Science, Technology and Innovation for Poverty Reduction

Report of the seminar held on 9 December 2009 highlighting how scientific applications are improving the lives of people in the world’s poorest countries
The Parliamentary Office of Science and Technology, the Institute of Physics, and the Engineering and Physical Sciences Research Council (EPSRC) held a joint seminar on 9 December 2009 to discuss how new developments in science and technology can be used to improve the lives of the world’s poorest people.

**Introduction**

More than one third of the world’s population lacks the resources and information to meet basic human needs such as adequate food, clean drinking water, sanitation, good health provision, shelter and education. Science, technology and innovation can play a crucial role in alleviating poverty. They have led to a wide array of developments, from boosting agricultural productivity to providing the means to generate energy cheaply. Developments in science and technology can make a significant contribution to meeting the key commitments of the eight Millennium Development Goals that United Nations (UN) members and international aid organisations agreed to achieve by 2015. They include reducing extreme poverty and child mortality rates, fighting disease and creating a global partnership for development.

The seminar showcased a range of projects designed to benefit people in the poorest parts of the world, particularly those living in rural areas. These included technologies to provide clean water, electricity, disease control and mobile communications. The speakers also explored financial, social and cultural factors affecting the uptake of new technologies in developing countries.

**Dr David Grimshaw**, head of International Programme: New Technologies at the charity Practical Action and senior research fellow (Emerging Technologies) with the Department for International Development (DFID), summarised the main issues concerning the development of suitable technologies to reduce poverty.

**Paul Riley** of the University of Nottingham and project director of the SCORE consortium (funded by the EPSRC), described the SCORE low-cost cooking stove and generator based on innovative physics and engineering.

**Ken Banks**, who runs kiwanja.net – a company that develops mobile communications technology for non-profit organisations in developing countries – explained the advantages of new software to enable group communications without the internet.

Finally, **Peter Bernstorff** of the European company Vestergaard Frandsen, which specialises in affordable disease-control products for the developing world, showcased some recent developments in water purification and insect control.

The **Rt Hon. Tom Clarke CBE MP** chaired the meeting.
Almost a decade ago, world leaders adopted the UN Millennium Declaration committing their nations to a new global partnership to reduce extreme poverty, and setting out a series of targets with a deadline of 2015 – the Millennium Development Goals. These goals aim to:

- eradicate extreme hunger and poverty;
- achieve universal primary education;
- promote gender equality and empower women;
- reduce child mortality;
- improve maternal health;
- combat HIV/AIDS, malaria and other diseases;
- ensure environmental sustainability; and
- develop a global partnership for development.

While there has been progress, it has so far been uneven, with poverty still being greatest in the rural areas of developing countries. Over a billion people still do not have access to clean drinking water, more than two billion do not have sanitation and two billion do not have access to electricity for cooking, lighting and communication. However, new advances in scientific fields such as electronics and nanotechnology could provide enabling technologies to alleviate poverty on many fronts, provided that they can be implemented appropriately. To benefit the lives of the world’s poorest people, innovation must be prioritised, developed and delivered in a way that fulfils their needs, as well as being supported with adequate funding at each stage.

New technologies to meet global challenges

In his talk, Dr David Grimshaw explained his vision of developing technologies to meet the needs of poor communities. His charity, Practical Action, aims to enable the implementation of simple technological ideas that will enhance the lives of these communities in a profound economic and social way. To ensure that ideas were not rejected, he emphasised that it was important to engage local universities and stakeholders (businesses and users) in the development and delivery processes at an early stage. He mentioned three areas where research-led technologies can help to reduce poverty: energy generation, agricultural productivity and the provision of clean water. Giving nanotechnology as an example of an enabling technology, Grimshaw described initiatives to improve the quality of drinking water in countries where pollution is a major problem.

Examples include industry-polluted ground water in Zimbabwe and the effects of gold mining in Peru, which has led to mercury pollution. Arsenic is a major source of pollution in several countries, including Bangladesh, China, India and Nepal.

One potential solution being developed at Rice University in the US employs nanoparticles of magnetite, the magnetic form of iron oxide (Fe₃O₄). These particles readily bind to arsenic in water and can then be removed using a magnet. The water-purification agent is prepared simply by mixing iron oxide particles with olive or coconut oil. “Our aim is to set up networks of scientists to test and deliver the results of such research,” said Grimshaw. He added, however, that research needs to be more openly disseminated, and that funding bodies need to give higher priority to appropriate innovation, with better communication between scientists and potential beneficiaries in the developing world.

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The SCORE cooking stove

Paul Riley discussed one initiative that has followed the principles of the Millennium Development Goals – the £2 m SCORE (Stove for Cooking, Refrigeration and Electricity) project, which is being undertaken by a consortium of universities and funded by the EPSRC. Supported by Practical Action, the consortium is led by the University of Nottingham and includes City University, the University of Manchester and Queen Mary, University of London.

Two billion people across the world cook on an open fire and have no access to electricity. The wood-burning stoves used in many rural communities in Africa and Asia are highly inefficient and the smoke produced often causes health problems. The aim was to design a combined smokeless cooking stove and generator that could be fuelled by burning various kinds of biomass, such as wood or animal dung. Exploiting simple physics, the appliance converts the heat generated into acoustic energy and then into electricity. A specially shaped pipe is heated by the stove at one end; the resulting temperature gradient causes the pipe to resonate internally, setting up a standing sound wave that drives an alternator to generate electricity. The incorporation of a heat exchanger enables the waste heat to be used for cooking.

“Many people have incomes of less than £1.50 per day, so keeping the cost down is absolutely key,” said Riley. The target is to achieve an output of 100 W of electricity for an initial outlay of £20, which would be enough to provide lighting, run a fridge and charge a mobile phone. Another target is to halve the household fuel consumption, which will also have the broader benefit of reducing a nation’s carbon emissions. The SCORE team envisages mass-producing up to a million stoves a year, using low-cost local materials wherever possible.

Mobile phones in the developing world

A pilot trial of the stove in Nepal revealed that 30% of the electricity generated was used to charge mobile phones, which are stimulating rural economies, enabling grass-roots businesses to emerge, creating jobs and driving forward social change. Ken Banks described a piece of open-source software that he has developed called FrontlineSMS, which turns a laptop and mobile phone into a central communications
hub. Groups of users can then communicate with each other without an internet connection. The technology has been particularly helpful to non-governmental organisations that have been able to monitor elections, and exchange information with rural communities and aid workers on issues such as security and human-rights infringements. FrontlineSMS has also helped healthcare networks to operate more efficiently in hard-to-reach areas.

**Innovation in disease control**
Improving health is a major issue in developing countries and is a field where innovation and technology can play a significant role. Peter Bernstorff described some of the products developed by the European company, Vestergaard Frandsen, for use in sub-Saharan Africa. These include bed nets treated with insecticide designed to kill malaria-carrying mosquitoes resistant to standard insecticides, and portable and household water filters to manage waterborne diseases such as guinea worm. The filters can remove the majority of harmful bacteria and viruses from contaminated drinking water, as well as microscopic particles. Another major disease control tool, recently launched, is a long-lasting alternative to continual insecticide spraying around the house. This is a treated woven fabric that can be hung on walls to control nuisance pests such as ants, cockroaches and termites, as well as mosquitoes. The company has since gone one step further in trying to help African communities affected by HIV/AIDS by offering

**Utilities in rural India**
A consortium of UK and Indian universities and companies is establishing the first India–UK Advanced Technology Centre of Excellence. The centre will develop wireless internet access across rural communities and wireless grid networks for remote management of utilities, water quality and flood monitoring.

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people an integrated care package consisting of a water-filtration kit, a bed net, condoms and also counselling, conditional to having an HIV test at the same time. “We are very proud of this,” said Bernstorff.

All of the speakers agreed that affordability and adaptability to specific local needs were critical in applying technological solutions to the problems of poverty. Early interaction at a local level is essential. Another major issue that non-commercial development projects face is that the funding mechanisms available are piecemeal, and while the initial scientific research might be supported by a government agency, financial assistance for implementation is often less reliable.

References
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The Physics for Development programme

The Institute of Physics has been involved in a number of projects that support capacity building or promote educational opportunities in developing countries. The Institute’s overall strategic goals are:
- to promote and support physics in furthering scientific knowledge and providing economic and social benefits; and
- to increase the number of people with knowledge and understanding of physics by promoting opportunities for all to benefit from a high-quality physics education.

In helping the developing world, the Institute focuses on two areas in terms of resources and expertise.

Promoting entrepreneurial skills
The Institute runs a programme of workshops on entrepreneurship, which are designed to give physicists and engineers from developing countries the skills they need to bring their innovations to the marketplace. This is done by translating research into practical economic and social benefits, including major social challenges, as listed in the Millennium Development Goals.

Supporting physics education
The Institute supports projects to promote low-cost, hands-on physics equipment and teacher training to schools in Rwanda. A complete lack of experimental equipment is a major problem for physics teachers in African schools. Following the success of the Rwandan model, the Institute has now rolled out this project in other African countries such as Uganda, Ethiopia, Malawi and Ghana.
About the organisations

The Parliamentary Office of Science and Technology (POST) is the UK parliament’s in-house source of independent, balanced and accessible analysis of public-policy issues relating to science and technology. Its aim is to provide members of both Houses with objective information on science and technology, to inform parliamentary debate.

The Institute of Physics (IOP) is a scientific charity devoted to increasing the practice, understanding and application of physics. It has a worldwide membership of over 36 000 and is a leading communicator of physics-related science to all audiences, from specialists through to government and the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

The Engineering and Physical Sciences Research Council (EPSRC) is the main UK government agency for funding research and training in engineering and the physical sciences, investing more than £800 m a year in a broad range of subjects – from mathematics to materials science, and from information technology to structural engineering.
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