Institution: University of Sussex		
Unit of Assessment: 14 – Geography and Environmental Studies		
Title of case study: Redesigning global climate technology policy and funding to meet the needs of low- and middle-income countries		
Period when the underpinning research was undertaken: 2012 – 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): David Ockwell	**Role(s) (e.g. job title):** Professor of Geography	**Period(s) employed by submitting HEI:** 2006-present
Period when the claimed impact occurred: 2015 – 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

Global climate technology policies and funding are widely viewed as having historically failed to meet the needs of low- and middle-income countries. Sussex research demonstrated this was due to failures to understand the importance of: building innovation systems around climate technologies; aligning technologies with the self-defined needs of poor individuals or communities; and responding to the political realities where interventions are made. Sussex researchers then designed a new policy approach that is able to deliver this. Globally, the policy approach has: informed the United Nations Framework Convention on Climate Change's (UNFCCC) review and future direction of its climate technology policy; been adopted as a funding mechanism by the USD10,300,000,000 Green Climate Fund (GCF); and informed the World Bank's review and reshaping of their climate technology approach in developing countries. At a continental level, the policy approach has been adopted by the African Union to train African government and intergovernmental policymakers in leveraging international climate funding. At a national level, the policy approach is being implemented by 16 policy organisations from 9 different African countries, framing national policy and practice, and underpinning proposals for GCF funding. To date, these GCF proposals have resulted in USD9,994,500 of GCF funding being awarded to Burundi (leveraging USD21,727,000 in match funding, with an estimated 573,500 beneficiaries). Kenya also has two proposals at advanced stages of GCF approval, worth a total of USD20,000,000.

2. Underpinning research

Facilitating the transfer of climate technologies (technologies that assist in mitigating or adapting to climate change, like low-carbon energy technologies, or drought-resistant farming technologies) to developing countries has been a core aim of global climate policy for the last three decades. It is, however, widely viewed to have failed in practice, benefiting only richer developing countries and international companies who supply technologies to them. For example, under the Clean Development Mechanism – one of the core global policy mechanisms that fund climate technology transfer to date – China accrued around 60% of total investment and India around 11%. Africa as a whole, including South Africa and the relatively richer countries of Northern Africa, accrued only 3% across the whole continent [R1].

Based on a combination of long-term empirical analyses in Sub-Saharan Africa [R2, R3], India and China and inter-disciplinary conceptual work [developed over a decade and summarised in R1], Sussex research has both demonstrated how climate technologies can be successfully transferred, and designed a new policy approach that can make this happen [R4]. The research focussed mostly on energy technologies, but used this to develop conceptual and practical policy insights of relevance to climate technologies more broadly. The key research insights that underpin this policy approach are:

1. Traditional climate technology policy only addresses two dimensions of the problem, namely technology and finance, reflected in a past dominance of engineering and economics in the technology and development literature [R1, R3]. This ignores the importance of attending to socio-cultural [R5] and political [R2] dimensions that help or hinder technology transfer and the need to build indigenous innovation systems in developing countries to foster broader change around new technologies [R1, R4]. Even where policy interventions have focused purely on the financial dimension, Sussex research has shown that aligning financial approaches with existing socio-cultural practices of paying for technology services (e.g. light) amongst poor individuals and communities can explain the success and longevity of initiatives [R5].

2. The research has highlighted the relevance of insights from the broader body of literature on national systems of innovation and applied this to show that, where climate technologies are successfully transferred, it is due to long-term processes of building indigenous technological capabilities and strengthening the systemic contexts through which sustained uptake of new technologies can be nurtured [R1, R4]. National systems of innovation provide the context within which all processes of technology development, transfer and uptake occur. They encompass the network of actors (e.g. firms, universities, research institutes, government departments, NGOs, suppliers, consumers, etc.) within which innovation occurs, and the strength and nature of the relationships between them. In developing countries, particularly around newer climate technologies, these systems are often either weak or non-existent, and need to be actively nurtured [R1, R4].

3. Importantly, by combining a 'national systems of innovation' theory perspective with conceptual insights from the strategic niche management literature, the research demonstrated that the 'national systems of innovation' perspective needed to be extended to also attend to the social contexts, and the political/economic impediments to new technology uptake [R1, R2]. This led to a new theoretical contribution, based on understanding successful climate technology transfer as requiring the development of 'socio-technical innovation system building' in developing countries [R1].

The researchers then used this understanding of requirements for 'socio-technical innovation system building', grounded in new empirical analysis in Sub-Saharan Africa [R2, R3] to formulate a concrete policy approach. The result was the 'Climate Relevant Innovation-system Builders' (CRIBs) policy approach [R4]. This asserted that successful climate technology transfer requires key actors (individuals and institutions with knowledge of local contexts and people's needs), to focus on actively building the innovation systems that provide the context within which new technologies are adopted, along the whole supply chain from importers, to suppliers, to vendors, to consumers. This should be done in ways that are aligned with – or can evolve – poor people's existing socio-technical practices [R1, R4, R5] and existing political interests [R4]. This is supplemented by Sussex research that develops a systematic approach to developing collaborative R&D efforts in relation to climate technologies. It created a taxonomic approach for analysing collaborative designs and provided policymakers with guidance on how to configure R&D collaborations to meet climate technology needs [R6].

The research is based on a long-term intellectual collaboration between Ockwell and Byrne (UoA 17 – Business and Management Studies) that began in 2009, with Ockwell originally focussing more on aspects of the innovation studies and energy geographies literatures in the context of climate technology transfer and Byrne focussing more on the strategic niche management literature. Since that time, the new empirical, theoretical and policy insights described above represent joint intellectual contributions that have emerged from over a decade of close collaboration, joint thinking and research, including co-convening the energy & climate research domain of the £9m ESRC STEPS Centre [G1].

3. References to the research

R1. Ockwell, David and Byrne, Rob (2016) *Sustainable energy for all: innovation, technology and pro-poor green transformations.* Routledge, Abingdon, 230 pages. Submitted to REF2. https://doi.org/10.4324/9781315621623 Described by one reviewer, Prof Marcus Power, Professor of Geography at University of Durham, as "*without doubt the most critical and insightful treatment of the subject to date.*"

R2. Byrne, Rob, Mbeva, Kennedy and Ockwell, David (2018) A political economy of niche-building: neoliberal-developmental encounters in photovoltaic electrification in Kenya*. Energy Research & Social Science*, 44: 6-16 https://doi.org/10.1016/j.erss.2018.03.028

R3. Ockwell, David, Byrne, Rob, Hansen, Ulrich Elmer, Haselip, James and Nygaard, Ivan (2018) The uptake and diffusion of solar power in Africa: socio-cultural and political insights on a rapidly emerging socio-technical transition*. Energy Research & Social Science*, 44: 122-129 https://doi.org/10.1016/j.erss.2018.04.033 (introductory article to a special issue showcasing contemporary work in the recent "socio-cultural turn" [see R1] in the energy and development literature)

R4. Ockwell, David and Byrne, Rob (2016) Improving technology transfer through national systems of innovation: climate relevant innovation-system builders (CRIBs). *Climate Policy*, 16 (7): 836-854 https://doi.org/10.1080/14693062.2015.1052958
R5. Rolffs, Paula, Ockwell, David and Byrne, Rob (2015) Beyond technology and finance: pay-as-you-go sustainable energy access and theories of social change. *Environment and Planning A*, 47 (12): 2609-2627 http://dx.doi.org/10.1177/0308518X15615368
R6. Ockwell, David, Sagar, Ambuj and de Coninck, Heleen (2014) *Collaborative research and development (R&D) for climate technology transfer and uptake in developing countries: Towards a needs driven approach.* Climatic Change, 131 (3). pp. 401-415 http://dx.doi.org/10.1007/s10584-014-1123-2

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G1. ESRC via the £9m STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre, 2006-11, 2011-17, 2018-21 (Ockwell & Byrne co-convene the 'Energy & Climate Change' domain); G2. DFID Climate and Development Knowledge Network, £500k, 2012-14 (competitive 5.6% success rate) (PI: Ockwell, Co-I: Byrne); G3. International Social Science Council, £650,000 (Co-I: Ockwell; 0.6% success rate).

4. Details of the impact

The Sussex research that led to the CRIBs policy approach has had significant impact on policy and funding at global, continental and national levels.

Global climate policy impact

The UN Framework Convention on Climate Change's (UNFCCC) Technology Executive Committee – the political body responsible for implementing climate technology policy under the UNFCCC and the Paris Climate Agreement – used the CRIBs approach to evaluate their existing climate technology policy and inform their agreed way forward to improving it [S1]. In particular, they adopted the CRIBs recommendation that future technology interventions under the UNFCCC act as 'innovation system builders' [S1]. The resulting recommendations were officially adopted by the UNFCCC's Subsidiary Body for Implementation [S1, S2 p.12,16,18, 20,21]. The significance of this is emphasised by [text removed for publication] the UNFCCC Secretariat who acknowledged that the Sussex research *"has been adopted as a key concept in the technology development and transfer work and advice of the UNFCCC Technology Mechanism… It was also relevant in the context of the evaluation of the GEF Poznan strategic programme on technology transfer (PSP) undertaken in 2018/19, as the UNFCCC Climate Technology Centre and Network and the PSP pilot regional centres operate as new climate innovation system builders, that connect actors and networks, provide technical and policy support and mobilize climate finance for climate technology projects"* [S3].

One mode through which the UNFCCC recommends climate technology transfer be achieved is via collaborative research, development and deployment (where Sussex research has contributed in the past, [R6]). The UNFCCC used CRIBs to frame their assessment of how to fund collaborative research and development through the Green Climate Fund (GCF). The GCF is a USD10,300,000,000 fund set up by the UNFCCC to fund global efforts towards attaining international climate change goals in developing countries. The GCF board acknowledged CRIBs as a policy approach and agreed to fund its implementation. It also used the analytical categories set out in Sussex's CRIBs paper [R4] to frame how the GCF would target its funding [S4, S5]. This included whole sections of these GCF policy documents [S4, S5, see annotated pdfs] that attend to "building innovation systems' and "understand[ing] and respond[ing] to context-specific conditions and needs" in recipient countries, as per the CRIBs paper [R4]. The policy documents [S4 p3-4, S5 p16-17 & 32] also directly cite the CRIBs paper and mention the CRIBs approach multiple times. [text removed for publication], UNFCCC Secretariat, confirms "*This [the CRIBs] approach was central in advising the Green Climate Fund in 2018*" [S3].

Sussex's CRIBs work was also used to inform a change in direction in the World Bank's Climate Technology Programme. This Programme originally focussed exclusively on traditional mechanisms, such as supporting entrepreneurs and business incubation, but insights from CRIBs introduced the value of building innovation systems to achieve broader change. [text removed for publication] the World Bank confirmed: *"Evidence, insights and recommendations from David Ockwell and Robert Byrne's publications on Climate-Relevant Innovation-systems*

Builders were valuable inputs to the strategy of the World Bank infoDev Climate Technology Program and to the development of its program activities. The publications provided a strong policy rationale and a convincing practical framework for the role of institutions in building innovation systems that advance climate technology goals in developing countries. The publications advance unique ideas that cannot be found elsewhere in the literature and therefore were a significant resource for the Climate Technology Program." [S6]. As a result, the programme now includes "market ecosystem creation" as the first of its five core activities [S11].

Continental-level African climate policy impact

In the light of difficulties African countries have had to date in leveraging international climate finance, the African Union (AU) recognised the Sussex CRIBs approach as an opportunity for African countries to improve access to GCF funding. They therefore commissioned Sussex's key research partners in Africa (the African Centre for Technology Studies, ACTS, which hosts the Africa Hub of the ESRC STEPS Centre's Global Sustainability Consortium, convened by Ockwell and Byrne) to provide CRIBs training to 41 African and international climate policymakers from 18 different countries [S7] (https://www.acts-net.org/cribs). The training focussed on equipping participants with the necessary knowledge and capacity to advise their governments on using the CRIBs approach to leverage climate finance via the GCF, and use CRIBs to improve the implementation of climate technology policy in their respective countries.

18 different African countries were represented at the AU training event, sometimes with several delegates from each, including representation of: 14 different African government ministries; four intergovernmental organisations, including the AU, World Bank, and African Development Bank, and 16 organisations with formal roles in advising and implementing national climate policy in their constituent countries [see participant list in S7]. [text removed for publication], African Union concluded that "*CRIBs presents a paradigm shift for the participants in these processes as articulated in most of their comments in the evaluation after the meeting [AU CRIBs training event]. This methodology will open gateways for easy access to climate funds. The African Union continues to get more requests for continuation of similar trainings in different regions of the continent."* [S7, S8].

[text removed for publication] also asserts that the AU CRIBs training "*triggered the development of the African Union Green Innovation Framework for the continent*" [S8] which aims to help AU member countries' transition to green economies for sustainable development in line with AU's "Agenda 2063: The Africa We Want" ("*the continent's strategic framework that aims to deliver on its goal for inclusive and sustainable development"* [S9b]). The AU Green Innovation Framework, which builds directly on the CRIBS approach, is now complete with public launch expected in early 2021 (having been delayed by COVID-19) [S9a].

National-level African climate policy impact

At a national level, as a result of the AU-commissioned CRIBs training, and two further focussed training and capacity-building programmes run by Sussex with ACTS, 16 policy organisations from nine different countries are now in the process of either developing funding proposals to the GCF to implement CRIBs in their countries, or using the CRIBs approach to inform their climate policy-making and implementation processes [S7]. In both Kenya and Burundi, CRIBs-based GCF funding proposals have already been submitted [S10]. To date, this has resulted in USD9,994,500 in GCF funding being awarded to Burundi (leveraging USD21,727,000 in match funding, with an estimated 573,500 beneficiaries) [S12a & b]. Kenya also has two proposals at advanced stages of approval, worth a total of USD20,000,000 [S12a]. This national-level uptake of the CRIBs approach represents a significant shift in emphasis towards focussing policy and practice on building innovation systems around climate technologies based on understanding the context-specific needs and political realities of different countries and people therein. Some examples are included below (with further examples from Ghana, Egypt, Tanzania, Zimbabwe, Botswana, Nigeria and Malawi available in S7).

In Kenya, the National Environment Trust Fund (NETFUND) supports implementation of the AU's action plans and is designated by the Ministry of Environment to apply for GCF funding. The research director of NETFUND has adopted the CRIBs approach in all programme design: *"we have adopted this as the approach in developing ministerial projects and programmes. So far we have developed 12 programmes under this approach and they are under consideration*

for funding within government budgets… One of the concepts… was shared with GCF and they have sent back very positive comments and also ideas on how to improve on it. We intend to pursue this concept under the [GCF's] simplified approval process." [S7, p13]. This funding proposal has since been submitted and is currently under its second round of review by the GCF; initial GCF comments having been very positive, leading to a request for revision and resubmission [S10]. Similarly, Dr Kelvin Khisa, Head of the Kenya Industrial Research and Development Institute (a state corporation under the Kenyan Ministry of Industry, Trade and Cooperatives), states that: *"We are currently developing a GCF readiness proposal for Kenya on the development of energy efficiency regulations following the 4 CRIBs goals"* [S7, p16].

Another example is the work of the Ministry of Water and Environment in Uganda. *"At the Ministry of Water and Environment, we have really made progress after the CRIBS training and we have changed the way we think in terms of applying for GCF and AF [UNFCCC Adaptation Fund] funds. The theory of change that the CRIBs approach advocates for has improved our skills in writing bankable proposals. I and my team are currently building on the knowledge I attained from the training to develop GCF and AF fundable proposals for my Ministry. This has been further instigated by the fact that the Ministry is in the process of being accredited as an implementing entity for both GCF and AF",* Mildred Namwiira, economist at the Ministry of Water and Environment, Uganda [S7, p15].

5. Sources to corroborate the impact

S1. Email testimonial from [text removed for publication], asserting the CRIBs approach was the basis for the review and subsequent recommendations, adopted under the UNFCCC, for improving climate technology policy under the UNFCCC
S2. UNFCCC policy document which, based on the CRIBs approach, frames future climate technology interventions under the UNFCCC as "innovation system builders" https://undocs.org/en/FCCC/SBI/2019/7 – annotated PDF also supplied.
S3. Email testimonial from UNFCCC Secretariat [text removed for publication] on the significance of the CRIBs approach to UNFCCC technology policy and GCF climate technology funding GCF
S4. GCF policy document citing CRIBs as a mechanism through which climate technology research, development and deployment in developing countries will be funded and using the CRIBs approach to frame its analysis https://www.greenclimate.fund/document/gcf-b18-12 – annotated PDF also supplied.
S5. GCF policy document (addendum to S4], also citing CRIBs https://www.greenclimate.fund/document/gcf-b18-12-add01 – annotated PDF also supplied.
S6. Email testimony from [text removed for publication] the World Bank
S7. Evaluation report on African Union funded training on Climate Relevant Innovation-system Builders (CRIBs) approach for accessing GCF funding and improving climate technology policy and practice https://www.arin-africa.org/wp-content/uploads/2020/11/AU-CRIBs-training-evaluation-report-final.pdf
S8. Email testimony from [text removed for publication] African Union
S9. a) Email confirmation that African Union Green Innovation Framework uses CRIBs and is to be launched in the first half of 2021, [text removed for publication] and b) https://www.ash-net.org/dr-joanes-atela-appointed-to-a-high-level-panel-for-the-african-union-green-innovation-framework-au-gif/ confirms AU-GIF and role of CRIBs
S10. Email confirmation from [text removed for publication] confirming CRIBs funding proposals for Kenya & Burundi submitted to GCF
S11. World Bank InfoDev Climate Technology programme https://www.infodev.org/climate
S12. a) Email corroboration [text removed for publication] confirming CRIBs funding awarded to Burundi and in final stage of review for Kenya; b) GCF website with Burundi project details https://www.greenclimate.fund/project/sap017