

## Technology Transfer in Environmental Health Science

The Generation of Electricity from Wood Fired Stoves:

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### Malawi, sustainable energy, and the god of the developing world

Apr 17th, 2012 Village Magazine [www.villagemagazine.ie](http://www.villagemagazine.ie)

<http://www.villagemagazine.ie/index.php/2012/04/malawi-sustainable-energy-and-the-god-of-the-developing-world-current-magazine/>

As Malawi elects a new and female President, Joyce Banda, following the controversial death of her 78-year old predecessor, **Deirdre Mulrooney** reflects on her recent visit there.

So you think Ireland has fuel and energy worries? Things could be a lot worse. Consider Malawi, the 'warm heart of Africa', where only 10% of the population has access to grid electricity. The charming little southern African country ground to a halt recently while I was there with a team of Trinity College Dublin Engineers who were implementing the pilot of their thermo-electric generator project with Concern Universal. Left high and dry, petrol stations were encircled by kilometre-long queues. Motorists slept overnight in their cars in the hope of an elusive drop of fuel. The reason? "Lack of forex" (foreign currency), locals shrugged.

When the honey smell of diesel filled the air again, a din of "it is God's will" seemed to emanate from a post-apocalyptic sea of yellow jerry-cans. When the fuel ran out once more, no-one could say for sure when they would get some more – maybe a month? As recently as July 2011 fuel shortages partly led to anti-government demonstrations, when 19 people were killed by police. But Malawi is actually the only country among the ten poorest countries in the world never to have experienced a major revolution. Peace-loving Malawians embrace and display their Christian faith with extraordinary gusto, shunning their own indigenous religious practices for the most part. Malawi is 80% Christian, in the tradition of Scottish missionary, explorer, and doctor, David Livingstone who arrived in 1859 to curb the slave trade – among other things.

Apart from the fuel crisis, Malawi is a popular tourist spot whose top draw, the magnificent Lake Malawi, is home to spectacular fish that are sought after by aquaria worldwide; and which boasts a burgeoning international scene.

Travelling here however, one of the least developed nations in the world, feels like getting into Tardis and travelling back through time. Oxen pull ploughs with which people till the fields, and

women, with babies strapped to their backs, happily cook nSema (their Maize-based staple), on woodfire stoves three times a day in thatched huts without ventilation – and often without windows. Yet sitting beside you on chaotic minibuses, the same people pull out cheap Chinese mobile phones to check their text messages. It's an odd technological overlay that could be going somewhere very interesting. It could herald a technological leap from the iron age to the digital age, though for the moment Malawian Internet is capricious in a country where even water is an expensive commodity, with most of the rural population (80% of Malawians live in the countryside), pumping water up from the earth's belly via bore-holes.

The sky-rocketing population is currently 15 million in a country not much bigger than Ireland. Children are considered a status symbol in traditional Malawian culture. On a trip to Chimteka Children's Support in Michinji – supported by a Sutton, Ireland-based charity – near the Zambian border, I was interested to visit Chioshya Medical Centre, run by Malawi's Ministry of Health, which does its best to curb population growth. They promote not only the contraceptive pill, and male and female condoms, but also a female contraceptive injection that lasts three months, and is more easily hidden from husbands.

Madonna famously adopted her Malawian son David Banda from this area where Paul Mashati, Headmaster of Chikomani School cheerfully informed me that "it's not easy to manage a class with over 100 learners". Keeping in line with UN Millennium Development Goals, primary class sizes in Malawi were recently reduced to 60 pupils per class – from the usual 100 to 200. Primary school is free, but not compulsory. Secondary school costs about \$24 per year – a big chunk of average earnings of one or two dollars per day. Apart from admirable NGO interventions, classroom special-needs assistants are unheard of and even school desks are rare.

With about 11% of Malawi's population HIV positive, AIDS is another big challenge. No longer the death sentence it used to be, testing, retroviral drugs and counselling are becoming more common. It's hard to change people's habits, but NGOs can be smart. For example, while evangelical radio programmes rang out in Concern Universal's office when I was there, chocolate-flavoured studded condoms were freely available in the toilets.

With a GDP of \$13.1bn (compared to Ireland's \$172.3bn), the fact that Malawi is geographically landlocked by Mozambique, Zambia, and Tanzania makes trade difficult. But so does democratically-elected President Bingu Wa Mutharika's notoriously undiplomatic nature. For example, Mutharika's plans to construct a canal to the sea from Nsanje Inland Port through Mozambique stalled when he fell out with the Mozambican regime. Last summer, he expelled the British Ambassador, thus estranging Malawi's traditional primary donor. He deported new Zambian President Michael Sata before Sata was elected, and now refuses to apologise. Worryingly, Mutharika's one firm friend in the region is Zimbabwe's Robert Mugabe.

Malawi is the world's most tobacco-dependent economy, with more than 75% of the population depending on it. Malawian tobacco may be found in nearly every cigarette worldwide, but its main

cash crop is in serious jeopardy – not only because of the international health drive, but also because Mutharika recently deported international tobacco buyers for not paying uncompetitive minimum prices set by himself.

Malawian Hazel Mwawembe of Concern Universal says that this sudden withdrawal of tobacco has sent the vulnerable communities she and her Balaka team work with into a spin. “They don’t know what to plant next”, explains this graduate of Development Studies in Kimmage, Dublin who is as easily on a wavelength with Malawian villagers as with us Westerners. Hazel has been working for Concern Universal since the early 1990s and exemplifies why liaison with on-the-ground agencies like Concern Universal is crucial for effective aid delivery, even if NGO initiatives can be blocked on a whim. And democracy can sometimes be a little strange as last February when hours of precious time in parliament were devoted to debating the criminalisation of public farting.

Soon after Mutharika (set to be in power until 2014), was elected in 2004 he invented his own party, the Democratic Progressive Party (DPP). Renowned Malawian singer of “rock-bottom African Reggae”, Lucius Banda, who I serendipitously ran into in his hometown, Balaka, was also elected in the same election. Banda declined Mutharika’s invitation to join his new party, instead proposing a law that would allow for impeachment of a president. The singer-turned-politician was duly accused of forging his primary school certificate, and imprisoned. When, fearing for the safety of his family, Banda (which means “a little hut” and is the Malawian equivalent of “Murphy”), eventually apologised, he was banned from politics. Nowadays he sings subversive songs and “letters to the President”. Nevertheless he has been mooted as a presidential candidate himself. After all singer Yousou N’Dour is running for the presidency in Senegal.

Malawi is relatively new to democracy. Known for his 3-piece suits, and homborg hat, Dr Hastings Banda, ‘one of the most enigmatic characters of twentieth century Africa’ assumed power after the British pulled out in 1962. In 1971 he declared himself president for life, and true to his word, remained until 1993 when the British “abandoned” him to “democracy” – he was 95. It was Banda who re-named British Nyasaland “Malawi” after the agriculture and trade-based “Maravi Empire” which existed from 1480 to 1700, sprawling over eastern Zambia, northern Mozambique, and southern Malawi.

Formerly a popular London GP, Banda’s attitude towards his people was condescending, and oddly he was the only African leader to maintain diplomatic relations with South Africa during apartheid. His numerous eccentricities included banning the Simon and Garfunkel song “Cecilia”, when he was having a romantic tiff with Malawi’s “Official Hostess”, the politically powerful Cecilia Kadzamira. (Kadzamira’s uncle, John Zumba, is today head of the opposition party). Other topics outlawed by the arch-conservative Banda included discussion of his age, his relationships, and family planning generally.

I had hoped to stay longer to explore more of the ‘warm heart of Africa’ but, due to the fuel crisis, I didn’t see much – not even the lake. It was sad to see a “Failed State” theory being bandied about

in Malawian newspapers while I was there. I would prefer to see Malawi's problems as an opportunity for innovation – particularly to avoid the energy traps we have fallen into in the developed world.

## **Irish Aid**

Malawi's energy problems call for ingenuity, lateral thinking, and technological know-how. It's not often that scientists get the opportunity to see their problem-solving really make a difference to people's lives, but last month in the 43-degree heat of Balaka, Malawi, far from the comfort zone of their laboratory, this is what started to happen for Principal Researcher Anthony Robinson, Post-doctoral researcher Seamus O'Shaughnessy and M.Sc researcher Maurice Deasy of TCD's Department of Mechanical and Manufacturing Engineering.

Their journey began in 2009 with an initial exploratory visit to Malawi with Irish NGO Cara Malawi. Once back in Dublin, Robinson's team tried to recreate the conditions of a Malawian chimney-free thatched hut, to work out a likely energy solution that could suit Malawi – which is an Irish Aid target country.

After their subsequent thermo-electric invention was showcased at the Clinton Global Initiative in New York last September, Irish Aid (who are the main funder of this project) set up a synergy between the TCD engineers and Concern Universal Malawi, who have an impressive on-the-ground operation, run mostly by Malawian staff.

It's a perfect match as part-funded by Irish Aid, Concern Universal are already promoting 20,000 of the same clean cooking stoves the TCD Team chose to work with.

These stoves are a massive improvement on widespread indoor cooking on three-stone stoves, which is akin to bringing the barbeque indoors. As hazardous to health as smoking 20 cigarettes per day, it's also a huge cause of infant mortality. Mitigating deforestation, the stove uses 60% less wood than three-stone stoves, can easily be brought outdoors, emits less fumes, only costs 250 kwacha (about €1), and is now locally produced.

At the end of November the engineers carried the components for the thermo-electric generator they have been ingeniously adapting for this stove in their luggage from Dublin to Lilongwe. Concern Universal gave them the work space to construct and test five prototype generator stoves before helping distribute them in nearby Mponda village just before Christmas for a three-month pilot run.

Recipient Funny Chiywere (pictured), is one of the lucky 10% who have grid electricity, but she still doesn't have enough electricity to cook on an electric stove, and suffers daily powercuts.

Others like hotel manager Cimango Nyirongo, who has a college diploma, and earns \$30 per

month (twice as much as in her previous job), represents the 90% of Malawians, who have never had electricity. They happily cook nSema three times a day on a wood or charcoal fire stove, and light their homes by candle or paraffin lamp. They walk long distances to recharge their cheap Chinese mobile phones whose batteries don't last long. For most, the reality is, even if they had grid electricity, they couldn't pay the bills.

There are now five Malawian families generating enough electricity to charge a mobile phone (saving 40 kwacha, and a journey each charge), and to power reading and ambient lights, from just cooking. The day we went back to check how they were getting on, they had also figured out how to plug in a radio.

So far so good. Informed by this pilot run the next phase is to take on board feedback, make the generator more robust and cost-effective – bringing down the price which, currently at \$35 for the prototype is naturally out of reach for the average Malawian.

Even more importantly, having encountered the ingenuity of resourceful Malawians, Robinson believes that local industry can be developed around the manufacture of the generators. (There is less hope for such capacity building with expensive, farmed-in Solar Panels).

If I were an investor, I would put my money on Version Two of this modest, but ingenious, invention which is making a significant improvement in the daily life of some of the poorest people on our planet.