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Opportunities for Solar in the Developing World

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Malins, Christopher. 2023. "Opportunities for Solar in the Developing World". Loughborough University.
<https://doi.org/10.17028/rd.lboro.24763374.v1>.

Opportunities for Solar in the Developing World

SuperSolar Network+ and the Low Carbon Energy for Development Network hosted a workshop on 9th May 2019 at Loughborough University, exploring Opportunities for Solar in the Developing World.

The workshop presented an exciting opportunity to bring together those working in solar applications across the developing world, in both grid and off-grid contexts, with the UK research and innovation community working on the latest developments in solar PV materials and production techniques that have potential application in developing communities.

The workshop attracted 50 attendees from academia and industry, with delegates from the international development community gaining an opportunity to hear about the technical focus of current PV research at an early stage, and for such researchers to understand the driving factors for those engaged in developing technologies for international markets.

The workshop opened by highlighting the broad challenges and opportunities for solar in the developing world, then reviewing potential funding opportunities and finance models for those engaged in the field, before presenting a selection of the latest research developments, and closing with a panel discussion where all attendees could put forward their ideas, share experience and offer feedback to funders offering significant current and future opportunities for collaboration with developing countries in the field of low-carbon energy technologies.

Review of Challenges and Opportunities for Solar in the Developing World

Ed Brown (LCEDN, Loughborough University) – Overview of LCEDN and opportunities

The event was opened by Prof. Ed Brown of Loughborough University, National Co-Coordinator, UK Low Carbon Energy for Development Network (LCEDN), who welcomed the attendees and introduced LCEDN as a platform for academics, practitioners, policy-makers and private sector organisations to interact and cooperate on research for low-carbon development in developing countries, sharing ideas and information, identifying emerging opportunities and promoting collaborations between UK based academics and researchers from developing countries, bringing together technologists, social scientists and other key stakeholders.

Prof. Brown highlighted energy for international development as an area of major interest to DFID within the Transforming Energy Access programme; UKRI through the Global Challenges Research Fund; and Innovate UK through the Energy Catalyst programme.

Prof Brown continued by discussing the partnerships that LCEDN has forged to address the challenges of developing new technologies, addressing policy challenges, community mobilization, social barriers and industrial uses.

Mike Walls (SuperSolar, Loughborough University) – overview of key technologies and challenges

Prof. Walls, Director of the SuperSolar Network+, first set out the economic, social and cultural drivers for solar power in the developing world. Costs of deployment are reducing, but are still a barrier to flexible PV, much off grid deployment is being undertaken to help some of the world's

poorest people and further deployment of solar is key to mitigating climate change. Global capacity is growing exponentially, bringing with it lower costs per Watt.

Key challengers were identified; low cost and flexible solar for easy transportation and installation; lightweight solar for non-structural roofs; anti-soiling coatings for cover glass to ease maintenance; low cost energy storage.

Leading flexible PV systems were described, such as those from RenovaGen and Power Roll. The emphasis is on rapid deployment capability because of the significant weight advantages, but module lifetimes are still less than 5 years.

The impact of PV module soiling was briefly discussed, particularly important in arid, near equatorial regions, where significant drops in power output can result and cleaning regimes can be costly and use significant amount of water – a scarce resource. Leading current solutions were discussed, such as the Solar Sharc coating, but improvements are still required.

Finally, Prof. Walls make the audience aware of the SuperSolar Network+ objectives; providing a network for PV R&D to include universities, industry and finance; training for new university and industrial PV researchers; provision of a UK national cell efficiency measurement facility; organisation of events of interest to all sectors of the PV community; funding for international research secondments, conference attendance and events; business and industry engagement; small scale research projects with industrial and international partners.

First Session Funding Landscape

Alice Goodbrook (Innovate UK) – funding for international development focused projects via Energy Catalyst

Alice Goodbrook, Innovation Lead for Energy at Innovate UK, discussed Innovate UK's support for UK-based businesses to develop highly innovative, market-focused energy technologies through the Energy Catalyst programme, drawing attention to the need for projects to address the challenges of cost, emissions and security. Alice reviewed the typical characteristics of Early-Stage, Mid-Stage and Late-Stage projects through which businesses can apply for grant funding, emphasising that grants are available for projects at different stages of development, from early feasibility studies through to late-stage prototyping and demonstrators, and for any technology or industry area. Alice went on to discuss how the emphasis on projects associated with activities in developing countries has increased over recent years, providing significant funding opportunities for projects associated with energy provision in the developing world.

Ben Good (Energy4Impact) – Crowdfunding in the energy access sector

Ben Good, CEO of Energy 4 Impact, summarised the findings of the Crowd Power project, which researched the role of financial innovation in the financing of energy access companies. It found that crowdfunding and peer-to-peer lending are growing rapidly, with the latter driving the significant growth in the sector. Demand for alternative fundraising channels from companies and social impact investment from 'citizen' investors was identified. Innovative fundraising approaches were also found to be a natural fit for the sector. P2P lending in the sector was split into business lending: accounting for 88% promising returns of up to 10% p.a.; and microlending accounts: a small part of the sector, largely driven by altruism, with an expectation of capital preservation only.

Different crowdfunding models were set out; Donation, Reward, Equity and Initial Coin Offering, which covered the range of donor/investor expectations, from small donations to large equity purchases.

Will Blythe (Department For International Development) – current energy research and delivery portfolio

Will Blyth, Senior Research Fellow in the Climate, Energy and Water Team, Research and Evidence Division at DFID, began by introducing Rory Stewart MP, the new Secretary of State for International Development, who believes “...we are facing a climate cataclysm...” and could bring new priorities to the role. Will then set out the range of forces in the energy sector that might act to disrupt the status quo and transform energy supply, such as constraints of fossil fuel use.

Will then summarised the existing and recent support for ODA energy research from DFID and BEIS, such as the targeted efforts of the Transforming Energy Access programme and Modern Energy Cooking Services, as well as wider programmes such as the Global Challenges Research Fund and Newton Fund.

DFID’s Energy Operation Model was then set out, which provided a roadmap from policy and enabling programmes that covers new technologies, new business models, kick-start grants and equity access. Combined with the Sector Specialist Programmes, such as TEA and MECS this model intends to guide activities as technologies mature.

Areas of technological need were then highlighted; low carbon generation & flexible supply; Replacing diesel gensets; clean cooking; storage; smart grids & long-range transmission; responsive demand, as were important economic and regulatory factors, such as; the implications for economic growth; energy pricing, markets & regulation; transformation of business models; political economy of power sector reform.

Second Session – Technical Developments

Richard Blanchard (CREST, Loughborough University) – The role of solar in decentralised power provision in developing countries

Dr Blanchard, Senior Lecturer in Renewable Energy at CREST, Loughborough University summarised recent activities on projects focussed on providing sustainable energy to the poorest of communities. The Solar Nano-Grids project has already transformed village life in Lemolo B, Kenya, with solar power micro-grids that not only provide electricity to households, but help generate income for the community, for example by powering 1200 egg incubators.

Dr Blanchard continued to discuss the Innovate UK funded eCook project, led by Gamos Ltd, which has addressed the strategic use of solar photovoltaics and batteries for cooking, developing a solar-powered, highly efficient pressure cooker that would meet the needs of developing communities. Dr Blanchard emphasised the need to consider a variety of social and cultural factors that may have significant impact on implementing new technologies, discussing the lessons learned during these projects that are set to have ongoing and lasting effects.

Ed Brown (LCEDN, Loughborough University) – Modern Energy Cooking Services (MECS)

Prof. Brown returned to discuss the MECS programme, a major initiative funded by DFID that aims to transform the way people cook in low income countries by focusing on the use of electricity and other modern fuels. The programme is led by Loughborough University who will oversee a partnership of other UK universities and innovators together with the World Bank multi-donor trust fund ESMAP. Prof. Brown explained how the rise in the cost of traditional cooking fuels such as charcoal, coupled with the decrease in cost of solar energy and batteries has triggered a great opportunity to change the way communities throughout the developing world use fuel to cook. The programme not only focusses on new technologies, but also emphasises social and cultural factors that can secure wider adoption of these technologies.

Prof. Brown highlighted the MECS Challenge Fund, which is currently open to projects of up to £30k, from all sizes of company or research organisation. Projects must address challenges in countries supported by DFID and align with DFID's priorities of energy storage for cooking, grid and infrastructure adaptability, alternative fuels and gender, accessibility and inclusion in MECS.

Fabiana Lisco (CREST, Loughborough University) – Anti soiling coatings for solar modules: more power and less maintenance

Dr Fabiana Lisco, Researcher at CREST, discussed in detail how the problem of soiling of PV modules has greatest impact in developing countries, and particularly in arid regions. Soiling from pollutants, pollen, particulates from construction, bird droppings, vegetation and particles in rain all impact solar assets significantly, which require cleaning, either by manual or mechanical means. Manual cleaning usually relies on manpower, water and brushes; mechanised manual washing often employs a tractor, robotic brushing is water free, but relies on rails to guide the robot and air flow to clean the panels. The drive for self-cleaning coatings is clear, but durability of existing solutions is an issue.

Dr Lisco described work being undertaken at CREST to test market leading coatings, employing standardised abrasion testing procedures, coupled with sophisticated structural characterisation tools to fully assess the stability of the coatings under test. The relatively rapid degradation of coatings was discovered, and work at CREST continues to develop hydrophobic coatings that truly meet industry needs for stability over 5 years.

Tom Routledge (University of Sheffield) – New lightweight and flexible PV for off-grid deployment

Dr Tom Routledge, Researcher at the Electronic and Photonic Molecular Materials research group at The University of Sheffield discussed recent research undertaken in collaboration with Power Roll in developing flexible PV, with the goals of making systems cheaper to manufacture, ship and install, and increasingly lightweight. Dr Routledge described the Solar Groove system, where micro-grooves in polymer sheets are used as the basis for constructing the architecture of PV cells with perovskite semiconductors. Work has progressed from small arrays of grooves to modules of 2.67 cm² comprising 3040 grooves, to achieve an efficiency of 2.7%.

Jo Coleman (Shell) – Thriving through the energy transition – what role will Shell play in delivering more and cleaner energy solutions?

Jo Coleman is UK Energy Transition Manager at Shell and she began by emphasising Shell's commitment to The Paris Agreement, illustrating how the blend of global energy sources was predicted to change over the 21st century, with reductions in solid, liquid and gas fossil fuels and the increasing predominance of solar and wind power. Jo set out how Shell would align with this predicted trend, with corporate acquisitions in the renewables sector and the work of the Shell Foundation, which has set goals to help meet the challenges of access to energy and affordable transport in the developing world through a programme of business support.

Cecile Charbonneau (Swansea University) – Strategies enabling low-C processing of metal oxide films for the fabrication of 3rd generation photovoltaics

Dr Cecile Charbonneau, Senior Lecturer at Swansea University, discussed her recent work in the development of technologies for third generation PV, particularly in the deposition of TiO₂ layers by UV curing methods at ambient temperatures, resulting in perovskite PV cells of over 10% efficiency – comparable to those produced by high temperature methods.

Dr Charbonneau then summarised work at the SPECIFIC centre in Swansea on realising an Active Classroom, that generates 1.6 times the energy that it consumes. The GCRF funded SUNRISE project is led by Swansea to transfer this technology to communities in India, where a series of demonstrator buildings will be constructed in five rural Indian villages, incorporating PV and other renewable technologies. Dr Charbonneau highlighted careful consideration of relevant social and cultural factors as being crucial elements during the initial phase of the project, to ensure lasting impact.

Discussion Panel

Ed Brown reviewed the day, which offered potential to feed into response for the minister around the wider discussion of applications of PV as well as an opportunity to feedback to Will Blythe at DFID.

Mike Walls: Conversations suggest India and Sub Saharan Africa display great interest in new technologies, but these are too low TRL level for DFID funding. The issues are in areas such as deployment and degradation – we don't want solar panels to degrade quickly and damage the industry. We need to anticipate problems. Flexible PV is a deployable technology but has issues in terms of cost and technologies such as barrier layers. DFID working more closely with universities would be welcomed.

Ben Good: The sector economics are transformed by factors such as efficiency and the importance of storage has become greater, so these are important areas. Cooking is currently a much bigger problem with much to be done.

Will Blythe: Support for solar research from DFID will continue. We ask where the state of the art is, where it is moving and at what trajectory. A sense of the design criteria is useful and knowledge of where the UK sits into that. DFID encourage research partnerships globally, looking for a UK role. We would encourage the UK to work with China to increase the rate of deployment of technologies.

Alice Goodbrook: The Energy Catalyst programme has previously invested in perovskites, currently, funding for projects involving mini grids and networks has been predominant, with a view to maximising the existing UK expertise in these areas.

Floor: Articulating offset costs and delivered value could be important, such as emphasising the benefits of flexible solar and anti-soiling treatments. These elements help the business case.

Floor: Flexible solar can be very complicated devices and when flexed have limited lifetimes, but some flexible technologies are very well proven. Dissemination of this information is important to see value from such research.

EB: There is a constant call for the new, but we should be aware of what has gone before.

Floor: Research in new PV materials has improved so much recently that we need to give it a chance to deliver its potential.

MW: A low cost barrier layer and encapsulant are important to deploying flexible in an economically viable way.

EB: Where could we be in 10 years with greater investment in third generation PV?

Floor: Huge efficiency improvements have been seen. To get the full benefit from this, it would be helpful for experiences from deploying existing PV technologies to be fed back to inform and assist those working on third generation PV.

Floor: Further away from the equator, we don't know much about how PV technologies compare, such as spectral matching. Such as in dual junction cells.

EB: Greater engagement between companies already funded by DFID and the next generation of uptake would be beneficial.

Floor: Could printable panels be made efficiently in-country, and we should raise the point of end-of-life of panels.

Floor: There is a balance between cost, efficiency and other factors. Marrying a panel to the electronics that it powers is the important thing.

Floor: How do we manage the legacy of global projects?

AG: We have to take account of depreciation costs, capital costs etc. In practice most projects take away the technology they have installed at the end of the project and often there is no-one remaining on-site to man the project, but there is the option of leaving it and dealing with the legacy. It is hoped that the project may become an economically viable business, and that is the goal, to create a viable business.

WB: Research will always have failures. The legacy is in the systems that work and that will have the opportunity to grow.

Floor: Do we need government help to decide who takes responsibility for the deployment of solar assets.

Floor: Part of the legacy is in knowledge transfer – this must be ensured.

EB: Partnership with companies that already work in the developing world is very important.

BG: Part of the legacy is the economic incentive and the ability to sustain the initiative. Viable metering and charging plans are also two important areas when considering the legacy.

Floor: Are funders investing in the technology, or the business.

Floor: What support is most important for technologically mature, but not economically mature companies?

WB: Research can mean a new business model. Those are also experiments. Some technologies may not work but they can still be part of a successful project. The spectrum of how we define research is broad.

AG: We fund businesses, but through the mechanism of investing in technology. Who hope to get businesses in a position to launch TRL 8 or 9 products to market.