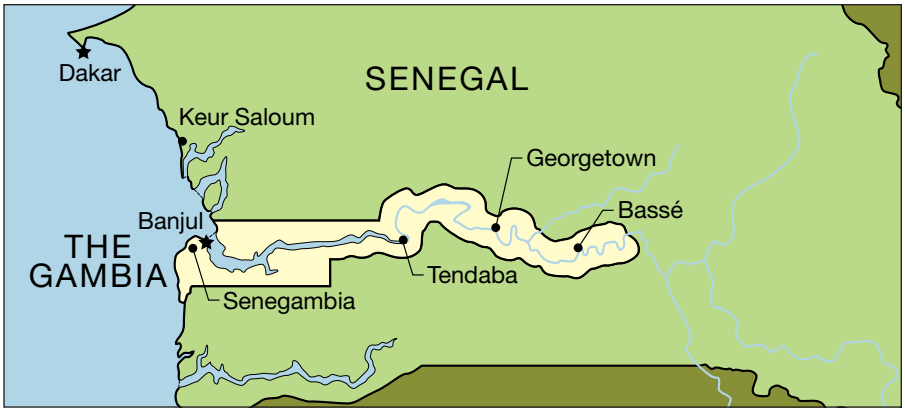
Strathclyde University Going Solar in The Gambia

Mike Dolan, Robert Currie, Scott Strachan, and Graham Ault

Over the last two years, volunteer staff and students from the Department of Electronic and Electrical Engineering, University of Strathclyde, Scotland have worked on a project to install a solar light and power system to provide electrical energy to light a school and provide light and refrigeration for medicine for a medical clinic in the small village of Sambel Kunda in The Gambia. Students competed for the opportunity to take part in raising funds, designing the power and lighting systems, and visiting The Gambia for the installation.



The Gambia

The Gambia is Africa's smallest nation with a population of around 1.5 million people. Two-thirds of the nation's population reside in the rural floodplain flanking both sides of the Gambia River, traversing the spine of the country (see map). The remaining urban dwelling population are concentrated in the Greater Banjul Area located on the country's West coast. The current socio-political and economic climate has created an environment where it is difficult, if not impossible, for Gambians to achieve their true potential. The Gambia is a nation with no significant minerals or natural resources to use or trade, relying on agriculture and more recently tourism to buoy its struggling economy. With a gross domestic product (GDP) of around $240 per capita (compared to that of $40K per capita in the United States), The Gambia suffers from widespread poverty; 60% of the rural population of one million live below the poverty line and over 20% are malnourished. The World Bank estimates the average per capita Gambian household income to be $1 a day. Two-thirds of the annual household salary is spent on food—a classic indicator for poor nations. The impact of such poverty on public health and education is compelling. The average life expectancy in The Gambia is 53 years of age, where 30% of Gambians will die before they reach 40. Only 11 doctors exist to attend to the health care of every 100,000 people in The Gambia, contributing to the rising infant mortality rate and increasing number of cases of HIV/AIDS and malaria. While state-subsidized primary education has recently been made compulsory for children below eight years of age, this has failed to benefit the 63% of The Gambia's adult population who are illiterate. In addition, despite compulsory school attendance, the enrollment ratio of children (particularly females) in rural areas remains disappointing.

There is a direct correlation between metrics used to measure the prosperity or development of a nation and its modern energy consumption. The United Nations Development Programme uses a Human Development Index (compares life expectancy, literacy, education, standard of living, and GDP) to rate the development of 177 nations across the globe. The Gambia rates 155 out of 177. In addition, only 2% of The Gambia's total energy consumption is supplied in the form of electricity, while 80% relies on firewood, mainly for cooking in rural areas. The World Bank estimates that close to two billion of the World's population live without access to electricity. It is no coincidence that those without access to electricity are among the world's poorest. The paradox here is that those most in need of electricity are those least able to afford it. The United Nations' Millennium Development Goals is designed to make developing nations and institutions more proactive in issues ranging from the eradication of poverty to the combating of HIV/AIDS and achieving environmental sustainability. While no explicit reference is made to the energy sector of developing nations, it is widely accepted that a reliable electricity infrastructure is a pre-requisite for socio-economic growth.

Lack of investment in The Gambia's electricity infrastructure has resulted in a poorly designed and un-maintained network. As a consequence, this degrading network is plagued with frequent blackouts while serving only one-third of households in the Greater Banjul Area, and a meagre 2,500 customers of Gambia's one million rural population. The Rural Electrification Project, commissioned by the government in conjunction with the country's sole electricity producer NAWEC, aims to address some of this shortfall in demand by providing a continuous power supply to 290,000 rural inhabitants by 2016. Despite having been fraught with delays, even in the event that this ambitious project achieves its objectives, strict tariff structures would make electricity unaffordable for the vast majority of rural consumers. However, there is an alternative, which utilizes the one natural resource The Gambia has in abundance—sunshine. Harnessing solar energy from the sun may present an affordable alternative to rural electrification and go some way to achieving the development goals of The Gambia.

In late 2005, a project was undertaken by staff and students at Strathclyde to design and install two solar energy

The installation team from Strathclyde University and GamSolar (front row): Ebrima Jarju, Mike Dolan, Colin Prentice, Michael Horne, Malik Bah, and Matt Berrington; (back row): Ronald Mason, Peter McTaggart, Robert MacDonald, and Robert Currie.

https://doi.org/10.1557/mrs2008.101 Published online by Cambridge University Press

schemes in the remote Gambian village of Sambel Kunda, located in the Central River Region, between Tendaba and Georgetown on the map. The population of around 1000 are mainly comprised of subsistence farmers, although employment in the local school and non-governmental organizations is also found.

There is an established link between the community in Sambel Kunda and Scotland. Glasgow University's Faculty of Veterinary Medicine sends students and staff members to the Horse and Donkey Trust located in Sambel Kunda. The BBC Scotland correspondent Rhona MacLeod took a BBC film crew to Sambel Kunda to make a "donkeymentary" about this relationship, which was aired late in 2005. The documentary led to the twinning of Fintry Primary School, Stirlingshire, Scotland with Sambel Kunda Primary School. Two teachers from Fintry—David and Jackie Smith—took it upon themselves to set the link up between the two schools. Children at Fintry Primary School wrote letters and donated books (including a class set of atlases) for the new library, opening up an exciting friendship between the two village schools. Through a final year EEE student—Michael Dolan—Fintry Primary School then approached the Institute for Energy and Environment to request assistance with providing electricity to Sambel Kunda Primary School and to a new health clinic.

Solar energy is an effective means of providing electricity to a community such as Sambel Kunda, where no main electricity supply exists and other forms of generation require significant capital investment or skilled installation and maintenance personnel. In addition, the long hours of sunshine experienced in The Gambia and the availability of solar energy equipment made solar the choice for providing the school and clinic with electricity.

The health clinic installation provides electricity to a medical refrigerator to maintain medicines and vaccinations at the required temperature. In addition, the installation of lights in the health clinic means that candle and torch light are no longer necessary for any routine or emergency procedures carried out at the clinic.

The team from Strathclyde that completed these projects was comprised of six undergraduate students and two members of staff from the EEE department. The team designed the solar energy schemes and contracted with a local solar provider—GamSolar—for the installation. The team raised the funds for the project through charitable donations from a combination of Scottish businesses and dedicated fundraising events.

The team began the design of the solar energy schemes late in 2005. Understanding the ac and dc electrical loads to be met by the scheme was a crucial first step to effectively designing the solar energy schemes. This allowed the peak demands on the system to be calculated and the components to be sized accordingly. Batteries were sized for each site based on the days of autonomy required, that is, the number of days that the scheme will be able to meet the demand if there is no or reduced output from the solar panels due to cloud cover, particularly in the rainy season from June to November. The health clinic scheme was designed for greater days of autonomy to provide extra security for the medicines and vaccinations being stored.

A visit to Sambel Kunda by one staff member in March 2006 permitted a solar survey of the school and clinic buildings, resulting in the identification of the location of solar panels and the electrical components at each site. It was of paramount importance that these locations were selected to achieve security and safety for the users of the schemes. The team returned in September 2006 to complete the installation at both sites; the medical refrigerator was finally transported to Sambel Kunda and installed in April 2007. All systems are operational to date.

The Strathclyde team and the local contractor erect the solar panels on the roof of the village health clinic.

Mike Dolan educates the Sambel Kunda villagers in the operating, maintenance, and safety practices associated with their new solar installation.

The students installed a solar light and power system, providing the electrical energy to light classrooms and the school office, light the medical clinic, provide refrigeration in the clinic and power a laptop computer at the school. Fun activities and film nights are also being held to open up the scheme to the entire Sambel Kunda community.

"The lights are on for about two hours every night and the kids use it for homework and to read," said Stella Marsden, a conservationist based in Sambel Kunda. "The solar panels are really being used and your efforts are appreciated. You have made a big difference to the length of the day and opportunities for reading and learning for a lot of the kids."

The Strathclyde team were also instrumental in the Gambian telecoms provider—GamTel—installing a communications mast in the village, providing an important link to the outside world. One line from the mast has been connected to the school and telephone and dial-up internet services have been established. The school is now believed to be the only school in rural Gambia with internet access, bringing Fintry and Sambel Kunda a lot closer together and further enhancing the educational exchange.

The Strathclyde students also benefited from the project by applying their engineering and project skills. Needless to say, the experience gained was invaluable and the project changed their outlook on their studies and professional lives. Robert MacDonald discovered that "Involvement with the Sambel Kunda solar project has not only provided me with a sound technical understanding of the design and operation of solar schemes, but most importantly, has given me first-hand experience of the tremendous impact that such a project can have on the local community and the technical challenges engineers face when working on projects in developing countries."

Providing such an opportunity to undergraduate students will be integral to future plans of the EEE department as further projects in The Gambia and other developing countries are undertaken. If you would like to sponsor future projects, receive more information, or get involved with the team then please contact Dr. Graham Ault at g.ault@eee.strath.ac.uk. □

https://doi.org/10.1557/mrs2008.101 Published online by Cambridge University Press