets to increase this rate to 16% of the population connected by 2012 and 35% by 2020, some areas will remain without access to grid electricity for the next years to come.

The Government is therefore strongly encouraging alternative energy solutions such as Solar Photovoltaic Systems to respond to electricity needs in areas far from the grid. Since the capital investment for a solar home system is rather heavy, a solar battery charging station or solar kiosk with a central electricity production for a community will be on of the sensible options for remote rural areas. This will enable people to charge batteries for a relatively small fee at a time at a central kiosk and take them home to serve lighting and other purposes, while providing an interesting business opportunity for the kiosk manager.

E.quinox is a group of students from Imperial College London who are dedicated to developing solar kiosk stations and install them in Rwanda. In this endeavor they will be cooperating closely with a group of local Rwandan students from the Kigali Institute for Science and Technology (KIST).

The Rwandan Government, through its Ministry of Infrastructure is hereby assuring its full support of this initiative. It will assist and contribute to the extent possible to a successful project implementation.

MINISTERE DES INFRASTRUCTURES

Dr. Albert Butare
Minister of state in charge or Energy and Water

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SUPPORT LETTRE FROM THE BELGIAN TECHNICAL CORPORATION

REPUBLIQUE DU RWANDA

EPRER

Accès à l'Electricité des Populations Rurales
A travers les Energies Renouvelables

COOPERATION BTC CTB BELGO-RWANDAISE

MINISTERE DES INFRASTRUCTURES

rue Député Kayuku, 41, B.P.6089 KIGALI

To Equinox authorities

DATE
13/01/2009

NOTRE RÉF. | OUR REF.
DELCORWA/EVM/09/005

VOTRE REF. | YOUR REF.

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Subject: support from BTC to *equinox* projects

The Belgian Technical Cooperation in Rwanda is currently conducting a programme of rural energy. This includes:

- Construction of three micro-hydro plants and their connection to the national grid
- Construction of a 30 kV line of 68 km between Kigali and Ndiza and connecting of rural centres crossed
- Electrification of 64 off grid health centres and other public buildings by photovoltaic panels and other renewable energies
- Various studies, inter alia, on the wind energy potential of Rwanda, the maintenance of photovoltaic installations nationwide

We are attentive to any solution to the supply of electricity to populations underserved by the grid in Rwanda, particularly those exploiting renewables energies.
The proposal of *equinox*, therefore, keenly interested us as pilot project, before potential national scale extension.
By the present, Belgian Technical Cooperation , through its EPRER project ensure its plain support and availability in the implementation of the Energy Kiosk and wishes *equinox* team full success.

Félicien NDABAMENYE
Directeur d'Intervention

Erik Van Malderen
Délégué à la Cogestion

MININFRA - CTB
HYDRO - ELECTRIQUE MCH