Making links with the energy sector: industrial engagement through the Africa Capacity Building Initiative (ACBI) programme

Ensuring research has impact in the renewable energy sector requires multiple routes for engagement – with companies large and small and with public and private utilities.

That was certainly the experience of two of the research consortia funded through the Africa Capacity Building Initiative (ACBI), one of which studied the challenges associated with concentrated solar power, a technology that uses solar energy to replace gas, oil or coal in large scale power stations, while the second developed methods to use locally available resources to create new porous materials for use in the renewable energy sector, such as in batteries, for storing hydrogen or as catalysts to create biofuel.

In Kenya, Dr Chrispin Kowenje, lead investigator at Maseno University, was one of the African partners in the porous materials consortium, involving the University of Nottingham, the University of Yaoundé in Cameroon and the Council for Scientific and Industrial Research in South Africa. He has been working with a small local enterprise, CIST (Centre for Innovation, Science and Technology) Africa, that is creating bio-ethanol from plants for use in cooking and lighting, as a more sustainable alternative to kerosene or charcoal.

Water hyacinth is an invasive plant first introduced to Africa in the 1880s. 110 years later, it reached the continent's largest lake, the Lake Victoria. Efforts to eradicate the invasive plant have been largely unsuccessful. Water hyacinth has become a serious problem, destroying fish stocks by draining oxygen from the water, clogging irrigation channels and transportation routes and providing a breeding ground for mosquitoes. While water hyacinth makes excellent biogas, it is only available locally for six months of the year. Understanding this challenge, the ACBI consortium supported CIST in looking at alternative sources to water hyacinth for making biofuel, such as tropical sugar beet or sorghum.

The Africa Capacity Building Initiative (ACBI)

The aim of the ACBI – beyond the goals of the individual projects – was to support partnerships between research institutions in the UK and sub-Saharan Africa and strengthen the research capacity of the African partners, through PhD studentships, training, improved infrastructure and knowledge exchange.

Image: Mr Richard Arwa, CIST Director, demonstrates bio-fuel analysis to Professor Chrispin Kowenje and Professor David Onyango, PI and Co-PI of the Strengthening African Capacity in Porous Materials consortium at Maseno University.

As part of their fermentation process, CIST had been importing yeast from commercial sources. However, via their partnership with the consortium, the ACBI-funded laboratory infrastructure allowed the researchers to gain funding from the Kenyan government to investigate sources of local, natural, or wild yeast to use instead.

The consortium-CIST partnership has also enabled the company to use ACBI-funded quality control equipment. This has helped them to develop standard operating procedures and improve their production processes. The company now has a better understanding of the composition of their final product, which will help it navigate regulatory hurdles and improve sales. One key market for the fuel is a nearby refugee camp, where it provides residents with a cheaper alternative to kerosene.

Dr Kowenje said: "Our work with CIST through the ACBI project has helped to raise their profile and given the enterprise access to new sources of funding, including an FCDO grant for a larger capacity fermenter. It also helps to give us credibility to show we've conducted research with an industry partner.

"The company has also received money from the Kenyan National Research Fund to support their growth, and they are working with other researchers at Maseno University in the business and economics field."

Dr Justin Claude Kemmegne Mbougen, lead investigator at the University of Yaoundé in Cameroon, was another of the African partners in the porous materials project. The PhD student based at Yaoundé, Ms Edwige Mouafo Tchinda, has been developing porous material using different forms of clay for use in energy storage and sensing applications. The aim was to use naturally available, environmentally friendly and locally sourced materials to prepare organoclay and clay base composites which are more sustainable. Dr Mbougen was also working with a local company, DMR Green Energy, which builds and maintains biogas production plants and spotted an opportunity to connect them with the ACBI project.

Dr Mbougen said: "A student from the University was seconded to the company for training on biogas production, and during this training we discovered that the company was struggling to find low-cost materials that it could use to purify the biogas it produced. We realised that the materials we were developing through the ACBI project could be used for this purpose."

Sustainable resources for renewable energy

Another ACBI consortium is working on the challenge of converting the water hyacinth into a sustainable resource for renewable energy. Through the capacity built by the ACBI programme, the ACERA consortium partners were able to expand their research to other projects, including a £1.7M BBSRC-GCRF project on generating energy from water hyacinth. Growing in lakes, rivers and stagnant water, water hyacinth is normally associated with poor sanitation and discharge of sewage into the water body. Led by Dr Andrew Ross from the University of Leeds, and in collaboration with researchers from the UK and India, ACBI researchers are working on a project creating biogas from the water hyacinth as well as the nutrient-rich sewage and manure in the water it grows in. If successful, this project will provide a recipe for environmentally friendly fuel and cleaner water. For more information, see Project overview : Clean Energy Research Alliance (CERA) (leeds.ac.uk); Using water hyacinth to improve the performance of biogas digestors - YouTube. A massive open online course on the FutureLearn platform developed by the ACERA consortium as part of their outreach work contained information on how this invasive species can be utilised for clean energy. Bringing the debate of how to solve the challenge of the water hyacinth beyond academia, one of the ACERA partners, CREEC, also created a series of radio drama podcasts that feature water hyacinth as an energy source.

The University is now planning to work with the company to supply them with porous materials developed through the ACBI research for them to test for gas purification.

Professor Khalil Elahee, lead investigator at the University of Mauritius, was one of the partners in the concentrated solar power consortium, alongside Imperial College London in the UK, the University of Pretoria in South Africa and the University of Lagos in Nigeria.

He believes the added capacity his institution has gained and the stronger relationships he has built with utilities and energy authorities is helping his research to reach beyond academia.

Professor Elahee said: "The modelling and numerical analysis work for the research was carried out in Mauritius and Nigeria, while the UK and South African partners, who had the more advanced laboratory facilities, completed the experimental work. This enabled us to invest in better servers, software and hardware which has given us a stronger footing to engage with external partners.

Image: Members of the *Harnessing phase-change heat exchange in solar power systems* consortium at an international training event at University of Mauritius, 2017.

"During the project, we ran several workshops with energy utility stakeholders, such as the Mauritius Renewable Energy Agency. The training we provided for the project partners was also opened out to professional engineers from the energy sector, giving us new opportunities to meet and engage with industry stakeholders to better understand how we could work together. We are now actively building on these contacts".

He added: "The ability to bring over others from the consortium to Mauritius to present the research has given us added prestige and influence with the authorities here, with whom we had been working to promote sustainable and renewable energy options for Mauritius. Concentrated solar power is more viable for other countries in southern Africa than it is for Mauritius, due to our lower levels of solar energy and lack of available land. But other uses for solar energy are possible and the discussions we had through the programme perhaps played a small part in giving the government the confidence to raise the country's renewable energy targets."

Mauritius currently generates just under a quarter of its electricity from renewable sources, but has now committed to raise this to 60% by 2030. In the most recent budget, the government identified renewable energy as a key pillar for Mauritius' economic growth.

Industry engagement from international research collaborations needs to be tailored for each country, according to Professor Elahee. "We were addressing very specific challenges in quite a niche technology, without being directly commissioned to do so by industry," he said. "To work with industry in each country, you need a solid understanding of each location's needs challenges in order to tailor solutions to fit the local context.

"For Mauritius, as concentrated solar power is unlikely to be a viable option, our engagement was more broadly with the wider energy sector. In Nigeria, the key issue is investment, so our partners engaged more on the business and commercial side. And our UK partner reached out to the engineering sector more broadly. But for all of us, the additional capacity gained through the research has helped to strengthen industry interactions."

The Royal Society-FCDO Africa Capacity Building Initiative (ACBI) is a pilot programme funded by the UK Government's Foreign, Commonwealth and Development Office in collaboration with the Royal Society to increase the research capacity of universities and research institutes in sub-Saharan Africa.