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# COMMUNITY ENERGY RESILIENCE & ELECTRICITY SYSTEMS: WORKSHOPS REPORT

June 2020



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## Executive Summary

This report captures the outcomes of three workshops on community energy resilience and electricity systems that were part of the *Research Collaborations on Community Energy Resilience in Low-Income Countries Project* led by the Low Carbon Energy for Development Network (LCEDN) and the Energy and Economic Growth Programme (EEG), with funding from the UK Energy Research Centre (UKERC) Whole Systems Networking Fund.

Many low-income countries are vulnerable to natural hazards, long-term processes of ecological degradation, and global climate change. These factors threaten progress towards economic development enabled by energy access. Despite this, researchers have until recently failed to address resilience at a community level in sustainable energy systems. Research on energy access in low-income countries has also tended to be divided between on-grid, mini-grid, and standalone solutions. However, communities often utilise different combinations of systems in a strategic way in order to improve their resilience.

The project explored the potential of a whole systems energy research approach to address questions of community resilience. Three workshops were held to catalyse new research collaborations, open up dialogue, facilitate knowledge exchange, and establish a working relationship between academics, policy-makers, energy practitioners, and donors in the UK, South Asia, and sub-Saharan Africa. The first workshop was held in Oxford, UK in November 2018, the second in Kathmandu, Nepal in February 2019, and the third was held in Salima, Malawi in April 2019. Participants included representatives from Bangladesh, India, Myanmar, Nepal, Sri Lanka, Kenya, Malawi, Mozambique, South Africa, Zambia, Zimbabwe, UK and USA. The discussions included: technical innovations needed for more resilient electricity systems, linking resilient electricity systems with broader community resilience, and exploring the governance and planning processes required. The workshops were particularly successful in bringing together perspectives from disaster risk reduction and energy access for the first time.

Each workshop identified the most impactful research questions for the region on community energy resilience. Three research themes emerged from the workshops:

1. Energy system design to improve energy system resilience
2. The role that community plays in ensuring energy system resilience, and
3. The role energy systems play in community resilience

These themes highlight the need for further research on the interconnection between the resilience of energy systems and community resilience.

## 1 Introduction

This report summarises the presentations, discussions and outcomes of three workshops which included researchers, practitioners and policy-makers in the UK, South Asia and sub-Saharan Africa from November 2018 until February 2019. The workshops were held as part of the *Research Collaborations on Community Energy Resilience in Low-Income Countries Project* led by the Low Carbon Energy for Development Network (LCEDN) and the Energy and Economic Growth Programme (EEG), with funding from the UK Energy Research Centre (UKERC) Whole Systems Networking Fund.

The LCEDN is a network of UK researchers focused on renewable energy and international development. EEG is an applied research programme examining the role of energy in driving economic growth in low-income countries to aid policy-makers in designing large-scale (grid) energy systems.

The project aimed to catalyse research collaborations on community energy resilience in low-income countries using a whole systems energy research approach, bringing together social science perspectives on governance, economic modelling, disaster risk management, and technical expertise on designing resilient infrastructure. The project objectives were to:

1. Facilitate knowledge exchange and establish a working relationship between academics, policy-makers, energy practitioners, and donors in the UK, South Asia, and sub-Saharan Africa;
2. Identify research opportunities to increase community energy resilience in on-grid, mini-grid, and standalone electricity systems; and
3. Explore opportunities to extend this research area through further funding.

This report captures a diversity of views and experiences on community energy resilience across regions and stakeholder groups.

## 2 UK Workshop



*Figure 1: Discussions during the UK workshop*

This first workshop was held on 28<sup>th</sup> November 2018 in Oxford, UK. Simon Trace, Director of the EEG and Principal Consultant at Oxford Policy Management gave a brief introduction emphasising the importance of identifying research needs and gaps in community resilience against natural disasters in relation to their energy systems. This was followed by an introductory presentation by Long Seng To from Loughborough University who situated the discussion in resilience debates and community-centred approaches.

The day was structured into three panel sessions with discussions focusing on different themes of community resilience and electricity systems. These focused on the intersections between different types of electricity systems and energy resilience, the contribution of energy resilience to broader community resilience, and the governance and planning required for resilience (see Figure 2).

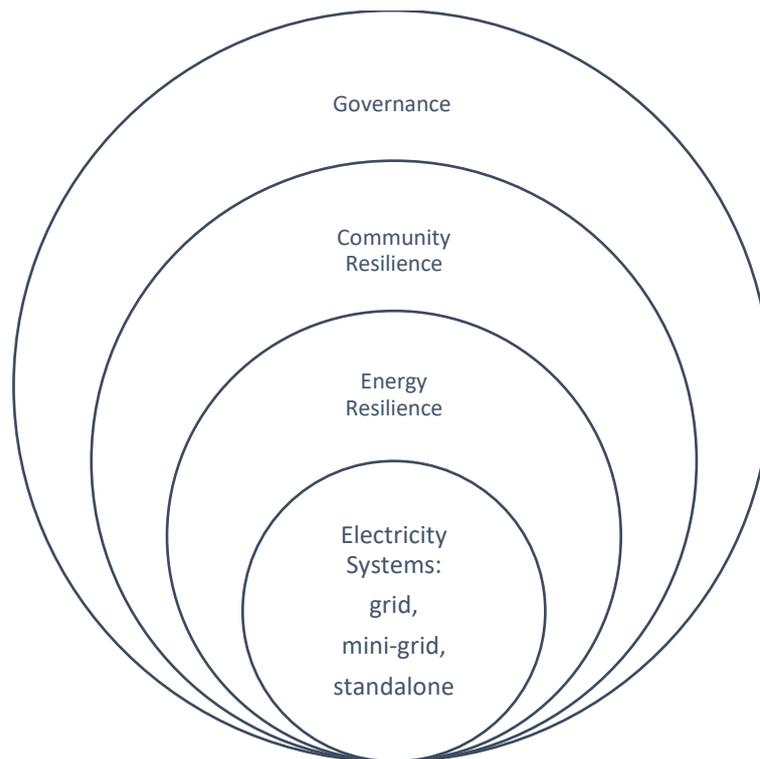


Figure 2: Framework for discussions on community energy resilience and electricity systems

## 2.1 Designing Electricity Systems for Resilience

This first panel session was chaired by Ryan Hogarth from Oxford Policy Management and panellists were asked to respond to the following questions:

1. What technical innovations are needed for more resilient electricity systems?
2. Could on-grid, mini-grid and standalone systems work together to improve resilience?

Nick Spicer from Team Rubicon gave an overview of the operations and capabilities of this international disaster response NGO, detailing its off-grid electricity systems in British Virgin Islands and Nepal. Anh Tran, a Senior Lecturer in Humanitarian Engineering at Coventry University, presented some aspects of her research including “blackout” chasing in peri-urban Lagos, Nigeria, user-driven micro-power generation devices in the Philippines and the technical, economic and social factors affecting micro-hydropower plants in Nepal. Yetunde Abdul from the Building Research Establishment, a leading centre of building science, spoke about Quantifying Sustainability in the Aftermath of Natural Disasters (QSAND) and micro-generation and off-grid systems in rural areas and its links to livelihoods. Finally, Jon Lane, from the Carbon Trust and Director of DFID’s Transforming Energy Access (TEA) programme, spoke about what technical innovations are needed for more resilient electricity systems, using Nigeria as an example.

Many interesting issues, challenges and solutions for designing resilient electricity systems were raised in the discussions and there was a consensus on the importance of technology and innovation in not only optimising the electricity systems themselves, but the efficiency and effectiveness of disaster response.

Acknowledging some of the key challenges developing countries face in their electricity systems was one of the first talking points. Issues such as the significant losses of electricity in underfunded and

unmaintained national grids, illegal tapping, inadequate state investment, constraints in fuel and water supply, and pipeline vandalism were all identified as key problems of energy systems in developing countries. These are severe problems that directly affect a community's resilience, so it was suggested that off-grid alternatives such as mini-grids could be utilised by vulnerable communities to improve their resilience, especially as the costs and availability of mini-grids are increasingly affordable and accessible. However, mini-grids are often seen in developing countries as competing electricity systems rather than complementary to grid electricity. Also, the issue of how these off-grid alternatives could be financed was a key challenge that emerged from the discussion.

Mini-grids can be particularly effective in improving community resilience and the panel discussed learning from countries such as Myanmar and Nepal, where there has been 20 years of utilising mini-grid systems for community resilience. It was proposed that these lessons could be useful in other contexts, such as refugee camps in Uganda which are located within reach of the grid, but refugees are unable to access it.

Various innovative technologies that can contribute to both designing off-grid and grid electricity systems were also discussed; including a mobile app developed by GridWatch that crowdsources information on blackouts to alert the utility to where action is required, which is looking to be rolled out in Ghana. Technological development in electricity storage was also discussed, including the Faraday Battery Challenge. Utilising data-driven decision-making models was also suggested, for example using satellite systems to identify potential tsunamis and alerting communities via sirens so responses can be as swift and effective as possible based on evidence-backed information. One panellist suggested that rather than attempting to find a specific technical system or solution to these resilience problems, it was more of a question of how to work innovatively to improve communities' resilience to natural disasters besides from technologies (for example, QSAND which was presented later in the workshop).

Regarding disaster response and relief, the role of military personnel and veterans in international disaster relief was discussed. There was a call for more focus on the response side of disaster relief, in conjunction with effective planning and preparation. The faster and more effective the response is, the greater impact it can have in rebuilding electricity systems, which usually take a very long time to rebuild.

Discussions on livelihoods was also a key point of the session, particularly with long-term refugees and victims of natural disasters. Understanding the specific needs of each community is critical in community resilience as energy, livelihoods, economic and social systems are all strongly linked with community resilience. It is important to develop sustainability in the approach to resilience and tailoring the approach to the context.

## 2.2 Electricity Systems and Community Resilience

The second panel session was chaired by Ed Brown, Professor of Global Energy Challenges at Loughborough University and Research Director of the Modern Energy Cooking Services (MECS) programme. There were four panellists who each gave a presentation which were based around two questions:

1. What research is needed on how resilience in electricity systems and community resilience are linked?
2. How are they different for on-grid, mini-grid and standalone systems?

Andrew Scott from global think tank Overseas Development Institute (ODI), outlined a conceptual framework on how solar household systems contribute to resilience; Liz Hooper, Senior Technical

Energy Advisor at Practical Action, spoke about their Total Energy Access Framework and focused on planning involving multiple stakeholders; Tami Bond, Professor of Civil and Environmental Engineering at the University of Illinois, presented on the standards of cooking stoves and household services. Finally, Xinfang Wang, a Research Fellow at the University of Birmingham, spoke about three projects relating to community energy resilience: an energy storage prioritisation project in Mexico, IGI resilient cities workshops in Nairobi and Masai Mara, and a project on Long-Term Institutional Change in the Wake of Crises: Understanding Implications for Energy System Resilience in Nepal in collaboration with Long Seng To.

The discussion began with how solar household systems can contribute to resilience and how the relative lack of research on the topic is leaving a gap in the literature and limiting a key electricity resource that could have huge potential for vulnerable communities in response to natural disasters. The need to integrate grid and off-grid electricity with longer term approaches focusing on energy services was identified. Bottom-up planning was also suggested as being essential in building community resilience and resilience in the electricity systems.

Governance was a key theme that emerged from this panel session, with one panellist concluding that it all came down to governance and that governments and energy planners need to have a mindset change and consider what energy needs citizens require to thrive and how this can best be achieved. National energy planning (including finances) to achieve scale and inclusivity (e.g. gender, rural) was considered as key and it was proposed that supply and finances can be bolstered by interconnections with neighbouring countries, as well as collaborating with private sector actors. Coordination across all stakeholders and sectors was identified as paramount and the importance of stakeholders sensing themselves as members of the community and as agencies of change was also emphasised - as it is the involvement across the community that is key to building resilience.

There was also some discussion on cooking and fuel stacking, and the importance of ensuring household access to cooking services following a natural disaster. Also, diversity and intersectionality arose as factors (e.g. gender and age) and the need to look at different contexts together. The discussions emphasised the need to understand community needs, the differences in approach needed for urban and rural contexts and the importance of long-term institutional changes that are necessary for effective long-term community resilience strategies.

### 2.3 Electricity Governance and Planning for Resilience

The third panel session was chaired by Simon Trace and the questions explored were:

1. What research is needed on governance mechanisms that can improve energy resilience at different scales?
2. How do these map onto different electricity system configurations (including grid, mini-grid and standalone systems)?

Anne Nyambane, an Academy Mo Ibrahim Fellow at Chatham House, began the presentations by asking how communities can influence decision-making and evaluated the role that development agencies and the private sector play in shaping the relationship with governance actors. Ed Brown from Loughborough University and MECS spoke about governance and decision-making, particularly the role of communities and the impact of political decentralisation. Vanesa Castan Broto, Professorial Fellow at University of Sheffield, asked what community energy is, and presented her research on sustainable energy access in Mozambique, outlining a multi-level understanding of energy transitions. Lastly, Ryan Hogarth from Oxford Policy Management gave a presentation on large-scale electricity

infrastructure and questioned why households and businesses frequently fail to assess risks and take steps to mitigate them.

Like the preceding panel session, governance was a recurring theme of the discussion. The question of what we mean by governance was analysed and distinctions between the academic context and the wider implications of governance in community resilience were important to understand. Three dimensions were identified for the context of resilience: authority, decision-making and accountability. Governance has been massively underplayed and a decentralised approach was discussed as potentially useful because local and regional governments can often be more effective in planning for resilience (e.g. nano grid implementation in Kenya vs Bangladesh). It was discussed how community-level governance and exploring how communities can influence decision-making can have a major impact in the success of a community's resilience.

Debates within energy and international development evoked questions on the role development agencies and private sector organisations play in shaping the relationship with governance actors as there can be a disconnect between energy delivery and policy aims if the agendas between them are not aligned or the relationship is weak or problematic. Similar issues occur in the humanitarian sector.

There was also a call for a more collaborative approach in planning for resilience, particularly for large-scale electricity infrastructure. Key discussion points included which stakeholders are best placed to make governance decisions and how risks to energy systems interact with other systems to create vulnerability. Also, identifying what political, financial and coordination barriers were limiting resilience was paramount and necessitates a specific understanding of community needs and the socio-economic environment. Energy sovereignty was also identified as a useful approach. Three issues arose from this discussion: 1) legitimacy in energy decisions (who has control over resources and how are they being used?) 2) understanding user needs, and 3) the need for bottom-up energy planning.

#### 2.4 Outcomes of UK Workshop

At the end of the workshop, an open discussion was chaired by Long Seng To which sought to identify some key research questions emerging from the workshop. She identified some implications for research from the workshop: 1) confirmed the need for research at each of these boundaries; 2) need to focus on energy services and; 3) need for inclusion and capacity development.

At the end of each session, session chairs had sought agreement on the key research questions that emerged from the discussions and presentations. In this final session, participants voted on which research question they felt would make the most significant impact (see Table 1). A clear winner emerged - How does energy fit into wider understandings of resilience?

Table 1: Votes for Research Questions Following UK Workshop

| Research Questions  | Percentage |
|---|------------|
| 1. How does energy fit into wider understandings of resilience?   | 18%        |
| 2. How can we build energy systems to be resilient – both continue operating and bounce back quickly/forward quickly? When is it financially viable?  | 13%        |
| 3. What are the most critical energy services to continue operating?  | 10%        |
| 4. Evidence base – how do different aspects of service delivery relate to different capacities?   | 10%        |
| 5. Who is the community? (youth/diversity/intersectionality)  | 8%         |
| 6. Who decides, governs, and influences governance decisions at the national, international & local level that influences energy access and its impact on resilience? Where does the legitimacy come from? How are they held accountable? | 8%         |
| 7. Under what conditions will communities be interested in being involved in managing or taking part in energy system decision-making?  | 8%         |
| 8. How are incentives structured for different actors to mitigate risks to energy systems?  | 8%         |
| 9. Availability of labour and skill sets to continue operation of energy systems in the face of shocks and build systems that are resilient   | 8%         |
| 10. What are the synergies between decentralised and centralised energy systems and governance structures?  | 5%         |
| 11. How is technological innovation helping and/or hindering resilience?  | 3%         |
| 12. The role of energy in buildings resilience ‘agents of change’   | 3%         |
| 13. Capabilities of local communities to impact on results of energy resilience   | 0%         |
| 14. Community resilience beyond the community (interconnection, integration, communication, migration)  | 0%         |

Overall, the workshop evoked some very insightful, productive discussions on a range of themes, challenges and solutions relating to all aspects of community resilience and electricity systems. Some key themes discussed throughout the day included governance (local, regional and national), collaboration with international actors and the private sector, integrating different types of energy systems, particularly off-grid and grid electricity, and acknowledging the importance of taking a bottom-up approach to community resilience that bases decision-making on community needs, society and the types of natural disasters the community faces. The research questions identified informed the subsequent workshop in Nepal, which focused on energy resilience in the context of disaster risk reduction.

### 3 Nepal Workshop



*Figure 3: South Asia workshop in Kathmandu*

The second of the three workshops was held on 11<sup>th</sup> February 2019 at the Radisson Hotel Lazimpat, Kathmandu, Nepal. The aim was to jointly identify research opportunities to increase community energy resilience in on-grid, mini-grid and standalone electricity systems through three panel sessions each focused on a specific aspect of community energy resilience in the context disasters in South Asia. Participants from Bangladesh, India, Myanmar, Nepal and Sri Lanka shared country experiences on the energy and resilience situation, and identified research needs in disaster prevention, preparation, response and recovery. Discussions focused on the opportunities for on-grid, mini-grid, and standalone systems and how they might interact, and the role of community groups, the private sector, and government.

After a welcome address by Simon Trace, Long Seng To gave a presentation summarising the overall project and outlining the agenda and key outcomes of the UK workshop, including the research questions identified.

#### 3.1 The Energy Resilience Situation in South Asia

The first panel session of the workshop was chaired by Niraj Subedi, an energy sector specialist at KfW Development Bank. As this session was about the current situation in South Asia, the presentations focused on regional activities or a specific case study. There were three questions put to the panellists for this session:

1. What are the most critical energy services to continue operating for communities most vulnerable to disasters?
2. What are the major vulnerabilities in the electricity system (do grid, mini-grid and standalone systems differ)?
3. How does energy fit into wider understandings of resilience?

Ayesha Bhatnagar from Development Alternatives, India began the presentations with an overview of the Society for Technology and Action for Rural Development (TARA) and their work on micro-grids, biomass and social incubation engine projects, as well as Community Engagement, Load Acquisition, and Micro-enterprise Development (CELAMeD), a micro enterprise focusing on social inclusion, particularly focusing on women entrepreneurs.

Enamul Karim Pavel, Head of Renewable Energy at Infrastructure Development Company Limited (IDCOL) in Bangladesh outlined their activities on solar irrigation, solar home systems, mini-grids, improved cook stoves and biogas in relation to the Bangladesh Climate Change Strategy and Action Plan (BCCSAP).

Wathsala Herath from the Energy Forum presented on the development of micro hydro power plants for rural electrification in Sri Lanka over the last 20 years. Approximately 300 micro hydro systems were established and owned by local Electricity Consumer Societies which consisted of community members. In 2002, the Energy Forum formed the Federation of Electricity Consumer Societies (FECS) to collectively address issues faced by micro hydro electricity consumers. A national government programme to provide “Electricity for All” was launched in 2012 and connected villages to the national electricity grid. As consumers moved to grid connections to access higher levels of energy services, the micro hydro power plants were abandoned. There are efforts to connect these plants to the grid, with three such connections already made and the potential for 100 more.

Lastly, Anil Pokhrel of Plan8 Risk Consulting based in Nepal presented case studies of energy resilience needs in Nepal including a flooded sub-station that caused a whole systems failure, a failed transmission line following a flood, and the damage that was caused by the 2015 Gorkha earthquake. He also emphasised the importance of integrating risk assessments with flood, landslide, fire and sediment risks to help make informed decisions.

The presentations were followed by a discussion around the experiences in Nepal, Sri Lanka, India and Bangladesh. In Nepal, it was discussed how the government was not reactive in terms of understanding the earthquake risks to investments in energy systems and that Nepal needs resilience plans for all hydro-power plants to build resilience. It was emphasised that we need to look at sector risk in energy systems and not just focus on individual investments. Other ideas were to retrofit hydropower plants to build resilience and integrate earthquake risks with other risks such as fire, flooding and landslides to help make informed decisions on preparedness and for an effective response to prevent losses. Moreover, if risks can be quantified in monetary terms, then communicating this to investors would be very powerful – the importance of understanding and communicating risk amongst all stakeholders was a key conclusion of the discussion.

In Sri Lanka, there was a call for government support to expedite and spur the development of the renewable energy sector. Also, there was a call for more research into how to protect catchment areas and a need for more community training in technologies of systems which can build resilience. The latter is especially critical in times of drought as people need electricity for water pumping. Micro hydro projects has played a major role in rural electrification in Sri Lanka but the number of projects being abandoned is a cause for concern. Technical challenges need long-term planning and resilience planning, and questions were raised about whether the initial infrastructure was robust enough to last in the long-term.

In India, the discussions revolved around two key areas – the impact on change in the lives of people through access to renewable energy in quantifiable terms, and how giving control of local distribution and generation to local people had empowered them. Issues surrounding the logistics of assessing

these social impacts after projects end were discussed, and it was emphasised that continued contact and monitoring of the energy systems were critical. For example, TARA kept interacting with the communities for 3-4 months following the end of projects, but even though this is a long enough time period to observe an enterprise's revenue increase over 3-4 months, it would be even better to have the resources and capacity to assess this in more detail and for a longer time period. There were also points raised about how energy resilience can be built into existing energy systems and if transitioning into a new system was cost effective for farmers. Overall, two questions emerged: 1) how can the energy component make a community resilient? and 2) how are the energy components themselves resilient?

In Bangladesh, three primary adaptation areas were identified: food security, livelihoods and health. The discussion referred to how the projects managed by IDCOL were having a direct impact on these areas in Bangladesh. However, key challenges of resilience arose, such as how the lowering of the water table is causing stagnation and salty water, and that if technology fails then people became more vulnerable because they have come to rely on it. Also, hailstorms and thunderstorms posed major risks to the solar irrigation and mini-grid projects. Insurance was discussed as a strategy to transfer risk. However, it was acknowledged that timely pay out and verification of claims was needed to make it effective.

### 3.2 Identifying Research Needs: Disaster Response and Recovery

The second panel session was chaired by Simon Trace and was based around the questions:

1. How do households and communities respond and recover from disasters in terms of energy services?
2. What research is needed on the role of energy in response to disaster and recovery?
3. Do on-grid, mini-grid and standalone systems offer different solutions?

Anu Prasai Lama and Minar Thapa Magar, from the Housing Recovery and Reconstruction Platform, presented on the loss of electricity in 11 of Nepal's 14 districts most affected by the Gorkha earthquake in 2015. Anukriti Goyal from SELCO Foundation, India, spoke about sustainable energy in situations of displacements using an ecosystems approach to deliver solutions to end users, emphasising that energy access is an enabler, not an end goal, to wellbeing and health. Dipendra Bhattarai from the International Centre for Integrated Mountain Development (ICIMOD) in Nepal, presented responses to the three questions by focusing on needs at different scales and contexts. For example, macro level mapping of energy infrastructure and sensitivity analysis on the impact of disasters is needed. While at the micro level, further understanding of the role of community infrastructure and their role in providing energy access in response to disasters is needed. He also called for financial aspects to be explored further.

Ram Bahadur Ghimire from the National Association of Community Electricity Users (NACEUN) in Nepal spoke about the importance of its constituent organizations - Communities Rural Electrification Entities (CREEs) in restoring electricity grids after the 2015 Gorkha earthquake. Netaji Basumatary gave an overview of the Indo-Global Social Service Society (IGSSS) and its work in areas of India affected by floods, earthquakes and wind cyclones. Pooja Sharma from Practical Action, spoke about research needs relating to earthquakes and social impacts. Finally, Sambriddhi Kharel from Social Science Baha Kathmandu in Nepal presented on the Energy on the Move project, which focused on longitudinal perspectives on energy transitions among marginal populations, including in households displaced by the 2015 earthquake in Nepal. She emphasised that existing inequalities led to vastly different experiences of recovery and access to energy after the disaster.

There was a wide range of issues discussed following the presentations based around the need for more research into energy systems before and after disasters in South Asia. Research into the maintenance and governance of energy systems was a key theme, especially following the response to natural disasters, and the logistical and corporative challenges of transitioning the projects into long-term sustainable models and businesses. There was an emphasis on boosting and improving the governance of maintenance, tracking the progress and working with communities, government, international donors and private sector actors to optimise the management and governance of resilient energy systems. Decentralisation was also a key theme, participants discussed the opportunities of empowering local authorities with the capacity to formulate an integrated assessment for a local plan of action when there is no access to energy, as well as the role of the informal sector.

Furthermore, it was suggested that Public-Private Partnerships (PPPs) be considered for promoting renewable energies in vulnerable communities in building the initial infrastructure, but not necessarily in the follow-up or responses of disasters. Another consideration is how other energy sources, such as biofuels and gas, can contribute to energy resilience, and that in discussions around energy systems in disaster response, it is prudent to think more broadly and utilise all viable forms of energy to ensure disaster response and recovery is as effective and expedient as possible.

### 3.3 Identifying Research Needs: Disaster Prevention and Preparation

The final panel session was chaired by Ajaya Dixit of the Institute for Social and Environmental Transition, Nepal. The questions the panellists were asked to respond to were:

1. What research is needed on the role of energy in preventing and preparing for disasters at different scales?
2. How can we build more resilient energy systems?
3. What is the role of different actors, e.g. community, private sector, government?

Dilip Gautam from Water and Environment Engineering Services gave a presentation based around the water-energy-food nexus and spoke about how diversification, intelligence, coupling and decoupling, pooling and coordination, and having redundancy in the system are key to resilience. Dipti Vaghela from Hydro Empowerment Network in Myanmar presented on small-scale hydropower in Nepal and Myanmar, focusing on an output-based multi-stakeholder facilitation approach, emphasising how it is local people who make projects resilient and it is important to identify what community needs and how systems can operate effectively with transparency. Govinda Prasad Devkota from People, Energy & Environment Development Association (PEEDA) in Nepal spoke about earthquake hazards and building earthquake resilient buildings and stressed the importance of joining community, academia and government together and preparing risk management plans at community, organisation and government levels. Finally, Mukesh Ghimire, from the Alternative Energy Promotion Centre in Nepal summarised their engagements in energy access via community electrification and its impact on economic prosperity and the environment for entrepreneurship creation.

There were two key areas that were the focal points of the discussion. The first was whether private financing increases risk. This is not necessarily the case as self-financing means that developers are accountable to them, whereas if it is grant funded there is less capital invested so therefore accountability is less. The second area revolved around the resilience of physical systems and how they are intertwined with practices. There were also some discussions on regional interdependencies and the significance of India's role in the regional energy systems and community resilience.

### 3.4 Outcomes of Nepal Workshop

At the end of the Nepal workshop, Long Seng To chaired a group discussion based around three questions:

1. What research questions emerging from our discussions would have the greatest impact?
2. What similarities and differences are there across countries?
3. What opportunities are there for collaboration over the next 6 months?

Opportunities for collaboration was a focal point of the discussion, with an emphasis on interdisciplinary collaboration and action-oriented research. There was interest from energy access and disaster risk reduction practitioners, policy-makers and academics in pursuing further practical work in this area. This would be extremely valuable for disaster response, recovery, prevention and preparation in South Asia.

After the workshop, participants were asked to vote for which research questions identified during the workshop were most important for community energy resilience in South Asia. The research question that was identified as most important was 'How to ensure the opportunity to build back better energy systems post-disaster is taken (e.g. quality assurance of equipment, opportunity to test new technology, standards, etc)?' (see Table 2).

Table 2: Votes for Research Questions Following Nepal Workshop

| Research Question   | Percentage |
|---|------------|
| 1. How to ensure the opportunity to build back better energy systems post-disaster is taken (e.g. quality assurance of equipment, opportunity to test new technology, standards, etc)?  | 17%        |
| 2. Can energy resilience be improved by considering mini-grids and national grids hand-in-hand?   | 13%        |
| 3. What actions are required to prepare for and cope with risks to electricity supplies at operational, regional and national levels?   | 10%        |
| 4. What is the role of social capital in energy resilience?   | 10%        |
| 5. How to address the specific challenges of resilient energy systems for informal urban communities and communities being displaced?   | 8%         |
| 6. How did different institutions at community (e.g. Community Rural Electric Entities or micro-hydro user groups) and national levels cope with restoring power post-earthquake in Nepal. What lessons about critical capacities can we learn for other countries in South Asia? | 8%         |
| 7. What are the trade-offs between centralised and decentralised electricity systems in terms of energy resilience?   | 8%         |
| 8. What difference does including productive use support alongside electricity provision make to community resilience post-disaster (e.g. the NAECUN's approach in Nepal)?  | 6%         |
| 9. What are the costs and benefits of renewable energy systems with backup systems? Where the increased cost of including backup is weighed against increased energy resilience.  | 6%         |
| 10. How to ensure energy systems are included in post-disaster recovery programmes' monitoring?   | 4%         |
| 11. How do the changing nature of exposure to risks; natural and build systems; users and managers of energy; and rules and regulations interact to create energy resilience?   | 4%         |
| 12. Can quality control guidelines help enhance energy resilience?  | 2%         |
| 13. What part can energy efficiency have in improving resilience (or at least providing more services with less)?   | 2%         |
| 14. How can energy dependence on outside be addressed?  | 0%         |

## 4 Malawi Workshop



*Figure 4: Participants of the Malawi Workshop*

The third and final workshop of the Community Energy Resilience and Electricity Systems series was held on 24<sup>th</sup> April 2019 at the Sunbird Livingstonia Hotel, in Salima, Malawi in collaboration with Mzuzu University and the Civil Society Network on Climate Change (CISONECC). Participants from Kenya, Malawi, Mozambique, South Africa, Zambia and Zimbabwe shared country experiences and analysed critical energy services, vulnerabilities in the electricity system, and how energy fits into the wider understanding of resilience. The workshop took place shortly after Cyclone Idai, which became a focal point of the discussions. Julius Ng’oma from CISONECC began the day by welcoming participants to the event. Wales Singini, Associate Professor at Mzuzu University, gave the opening speech highlighting the benefits and challenges of collaboration between academic institutions and stakeholders from various sectors when working on a research project such as this. He emphasised that co-generation of knowledge produces research that has a meaningful impact on society.

### 4.1 Energy Systems and Community Resilience

Michael Zimba, Dean of Science, Technology and Innovation at Mzuzu University chaired the morning session, and the presentations started with Joseph Kalowekamo, the then Acting Director of the Department of Energy Affairs, whose presentation addressed the question “Is Malawi resilient?”. He illustrated how vulnerable Malawi is to flood risks and went on to describe the damage done to hydropower plants and transmission lines caused by flooding following Cyclone Idai. He also detailed the impact flooding had on domestic and commercial sectors, as well as food security and effects on the supply of biomass fuels since a substantial number of trees were damaged by the floods. He then suggested what Malawi could do as a country going forward, including implementing an early warning system through different network platforms to enhance resilience, restoring the landscape by involving the Ministry of Agriculture and other state departments and relevant institutions, diversifying power generation options, identifying other potential hydropower sites, installing trash booms at the intake points for hydropower plants to trap debris, formulating guidelines to construct a resilience management framework, and interconnecting electricity systems with neighbouring countries.

Collen Zalengera, Senior Lecturer at Mzuzu University gave the next presentation on energy systems resilience and sustainable energy livelihoods. He emphasised how energy systems are physical assets for achieving livelihood outcomes including generating higher incomes, improving wellbeing, reducing vulnerability and increasing food security. Moreover, he spoke about how energy systems should be capable of planning and building resilience to adverse shocks and events that may occur in the future. He also identified four lessons that have been learnt. Firstly, delivering resilient energy systems require a programmatic approach. Secondly, socio-economic factors have a significant impact on the resilience of energy systems. Thirdly, projects need cost-planning for a technical and socio-economic resilience approach. Finally, he identified a need for formulating frameworks that incorporate an energy resilience approach.

Long Seng To from Loughborough University, gave the third presentation of the day on community energy resilience in Nepal. This case study presentation was based on research conducted following the Gorkha earthquake that displaced 2.4 million people in Nepal. The research was conducted in 16 villages across four affected districts and targeted 160 households and key informants. The study found that a high number of households were forced to use alternative sources of energy to meet their energy demand, but most were proactive in restoring some energy services and overall, most households had regained some energy access after the earthquakes. Furthermore, she stressed the importance of establishing research collaborations between academic institutions and stakeholders from various industries that can play a role in promoting energy resilience, and the need to focus on opportunities to increase community energy resilience in on-grid, mini-grid and standalone electricity systems in South Asia and sub-Saharan Africa. When asked what Malawi can learn from Nepal's experience, she suggested that Malawi can invest more in capacity building and promote integration of renewable energies into the current energy system to diversify the energy mix.

Finishing off the morning session, Admore Chiumia from Practical Action presented on the role of mini-grids in enhancing community resilience. He outlined Practical Action's mini-grid installations in Malawi and Zimbabwe using an anchor-community business model. He also spoke about the Mulanje Electricity Generation Agency (MEGA), which was facilitated and implemented by Practical Action to increase rural energy access and advance socio-economic development. Furthermore, he suggested lessons learnt from Cyclone Idai will be helpful in preparation for Cyclone Kenneth, which was heading towards Malawi at the time.

Following the presentations, there was a panel discussion based on the theme: how can energy systems enhance community resilience? A key theme of the discussion was the importance of energy systems on livelihoods and socio-economic development. Energy systems foster economic development through productive uses of energy, which is a source of income for households. Also, people with access to cleaner energy are better off than those without and that is a key element to building energy resilience in a community. Having sustainable and reliable access to electricity can increase a community's energy resilience by accessing information on disasters through phones, radios, internet and social media platforms. Decentralised energy systems were seen as more resilient than centralised energy systems which can take time to restore after a disaster.

Furthermore, there was discussion around distribution challenges and how they have been the cross-cutting issue in the implementation of clean energy, and the example of distributing LPG to rural areas was discussed as poor road infrastructure and long travel times are severe challenges for LPG distribution. Quality control of energy services was also found to limit energy resilience by affecting consumer attitudes towards various alternative sources of energy e.g. batteries, solar and the quality of pumps.

## 4.2 Managing Impacts of Natural Disasters on Energy Systems

The afternoon session was split into two parts: the first part was chaired by Esther Phiri of the Malawi Polytechnic, and comprised three presentations followed by a panel discussion.

The first presentation was given by Rex Muhome from the Malawian Electricity Generation Company Limited (EGENCO), who presented on the impact of climate change on EGENCO's hydropower generation facilities in Blantyre, Neno, Chikwawa and Karonga (all in Malawi) with a total installed capacity of 422.9 MW. He then spoke about how the power generation sector for hydropower had been affected by a change in rainfall patterns, which has caused floods and sedimentation, and that these effects have damaged the generation equipment and caused severe power outages across the country. Regarding building energy resilience specifically, he believed that energy diversification is necessary and viable, citing examples such as the Salima solar project, diesel generators and a proposed coal-fired power plant.

EGENCO is working towards reducing the damage to generation equipment caused by debris, which is challenging due to the large coverage, although they are planning to plant trees and harvest water hyssop along the banks to help mitigate some of the risks.

Fabio Buque from Unifreight Limitada then presented on efforts to build resilience in the aftermath of Cyclone Idai in Mozambique. He outlined how deadly the devastating cyclone was, claiming 602 lives, damaging 239,682 houses and 715,378 hectares of crops. He focused on the impact the cyclone had on the fish farming sector: damaging 53 tanks, of which 41 were fish cages destroying 523,500 fish-seed hatcheries, which overall affected 104 fish farmers. He also described how the cyclone destroyed transmission and distribution lines, in Beira and neighbouring provinces, as well as a key substation in Munhava being under water, which made it impossible to repair the damage until the water level dropped. Regarding building energy resilience in Mozambique, he called for more investment into renewable energies, and spoke about the example of a solar system project implemented by Unifreight, which helps provide clean water to the affected areas through solar water pumping mechanisms which aims to build community resilience, reduce waterborne diseases and improve the social welfare of the households affected by Cyclone Idai. Another advantage of these solar systems is that they can easily be dismantled once there are alerts of climate change related hazards.

Welton Saiwa from the Malawi Energy Regulatory Authority (MERA) gave the third presentation on electricity governance and planning for resilience. One of the key themes of his presentation was that the best practice to promote community energy resilience is through electricity governance and regulation, and that MERA has the mandate to regulate the issues of licences in the power sector. He also stressed the importance of diversifying the energy supply mix for a resilient and sustainable supply system but identified the challenge that the existing energy supply is dominated by hydropower which is easily affected by droughts and floods. He concluded the presentation with two recommendations. Firstly, he called for a need for more collaboration and a review of the roles and functions of relevant ministries in the management of the Shire River catchment area. Secondly, he suggested that Malawi should make it a legal obligation on the relevant authority to implement investments identified through the due process.

A panel discussion was then held with three panellists: Emmanuel Mjimapemba, Programme Manager of Increasing Access to Clean and Affordable Energy; Hazel Kwaramba from Zimbabwe Evidence Informed Policy Network (ZeipNET) and Isaac Simate, Assistant Dean Research, Department of Agricultural Engineering at the University of Zambia. Esther Phiri continued to chair the session

throughout this panel discussion, which began with the question: What research actions are needed on community energy resilience?

Six priorities for researching community energy resilience were identified:

- Energy efficiency;
- Energy costs;
- Proactiveness of addressing issues in advance;
- Efficiency measures - particularly measures of electricity usage;
- Resilience response and restoration; and
- How resources are allocated to the climate hazards once they occur.

A key discussion point revolved around governance and planning. There is a relatively weak framework as far as energy resilience is concerned in Malawi and the risks of extreme events are mounting. It is possible to slow down the magnitude of the impact through sufficient planning. One of the problems of developing energy resilience systems based on historical data has caused poor performance of energy systems against climate hazards. Regarding modelling systems, it was also discussed how resilience is built on redundancies which is expensive, and that Malawi should utilise smart technologies since they can enhance resilience. There was also a call for a holistic, interdisciplinary approach for research in this field.

The role LPG can play in energy resilience was also discussed. There is a need to enhance the promotion of LPG, beginning by formulating good and favourable policies to promote LPG in Malawi, particularly in the urban centres to address environment degradation. The panellists also acknowledged that there is a limitation in mindset when it comes to LPG in Malawi, and that the perception that it is unsafe limits adoption. Research and case studies from Practical Action and Christian Aid were also discussed as models or potential frameworks to foster the development of LPG through making it more affordable and accessible.

#### 4.3 Outcomes of Malawi Workshop

This session, chaired by Jiska De Groot from the Energy, Poverty and Development Group at the University of Cape Town, began with a presentation from Mayamiko Nkoloma of iMOsys on remote monitoring for renewable energy systems. His presentation called for energy systems to be monitored to ensure proper management and that remote monitoring helps improve the management and therefore building energy resilience. He outlined advantages of remote monitoring including efficient and effective grid/load management, grid-expansion planning, efficient and effective grid monitoring and regulation, mini-grid back-office efficiency, enhancing and enabling mini-grids to generate more cash. He also spoke about how the decision-making process can be optimised through remote monitoring, which will help to determine the kinds of projects best implemented in a specific environment.

Smart technologies are able to detect if a client has connected a large load to the electricity system, although recognises that it can be tricky if everyone has connected their appliance at the same time. Mayamiko Nkoloma also called for more research focusing on how we can best build climate-proof infrastructure, and discussed how the local market is welcoming to these technologies and changes in their energy usage.

Finally, participants were invited to identify and vote on the most important research questions to emerge from the workshop (see Table 3).

Table 3: Votes for Research Questions Following Malawi Workshop

| Research Question  | Percentage |
|--|------------|
| 1. What are the critical aspects of energy systems that will make the system resilient?                        | 16%        |
| 2. How do we create a balance between biomass and alternative energy sources in building community resilience? | 16%        |
| 3. How does community power dynamic affect community energy resilience?  | 13%        |
| 4. What are the favourable community models that can enhance community resilience?                             | 13%        |
| 5. What are the structural and unstructural measures that can enhance energy resilience?                       | 13%        |
| 6. How best can we engage and support communities in building energy resilience (last mile)?                   | 9%         |
| 7. How robust are our energy systems so that they can withstand and recover from natural disaster?             | 9%         |
| 8. How best can we incentivise supplies to operate in rural areas more than in urban areas?                    | 6%         |
| 9. To what extent are investments made in energy resilience in some communities in comparison to others?       | 3%         |
| 10. What are the differences in resilience between communities with and without access to energy?              | 3%         |
| 11. How does the infrastructures' siting affect energy resilience?   | 0%         |
| 12. How far can we design for resilience versus self-failure?  | 0%         |

## 5 Conclusions

The three workshops generated new insights into community energy resilience and electricity systems across South Asia and sub-Saharan Africa, particularly in the context of Nepal and Malawi. In total, 76 participants attended from 13 countries, sharing presentations and discussions, and forming new networks. The three workshops gave participants an opportunity to exchange knowledge and to discuss further action on community energy resilience. Each workshop was unique with its own key themes and contexts discussed throughout the sessions, and collectively informed the LCEDN and EEG with significant research outcomes such as the desire for more collaboration among all stakeholders, the significance of the governance and regulatory frameworks, the importance of approaching community resilience with a locally-specific, holistic and interdisciplinary approach, and utilising all renewable energies in order to design and implement optimal energy systems and community energy resilience strategies.

An analysis of the research questions from each workshop revealed three emerging research themes (see Table 4):

1. Energy system design to improve energy system resilience
2. The role that community plays in ensuring energy system resilience, and
3. The role energy systems play in community resilience

These themes highlight the need for further research on the interconnection between the resilience of energy systems and community resilience.

Table 4: Emerging Research Themes

| Key   | Energy system design to improve energy system resilience | The role 'community' plays in ensuring energy system resilience  | The role energy systems play in community resilience |  |          |
|---|--|--|--|--|----------|
| <b>Research Question (Malawi)</b>   | <b>%</b>   | <b>Research Question (Nepal)</b>   | <b>%</b>   | <b>Research Question (UK)</b>  | <b>%</b> |
| What are the critical aspects of energy stems that will make the system resilient?                          | 16   | How to ensure the opportunity to build back better energy systems post-disaster is taken (e.g. quality assurance of equipment, opportunity to test new technology, standards, etc)?  | 17   | How does energy fit into wider understandings of resilience?   | 18       |
| How do we create a balance between biomass and alternative energy sources in building community resilience? | 16   | Can energy resilience be improved by considering mini-grids and national grids hand-in-hand?   | 13   | How can we build energy systems to be resilient – both continue operating and bounce back quickly/forward quickly? When is it financially viable?  | 13       |
| How does community power dynamic affect community energy resilience?  | 13   | What actions are required to prepare for and cope with risks to electricity supplies at operational, regional and national levels?   | 10   | What are the most critical energy services to continue operating?  | 10       |
| What are the favourable community models that can enhance community resilience?                             | 13   | What is the role of social capital in energy resilience?   | 10   | Evidence base – how do different aspects of service delivery relate to different capacities?   | 10       |
| What are the structural and unstructural measures that can enhance energy resilience?                       | 13   | How to address the specific challenges of resilient energy systems for informal urban communities and communities being displaced?   | 8  | Who is the community? (youth/diversity/intersectionality)  | 8        |
| How best can we engage and support communities in building energy resilience (last mile)?                   | 9  | How did different institutions at community (e.g. Community Rural Electric Entities or micro-hydro user groups) and national levels cope with restoring power post-earthquake in Nepal. What lessons about critical capacities can we learn for other countries in South Asia? | 8  | Who decides, governs, and influences governance decisions at the national, international & local level that influences energy access and its impact on resilience? Where does the legitimacy come from? How are they held accountable? | 8        |
| How robust are our energy systems so that they can withstand and recover from natural disaster?             | 9  | What are the trade-offs between centralised and decentralised electricity systems in terms of energy resilience?   | 8  | Under what conditions will communities be interested in being involved in managing or taking part in energy system decision-making?  | 8        |
| How best can we incentivise supplies to operate in rural areas more than in urban areas?                    | 6  | What difference does including productive use support alongside electricity provision make to community resilience post-disaster (e.g. the NAECUN's approach in Nepal)?  | 6  | How are incentives structured for different actors to mitigate risks to energy systems?  | 8        |
| To what extent are investments made in energy resilience in some communities in comparison to others?       | 3  | What are the costs and benefits of renewable energy systems with backup systems? Where the increased cost of including backup is weighed against increased energy resilience.  | 6  | Availability of labour and skill sets to continue operation of energy systems in the face of shocks and build systems that are resilient   | 8        |
| What are the differences in resilience between communities with and without access to energy?               | 3  | How to ensure energy systems are included in post-disaster recovery programmes' monitoring?  | 4  | What are the synergies between decentralised and centralised energy systems and governance structures?   | 5        |
| How does the infrastructures' siting affect energy resilience?  | 0  | How do the changing nature of exposure to risks; natural and build systems; users and managers of energy; and rules and regulations interact to create energy resilience?  | 4  | How is technological innovation helping and/or hindering resilience?   | 3        |
| How far can we design for resilience versus self-failure?   | 0  | Can quality control guidelines help enhance energy resilience?   | 2  | The role of energy in buildings resilience 'agents of change'  | 3        |
|   |  | What part can energy efficiency have in improving resilience (or at least providing more services with less)?  | 2  | Capabilities of local communities to impact on results of energy resilience  | 0        |
|   |  | How can energy dependence on outside be addressed?   | 0  | Community resilience beyond the community (interconnection, integration, communication, migration)   | 0        |

## 6 Appendices

### 6.1 UK Workshop Agenda (28/11/2018)

|               |   |
|---------------|---|
| 9:30 – 10:30  | <p>Welcome – Simon Trace, Oxford Policy Management</p> <p>Presentation &amp; mapping exercise: What do we mean by energy resilience? Why take a community-centred approach? - Long Seng To, Loughborough University</p>   |
| 10:30 – 10:45 | Break   |
| 10:45 – 12:15 | <p><b>Designing electricity systems for resilience</b></p> <p>What technical innovations are needed for more resilient electricity systems? Could on-grid, mini-grid and standalone systems work together to improve resilience?</p> <p>Chair: Ryan Hogarth, Oxford Policy Management</p> <p>Panellists:</p> <ol style="list-style-type: none"> <li>1. Nick Spicer, Team Rubicon</li> <li>2. Anh Tran, Coventry University</li> <li>3. Yetunde Abdul, Building Research Establishment</li> <li>4. Jon Lane, Carbon Trust</li> </ol>   |
| 12:15 - 13:15 | Lunch   |
| 13:15 – 14:45 | <p><b>Electricity systems &amp; community resilience</b></p> <p>What research is needed on how resilience in electricity systems and community resilience are linked? How are they different for on-grid, mini-grid and standalone systems?</p> <p>Chair: Ed Brown, Loughborough University</p> <p>Panellists:</p> <ol style="list-style-type: none"> <li>1. Andrew Scott, Overseas Development Institute</li> <li>2. Liz Hooper, Practical Action</li> <li>3. Tami Bond, University of Illinois</li> <li>4. Xinfang Wang, University of Birmingham</li> </ol>  |
| 14:15 – 14:30 | Break   |
| 14:30 – 16:00 | <p><b>Electricity governance and planning for resilience</b></p> <p>What research is needed on governance mechanisms that can improve energy resilience at different scales? How do these map onto different electricity system configurations (grid, mini-grid and standalone systems)?</p> <p>Chair: Simon Trace, Oxford Policy Management</p> <p>Panellists:</p> <ol style="list-style-type: none"> <li>1. Anne Nyambane, Chatham House</li> <li>2. Ed Brown, Loughborough University</li> <li>3. Ryan Hogarth, Oxford Policy Management</li> <li>4. Vanesa Castan Broto, University of Sheffield</li> </ol> |
| 16:00 – 16:15 | Break   |
| 16:15 – 17:00 | <p>Small group &amp; open discussion: What major research questions are emerging from our discussions? What opportunities are there for collaboration over the next 6 months?</p> <p>Chair: Long Seng To, Loughborough University</p>   |

## 6.2 UK Workshop Participant List

| <b>Name</b>             | <b>Institution</b>              | <b>Country</b> |
|-------------------------|---------------------------------|----------------|
| 1. Andrew Scott         | Overseas Development Institute  | UK             |
| 2. Anh Tran             | Coventry University             | UK             |
| 3. Anne Nyambane        | Chatham House                   | UK             |
| 4. Ed Brown             | Loughborough University         | UK             |
| 5. Jon Lane             | Carbon Trust                    | UK             |
| 6. Liz Hooper           | Practical Action                | UK             |
| 7. Long Seng To         | Loughborough University         | UK             |
| 8. Nick Spicer          | Team Rubicon                    | UK             |
| 9. Ryan Hogarth         | Oxford Policy Management        | UK             |
| 10. Simon Trace         | Oxford Policy Management        | UK             |
| 11. Tami Bond           | University of Illinois          | USA            |
| 12. Vanesa Castan Broto | University of Sheffield         | UK             |
| 13. Veronika Dvorakova  | Oxford Policy Management        | UK             |
| 14. Yetunde Abdul       | Building Research Establishment | UK             |
| 15. Xinfang Wang        | University of Birmingham        | UK             |

### 6.3 Nepal Workshop Agenda (11/02/2019)

|               |   |
|---------------|---|
| 08:30 – 09:30 | Breakfast   |
| 09:30 – 10:30 | Welcome & introductions – Simon Trace, Oxford Policy Management<br>Overview of project & agenda - Long Seng To, Loughborough University   |
| 10:30 – 10:45 | Break   |
| 10:45 – 12:15 | <p><b>The energy &amp; resilience situation in South Asia</b><br/>What are the most critical energy services to continue operating for communities most vulnerable to disasters? What are the major vulnerabilities in the electricity system (do grid, mini-grid and standalone systems differ)? How does energy fit into wider understandings of resilience?</p> <p>Chair: Niraj Subedi, KfW Development Bank, Nepal<br/>Panellists:</p> <ol style="list-style-type: none"> <li>1. Ayesha Bhatnagar, Development Alternatives, India</li> <li>2. Enamul Karim Pavel, Infrastructure Development Company Limited, Bangladesh</li> <li>3. Wathsala Herath, Energy Forum, Sri Lanka</li> <li>4. Anil Pokhrel, Plan8 Risk Consulting, Nepal</li> </ol>  |
| 12:15 - 13:15 | Lunch   |
| 13:15 – 14:45 | <p><b>Identifying research needs: disaster response &amp; recovery</b><br/>How do households and communities respond and recover from disasters in terms of energy services? What research is needed on the role of energy in response to disaster and recovery? Do on-grid, mini-grid and standalone systems offer different solutions?</p> <p>Chair: Simon Trace, Oxford Policy Management<br/>Panellists:</p> <ol style="list-style-type: none"> <li>1. Anu Prasai Lama &amp; Minar Thapa Magar, Housing Recovery and Reconstruction Platform, Nepal</li> <li>2. Anukriti Goyal, SELCO Foundation, India</li> <li>3. Dipendra Bhattarai, International Centre for Integrated Mountain Development, Nepal</li> <li>4. Ram Bahadur Ghimire &amp; Shyamala Nepal, National Association of Community Electricity Users Nepal</li> <li>5. Netaji Basumatary, Indo - Global Social Service Society, India</li> <li>6. Pooja Sharma, Practical Action, Nepal</li> <li>7. Sambriddhi Kharel, Social Science Baha Kathmandu, Nepal</li> </ol> |
| 14:15 – 14:30 | Break   |
| 14:30 – 16:00 | <p><b>Identifying research needs: disaster prevention &amp; preparation</b><br/>What research is needed on the role of energy in preventing and preparing for disasters at different scales? How can we build more resilient energy systems? What is the role of different actors, e.g. community, private sector, government?</p> <p>Chair: Ajaya Dixit, Institute for Social and Environmental Transition, Nepal<br/>Panellists:</p> <ol style="list-style-type: none"> <li>1. Dilip Gautam, Water &amp; Environment Engineering Services, Nepal</li> <li>2. Dipti Vaghela, Hydro Empowerment Network, Myanmar</li> <li>3. Govinda Prasad Devkota, People, Energy &amp; Environment Development Association, Nepal</li> <li>4. Kirty Tiwari, National Society for Earthquake Technology, Nepal</li> <li>5. Mukesh Ghimire, Alternative Energy Promotion Centre, Nepal</li> </ol>  |
| 16:00 – 16:15 | Break   |
| 16:15 – 17:00 | <p>Group discussion: What are the research questions emerging from our discussions would have the greatest impact? What similarities and differences are there across countries? What opportunities are there for collaboration over the next 6 months?</p> <p>Chair: Long Seng To, Loughborough University</p>   |

## 6.4 Nepal Workshop Participant List

| <b>Name</b>                | <b>Institution</b>   | <b>Country</b> |
|----------------------------|--|----------------|
| 1. Ajaya Dixit             | Institute for Social and Environmental Transition (ISET-Nepal) | Nepal          |
| 2. Anil Pokhrel            | Plan8 Risk Consulting  | Nepal          |
| 3. Anu Prasai Lama         | Housing Recovery and Reconstruction Platform                   | Nepal          |
| 4. Anukriti Goyal          | SELCO Foundation   | India          |
| 5. Ayesha Bhatnagar        | Development Alternatives                                       | India          |
| 6. Dilip Gautam            | Water & Environment Engineering Services                       | Nepal          |
| 7. Dinanath Bhandari       | Oxford Policy Management                                       | Nepal          |
| 8. Dipendra Bhattarai      | International Centre for Integrated Mountain Development       | Nepal          |
| 9. Dipti Vaghela           | Hydro Empowerment Network                                      | Myanmar        |
| 10. Enamul Karim Pavel     | Infrastructure Development Company Ltd (IDCOL)                 | Bangladesh     |
| 11. Govinda Prasad Devkota | People, Energy & Environment Development Association           | Nepal          |
| 12. Kirty Tiwari           | National Society for Earthquake Technology                     | Nepal          |
| 13. Long Seng To           | Loughborough University  | UK             |
| 14. Louise Reardon         | University of Birmingham                                       | UK             |
| 15. Minar Thapa Magar      | Housing Recovery and Reconstruction Platform                   | Nepal          |
| 16. Mukesh Ghimire         | Alternative Energy Promotion Centre                            | Nepal          |
| 17. Netaji Basumatary      | Indo-Global Social Service Society                             | India          |
| 18. Niraj Subedi           | KfW Development Bank   | Nepal          |
| 19. Pooja Sharma           | Practical Action   | Nepal          |
| 20. Ram Bahadur Ghimire    | National Association of Community Electricity Users Nepal      | Nepal          |
| 21. Sambriddhi Kharel      | Social Science Baha Kathmandu                                  | Nepal          |
| 22. Shyamala Nepal         | National Association of Community Electricity Users Nepal      | Nepal          |
| 23. Simon Trace            | Oxford Policy Management                                       | UK             |
| 24. Wathsala Herath        | Energy Forum   | Sri Lanka      |
| 25. Xinfang Wang           | University of Birmingham                                       | UK             |

## 6.5 Malawi Workshop Agenda (24/04/2019)

| Time   | Session Chair                                  | Activity             | Theme/Topic  | Responsible  |
|--|--|----------------------|--|--|
| 08:30 - 09:00  | Julius Ng'oma<br>(CISONECC)                    | Registration         | Opening Ceremony   | Vincent Mwale - MZUNI  |
| 09:00 - 09:15  |  | Self - Introductions |  | All  |
| 09:15 - 09:30  |  | Opening Speech       |  | Assoc. Prof. Dr Wales Singini - Director of Research, Mzuzu University   |
| <b>GROUP PHOTO/Christopher Hara<br/>AND HEALTH BREAK</b> |  |                      |  |  |
| 10:00 - 10:15  | Dr Michael<br>Zimba (Mzuzu<br>University)      | Key Note Speech      | Disasters and Electricity Generation in Malawi   | Mr Joseph Kalowekamo - Director of Energy Affairs  |
| 10:15 - 10:30  |  | Presentation         | Energy Systems Delivery and Resilience   | Dr Collen Zalengera - Mzuzu University   |
| 10:30 - 10:45  |  | Presentation         | How Communities Access Energy After Disasters: The Case of Nepal   | Dr Long Seng To - Loughborough University  |
| 10:45 - 11:00  |  | Presentation         | The role of mini-grids on enhancing Community Resilience   | Admore Chiumia - Practical Action  |
| 11:00 - 12:00  |  | Panel Discussion     | How does Energy Systems Enhance Community Resilience; What are the synergies and challenges for grid based and decentralized energy systems. | Edgar Bayani - Community Energy Malawi<br>Barbra Banda – National Association of Business Women<br>Jones Ntaukira – Zuwa Energy<br>Eng. Welton Saiwa – Former Director of Renewable Energy and Electricity at MERA |
| <b>LUNCH BREAK</b>                                       |  |                      |  |  |
| 13:15 - 13:30  | Dr Esther Phiri<br>(The Malawi<br>Polytechnic) | Presentation         | Managing the Impacts of Natural Disasters on Electricity Generation in Malawi  | Rex Muhome   |
| 13:30 - 13:45  |  | Presentation         | Managing the Impacts of Natural Disasters on Energy Systems- The case of Idai Cyclone in Mozambique  | Fabio Buque  |
| 14:45 - 14:00  |  | Presentation         | Electricity governance and planning for Resilience   | Eng. Welton Saiwa - Former MERA Director of Electricity and Renewable Energy   |

|                     |                |                    |  |  |
|---------------------|----------------|--------------------|--|--|
| 14:00 - 14:45       |                | Panel Discussion   | What Research and Actions are needed on delivery and governance of grid-based and decentralized energy systems to enhance community and energy resilience  | Emmanuel Mjimapemba - Programme Manager, Increasing Access to Clean and Affordable Energy<br><br>Dr Hazel Kwaramba - Zeipnet<br><br>Dr Isaac Simate – University of Zambia |
| <b>HEALTH BREAK</b> |                |                    |  |  |
| 15:00 - 15:15       | Jiska De Groot | Presentation       | Remote Monitoring for (Renewable Energy Systems)   | Mayamiko Nkoloma - IMOSys Limited  |
| 15:15 - 15:45       |                | Plenary Discussion | What Research and Actions are needed to enhance resilience of energy systems to disasters? How is energy systems resilience linked to community resilience? Who are the stakeholders and what is their role in delivering resilient energy systems | All  |
| 15:45 - 16:30       |                | Plenary            | Prioritizing Research Actions on Energy and Community Resilience   | Eng. Dr Collen Zalengera-Mzuzu University  |
| 16:30 - 16:40       |                | Closing            | Closing Remarks  | Assoc. Prof. Dr Wales Singini – Mzuzu University   |

## 6.6 Malawi Workshop Participant List

| <b>Name of Delegate</b> | <b>Institution</b>                                       | <b>Country</b> |
|-------------------------|--|----------------|
| 1. Admore Chiumia       | Practical Action   | Malawi         |
| 2. Adwin Mtembezeka     | -  | Malawi         |
| 3. Barbra Banda         | National Association of Business Women                   | Malawi         |
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| 12. Elizabeth Banda     | United Purpose   | Malawi         |
| 13. Emmanuel Mjimapemba | United Nations Development Programme – Malawi            | Malawi         |
| 14. Esther Phiri        | Malawi Polytechnic                                       | Malawi         |
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| 18. Hazel Kwaramba      | Zimbabwe Evidence Informed Policy Network (ZeipNET)      | Zimbabwe       |
| 19. Ian Dodkins         | VSO Malawi   | Malawi         |
| 20. Isaac Chitedze      | Mzuzu University   | Malawi         |
| 21. Isaac Fandika       | Kasinthula Research                                      | Malawi         |
| 22. Isaac Simate        | University of Zambia                                     | Zambia         |
| 23. Jiska De Groot      | Energy Research Centre                                   | South Africa   |
| 24. Jones Ntaukira      | Zuwa Energy  | Malawi         |
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| 29. Lusungu Chinombo    | Christian Aid  | Malawi         |
| 30. Martin Chizalena    | Malawi Institution of Engineers                          | Malawi         |
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| 40. William Mota        | Mzuzu University   | Malawi         |

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The Low Carbon Energy for Development Network (LCEDN) brings together researchers, policy-makers, practitioners and the private sector from across the United Kingdom (and indeed the rest of the world) to expand research capacity around low-carbon energy development in the Global South. The LCEDN was launched in January 2012 centred around hubs at the Durham Energy Institute and Loughborough University.

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