Tyndall°Centre
for Climate Change Research

The Green Climate Fund and Lessons from other Global Funds' Experience

David Potten

June 2013

Tyndall Centre for Climate Change Research

Working Paper 158

The Green Climate Fund and Lessons from other Global Funds' Experience

David Potten - *University of East Anglia*
davidpotten@compuserve.com

David Potten has worked for over 40 years in international development for NGOs, developing country governments, in the private sector, with UNDP and for the World Bank, where he retired as Senior Policy Adviser on Trust Fund Management. He is now a Research Fellow at the UEA School of International Development and a consultant on trust fund issues.

Tyndall Working Paper 158, June 2013

The Green Climate Fund and Lessons from other Global Funds' Experience

David Potten (davidpotten@compuserve.com)

June 2013

Overview

The Green Climate Fund (GCF) was first proposed at the fifteenth conference of the parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen in 2009 but was described in May 2012 by a participant in the Bonn meetings preparing for the eighteenth conference in Doha as "an empty shell". The design of the fund appears to reflect many lessons from the experience of other funds, but the broader strategic foundation may be flawed. If the GCF is to offer any prospect of meeting its original objectives (see Section 1) it will be necessary to ensure that (a) the design will allow clear linkage between activities financed by the fund and the expected results of these activities, (b) the governance meets the needs of both developing and developed country partners, (c) there is a flexible approach to funding that reflects varying project requirements and encourages donor contributions, (d) that the Fund is designed to be cost-effective and (e) that the strategic approach does not result in further fragmentation of an already congested climate change aid framework.

This paper presents a brief summary of the proposed fund and its history through to May 2013. Some of the key lessons learned from other Global Funds are summarized and the extent to which the current approach to the GCF reflects these is analyzed. The final section examines what may be required if the GCF is to offer a prospect of meeting the high expectations generated in Copenhagen in 2009.

1 The Green Climate Fund (GCF)

In 2009 at the fifteenth conference of the parties to the United Nations Framework Convention on Climate Change in Copenhagen (COP 15) it was decided:

"… that the **Copenhagen Green Climate Fund** shall be established as an operating entity of the financial mechanism of the Convention to support projects, programmes, policies and other activities in developing countries related to mitigation including REDD-plus, adaptation, capacity-building, technology development and transfer."

"New multilateral funding for adaptation will be delivered through effective and efficient fund arrangements, with a governance structure providing for equal representation of developed and developing countries. A significant portion of such funding should flow through the Copenhagen Green Climate Fund."[1]

Since 2009 there have been numerous meetings at which the objectives and design of the GCF have been discussed. At the Cancun meeting (COP 16) the proposal for a "Green Climate Fund," was

[1] From the Copenhagen Accord, para 8: http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

endorsed and it was proposed that the fund be worth $100 billion a year by 2020, to assist poorer countries in financing emission reductions and adaptation. There was no agreement on how the $100 billion a year for the GCF would be raised. There was a much more detailed discussion at the Durban Conference of the Parties (COP 17) in 2011, prior to which a substantial draft design proposal had been drafted. The process of proposal preparation had clarified some of the areas where parties were not united and these were not resolved in Durban. These included issues related to fund governance, sourcing of funds and disbursement of funds.[2]

In May 2012 in Bonn there were further discussions, intended to lay the foundations for COP 18 in Qatar (November/December 2012). The Bonn meetings were not very productive. IISD Reporting Services (May 2012) describes them as being marked by distrust and confusion.

Since May 2012 there has been steady progress towards establishing the GCF (Schalatek *et al*, 2012). A Board has been established and has met three times, in August and October 2012 and in March 2013.[3] Two Co-chairs have been appointed, it has been agreed that the Republic of Korea will host the GCF Secretariat and some progress has been made to develop a "business model framework".[4]

Eleven donors had pledged funding to support the GCF as of end December 2012. A total of US $8.1 million had been pledged of which US $5.7 million had been received. Assuming all pledges are honoured, the funding available will just about cover GCF Secretariat costs to the end of 2013.[5] European donors and the Republic of Korea have been the main sources of funding delivered so far.

The overall UNFCCC negotiating environment is complex and at times seems to deliver limited benefits at high cost.

- At COP 18 in Doha there were 9,000 participants. The "conference" comprised the eighteenth session of the Conference of the Parties (COP 18) to the United Nations Framework Convention on Climate Change and the eighth session of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP 8). The conference also included meetings of five subsidiary bodies: the thirty-seventh sessions of the Subsidiary Body for Scientific and Technological Advice (SBSTA 37) and the Subsidiary Body for Implementation (SBI 37), the second part of the seventeenth session of the *Ad hoc* Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP 17), the second part of the fifteenth session of the *Ad hoc* Working Group on Long-term Cooperative Action under the UNFCCC

---

[2] See Bird *et al*, 2011 for a detailed summary of the key issues
[3] See Press Releases on the GCF website, http://gcfund.net/press.html
[4] GCF Press Release, 26th March 2013, http://www.gcfund.net/fileadmin/00_customer/documents/pdf/GCF_Press_Advisory-26_March.pdf
[5] See Financial Report by the Interim Trustee as of December 31st 2012 submitted to the third meeting of the GCF Board in March 2013. http://www.gcfund.net/fileadmin/00_customer/documents/pdf/B_01_13_Inf_02_Status_of_resources_incl_Trustee_report__final_26Feb13_EDITED.pdf

(AWG-LCA 15) and the second part of the *Ad hoc* Working Group on the Durban Platform for Enhanced Action (ADP 1).[6]

- There has been a proliferation of stakeholder groups at COP meetings. The common simplification that the forums pit developed against developing countries hides the multiplicity of interests, with both the developed and the underdeveloped groups being subdivided into smaller sections with divergent interests. For example, during the final session of the AWG-LCA at Doha separate statements were made on behalf of at least eight separate groupings, the G-77/China, the European Union, the Arab Group, the Environmental Integrity Group (EIG), the Alliance of Small Island States (AOSIS), the Africa Group, the Like-Minded Developing Countries and the Association of Independent Latin American and Caribbean States (AILAC). Groupings that made statements in other meetings at Doha included BASIC (Brazil, South Africa, India and China), the LDCs (Least Developed Countries), the Umbrella Group and the Bolivarian Alliance for the Peoples of our America (ALBA). In addition at some meetings there were statements made by different country groups allying on individual topics as well as individual country statements. [7] One advantage of the diversity of groupings is that it allows all interests to be expressed, and may increase the chances of a final decision being accepted by all parties.
- There is also a proliferation of meetings. The IISD website[8] lists 17 major climate change related international meetings scheduled to take place between COP 18 and COP 19 (Warsaw, November 2013). The clearest evidence of the dysfunctionality of these meetings is that they spend much of their time wrangling over procedural and organisational issues (chairpersons, agendas, terms of reference of the different ad hoc working groups…) rather than matters of substance This was particularly evident at the Bonn conference that preceded Doha [9].

As a result many participants in the conferences have been disappointed at the complexity and glacial pace of progress at these meetings. For example at the closing session of the COP 18 plenary Nauru, for AOSIS, lamented that the adopted package is deficient in terms of mitigation ambition and finance, stating that it "only promises that something might materialize in the future." The Nauru representative lamented that the outcome "provides little more than a gateway to a long path," and warned that if delegates take "a wrong turn in the road, this process will collapse and our nations will disappear."[10]

It is possible that the overall environment for the GCF is so unfavourable that the Fund will never become fully operational, swamped not by its own faults but by the deficiencies of the broader UNFCCC context. However most such initiatives do eventually lead to a result. The Adaptation Fund, for example, took eight years from agreement to its establishment in 2001 to operational status in 2009. This paper therefore takes a positive approach – reviewing lessons from other Global Funds which the GCF can learn from, looking at the design to date to see to what extent these are already being reflected

---

[6] IISD, "Summary of the Doha Climate Change Conference", http://www.iisd.ca/vol12/enb12567e.html
[7] IISD, *op cit*
[8] IISD, *op cit*, list of "Upcoming Meetings"
[9] http://www.iisd.ca/vol12/enb12546e.html - "A Brief Analysis of the Bonn Climate Change Conference"
[10] IISD, Summary of the Doha Climate Change Conference, *op cit*

and concluding with suggestions on the approach which might offer the GCF the greatest opportunities to meet its goals.

2 Learning from Other Global Funds

2.1 Sources of Lessons Learned

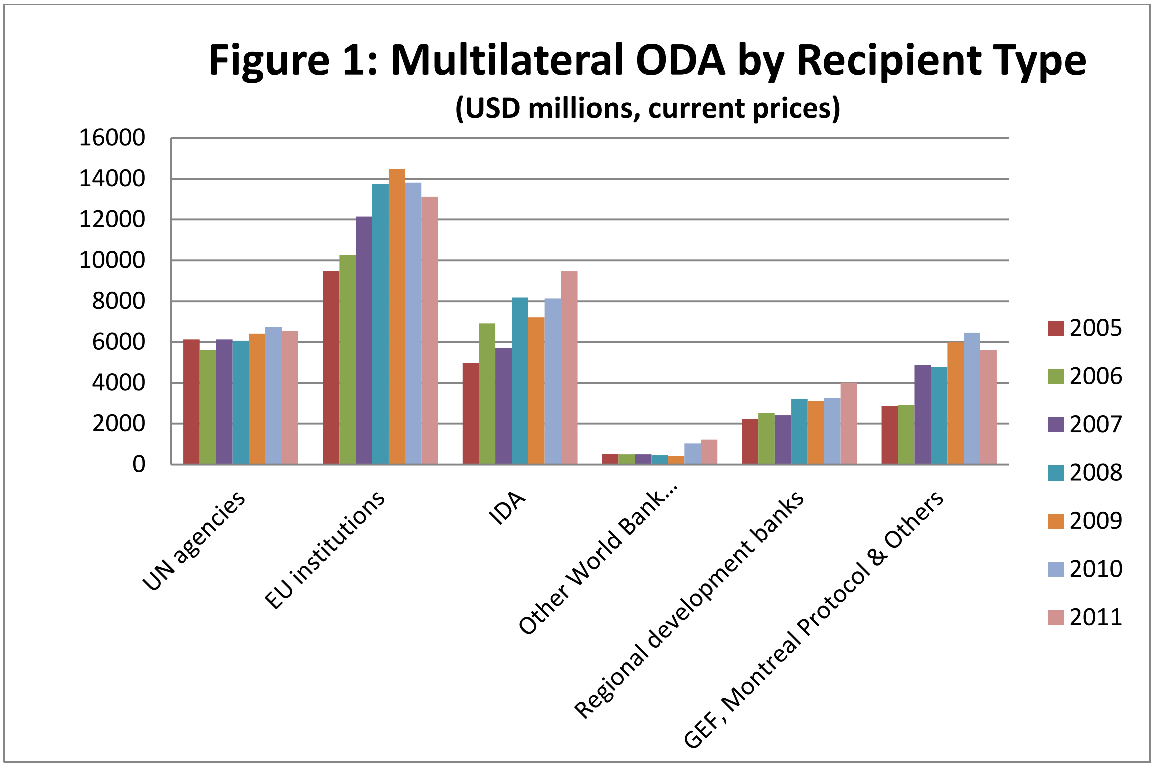
Global Funds are a relatively new feature of the global aid architecture. There is no formal definition of a global fund, and there are a variety of institutional models. The most common model is an autonomous legal entity which manages the fund, but with a separate "trustee" that receives income (grant contributions from donors), invests the funds while they are held and transfers resources to the fund in line with overall governance arrangements. The World Bank is often the trustee, for example for the Climate Investment Funds (CIFs), for the Global Alliance for Vaccines and Immunization (GAVI) and for the Global Fund to fight Aids, Tuberculosis and Malaria (GFATM).

However there are many variants of this model. In some cases the income is partly in the form of loans or other revenue (promissory notes to the International Finance Facility for Immunization (IFFIm), loans to the Climate Investment Funds (CIFs), income from Certified Emission Reductions to the Adaptation Fund). In some the fund is not (or was not originally) an autonomous legal entity (e.g. the Global Environment Fund (GEF), and the Global Partnership for Education (GPE)). The World Bank is not the only organization that acts as a trustee (e.g. the United Nations Environment Programme provides treasury services for the Montreal Protocol). Some Global Funds are managed (wholly or partly) by the same agency that provides trustee services (for example CIFs, GEF, and the Global Fund for Disaster Reduction and Recovery). Some Global Funds have several implementing agencies – often multilateral development banks or UN agencies. The Adaptation Fund (AF) combines the use of multilateral entities and "direct access", allowing accredited National Implementing Entities to apply direct to the fund (Trujillo *et al*, 2013, page 10).

The Global Funds have been receiving an increasing share of multilateral concessional aid. There appears to be a steady shift in the global aid architecture, with the share of resources going to United Nations (UN) agencies falling while the share going to Global Funds is increasing since 2005. Figure 1[11] shows that the contributions to UN agencies (in current prices) remained almost stable between 2005 and 2011, while the greatest growth was in contributions to "GEF, Montreal Protocol and Others" , which includes most of the major Global Funds.

---

[11] The "others" in this figure include 130 international bodies but the totals are dominated by the large Global Funds, such as the AF, CGIAR (Consultative Group for International Agricultural Research), GAVI, GCDT (Global Crop Diversity Trust), GEF, GFATM, IFFIm and PIDG (Private Infrastructure Development Group).



Source: OECD DAC "DAC1 Official and Private Flows" DAC Table 15:
http://www.oecd.org/dac/stats/statisticsonresourceflowstodevelopingcountries.htm

There have been many evaluations of Global Funds. Copies of these are usually available on the individual fund's website. The most valuable however are comparative evaluations of the performance of funds using common methodologies, which allow clear patterns to emerge from the overview. Three substantial comparative evaluations have been made by the World Bank's Independent Evaluation Group (IEG) and by the Governments of the UK (the Department for International Development, DFID) and Australia (the Australian aid agency, AusAID) (AusAID, 2012; DFID, 2011; IEG, 2010). Each one has a somewhat different coverage, reflecting the differing interests of the agencies involved. The IEG is interested in lessons to be learned from Global Funds managed by the World Bank. The bilateral donors are partly interested in seeing to what extent the funds are contributing to achievement of their own development objectives. However these limitations are substantially offset by their strengths as a source of broad lessons learned:

- The three studies use many individual fund-specific evaluations as part of their input;
- They each review a range of funds using common criteria;
- These criteria include many which most – perhaps all - stakeholders would agree are important: delivering results on poverty and sustainable development; contributing to the wider multilateral system; good partnership behavior; cost and value consciousness; transparency and accountability; gender focus; ability to work in fragile states…;

- The two bilateral reviews covered many of the same organizations. Seven Global Funds were included in both reviews[12], with similar, though not identical conclusions;
- These reviews provide a valuable window on what matters to major donors – a vital input when fund design is under consideration, as without the donors the funds would not exist.

In 2010 the World Resources Institute produced a paper based on case studies of ten institutions involved in climate change finance. The authors concluded that the success of future climate finance will depend on finding a new balance of power, responsibility, and accountability in the relationship between contributor and recipient countries and the financial institutions they create and operate (Ballasteros *et al*, 2010).

In 2013 two evaluations of Climate Funds have been published by the Overseas Development Institute (ODI) (Forstater *et al*, 2013 and Trujillo *et al*, 2013). These use an identical methodology, developed by Smita Nakhooda (Nakhooda, 2013) and it is expected that there will be further studies using the same methodology, which will provide a valuable database for understanding lessons learned from climate finance funds.

The following lessons learned draw substantially on these sources, and also on the author's experience in managing a number of global funds between 2004 and 2009 (including the Avian and Human Influenza Trust Fund, the Consultant Trust Fund, the Japanese Social Development Fund and the Japan funded Policy and Human Resources Development Fund) for the World Bank and in evaluations of the impact of these and other funds.

2.2 Lessons Learned

A Focus on Results

Funds that are most highly regarded by evaluators have generally been those which can show a clear link between inputs, outputs and outcomes. This is easier for funds with a clear and narrow focus – for example GFATM's focus on fighting three diseases, Aids, Tuberculosis and Malaria. However it is clear that effective results focus benefits from various approaches:

- Developing a logical and easily understood results framework, showing what the expected relationship is between inputs, outputs , expected outcomes and ultimate impact;
- Developing the results framework collaboratively with as wide a range of stakeholders as possible. This brings in a wide range of perspectives, and it also helps to give the stakeholders an understanding of the results logic;[13]

[12] AF, GAVI, GEF, GFDRR (Global Facility for Disaster Reduction and Recovery) , GFATM, GPE (ex EFA-FTI – Education for All Fast Track Initiative) and UNPF (United Nations Population Fund)

[13] The author found that stakeholder involvement in results framework development helped the fund managers to understand what information the stakeholders needed and the stakeholders to better recognize what could and could not be expected from the fund, given issues of attribution.

- Quantification of outputs, and of outcomes wherever possible. (It is often impossible to plausibly quantify ultimate impact indicators, mainly because the impacts are related to many other activities apart from the fund and it is often impossible to attribute change solely to the fund's activities)[14];
- Breaking a large fund into smaller components. Some Global Funds are fairly tightly focused (e.g. GAVI) but most are quite diverse in their activities and outcome indicators that relate to the overall fund activities become too vague to be useful. GFATM could naturally split its objectives into those related to each of three diseases. The CIFs have benefitted from establishing "sub-Funds" with differing results chains;
- Starting on the results framework at an early stage, while recognizing explicitly that after a few years it may be necessary to review the framework in the light of experience.

B Build on Country Programmes

One of the greatest weaknesses of many Global Funds is the impression they give that decisions on projects to finance are not based on country level priorities. At worst this can mean that approved grants are perceived as supporting "pet" projects prepared by fund staff members with little or no participation by representatives of the "beneficiary" country. At best projects may be proposed by stakeholders in the benefitting country, and be well intended efforts to meet domestic objectives consistent with the fund's aims, but not endorsed by all domestic stakeholders as part of a national programme of activities. As a result there may be limited ownership of the funded activity in-country, low priority activities may be funded leaving high priority projects unfunded, or domestic resources may be diverted from their best use. A well known example is the generous funding provided by GFATM in some countries (such as Burundi) resulting in resources going to the three GFATM target diseases being as high as all other medical expenditures, attracting medical professionals away from broader health service activity and substantially distorting resource availability from any optimal distribution of the overall resources available for health activities (Sridhar *et al*, 2009).

The best answer to this is to require all project proposals to fall within a widely endorsed national plan for the overall sector. This approach worked very well for the Avian and Human Influenza Trust Fund (AHIF). An effective response to the avian influenza threat anywhere required coordinated action by those working in human and veterinary health. In many countries the authorities responsible for human and animal health were not accustomed to working together closely, and the international agencies most concerned (the Food and Agriculture Organisation (FAO), the World Organisation for Animal Health (OiE) and the World Health Organisation (WHO)) were equally unaccustomed to close collaboration. AHIF required that all projects submitted for funding had to be included in a national

[14] As an example of the relationship between inputs, outputs, outcomes and impact, for an improved seed production project inputs might be the funds required to build an improved seed farm. The construction and operation of the farm would be the output. The measurable outcome would be production and distribution of improved seed. The impact would be increased yields and increased incomes but there might be other activities that also contribute to these changes – fertilizer, agricultural extension, irrigation projects etc., and determining what proportion of the impact is directly attributable to the seed production project may be a challenge.

avian influenza action plan, that was approved by the Ministries responsible for human and animal health (and any other key government stakeholders) and that was technically endorsed by FAO, OiE and WHO. This requirement may have slowed the flow of requests for funding, but it successfully encouraged potentially competing institutions to collaborate and often to submit joint requests for funding. It is considered to have resulted in better conceived projects. An independent evaluation of the fund concluded that "AHIF has been a very important stimulus for policy change and for animal - human health integrated cooperation in countries" (Marshang, 2009). A similar approach is used by the Adaptation Fund, which requires extensive stakeholder consultation during the process of accrediting National Implementing Entities entitled to direct access to the AF (Trujillo *et al*, 2013, pages 10 and 11).

C Avoid Fund Proliferation

This is probably the greatest challenge to the GCF. A remarkable number of funds that support climate change related projects already exist. One website lists 26 funds[15], including the GCF. It does not reflect the many individual projects supported by Non Government Organisations (NGOs), bilateral and multilateral donors that have climate change related objectives but do not come from narrowly focused "climate change" funds. In at least one region the volume of resources available for climate change projects already exceeds absorptive capacity. On a recent visit to the Pacific islands the author noted that there were multiple donors chasing the same projects, and that some over-hastily developed projects lacked local ownership and were already failing to deliver on their objectives or were being abandoned. Once the GCF is operational there will be a strong case for reforming or closing down existing funds that can finance the same projects. A paper by Ballasteros *et al* (2010) suggested that in order to generate a greater sense of trust and ownership, backers of existing agencies may have to accept a degree of duplication of existing capacity through the creation of new mechanisms. While this may be politically realistic it would be wasteful and undermine the long term strength of the GCF.

D Balanced Governance

Many existing global funds have governance structures dominated by major donors and the managing organization. This may be seen as simplifying logistics and avoiding conflicts of interest that could arise if the potential recipient governing body members are making judgements on proposed projects that can benefit their own countries. On the other hand this approach to governance excludes the beneficiaries, who are arguably the most important stakeholders. The larger funds have found ways to bring fund beneficiaries into their governance structures without compromising integrity. The Adaptation Fund for example seems to have done this effectively (Forstater *et a*l, 2013). However it must at the same time be recognized that Global Funds would not exist if donor countries do not contribute to their resources, and they will require a reasonable share of governance power.

[15] Heinrich Boll Stiftung, 2012, http://www.climatefundsupdate.org/listing

E Keep Costs Down

Stakeholders, and especially donors, monitor fund operating costs closely, particularly as a proportion of total fund disbursements. Provided the GCF can attract adequate contributions to make it a very large fund economies of scale alone should allow costs to be reasonable. Other factors that would assist include avoiding a high-cost headquarters environment, avoiding inclusion in high-salary employment structures and minimizing the number of bodies involved in fund management and supervision. However lessons from other funds suggest that none of these is critical compared with overall good management. Some of the funds (such as the GEF) that have headquarters in the United States, are closely linked in to international agency salary structures, and use multiple Implementing Agencies[16], nevertheless achieve acceptable cost levels. This is partly because they are able to use existing staff and country offices to support the development and supervision of fund activities. A key factor here is to try not to have both direct access to the fund **and** use of other implementing agencies, in order to avoid duplicating staff involved in developing, supervising and monitoring specific projects.

F Ensure Human Resource (HR) policies and practice are sound

The DFID and AusAID comparative reviews found that a number of institutions had poor HR policies and weak leadership. UN agencies were often the worst performers here. FAO, the United Nations Development Program (UNDP), the United Nations Childrens Fund (UNICEF) all attract critical comment in the AusAID AMA study and several others were noted as being in the process of reforming their HR or leadership systems –e.g. the United Nations Educational, Scientific and Cultural Organisation (UNESCO), UN Habitat, the UN Office for the Coordination of Humanitarian Affairs (UNOCHA), and the UN Office on Drugs and Crime, (UNODC).

G Choose a Good Trustee

Both Donors and Recipients place a high priority on ensuring that Funds are well managed between their contribution and their disbursement. The most successful approach to this has been to initially place funds with a Trustee, which is required to manage and invest the funds until it is formally requested to transfer them to the body or bodies that supervise the actual use of the resources. The World Bank is the most common choice, acting as Trustee for many of the most highly respected Global Funds – the Adaptation Fund, GAVI, GEF and GFATM for example. However it is not the only well regarded Trustee. The UN Environment Program (UNEP) is the Trustee for the Montreal Protocol, and the AusAID AMA is positive about its performance.

H Establish a clear logic for Resource Allocation

Some Global Funds appear to lose their way when it comes to overall resource allocation. This can result from various influences:

---

[16] GEF had 10 "Agencies" as of May 2013, responsible for creating project proposals and managing GEF projects – see GEF website: http://www.thegef.org/gef/gef_agencies

- Donors may earmark funds for specific regions, countries or types of activity. These earmarks ensure that the donors' contributions are aligned with their own priorities, but can substantially skew overall resources away from logical allocation. In the case of AHIF several donors wished to focus their resources on East Asia, where the avian influenza risk was highest. The overall result was that AHIF was able to support any project that emerged in Asia, whereas it was extremely short of resources for Africa and other areas where there was greater unmet need for assistance[17] .
- Projects may be approved on a "first come first served" basis, without a broader view of overall allocation by country, region or sub-activity. Each individual project may be well-prepared and fully endorsed by the recipient country, but the final result may be that resources go to those who are best at project preparation rather than to those with the greatest need. (This was the case for both AHIF and the AF. In both cases the pressure for rapid implementation and disbursement meant that it was difficult to turn down proposals that were ready for financing by arguing that there were more deserving cases in the pipeline.)
- In order to avoid resource allocation pitfalls the fund's managers and governing body need to establish overall needs and resource allocation principles at the outset of fund operation, to regularly review the application of these principles and to ensure that these are not undermined by resource availability that is skewed to support particular areas or by a pressure for rapid disbursement that gives priority to those who make early applications for funds. Introducing direct access modalities may not necessarily help, if these lead to pressure on the fund to provide resources to National Implementing Entities as soon as they are accredited.

I Avoid over demanding policies and processes

Every new Global Fund has to establish policies and processes for the management of project proposals, proposal assessment, project supervision and monitoring and evaluation. Some build on existing structures, particularly where existing institutions are used as Implementing Agencies and can apply their own systems (e.g. the 10 GEF Agencies). Others build new structures more or less from scratch. An example of the latter is GFATM, which has been strongly criticized for the demanding processes it has established [18]. These may have the advantage of being tailored precisely to the fund's needs, but from the point of view of recipients every new fund with a different application form, processing and approval system, disbursement and financial accounting structure, and reporting and monitoring and evaluation requirements adds to the burden already in place.

The fact, noted above, that at least 26 climate change funds already exist means that most recipients are already having to cope with a range of different policy and process requirements for climate change projects alone. The GCF must try to avoid making this burden worse.

---

[17] See regular reports on AHIF progress on AHIF website: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTAVIANFLU/0,,contentMDK:21355695~pagePK:210058~piPK:210062~theSitePK:3124441,00.html

[18] See e.g. Neil Squires blog on the Global Fund's new funding model: http://blogs.dfid.gov.uk/2013/02/the-global-funds-new-funding-model/

J Be Transparent

Lack of transparency generates suspicion. The Internet is the best tool for transparency, providing global and equitable access to information, and the GCF will need to maintain its own website with all relevant data easily accessible, including direct links to information from the Trustee, if this is a separate body.

K Be Realistic

The financial expectations for the GCF have regularly included the number of $100 billion (all figures are in US dollars unless otherwise indicated). However exactly what this means is not always clear. The Cancun conference (COP16, 2010) made a commitment for $30 billion in fast start finance up to 2012 and $100 billion a year in long term finance by 2020, for adaptation, mitigation and related bilateral, multilateral and related technical cooperation in developing countries, with the resources coming through a variety of channels.[19]

The hope that has been expressed in some quarters, that the GCF might attract $100 billion a year in new grant funding seems seriously misplaced. In 2010 total official development assistance (ODA) was $148 billion, and of this multilateral ODA came to $39.5 billion (OECD DAC website). Since 2010 the global economy and particularly economic conditions in major donor countries have generally deteriorated. Several countries have explicitly cut their aid budgets and significant increases seem unlikely in the near future (OECD, 2013).

The Climate Funds Update website managed by the Heinrich Boll Stiftung and ODI (Heinrich Boll Stiftung) monitors the totals pledged, deposited, approved and disbursed by 26 separate funds. Their latest figures (checked in May 2013) gave a total of $35.1 billion (bn) pledged to these funds, of which $26bn had been deposited, $18.8bn approved and $2.3bn disbursed. There were eight separate funds with over $1bn in pledged resources. In order of magnitude the largest were Japan Fast Start Finance ($15bn pledged), the Clean Technology Fund (CTF: $4.9bn), the UK International Climate Fund ($4.6bn), the Norway International Climate and Forest Initiative ($1.6bn), the Pilot Program for Climate Resilience (PPCR: $1.2bn), GEF 5 ($1.1bn), the German International Climate Initiative ($1.1bn) and the Amazon Fund ($1.03bn). The oldest of the 26 funds (GEF4) started in 2006 so the total of $35.1bn represents seven years of fund accumulation – on average less than $6bn a year.[20]

---

[19] See Cancun COP decision paras 95 to 100: http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2

[20] While there are undoubtedly many smaller funds that provide climate change grants, suggesting that the $34.4bn might be an *underestimate*, there is also almost certainly some double-counting. For example the largest fund, the Japan Fast Start Fund, includes Japanese contributions to Clean Investment Funds (CTF, PPCR, FIP, SREP – all included in the "24") and GEF, which are also counted as pledges to these funds. The exact magnitude of these overlaps is not clear but could be as much as $2bn, so there is also a risk that the $34.4bn figure is an *overestimate* of 6 years' pledges.

In this context even bringing the cumulative total for all ODA funds, existing as well as the new GCF, to $100m billion would be a major challenge. $100bn a year in new grant funds would be over double the recent annual total for all multilateral aid and more than 15 times the annual average for climate funds over the past six years.

This discussion however depends on what is included in the "climate funds" definition. Stadelmann *et al* (2011) looked at this issue to see what definitions would fit the requirement that funds be "new and additional". They concluded that only two of the eight options they examined were viable: "new sources only" and "above pre-defined business as usual level of development assistance".

A study by an OECD (Organisation for Economic Cooperation and Development) team (Clapp *et al*, 2012) looks at the implications of taking a much broader view of eligible financial flows that might be considered to be "climate finance", including public and private finance and "adds" different types of climate finance, from grants to non-concessional development finance and private capital. The study concludes that if a very broad definition is adopted "aggregate flows are estimated in the range of $70 to $120 bn annually" (Clapp et al, 2012, page 11). This suggests that in the future measuring, reporting and verification ("MRV") will be important but the debate over whether the $100bn a year target is being approached or overtaken will depend on arguments over definitions which are likely to be highly politicised. These debates might focus on what is really new, whether net or gross flows should be counted, whether private investment should be included, what really is "climate" finance and the reliability of the actual data.

L Allow for a Variety of Funding Sources and Instruments

Some civil society commentators have argued that all aid for climate change activities should be provided on a grant basis.[21] This is neither necessary nor desirable. One of the most important areas for reducing emissions of greenhouse gases is energy generation, and most energy projects, large or small, are capital investments intended to produce returns to the investor. The object of climate change projects in this context is to encourage investors to adopt low emission options, particularly investment in renewable energy (solar, hydro, wind, tides etc.). This can often be achieved by providing part of the capital required in the form of soft loans, making the overall investment more attractive if renewable energy options are selected (many CTF investments follow this logic). Provision of such funds in the form of soft loans provides a guarantee that the investor will follow the agreed renewable energy strategy, and eventually returns capital to the fund for further lending to new borrowers. The CTF (the second largest existing climate change fund) is partly financed by donors in the form of very soft loans, allowing access to resources that would not otherwise be available for ODA, and on-lends these resources to promote the use of clean technologies for investors in developing countries. This has been

[21] See e.g. "Climate Loan Sharks", World Development Movement, 2012

successfully achieved in a number of examples including Algeria, Egypt, Jordan, Libya, Morocco and Tunisia[22].

Several of the most successful recent new Global Funds have made major use of "innovative financing". The diversity of these is shown in a paper by Navin Girishinkar (Girishinkar, 2009). He distinguishes "*Private mechanisms* involving private-to-private flows in the market and in civil society; *Solidarity mechanisms* supporting sovereign-to-sovereign transfers and forming the backbone of multilateral and bilateral ODA and other official flows; *Public-private partnership mechanisms* leveraging or mobilizing private finance in support of public service delivery and other public functions, such as sovereign risk management and; *Catalytic mechanisms* involving public support for creating and developing private markets (*inter alia* by reducing risks of private entry)." Important examples include the Advanced Market Commitments (AMC) to strengthen the market for vaccines and essential drugs at the global level (supporting GAVI), the Certified Emission Reductions (CER)financing the Adaptation Fund[23], Stolen Asset Recovery, Output Based Aid and Carbon Funds.

At the same time there are other ideas for innovative sources of funding for climate change activities – aviation and maritime transport taxes, financial transaction taxes and private investment funds. However the potential for these to make a major contribution to the $100 bn target is limited, partly as many are controversial[24]. The AF offers an important lesson here – it was originally expected to be mainly resourced through the proceeds of CERs, but as carbon prices have been well below those forecast the revenue from CERs has been below expectations and a very substantial proportion of the AF's resources has come from multilateral ODA contributions (Trujillo *et al*, 2013, page 5).

The GCF should be open to funding from a variety of sources, and using a diverse range of financial instruments. The ambitious "$100bn" a year targets are unlikely to be achieved unless a broad approach is taken to what is to be included.

M Catch the Moment

The most successful Global Funds have built on a well-timed launch, exploiting an opportunity when the subject is high on the international profile and the fund has little competition for resources in the sector. The GCF may well have already missed its best opportunity for such a launch, as climate change has now been on the international agenda for over a decade and competing funds are well established. This means that once the GCF's broad parameters are fully agreed a "big launch" will need careful timing.

---

[22] See CTF website: https://www.climateinvestmentfunds.org/cif/content/north-africa-solar-scheme-boosts-capacity

[23] 2% of the value of the proceeds CERs under the Clean Development Mechanism goes to the Adaptation Fund

[24] Some of these were discussed in the context of Long Term Finance at the Doha COP, with no clear consensus emerging - see the IISD Doha COP summary at: http://www.iisd.ca/vol12/enb12567e.html and the UNFCCC website on Long Term Finance: https://unfccc.int/cooperation_support/financial_mechanism/long-term_finance/items/7405.php

N *Plan for Closure*

It may appear negative to think about closure of a fund at the start-up phase, but funds are not expected to have a perpetual existence, and ultimate closure needs to be prepared for. This requires consideration of where and how unused funds will be returned, something which some funds have failed to consider. It also requires thinking about the eventual costs of closure, as many funds find the closing down period extends over many years after the final contributions to their operating costs have been received.

3 Does the Emerging Design Address Lessons Learned ?

The GCF has now been under preparation for four years and many of its likely features are now emerging.

The clearest indicator of the form the GCF may take is the resolution passed at COP 17 in Durban.[25] This decision ("Decision 3") and its attached Annex indicate that many – but not all – of the lessons learned from past Global Funds' experience are being reflected in the emerging design of the GCF.

There is substantial emphasis on the need for a focus on results.[26] The GCF design allows for establishment of various windows, starting with separate ones for adaptation and mitigation.[27] However there is no explicit recognition that one of the arguments for such separate windows is the need to allow for clarity in results focus. The overall objectives and guiding principles of the GCF are very broad and would challenge any results monitoring: "The purpose of the Fund is to make a significant and ambitious contribution to the global efforts towards attaining the goals set by the international community to combat climate change." "The Fund will contribute to the achievement of the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC). In the context of sustainable development, the Fund will promote the paradigm shift towards low-emission and climate-resilient development pathways by providing support to developing countries to limit or reduce their greenhouse gas emissions and to adapt to the impacts of climate change, taking into account the needs of those developing countries particularly vulnerable to the adverse effects of climate change."[28] The objectives of the specific windows will need to be much clearer and quantifiable if their impact is to be effectively monitored.

The importance of country programmes is acknowledged several times in Decision 3. Paragraph 7 of the decision emphasizes the need to "ensure consistency with national climate strategies and plans and a country driven approach", and the Annex refers to the need to "promote coherence in programming at

[25] "Launching the Green Climate Fund", Decision 3/CP.17: http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf#page=55
[26] Op cit, Annex, Section VII, Para 58
[27] Op cit, Annex, Section V C, paras 37 and 39.
[28] Op cit, Annex Section I, paras 1 and 2.

the national level through appropriate mechanisms"[29] and commits the Fund to support developing countries in pursuing and preparing "project-based and programmatic approaches in accordance with climate change strategies and plans, such as low-emission development strategies or plans, nationally appropriate mitigation actions (NAMAs), national adaptation plans of action (NAPAs), national adaptation plans (NAPs) and other related activities."[30].

However the diversity of eligible recipients and possible strategies or plans (see previous paragraph) to which they may align may substantially weaken the effectiveness of attempts to align GCF support to country programmes. Access to GCF resources may be through subnational, national, regional and international agencies.[31] Private sector bodies are also likely to be able to be recipients in certain circumstances, and there may also be some eligibility for other civil society organizations.[32] The range of eligible approaches could easily lead to a situation where a variety of agencies submit proposals each of which is aligned to a different plan or strategy, all of which have a degree of legitimacy. This risk may be reduced by a process of accreditation of National Implementing Entities (NIE), following the AF model, but it would probably be necessary to ensure that all funding requests from a country with an accredited NIE are endorsed by that NIE, even if they are submitted through a multilateral or regional implementing entity.

At its third meeting the GCF Board (March 2013) confirmed that the fund "will...have a country-driven and owned approach"[33] during its discussions on the business model framework, but this did not add any detail to the earlier Decision 3.

Decision 3 makes no commitment to escape the challenge of <u>fund proliferation.</u> The GCF is expected to "initiate discussions on coherence in climate finance delivery with other relevant multilateral entities"[34] but there is no reference to any commitment to close other funds that have been established under UNFCCC or other auspices. Most, perhaps all, of the activities proposed for the Fund can be financed under existing entities. If the start of operations of the GCF is accompanied by a firm commitment to close several existing funds to new contributions, to cease financing new operations under these funds and to transfer outstanding uncommitted balances to the GCF this would enormously increase the

---

[29] Op cit, Annex Section V A, para 34
[30] Op cit, Annex Section VB, Para 36 and Section VC 1, para 40
[31] Op cit, Annex Section, Section VD, Paras 47 and 48. Para 45 notes: "Access to Fund resources will be through national, regional and international implementing entities accredited by the Board. Recipient countries will determine the mode of access and both modalities can be used simultaneously." It is not fully clear what "both modalities" refers to here – but it probably allows *direct* access from national (and subnational) entities as well as *indirect* access through regional and international entities.
[32] Op cit, Annex V C2 refers to "a private sector facility" and Annex VD1, para 47 notes that "the Board will consider additional modalities that further enhance direct access, including through funding entities with a view to enhancing country ownership of projects and programmes"
[33] Decisions of the Board, March 2013: B.01-13/06, section b): http://www.gcfund.net/fileadmin/00_customer/documents/pdf/Decisions_of_the_Board_V1_15March2013.pdf
[34] Decision 3 : Op cit, Annex Section VA Para 34

credibility and potential impact of the Fund. In many cases this may be difficult, but it should be possible for some of the funds that already operate under the auspices of the UN FCCC.

The future governance of the GCF is treated in detail in Decision 3[35] and addresses the lessons learned from past experience. The Board has now been established, with 24 members, composed of an equal number of members from developing and developed country Parties. There are representatives of Least Developed Countries and of Small Island Developing States. However there continue to be underlying disagreements over aspects of governance, which were evident at the Doha COP, with disagreements that could not be resolved over the body that would be responsible for drafting the arrangements between the GCF and the COP.[36]

There is little in Decision 3 to suggest that cost control is currently an issue that is being addressed. There is a reference to selection of the trustee using a "competitive bidding process"[37] but this does not necessarily mean that cost would be a major criterion. The potential proliferation of implementing entities noted above could mean that the number of organisations aiming to recover overhead costs and establish networks of staff to develop, support, monitor and evaluate operations will be excessive. There is also a high risk that the large number of entities could result in many small projects and significant diseconomies of scale.[38]

Decision 3 is silent on HR policies , the processes for applying for projects, and long term closure arrangements and this is not surprising as one would expect these to be established only after the Secretariat is up and running.

It seems probable that GCF trustee and management roles will be separate, in line with good practice elsewhere. The World Bank will be the interim trustee[39] and the GCF Board is "invited" to arrange for a competitive bidding approach to select the permanent trustee. [40]

Decision 3 includes proposals on the resource allocation process, but these are rather vague.[41] The Board "will balance the allocation of resources between adaptation and mitigation activities", it will "ensure appropriate allocation of resources for other activities", "a results-based approach will be an important criterion for allocating resources" and "in allocating resources for adaptation, the Board will take into account the urgent and immediate needs of developing countries that are particularly vulnerable to the adverse effects of climate change, including LDCs, SIDS (Small Island Developing States)and African States, using minimum allocation floors for these countries as appropriate. The Board will aim for appropriate geographical balance." There is no recognition here that firm policies on resource allocation are needed to offset donors' efforts to earmark contributions or that the variety of

[35] Op cit, Annex Section II
[36] See Earth Negotiations Bulletin, Vol12 No 567 Page 5: http://www.iisd.ca/download/pdf/enb12567e.pdf
[37] Decision 3, Op cit, para 16
[38] This risk is also highlighted by Germanwatch, 2011
[39] Decision3, Annex IIF paras 24 to 27
[40] Op cit, para 16
[41] Op cit, Annex V E, paras 50 to 52

entities involved in direct and indirect access to GCF resources (noted above) could result in inequitable disbursements.

The need for transparency is well recognized by Decision 3.[42] The GCF has now established its own website (gcfund.net) and this provides a comprehensive source for all official documentation. However even generally well informed commentators such as the International Institute for Sustainable Development (IISD) find it difficult to follow GCF progress: "The Board has yet to agree on procedures for reporting out from the meetings, making it extremely difficult for those not internally engaged to have a clear picture of what is happening" (Boyle, 2012).

Decision 3 makes no reference to funding targets. It allows for a broad range of funding sources. Section IV of the Annex to the Decision states the GCF "will receive financial inputs from developed country Parties to the Convention" and that it "may also receive financial inputs from a variety of other sources, public and private, including alternative sources." It is also open to using a range of funding instruments: "The Fund will provide financing in the form of grants and concessional lending, and through other modalities, instruments or facilities as may be approved by the Board."[43] A similarly broad commitment was made at the third meeting of the GCF Board: "The Fund will...leverage additional public and private resources through the operational facilities of the Fund including through the private sector facility".[44]

4 Conclusions

A comparison of the lessons learned from other Global Funds and the emerging structure of the GCF suggests that the team preparing the GCF are well aware of others' experience. At the same time there are some significant weaknesses in the emerging design. The length of time involved in the GCF gestation and the variety and number of participants seems to have resulted in a design that includes everything, and that could be very difficult to manage for results. The objectives and guiding principles are very broad, and unless the GCF is broken down into thematic windows with clear and measurable objectives donors who are looking for results-oriented operations will be disappointed. While the importance of country programmes and plans is recognized, the multiplicity of possible plans to refer to, and the number of entities that can approach the GCF for direct or indirect funding, risks leading to a poor linkage between country-driven programmes and approved operations. The diverse range of entities is also likely to undermine the GCF's cost-effectiveness and could result in relatively small operations, numerous participating entities and resulting high overhead costs. The proposals for GCF governance give an equal weighting to developed and developing partners, but the reality of recent meetings suggests that numerous separate interest groups are emerging leading at best to a more realistic reflection of the diversity of interests in climate change – but at worst to a totally dysfunctional governance process. The COP 17 decision made no reference to running down or closing competing climate change funds. There is already an excessive proliferation of climate change funds, and on its

[42] Op cit, paras 7, 13, 16 etc.
[43] Op cit, Annex VI, paras 54 to 56
[44] Decisions of the Board, March 2013, op cit

present lines the GCF will overlap with existing funds, add to confusion and increase the proportion of funds intended for beneficiaries that finish up paying for the costs of the GCF itself and the other entities that may be involved in planning and oversight of its operations.

How then could the emerging design be improved ? The following lessons might be observed

- Tie the approval of operations closely to their inclusion in national plans, and limit the range of acceptable planning frameworks;
- Establish relatively narrow issue-based windows with clear window-specific expected results;
- Allocate resources clearly to these windows and avoid distortions that can result from donor attempts to earmark resources geographically;
- Ensure that all or most projects are subject to direct access to the GCF. Only (if ever) use indirect approaches (i.e. disbursing via other international or regional implementing agencies) if the alternative entity has a very strong comparative advantage;
- Link the launch of the GCF with planned closure of some competing funds;
- Ensure that funding targets for the GCF are realistic.

References

AusAID, **2012**: "Australian Multilateral Assessment" (AMA), Australian Government, March 2012: http://www.ausaid.gov.au/Publications/Pages/693_6999_8205_7111_6531.aspx

Ballasteros et al, 2010: Athena Ballesteros, Smita Nakhooda, Jacob Werksman, and Kaija Hurlburt, "Power, Responsibility and Accountability, Rethinking the Legitimacy of Institutions for Climate Finance", World Resources Institute, 2010: http://pdf.wri.org/power_responsibility_accountability.pdf

Bird et al, 2011: Design Challenges for the Green Climate Fund, January 2011, ODI Climate Finance Policy Brief, Neil Bird, Jessica Brown and Liane Schalatek: http://www.odi.org.uk/resources/details.asp?id=6149&title=design-green-climate-fund

Boyle, 2012: "A Mirage in the Deserts of Doha? Assessing the outcomes of COP 18 " A Climate Insights Product Jessica Boyle, IISD, December 2012: http://www.iisd.org/pdf/2012/com_mirage_desert_doha_cop18.pdf

Clapp et al, 2012: "Tracking Climate Finance: What and How ?", Christina Clapp, Jane Ellis, Julian Benn and Jan Corfee-Morlet, OECD, May 2012 : http://www.oecd.org/env/cc/50293494.pdf

DFID, 2011: "Multilateral Aid Review", Department for International Development, March 2011: http://www.dfid.gov.uk/Documents/publications1/mar/multilateral_aid_review.pdf

Forstater et al, 2013: "The effectiveness of climate finance, a review of the Amazon Fund", Maya Forstater, Smita Nakhooda and Charlene Watson, ODI Working Paper 373, March 2013: http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8340.pdf

Germanwatch,2011: "Successful Start for the GCF", 2011: http://germanwatch.org/kliko/ks48e.pdf

Girishinkar, 2009: "Innovating Development Finance", Navin Girishinkar, 2009, World Bank: http://siteresources.worldbank.org/CFPEXT/Resources/CFP_Working_Paper_No1.pdf

Heinrich Boll Stiftung, Climate Funds Update, 2012: http://www.climatefundsupdate.org/listing

IEG, 2010: The World Bank's Involvement in Global and Regional Partnership Programs: An Independent Assessment**,** World Bank Independent Advisory Group, 2010: http://ieg.worldbankgroup.org/content/dam/ieg/grpp_eval.pdf

IISD Reporting Services: http://www.iisd.ca/

IISD, 2012: "A Brief Analysis of the Bonn Climate Change Conference", May 2012 http://www.iisd.ca/vol12/enb12546e.html

Marshang, 2009: "AHIF Mid Term Evaluation", Adelheid Marshang, 2009: http://siteresources.worldbank.org/INTAVIANFLU/Resources/WBEvaluationReportPresentation_Annex2.pdf

Nakhooda, 2013: "The effectiveness of international climate finance", ODI Working Paper 371, Smita Nakhooda, March 2013: http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8344.pdf

OECD DAC website: "DAC1 Official and Private Flows" DAC Table 15: http://www.oecd.org/dac/stats/statisticsonresourceflowstodevelopingcountries.htm

OECD, 2013: OECD DAC, March 2013: "Aid to Poor Countries Slips Further…": http://www.oecd.org/dac/stats/aidtopoorcountriesslipsfurtherasgovernmentstightenbudgets.htm

Schalatek *et al*, 2012: "The Green Climate Fund", Liane Schalatek, Heinrich Böll Stiftung and Smita Nakhooda and Neil Bird, ODI, November 2012: http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7478.pdf

Sridhar *et al,* 2009: Devi Sridhar and Tami Tamashiro, "Vertical Funds in the Health Sector: Lessons for Education from the Global Fund and GAVI", UNESCO, 2009

Stadelmann *et al,*2011: Martin Stadelmann, J. Timmons Roberts & Axel Michaelowa (2011): New and additional to what? Assessing options for baselines to assess climate finance pledges, Climate and Development, 3:3,

Trujillo *et al*, 2013: "The effectiveness of climate finance – a review of the Adaptation Fund", Nella Canales Trujillo and Smita Nakhooda, ODI Working Paper 373, April 2013: http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8341.pdf

UNCCCF, "Launching the Green Climate Fund", Decision 3, COP 17: http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf#page=55

World Development Movement,**2012:** "Climate Loan Sharks", June 2012 www.wdm.org.uk/sites/default/files/Climate%20Loan%20Sharks%20FINAL%20web%20copy_0.pdf

Tyndall°Centre for Climate Change Research

Tyndall Working Paper series 2000 - 2013

The Tyndall Centre working paper series presents results from research which are mature enough to be submitted to a refereed journal, to a sponsor, to a major conference or to the editor of a book. The intention is to enhance the early public availability of research undertaken by the Tyndall family of researchers, students and visitors. They can be downloaded from the Tyndall Website at:

http://www.tyndall.ac.uk/publications/working_papers/working_papers.shtml

The accuracy of working papers and the conclusions reached are the responsibility of the author(s) alone and not the Tyndall Centre.

Papers available in this series are:

- Potten, D. (2013) **The Green Climate Fund and Lessons from other Global Funds' Experience** Tyndall Working Paper 158;

- Martin, M.; Thornley, P. (2013) **The potential for thermal storage to reduce the overall carbon emissions from district heating systems** Tyndall Working Paper 157;

- Diaz-Rainey, I; Finegan, A; Ibikunle, G; Tulloch, DJ; (2012) **Institutional Investment in the EU ETS** Tyndall Working Paper 156;

- Kelly, S; Crawford-Brown, D; Pollitt, M.; (2012) **Building Performance evaluation and certification in the UK: Is SAP fit for purpose? Renewable and Sustainable Energy Reviews** Tyndall Working Paper 155;

- Kelly, S.; Shipworth, M.; Shipworth, D.; Gentry, M.; Wright, A.; Pollitt, M.; Crawford-Brown, D.; Lomas, K.; (2012) **A panel model for predicting the diversity of internal temperatures from English dwellings** Tyndall Working Paper 154;

- Bellamy, R.; Chilvers, J.; Vaughan, N E.; Lenton, T M.; (2012) **Appraising Geoengineering** Tyndall Working Paper 153;

- Nordhagen, S.; Calverley, D.; Foulds, C.; Thom, L.; Wang, X.; (2012) **Credibility in climate change research: a reflexive view** Tyndall Working Paper 152;

- Milman, A.; Bunclark, L.; Conway, D. and Adger, W N (2012) **Adaptive Capacity of Transboundary Basins in the Mediterranean, the Middle East and the Sahel** Tyndall Working Paper 151;

- Upham, P.; Kuttapan, V., and Tomeic, J. (2012) **Sustainable livelihoods and cultivation of Jatropha curcas for biodiesel in India: reflections on alternative agronomic models** Tyndall Working Paper 150;

- Shen, W.(2011) **Understanding the dominance of unilateral CDMs in China: Its origins and implications for governing carbon markete** Tyndall Working Paper 149;

- Mercure, JF.(2011) **Global electricity technology substitution model with induced technological change** Tyndall Working Paper 148;
- Gough, C., and Upham, P.(2010) **Biomass energy with carbon capture and storage (BECCS): a review** Tyndall Working Paper 147;

• Kebede, A., Nicholls R. J., Hanson S. and Mokrech, M.(2010) **Impacts of Climate Change and Sea-Level Rise: A Preliminary Case Study of Mombasa, Kenya.** Tyndall Working Paper 146;

• Dendler, L.(2010) **Sustainability Meta Labelling: A Discussion of Potential Implementation Issues.** Tyndall Working Paper 145;

• McLachlan, C.(2010) **Tidal stream energy in the UK: Stakeholder perceptions study.** Tyndall Working Paper 144;

• Upham, P., and Julia Tomei (2010) **Critical Stakeholder Perceptions of Carbon and Sustainability Reporting in the UK Renewable Transport Fuel Obligation.** Tyndall Centre Working Paper 143;

• Hargreaves, T. (2010) **The Visible Energy Trial: Insights from Qualitative Interviews.** Tyndall Working Paper 141;

• Newsham, A., and D. Thomas. (2009) **Agricultural adaptation, local knowledge and livelihoods diversification in North-Central Namibia.** Tyndall Working Paper 140;

• Starkey, R.. (2009) **Assessing common(s) arguments for an equal per capita allocation.** Tyndall Working Paper 139;

• Bulkeley, H., and H. Schroeder. (2009) **Governing Climate Change Post-2012: The Role of Global Cities – Melbourne.** Tyndall Working Paper 138;

• Seyfang, G., I. Lorenzoni, and M. Nye., (2009) **Personal Carbon Trading: a critical examination of proposals for the UK.** Tyndall Working Paper 136**.**

• HTompkins E. L, Boyd E., Nicholson-Cole S, Weatherhead EK, Arnell N. W., Adger W. N., (2009) **An Inventory of Adaptation to climate change in the UK: challenges and findings**: Tyndall Working Paper 135;

• Haxeltine A., Seyfang G., (2009) **Transitions for the People: Theory and Practice of 'Transition' and 'Resilience' in the UK's Transition Movement:** Tyndall Working Paper 134;

• Tomei J., Upham P., (2009) **Argentinean soy based biodiesel: an introduction to production and impacts:** Tyndall Working Paper 133;

• Whitmarsh L, O'Neill S, Seyfang G., Lorenzoni I., (2008) **Carbon Capability: what does it mean, how prevalent is it, and how can we promote it?**: Tyndall Working Paper 132;

• Huang Y., Barker T., (2009) **Does Geography Matter for the Clean Development Mechanism?** : Tyndall Working Paper 131;

• Huang Y., Barker T., (2009) **The Clean Development Mechanism and Sustainable Development: A Panel Data Analysis**: Tyndall Working Paper 130;

• Dawson R., Hall J, Barr S, Batty M., Bristow A, Carney S, Dagoumas, A., Evans S., Ford A, Harwatt H., Kohler J., Tight M, (2009) **A blueprint for the integrated assessment of climate change in cities**: Tyndall Working Paper 129;

• Carney S, Whitmarsh L, Nicholson-Cole S, Shackley S., (2009) **A Dynamic Typology of Stakeholder Engagement within Climate Change Research**: Tyndall Working paper 128;

• Goulden M, Conway D, Persechino A., (2008) **Adaptation to climate change in international river basins in Africa: a review:** Tyndall Working paper 127;

• Bows A., Anderson K., (2008) **A bottom-up analysis of including aviation within the EU's Emissions**

Trading Scheme: Tyndall Working Paper 126;

• Al-Saleh Y., Upham P., Malik K., (2008) **Renewable Energy Scenarios for the Kingdom of Saudi Arabia:** Tyndall Working Paper 125

• Scrieciu S., Barker T., Smith V., (2008) **World economic dynamics and technological change: projecting interactions between economic output and CO2 emissions :**Tyndall Working Paper 124

• Bulkeley H, Schroeder H., (2008) **Governing Climate Change Post-2012: The Role of Global Cities - London:** Tyndall Working Paper 123

• Schroeder H., Bulkeley H, (2008) **Governing Climate Change Post-2012: The Role of Global Cities, Case-Study: Los Angeles**: Tyndall Working Paper 122

• Wang T., Watson J, (2008) **Carbon Emissions Scenarios for China to 2100**: Tyndall Working Paper 121

• Bergman, N., Whitmarsh L, Kohler J., (2008) **Transition to sustainable development in the UK housing sector: from case study to model implementation:** Tyndall Working Paper 120

• Conway D, Persechino A., Ardoin-Bardin S., Hamandawana H., Dickson M, Dieulin C, Mahe G, (2008) **RAINFALL AND WATER RESOURCES VARIABILITY IN SUB-SAHARAN AFRICA DURING THE 20TH CENTURY:** Tyndall Centre Working Paper 119

• Starkey R., (2008) **Allocating emissions rights: Are equal shares, fair shares? :** Tyndall Working Paper 118

• Barker T., (2008) **The Economics of Avoiding Dangerous Climate Change**: Tyndall Centre Working Paper 117

• Estrada M, Corbera E., Brown K, (2008) **How do regulated and voluntary carbon-offset schemes compare?**: Tyndall Centre Working Paper 116

• Estrada Porrua M, Corbera E., Brown K, (2007) **REDUCING GREENHOUSE GAS EMISSIONS FROM DEFORESTATION IN DEVELOPING COUNTRIES: REVISITING THE ASSUMPTIONS**: Tyndall Centre Working Paper 115

• Boyd E., Hultman N E., Roberts T., Corbera E., Ebeling J., Liverman D, Brown K, Tippmann R., Cole J., Mann P, Kaiser M., Robbins M, (2007) **The Clean Development Mechanism: An assessment of current practice and future approaches for policy**: Tyndall Centre Working Paper 114

• Hanson, S., Nicholls, R., Balson, P., Brown, I., French, J.R., Spencer, T., Sutherland, W.J. (2007) **Capturing coastal morphological change within regional integrated assessment: an outcome-driven fuzzy logic approach**: Tyndall Working Paper No. 113

• Okereke, C., Bulkeley, H. (2007) **Conceptualizing climate change governance beyond the international regime: A review of four theoretical approaches**: Tyndall Working Paper No. 112

• Doulton, H., Brown, K. (2007) **'Ten years to prevent catastrophe'? Discourses of climate change and international development in the UK press**: Tyndall Working Paper No. 111

• Dawson, R.J., et al (2007) **Integrated analysis of risks of coastal flooding and cliff erosion under scenarios of long term change**: Tyndall Working Paper No. 110

• Okereke, C., (2007) **A review of UK FTSE 100 climate strategy and a framework for more in-depth analysis in the context of a post-2012 climate**

regime: Tyndall Centre Working Paper 109

- Gardiner S., Hanson S., Nicholls R., Zhang Z., Jude S., Jones A.P., et al (2007) **The Habitats Directive, Coastal Habitats and Climate Change – Case Studies from the South Coast of the UK**: Tyndall Centre Working Paper 108

- Schipper E. Lisa, (2007) **Climate Change Adaptation and Development: Exploring the Linkages**: Tyndall Centre Working Paper 107

- Okereke C., Mann P, Osbahr H, (2007) **Assessment of key negotiating issues at Nairobi climate COP/MOP and what it means for the future of the climate regime**: Tyndall Centre Working Paper No. 106

- Walkden M, Dickson M, (2006) **The response of soft rock shore profiles to increased sea-level rise.** : Tyndall Centre Working Paper 105

- Dawson R., Hall J, Barr S, Batty M., Bristow A, Carney S, Evans E.P., Kohler J., Tight M, Walsh C, Ford A, (2007) **A blueprint for the integrated assessment of climate change in cities.** : Tyndall Centre Working Paper 104

- Dickson M., Walkden M., Hall J., (2007) **Modelling the impacts of climate change on an eroding coast over the 21st Century**: Tyndall Centre Working Paper 103

- Klein R.J.T, Erickson S.E.H, Næss L.O, Hammill A., Tanner T.M., Robledo, C., O'Brien K.L.,(2007) **Portfolio screening to support the mainstreaming of adaptation to climatic change into development assistance**: Tyndall Centre Working Paper 102

- Agnolucci P., (2007) **Is it going to happen? Regulatory Change and Renewable Electricity**: Tyndall Centre Working Paper 101

- Kirk K., (2007) **Potential for storage of carbon dioxide in the rocks beneath the East Irish Sea**: Tyndall Centre Working Paper 100

- Arnell N.W., (2006) **Global impacts of abrupt climate change: an initial assessment**: Tyndall Centre Working Paper 99

- Lowe T.,(2006) **Is this climate porn? How does climate change communication affect our perceptions and behaviour?**, Tyndall Centre Working Paper 98

- Walkden M, Stansby P,(2006) **The effect of dredging off Great Yarmouth on the wave conditions and erosion of the North Norfolk coast**. Tyndall Centre Working Paper 97

- Anthoff, D., Nicholls R., Tol R S J, Vafeidis, A., (2006) **Global and regional exposure to large rises in sea-level: a sensitivity analysis**. This work was prepared for the Stern Review on the Economics of Climate Change: Tyndall Centre Working Paper 96

- Few R., Brown K, Tompkins E. L, (2006) **Public participation and climate change adaptation**, Tyndall Centre Working Paper 95

- Corbera E., Kosoy N, Martinez Tuna M, (2006) **Marketing ecosystem services through protected areas and rural communities in Meso-America: Implications for economic efficiency, equity and political legitimacy**, Tyndall Centre Working Paper 94

- Schipper E. Lisa, (2006) **Climate Risk, Perceptions and Development in El Salvado**r, Tyndall Centre Working Paper 93

- Tompkins E. L, Amundsen H, (2005) **Perceptions of the effectiveness of the United Nations Framework Convention on Climate Change in prompting**

behavioural change, Tyndall Centre Working Paper 92

• Warren R., Hope C, Mastrandrea M, Tol R S J, Adger W. N., Lorenzoni I., (2006) **Spotlighting the impacts functions in integrated assessments. Research Report Prepared for the Stern Review on the Economics of Climate Change**, Tyndall Centre Working Paper 91

• Warren R., Arnell A, Nicholls R., Levy P E, Price J, (2006) **Understanding the regional impacts of climate change: Research Report Prepared for the Stern Review on the Economics of Climate Change,** Tyndall Centre Working Paper 90

• Barker T., Qureshi M, Kohler J., (2006) **The Costs of Greenhouse Gas Mitigation with Induced Technological Change: A Meta-Analysis of Estimates in the Literature**, Tyndall Centre Working Paper 89

• Kuang C, Stansby P, (2006) **Sandbanks for coastal protection: implications of sea-level rise. Part 3: wave modelling**, Tyndall Centre Working Paper 88

• Kuang C, Stansby P, (2006) **Sandbanks for coastal protection: implications of sea-level rise. Part 2: current and morphological modelling**, Tyndall Centre Working Paper 87

• Stansby P, Kuang C, Laurence D, Launder B, (2006) **Sandbanks for coastal protection: implications of sea-level rise. Part 1: application to East Anglia**, Tyndall Centre Working Paper 86

• Bentham M, (2006) **An assessment of carbon sequestration potential in the UK – Southern North Sea case study:** Tyndall Centre Working Paper 85

• Anderson K., Bows A., Upham P., (2006) **Growth scenarios for EU & UK aviation: contradictions with climate policy,** Tyndall Centre Working Paper 84

• Williamson M., Lenton T., Shepherd J., Edwards N, (2006) **An efficient numerical terrestrial scheme (ENTS) for fast earth system modelling**, Tyndall Centre Working Paper 83

• Bows, A., and Anderson, K. (2005) **An analysis of a post-Kyoto climate policy model**, Tyndall Centre Working Paper 82

• Sorrell, S., (2005) **The economics of energy service contracts**, Tyndall Centre Working Paper 81

• Wittneben, B., Haxeltine, A., Kjellen, B., Köhler, J., Turnpenny, J., and Warren, R., (2005) **A framework for assessing the political economy of post-2012 global climate regime**, Tyndall Centre Working Paper 80

• Ingham, I., Ma, J., and Ulph, A. M. (2005) **Can adaptation and mitigation be complements?**, Tyndall Centre Working Paper 79

• Agnolucci,. P (2005) **Opportunism and competition in the non-fossil fuel obligation market**, Tyndall Centre Working Paper 78

• Barker, T., Pan, H., Köhler, J., Warren., R and Winne, S. (2005) **Avoiding dangerous climate change by inducing technological progress: scenarios using a large-scale econometric model**, Tyndall Centre Working Paper 77

• Agnolucci,. P (2005) **The role of political uncertainty in the Danish renewable energy market**, Tyndall Centre Working Paper 76

• Fu, G., Hall, J. W. and Lawry, J. (2005) **Beyond probability: new**

methods for representing uncertainty in projections of future climate, Tyndall Centre Working Paper 75

• Ingham, I., Ma, J., and Ulph, A. M. (2005) **How do the costs of adaptation affect optimal mitigation when there is uncertainty, irreversibility and learning?**, Tyndall Centre Working Paper 74

• Walkden, M. (2005) **Coastal process simulator scoping study**, Tyndall Centre Working Paper 73

• Lowe, T., Brown, K., Suraje Dessai, S., Doria, M., Haynes, K. and Vincent., K (2005) **Does tomorrow ever come? Disaster narrative and public perceptions of climate change**, Tyndall Centre Working Paper 72

• Boyd, E. Gutierrez, M. and Chang, M. (2005) **Adapting small-scale CDM sinks projects to low-income communities**, Tyndall Centre Working Paper 71

• Abu-Sharkh, S., Li, R., Markvart, T., Ross, N., Wilson, P., Yao, R., Steemers, K., Kohler, J. and Arnold, R. (2005) **Can Migrogrids Make a Major Contribution to UK Energy Supply?**, Tyndall Centre Working Paper 70

• Tompkins, E. L. and Hurlston, L. A. (2005) **Natural hazards and climate change: what knowledge is transferable?**, Tyndall Centre Working Paper 69

• Bleda, M. and Shackley, S. (2005) **The formation of belief in climate change in business organisations: a dynamic simulation model**, Tyndall Centre Working Paper 68

• Turnpenny, J., Haxeltine, A. and O'Riordan, T., (2005) **Developing regional and local scenarios for climate change mitigation and adaptation: Part 2: Scenario creation**, Tyndall Centre Working Paper 67

• Turnpenny, J., Haxeltine, A., Lorenzoni, I., O'Riordan, T., and Jones, M., (2005) **Mapping actors involved in climate change policy networks in the UK**, Tyndall Centre Working Paper 66

• Adger, W. N., Brown, K. and Tompkins, E. L. (2004) **Why do resource managers make links to stakeholders at other scales?**, Tyndall Centre Working Paper 65

• Peters, M.D. and Powell, J.C. (2004) **Fuel Cells for a Sustainable Future II**, Tyndall Centre Working Paper 64

• Few, R., Ahern, M., Matthies, F. and Kovats, S. (2004) **Floods, health and climate change: a strategic review**, Tyndall Centre Working Paper 63

• Barker, T. (2004) **Economic theory and the transition to sustainability: a comparison of approaches**, Tyndall Centre Working Paper 62

• Brooks, N. (2004) **Drought in the African Sahel: long term perspectives and future prospects**, Tyndall Centre Working Paper 61

• Few, R., Brown, K. and Tompkins, E.L. (2004) **Scaling adaptation: climate change response and coastal management in the UK**, Tyndall Centre Working Paper 60

• Anderson, D and Winne, S. (2004) **Modelling Innovation and Threshold Effects In Climate Change Mitigation**, Tyndall Centre Working Paper 59

• Bray, D and Shackley, S. (2004) **The Social Simulation of The Public Perceptions of Weather Events and their Effect upon the Development of Belief in**

Anthropogenic Climate Change, Tyndall Centre Working Paper 58

• Shackley, S., Reiche, A. and Mander, S (2004) **The Public Perceptions of Underground Coal Gasification (UCG): A Pilot Study**, Tyndall Centre Working Paper 57

• Vincent, K. (2004) **Creating an index of social vulnerability to climate change for Africa**, Tyndall Centre Working Paper 56

• Mitchell, T.D. Carter, T.R., Jones, .P.D, Hulme, M. and New, M. (2004) **A comprehensive set of high-resolution grids of monthly climate for Europe and the globe: the observed record (1901-2000) and 16 scenarios (2001-2100)**, Tyndall Centre Working Paper 55

• Turnpenny, J., Carney, S., Haxeltine, A., and O'Riordan, T. (2004) **Developing regional and local scenarios for climate change mitigation and adaptation Part 1: A framing of the East of England** Tyndall Centre Working Paper 54

• Agnolucci, P. and Ekins, P. (2004) **The Announcement Effect And Environmental Taxation** Tyndall Centre Working Paper 53

• Agnolucci, P. (2004) **Ex Post Evaluations of CO2 –Based Taxes: A Survey** Tyndall Centre Working Paper 52

• Agnolucci, P., Barker, T. and Ekins, P. (2004) **Hysteresis and Energy Demand: the Announcement Effects and the effects of the UK Climate Change Levy** Tyndall Centre Working Paper 51

• Powell, J.C., Peters, M.D., Ruddell, A. and Halliday, J. (2004) **Fuel Cells for a Sustainable Future?** Tyndall Centre Working Paper 50

• Awerbuch, S. (2004) **Restructuring our electricity networks to promote decarbonisation**, Tyndall Centre Working Paper 49

• Pan, H. (2004) **The evolution of economic structure under technological development**, Tyndall Centre Working Paper 48

• Berkhout, F., Hertin, J. and Gann, D. M., (2004) **Learning to adapt: Organisational adaptation to climate change impacts**, Tyndall Centre Working Paper 47

• Watson, J., Tetteh, A., Dutton, G., Bristow, A., Kelly, C., Page, M. and Pridmore, A., (2004) **UK Hydrogen Futures to 2050**, Tyndall Centre Working Paper 46

• Purdy, R and Macrory, R. (2004) **Geological carbon sequestration: critical legal issues**, Tyndall Centre Working Paper 45

• Shackley, S., McLachlan, C. and Gough, C. (2004) **The Public Perceptions of Carbon Capture and Storage**, Tyndall Centre Working Paper 44

• Anderson, D. and Winne, S. (2003) **Innovation and Threshold Effects in Technology Responses to Climate Change**, Tyndall Centre Working Paper 43

• Kim, J. (2003) **Sustainable Development and the CDM: A South African Case Study**, Tyndall Centre Working Paper 42

• Watson, J. (2003), **UK Electricity Scenarios for 2050**, Tyndall Centre Working Paper 41

• Klein, R.J.T., Lisa Schipper, E. and Dessai, S. (2003), **Integrating mitigation and adaptation into climate and development policy: three**

research questions, Tyndall Centre Working Paper 40

• Tompkins, E. and Adger, W.N. (2003). **Defining response capacity to enhance climate change policy**, Tyndall Centre Working Paper 39

• Brooks, N. (2003). **Vulnerability, risk and adaptation: a conceptual framework**, Tyndall Centre Working Paper 38

• Ingham, A. and Ulph, A. (2003) **Uncertainty, Irreversibility, Precaution and the Social Cost of Carbon**, Tyndall Centre Working Paper 37

• Kröger, K. Fergusson, M. and Skinner, I. (2003). **Critical Issues in Decarbonising Transport: The Role of Technologies**, Tyndall Centre Working Paper 36

• Tompkins E. L and Hurlston, L. (2003). **Report to the Cayman Islands' Government. Adaptation lessons learned from responding to tropical cyclones by the Cayman Islands' Government, 1988 – 2002**, Tyndall Centre Working Paper 35

• Dessai, S., Hulme, M (2003). **Does climate policy need probabilities?**, Tyndall Centre Working Paper 34

• Pridmore, A., Bristow, A.L., May, A. D. and Tight, M.R. (2003). **Climate Change, Impacts, Future Scenarios and the Role of Transport**, Tyndall Centre Working Paper 33

• Xueguang Wu, Jenkins, N. and Strbac, G. (2003). **Integrating Renewables and CHP into the UK Electricity System: Investigation of the impact of network faults on the stability of large offshore wind farms**, Tyndall Centre Working Paper 32

• Turnpenny, J., Haxeltine A. and O'Riordan, T. (2003). **A scoping study of UK user needs for managing climate futures. Part 1 of the pilot-phase interactive integrated assessment process (Aurion Project)**, Tyndall Centre Working Paper 31

• Hulme, M. (2003). **Abrupt climate change: can society cope?**, Tyndall Centre Working Paper 30

• Brown, K. and Corbera, E. (2003). **A Multi-Criteria Assessment Framework for Carbon-Mitigation Projects: Putting "development" in the centre of decision-making**, Tyndall Centre Working Paper 29

• Dessai, S., Adger, W.N., Hulme, M., Köhler, J.H., Turnpenny, J. and Warren, R. (2003). **Defining and experiencing dangerous climate change**, Tyndall Centre Working Paper 28

• Tompkins, E.L. and Adger, W.N. (2003). **Building resilience to climate change through adaptive management of natural resources**, Tyndall Centre Working Paper 27

• Brooks, N. and Adger W.N. (2003). **Country level risk measures of climate-related natural disasters and implications for adaptation to climate change**, Tyndall Centre Working Paper 26

• Xueguang Wu, Mutale, J., Jenkins, N. and Strbac, G. (2003). **An investigation of Network Splitting for Fault Level Reduction**, Tyndall Centre Working Paper 25

• Xueguang Wu, Jenkins, N. and Strbac, G. (2002). **Impact of Integrating Renewables and CHP into the UK Transmission Network**, Tyndall Centre Working Paper 24

• Paavola, J. and Adger, W.N. (2002). **Justice and adaptation to climate change**, Tyndall Centre Working Paper 23

• Watson, W.J., Hertin, J., Randall, T., Gough, C. (2002). **Renewable Energy and Combined Heat and Power Resources in the UK**, Tyndall Centre Working Paper 22

• Watson, W. J. (2002). **Renewables and CHP Deployment in the UK to 2020**, Tyndall Centre Working Paper 21

• Turnpenny, J. (2002). **Reviewing organisational use of scenarios: Case study - evaluating UK energy policy options**, Tyndall Centre Working Paper 20

• Pridmore, A. and Bristow, A., (2002). **The role of hydrogen in powering road transport**, Tyndall Centre Working Paper 19

• Watson, J. (2002). **The development of large technical systems: implications for hydrogen**, Tyndall Centre Working Paper 18

• Dutton, G., (2002). **Hydrogen Energy Technology**, Tyndall Centre Working Paper 17

• Adger, W.N., Huq, S., Brown, K., Conway, D. and Hulme, M. (2002). **Adaptation to climate change: Setting the Agenda for Development Policy and Research**, Tyndall Centre Working Paper 16

• Köhler, J.H., (2002). **Long run technical change in an energy-environment-economy (E3) model for an IA system: A model of Kondratiev waves**, Tyndall Centre Working Paper 15

• Shackley, S. and Gough, C., (2002). **The Use of Integrated Assessment: An Institutional Analysis Perspective**, Tyndall Centre Working Paper 14

• Dewick, P., Green K., Miozzo, M., (2002). **Technological Change, Industry Structure and the Environment**, Tyndall Centre Working Paper 13

• Dessai, S., (2001). **The climate regime from The Hague to Marrakech: Saving or sinking the Kyoto Protocol?,** Tyndall Centre Working Paper 12

• Barker, T. (2001). **Representing the Integrated Assessment of Climate Change, Adaptation and Mitigation**, Tyndall Centre Working Paper 11

• Gough, C., Taylor, I. and Shackley, S. (2001). **Burying Carbon under the Sea: An Initial Exploration of Public Opinions**, Tyndall Centre Working Paper 10

• Barnett, J. and Adger, W. N. (2001). **Climate Dangers and Atoll Countries**, Tyndall Centre Working Paper 9

• Adger, W. N. (2001). **Social Capital and Climate Change**, Tyndall Centre Working Paper 8

• Barnett, J. (2001). **Security and Climate Change**, Tyndall Centre Working Paper 7

• Goodess, C.M., Hulme, M. and Osborn, T. (2001). **The identification and evaluation of suitable scenario development methods for the estimation of future probabilities of extreme weather events**, Tyndall Centre Working Paper 6

• Barnett, J. (2001). **The issue of 'Adverse Effects and the Impacts of Response Measures' in the UNFCCC**, Tyndall Centre Working Paper 5

• Barker, T. and Ekins, P. (2001). **How High are the Costs of Kyoto for the US Economy?**, Tyndall Centre Working Paper 4

• Berkhout, F, Hertin, J. and Jordan, A. J. (2001). **Socio-economic futures in climate change impact assessment: using scenarios as 'learning**

machines', Tyndall Centre Working Paper 3

• Hulme, M. (2001). **Integrated Assessment Models**, Tyndall Centre Working Paper 2

• Mitchell, T. and Hulme, M. (2000). **A Country-by-Country Analysis of Past and Future Warming Rates**, Tyndall Centre Working Paper 1

Tyndall°Centre
for Climate Change Research

For further information please contact

[Javier Delgado-Esteban]