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**INNOVATION AND THE GEF
A STAP DOCUMENT**

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SUMMARY

The Global Environment Facility (GEF) was designed to be innovative in its design, governance, and operation from the initial pilot program in 1991. Determining how the GEF would be “innovative” in technology, promoting policies, sector transformation, and business models, has been a central debate ever since. The GEF has evolved in many ways – expanding its scope, adding more agency partners, testing new modalities, and more. Nevertheless, the world in which it operates has changed even more dramatically.

The GEF invests about \$1 billion each year. Public expenditure will never be enough to solve major environmental problems. This means doing much more with the funds available: finding ways to leverage more investment for each GEF dollar, identifying creative uses of emerging technologies, and engaging a wider range of partners to promote policy and institutional reform.

All of the GEF agencies have extensive experience in supporting technological, institutional, and business innovation. The incentives for greater innovation in the GEF are clear: increased environmental effectiveness (to achieve deeper and wider changes), economic efficiency (to achieve more benefits for the same amount of investment), and the longevity of results (to secure self-sustaining mechanisms with durable outcomes).

This paper reviews the GEF’s experience with innovation in technology, finance, business models, policy, and institutional change, and makes a number of recommendations in each of these contexts.

In addition, it makes the following cross-cutting recommendations:

1. Define a risk appetite

The key issue for innovation in the GEF is risk. Innovation brings with it the possibility of less good outcomes or even failure. Falling back on trusted and true solutions which have been proven to work is a safe option but will not deliver transformational change. The enemy of innovation is a solution that works. Incremental progress is inadequate to deliver transformational change. It is therefore important to question and assess at the strategic level what would be a desirable and acceptable level of risk in different areas of the investment portfolio. This could involve setting targets for success, recognizing that some innovations will fail.

2. Responsibility for innovation

Innovation in the GEF comes from diverse sources, including the GEF Secretariat, the Scientific and Technical Advisory Panel (STAP) and Independent Evaluation Office (IEO), agencies, the private sector, academia, and NGOs. But there is considerable variation between focal areas, agencies, regions, and recipient countries. For example, although project proponents are explicitly asked about innovation in the Project Identification Form (PIF), the extent to which this question is addressed or how seriously it is taken varies greatly. Requiring a better explanation of what is new in a proposed project might encourage project proponents to consider innovation more seriously.

3. Cultivate innovation in design

The GEF would benefit from a more systematic approach to innovation. This could include a more rigorous expectation to define and evaluate the innovative elements in project design; and defining potential future outcome scenarios could help to identify “big bets” that are high risk but potentially very high

reward. The GEF partnership could consider assigning responsibility to monitor and identify potential innovations for investment in order to help expand the “menu” that country and regional teams consider in project development.

4. Encourage adaptive implementation and exchange lessons

Significant, lasting impact requires time, persistence, and some adaptation to and learning from failure. Opportunities for innovation cannot all be planned or foreseen at the design stage. Project proponents need to demonstrate how they are identifying obstacles and opportunities for innovation during the course of implementation. Innovative solutions to environmental problems are often location specific and can vary by region and even within a country; mechanisms are therefore needed to ensure that experiences are shared in order to help shorten the cycle from innovation to replication and adaptation in other contexts.

Innovation and the GEF

1. *What is the issue, and why does it matter to the GEF?*¹

Innovation has been defined as “... an idea, embodied in a technology, product, or process, which is *new and creates value*. To be impactful, innovations must also be scalable, not merely one-off novelties”².

At the time of its creation as a pilot program in 1991, the Global Environment Facility (GEF) was, with the limited exception of the Multilateral Ozone Fund, a unique source of dedicated donor support for achieving global environmental benefits. The notion that the GEF would be innovative — in its design, governance, and operation — was fundamental to its creation. The initial “innovation” envisioned by the creation of the GEF was primarily that it would be both global in nature and would deliver its resources through existing institutions, leveraging their network, mandates, and staff. Determining the focus of the GEF — in terms of scope, funding approach and application, and indeed how GEF would be “innovative” in promoting policies, sector transformation, business models, institutional reforms, and technologies — was a central debate from the earliest days of the GEF.

However, remaining innovative has become much more challenging. While the GEF has evolved in many ways — expanding its scope, greatly increasing the number of agency partners, testing new modalities, and more — the world in which it operates has changed even more dramatically. In recent decades, the financial landscape has also changed dramatically, with marked growth in the global financial market, including long-term assets under management; the creation of investment funds with some focus on non-financial, social returns; and new forms of fundraising utilizing social media and new technology. In this new, expanded financial landscape, the challenge for addressing global environmental problems is to shift a larger share of the trillions of dollars under management to “green” investments in developing countries.

The GEF invests about \$1 billion a year. Public expenditure alone will always be insufficient for solving major environmental problems. This means doing much more with the funds available, such as by finding ways to leverage much greater investment for each GEF dollar; identifying creative uses of emerging technologies to address global environmental problems; and engaging a much wider range of partners to promote policy and institutional reform.

This paper looks specifically at how the GEF might identify and support technological, financial, business model, policy, and institutional innovation.

2. *What has been the GEF’s experience with innovation?*

All of the 18 GEF agencies — a diverse mix of organizations from the UN system, multilateral and national banks, and global NGOs — have extensive experience in supporting technological, financial, business model, policy, and institutional innovation. The GEF portfolio, which contains many projects with innovative elements, underscores the degree to which innovation has been incorporated in GEF strategy, if not always addressed explicitly.

- (a) **Technological innovation** comprises new products and processes and significant technical changes in existing products and processes (see Box 1 for examples of GEF technological innovation).

Support for new climate technologies was an early GEF priority, but it became clear that GEF resources were inadequate for reducing GHG emissions significantly through a strategy based on paying the incremental costs of short-term response measures³. Following a review of this experience, STAP recommended in 2004 that the GEF largely abandon the effort to buy-down first costs. Instead, the GEF would “play more of a facilitating role, for example, by entering into more partnerships with the private sector. And more attention should be paid to developing supportive policy and regulatory frameworks which reduce the cost of energy services....”⁴

Box 1. Examples of GEF technological innovation

Biodiversity technologies: GEF support for biodiversity-related technology was included in a project to support engagement with industries such as cosmetics, agriculture, and pharmaceuticals. The first project was an effort in Panama to prospect for nature-based products of interest to the pharmaceutical and agro-chemical industries. The project engages major private sector partners to transfer technology and is a direct response to the signing of the Nagoya Protocol on Access and Benefit Sharing⁵.

Technology transfer centers and needs assessments: the GEF has also supported technology development and deployment through technology needs assessments, knowledge sharing, and capacity building. The GEF-4 Poznan Strategic Program on Technology Transfer, a response to a decision at COP13, was a \$50 million effort that included support for needs assessments, associated projects, and knowledge sharing. In GEF-5, GEF agreed to support Climate Technology Centers and a Climate Technology Network as a means of building capacity and sharing knowledge⁶.

Innovation in building materials: a project to transfer and adapt technology for energy efficient brick-making (a very energy-intensive process) in Bangladesh built on an earlier project in China and included sharing of experience through an on-site visit of a team from a Bangladeshi university⁷. The enhancement in local capacity is considered perhaps as important as the short-term improvements in processes, illustrating the often-close relationship between capacity building and technology transfer.

Agricultural production technologies: GEF adaptation projects have supported the introduction of drought-resistant seeds and the sharing of knowledge on water harvesting and management, for example in East Africa⁸.

Many emerging technologies appear to offer the potential for helping address global environmental challenges, particularly digital technologies, as discussed in the *World Development Report 2016: Digital Dividends*⁹. Mobile phone communication is now reaching even remote areas in Africa, providing access to banking services, emergency weather alerts, and a range of other information. In many countries, these services are provided for free and are available through vocal menus that avoid the need for literacy¹⁰. For example, a program in Niger is allowing farmers to control their irrigation systems remotely by mobile phone, while also collecting real-time weather and climate data, thereby improving agricultural productivity and water management¹¹. A combination of low-cost sensors, the Internet, and high-speed data processing is enabling new conservation services, such as much better watershed management¹² and tracking of endangered species to facilitate protective efforts¹³. The application of remote sensing has also created new opportunities to provide information to rural communities. For example, a Swiss Re program in Kenya uses satellites to monitor vegetation available to livestock and triggers financial

assistance for feed, veterinary medicines, and water trucks when drought gets so bad that animal lives are at risk¹⁴.

Several recent reports and initiatives illustrate the importance of technological innovation to solving global environmental problems. A report by the International Energy Agency, *The Future of Cooling*, reviews the rapid growth in air conditioning in buildings and concludes that without substantial improvements in energy efficiency the result will be an enormous increase in greenhouse gas emissions due to the associated increase in the demand for power¹⁵. A report by Sustainable Energy for All focuses on the implications of more frequent temperature extremes and the need for innovative solutions for climate adaptation¹⁶. In September 2018, the World Bank announced a \$5 billion initiative to accelerate the use of battery storage in emerging markets; \$1 billion in World Bank Group financing is expected to mobilize another \$4 billion in concessional climate financing and public and private investments. The program aims to finance 17.5 gigawatt hours (GWh) of battery storage by 2025 — more than triple the 4-5 GWh currently installed in all developing countries¹⁷.

Looking ahead, STAP has examined a number of novel entities¹⁸ that could have both positive and negative disruptive effects on the earth's system. Novel entities are broadly defined as, "things created and introduced into the environment by human beings that could have positive or negative disruptive effects on the earth system; and may include synthetic organic pollutants, radioactive materials, genetically modified organisms, nanomaterials, micro-plastics."

Three of these novel entities are of particular relevance to the GEF:

- Gene editing (CRISPR¹⁹) offers the possibility of better control of vector-borne diseases, improved animal husbandry, and helping plants adapt to climate change, but could pose a threat to biodiversity unless adequate governance and institutional structures are put in place.
- Technology-critical elements²⁰ (e.g., rare earth elements, such as the lanthanides, platinum, palladium, rhodium, and germanium) are used in emerging and green technologies, but their mining and processing and the disposal of their end products are leading to chemical pollution, biodiversity loss, deforestation, and land degradation, as well as negative plant and human health impacts.
- Cellular agriculture, used to produce livestock products like meat, leather, and fur without using the animal itself, could help reduce the environmental effects associated with the current food production system. There are issues regarding how products will be regulated, the challenge of intellectual property, ethical concerns, and public acceptance.

(b) **Innovative financing** can include any financing approach that helps to generate funds by tapping new funding sources or by engaging new partners, including those that enhance the "efficiency" of financial flows by reducing delivery time and/or costs, and make financial flows more results-oriented²¹.

The GEF has been largely a grant-making entity since its creation, with relatively limited experience in using non-grant instruments (see Box 2 for examples of the GEF's experience with non-grant instruments). Making non-grant projects attractive for recipient countries can be challenging. However, there is

substantial evidence that non-grant approaches may in many circumstances achieve better and more sustainable outcomes.

Box 2. GEF experience with non-grant instruments

The GEF's experience with non-grant instruments is relatively small, notwithstanding the emphasis by GEF on engaging the private sector and getting more innovative approaches to mitigation and adaptation through the GEF pipeline.

Of the more than 9,000 projects GEF has funded since its inception, only about 97 projects have used GEF funding in non-grant instruments, less than 1% by number of projects approved. Of these, only 17 have included provisions for "reflows," or return of funds to the GEF. The most recent effort to promote the use of non-grant instruments in GEF projects was a GEF-6 set aside of \$100 million, outside country allocations, through the System for Transparent Allocation of Resources (STAR). This was in response to countries that rarely choose to use their allocations for private sector projects, even when some bonus or incentive is provided.

A summary of projects approved under this program shows a total of nine projects (eight full-sized and one medium-sized) using \$97.4 million in GEF funding and attracting co-financing of \$1,637 million. Four were based on equity investments, one was a loan, one was based on a risk guarantee, and one was a reimbursable grant (funding for project development to be reimbursed if developers obtain financing). Four relate to energy, one to biodiversity, two to forestry and land restoration, and two to fisheries management. The projects have been approved too recently to allow any assessment of outcomes²².

A review by the GEF Independent Evaluation Office (IEO)²³ notes that the GEF's support for innovative non-grant instruments, while limited, dates from the earliest days of its operation. Such support includes clean energy finance projects, the use of guarantees to support greater balance sheet leverage by development finance institutions, and blended finance approaches and funds, such as the Earth Fund with the International Finance Corporation (IFC).

The following issues were among those identified in a 2017 IEO brief:

- Diversification: the climate finance landscape is crowded, but the GEF "can distinguish itself and continue to support private markets in biodiversity and prevention of land degradation where external financing is a viable growth option for private firms and where the GEF remains one of the few financiers of other Convention areas."
- Complexity in financial structures, and consequently high transaction costs: "A number of terminal evaluations point to the challenges involved in implementing innovative structures, and advocate for simplicity in design."
- Ambition: "Many non-grant projects set overly ambitious targets for implementation results which require midcourse correction, resulting in implementation delays and additional transaction costs." Reflow projections seem overly optimistic.

Some recent partnerships illustrate uses of non-grant instruments for natural resource objectives. The Coalition for Private Investment in Conservation was announced jointly in September 2016 by the

International Union for the Conservation of Nature, the Nature Conservancy, Credit Suisse, and Cornell University²⁴. The Coalition believes that projects with good environmental and financial returns can make a significant contribution to the annual funding gap (estimated to be \$200-300 billion) in conservation investment. Another example is debt conversion for marine conservation and climate adaptation in the Seychelles. An innovative financial agreement, The Seychelles Conservation and Climate Adaptation Trust, facilitated by NatureVest, the investing unit of the Nature Conservancy, is supporting the creation of a marine reserve through a loan to the government of the Seychelles allowing purchase of \$21.6 million in sovereign debt at a discount²⁵. Debt payments will repay the loan and fund marine conservation and climate adaptation efforts.

(c) **Business model innovation** is the development of new concepts supporting an enterprise's financial viability, including its mission, and the processes for bringing those concepts to fruition.

A report by Harvard Business Review Analytic Services stated that, "In emerging markets, developing a new and innovative business model often is far more important to achieving revenue goals than is technological superiority or being a technological innovator"²⁶. The experience in developing countries is very much in line with this assessment, e.g., selling to very poor populations, overcoming weak infrastructure, addressing cultural barriers, and reaching rural areas without established distribution systems. This may require new forms of entrepreneurship and innovative ways of setting up and running businesses.

Box 3. Cookstoves - an example of the importance of business models.

Low quality cooking fuels cause an estimated 4 million deaths per year, as well as significant emissions of black carbon — a potent contributor to global warming. A World Bank study in 2012 reviewed 19 Bank projects dealing with fuelwood management or improved stoves, implemented over 20 years at a cost of \$1.2 billion, many with GEF support. The Bank invested a comparable amount in biogas for cooking, but with limited impact. Follow-up studies have found that "despite the recognized benefits of clean cookstoves for health, local environment and climate change, their large-scale adoption and sustained use are not yet occurring"²⁷. While technology failures are an issue, the primary barriers have been non-technical: lack of local awareness, affordability issues, poor distribution channels, and cultural resistance to changes in cooking practices. The design of good projects also faces practical challenges, including the need for detailed, time-consuming upstream studies with high transactions costs relative to the volume of lending leveraged²⁸.

Making technologies work well is therefore often far less difficult than finding a business model that has broad appeal, particularly when attempting to serve dispersed and poor populations. Up-front costs can be a major obstacle, even when products pay for themselves relatively quickly and offer other co-benefits.

Recent growth of sales of small solar products reflects an innovative response to this problem: pay-as-you-go financing, which allows low-income consumers to pay according to the availability of funds and make payments over time in small increments or pay small fees for the service. It uses information technology to enable remote activation with payment receipt (systems can be shut-off for non-payment)²⁹. Pay-as-you-go companies retail solar home systems, for example, designed to power basic appliances. The systems are sold against a small upfront payment and purchases make regular "top-ups",

usually sent via low-cost mobile phone money services (see Box 4). And Box 5 provides examples of effective business models in the GEF portfolio.

Box 4. Pay-as-you-go financing for solar lamps

“People pay a dollar or two upfront to take a solar lamp home and try it out. Then each week they purchase an allotment of energy for their lamp, just like buying kerosene, or airtime for a prepaid phone ... if the customer misses a payment, the lamp deactivates until they pay again. ... [E]ach payment accrues towards the final price. When the customer reaches this price, the lamp is permanently unlocked and the energy is free. ... when purchased over time, for \$1-2 per week, these lamps are truly affordable to all families living beyond the grid. By breaking through the cashflow and trust barriers with a non-threatening, accessible, entry-level solar lamp, off-grid energy consumers of all income levels can finally be free of kerosene”³⁰.

Box 5. Examples of business model innovations from the GEF portfolio

Public/private collaboration on climate information services. The UNDP program on Climate Information for Resilient Development in Africa (CIRDA)³¹ aims to improve weather and climate information in Africa, including emergency warnings of extreme events, by a combination of low-cost, automated weather stations, modern software systems for weather forecasting, and mobile phone communication essential for climate change adaptation. One option being tested is to place stations on cell phone towers to address security and power issue and facilitate maintenance, all common problems in Africa. The hardware and computer systems are widely used and proven outside Africa; the challenge in their implementation has been the institutional arrangements and public-private partnerships (PPPs), a mixture of business model and institutional innovation that is new to Africa³².

Taking tropical deforestation out of commodity supply chains. Three commodities, soy, beef, and palm oil, are estimated to account for close to 80% of tropical deforestation worldwide³³. The GEF is supporting a program to turn the sustainable production of key commodities from a niche market and non-scalable specialized operations to mainstreamed business practices with the aim of inventing a new business model based on cooperation between the major producers, governments, civil society organizations, and consumers. Transformational change will require success across several strategies, including the capacity for tracking and reporting, supportive policies, and finance for sustainable management practices.

New distribution channels for rural electricity. Lighting Africa, an ICF/World Bank project, has enabled 15.8 million people across Africa to meet their basic electricity needs (lighting and mobile phone charging) through off-grid solar products and aims to reach 250 million more people by 2030³⁴. The project adopted a broadly-framed approach to identify and address barriers, including the availability of good products, the adequacy of distribution channels in rural areas, consumer awareness and acceptance, financing for sellers (often small and medium-sized enterprises or SMEs), as well as consumers, and product quality assurance to reduce the risk of cheaper, low-quality knock-offs that poison the market. Knowledge sharing is a key part of the strategy, as well as support for innovative ways to finance purchases by poor households in rural areas³⁵.

Insurance approaches to support climate resilience. The Southeast Europe and Caucasus Catastrophe Risk Insurance Facility was designed to insure yields for farmers against the risks of droughts and floods, which are more likely due to climate change. The project, Scaling up Risk Transfer Mechanisms for Climate Vulnerable Farming Communities in Southern Philippines focuses on expanding access to index-based weather insurance for smallholder farmers³⁶. These projects illustrate that effective solutions sometimes require cooperation between governments and private companies, and, while they may need some subsidies, may still be the most cost-effective solution.

(d) Policy innovation

The successful implementation of innovative technologies, business models, and institutions often requires a supportive enabling and policy environment, the absence of which is a common reason for the failure of otherwise well-designed projects. In some cases, this may include new regulations or standards that enable others to achieve investment objectives, e.g., climate-smart agriculture, resilient cities, or policies that support pricing mechanisms that provide a level playing field and transparency about costs.

Box 6. Examples of GEF support for policy innovation

Support for Policies to Promote Renewable Energy. Policy reform has been a major driver in the recent growth of renewable energy in many developing countries³⁷, and the GEF has made some notable contributions to this trend. One success story is Uruguay, which was entirely dependent on a single resource, hydropower, and in low rainfall years was forced to import oil — a threat to the economy in periods of high oil prices³⁸. With the help of a \$1 million GEF grant managed by UNDP, in 2007 Uruguay initiated a national wind energy program focused on policy reform and technical capacity building³⁹. Key elements of the program were a competitive bidding system for large-scale renewable energy development and a feed-in tariff for smaller-scale systems⁴⁰. Incentives were also included to reward early actors. Starting with virtually no wind power at all, the country became a global leader and repeatedly exceeded its targets; Uruguay now aims to generate 38% of its electricity from wind by the end of 2017. Evaluations for other renewable energy projects including IFC and World Bank projects supporting solar business development similarly emphasize the importance of measures to create a supportive legal and policy environment⁴¹. By contrast, numerous examples demonstrate the likelihood of failure when projects conflict with the policy environment, particularly subsidies for fossil fuels that undermine incentives for clean energy⁴².

Natural Resource Management Policies. GEF forestry projects often conclude that strong natural resource management policies — and enforcement — are essential for project success. For example, a project with the Brazil Forest Service emphasized the restructuring of national forest management systems to support more effective policy formulation as the basis for mainstreaming sustainable forest management practices into national development policy⁴³.

Policies to support climate-smart urban planning. Some of the most effective GEF projects have supported the development of strategies and planning, particularly at the urban level, while others have promoted voluntary, cooperative approaches based on guidelines and “good practice.” A good example of the former are projects supporting bus rapid transit (BRT) systems, which aim to improve the efficiency and ridership of public buses through dedicated lanes, rapid boarding, and traffic management⁴⁴. The GEF approach to transportation projects initially focused on technology solutions like fuel cell buses, electric 3-wheelers, and alternative fuels. Starting with GEF-3, however, the approach shifted to favor support for planning, capacity building, and raising public awareness — all

particularly important in promoting the adoption of a relatively new approach to urban transportation⁴⁵. Building on early collaboration between the World Bank, Brazil, and Mexico City, GEF approved BRT projects in multiple countries in South America, China, Indonesia, South Asia, and Central Asia⁴⁶.

Environmental standards and best practices. There are also success stories in the GEF portfolio based on support for voluntary collaborative efforts to define good practice, e.g., for the production and distribution of agricultural commodities, which have historically sometimes been associated with loss of biodiversity and damage to natural resources. Examples include the Green Cocoa project in the Earth Fund set aside⁴⁷ and the Biodiversity Agricultural Commodities Program⁴⁸. In these projects, companies interested in the adoption of good environmental practices work with civil society organizations, academic experts, and representatives of affected populations to agree on best practices⁴⁹. There is also an increasing role for non-legally based policies within the financial sector, which often relies on “good practice” in the absence of clear policy guidance (as in many emerging markets) and as a source of transparency when dealing with new concerns such as climate risks.

The circular economy is another example of policy innovation. For example, see STAP’s paper on the food system⁵⁰, which examines how the current food production and consumption model, with its “take-make-waste” linear model, has significant deleterious effects on the environment, including on greenhouse gas emissions, the conversion of forests and peatlands to farmland, biodiversity loss, extensive land and water degradation, and the use of freshwater. Making the transition to a more sustainable food supply system would be assisted by reducing food losses and wastes and implementing a “circular economy” approach. This approach aims to recycle nutrients and water, adopt conservation farming systems, improve resource use efficiency, displace fossil fuels with renewable energy, and maintain materials and resources in the economy at their highest utility and value for as long as possible. As a result, food production systems would become more resilient to climate change impacts, and other global goals of the GEF would be advanced, such as clean water, sustainable forest management, climate change mitigation, biodiversity conservation, and avoiding land degradation.

And STAP’s paper on plastics⁵¹ shows how the circular economy is an alternative to the current linear, “make, use, dispose” economy model: it aims to keep resources in use for as long as possible, to extract the maximum value from them while they are in use, and to recover and regenerate products and materials at the end of their service life. It offers an opportunity to minimize the negative impacts of plastics, while maximizing the benefits from plastics and their products and providing environmental, economic, and societal benefits.

(e) **Institutional innovation**

Institutional innovation has two aspects. The first includes change in informal institutions such as values, beliefs, customs, traditions, rituals, and formal institutions such as markets, marriage, codified rules, laws — all of which guide the behavior of individuals and their interactions in communities. The second comprises change in organizations, encompassing governmental agencies from the national to the local level and organizations outside the government system, such as farmers’ organizations; industry and trade chambers; other business associations; and religious, cultural, and civil society advocacy networks. Innovation in formal organizations is closely related to policy innovation, especially innovations in governmental structure and organizations that are a consequence (and sometimes a cause of) policy change.

Institutional challenges have been the focus of many GEF projects, often closely associated with challenges to technical capacity and/or policy barriers. Poorly designed or outdated institutions are often among the root causes of natural resource degradation and depletion. Reforming or replacing them is often the first necessary step toward restoring the resource base.

Box 7. Examples of institutional innovation

Strengthening capacity for natural resources management

A GEF/UNDP joint review⁵² on transforming markets to restore and protect the global oceans identified the importance of science-based planning and the need for engagement with four main groups of stakeholders — communities, industries that affect the oceans, policy makers, and financiers — with the potential for “blue economy” outcomes that generate substantial jobs in support of marine ecosystem restoration and protection. The objectives are dependent on numerous policy reforms (e.g., removing negative fishing subsidies), developing necessary tools and methodologies (e.g., standards for ship hull fouling), and support for private sector technology R&D⁵³. In biodiversity conservation, the weakness of public institutions and the feasibility of effective community management options have been recurrent themes, with recurrent efforts for resources and technical assistance to enhance both⁵⁴. Institutions with good technical capacity and adequate resources have been a critical issue for sustainable fisheries management⁵⁵.

Innovations to promote sustainable rangeland management include the organization of land use and infrastructure among nomadic pastoral communities in Central Africa, the upgrading of traditional land management systems in to modern cooperatives in Morocco, and the transformation of land tenure systems for cattle breeding in Botswana⁵⁶.

International networks for environmental accountability

An issue for climate change planning under the Paris Climate Agreement has been support for national climate agencies and planning processes⁵⁷. For example, the Partnership on Transparency in the Paris Agreement promotes ambitious climate action through peer-to-peer learning on transparency and nationally determined contribution implementation.

Adaptation for market relevance

A UNDP/GEF/LDCF (Least Developed Countries Fund) project aims to modernize African weather services through a strategy that includes expanding the skills and objectives of weather agencies to include business outreach and tailored weather products with the potential for revenue generation, a transformation that may require some combination of a revised mandate, new staff, and commitment to move in new directions⁵⁸. In the agriculture sector, innovations to supply local markets with sustainable agricultural products include participatory guarantee systems, multi-actor innovation platforms, and community-supported agriculture⁵⁹.

3. How can the GEF respond?

The incentives for greater innovation in the GEF are to increase environmental effectiveness (to achieve deeper and wider changes), economic efficiency (to achieve more benefits for the same amount of investment), and the longevity of results (to secure self-sustaining mechanisms with durable outcomes).

STAP offers the following cross-cutting recommendations.

Define a risk appetite. The key issue for innovation in the GEF is risk. Innovation brings with it the possibility of poor outcomes or failure to meet project or program objectives.

In the Sixth Comprehensive Evaluation of the GEF (OPS6)⁶⁰, the IEO reported that about 80% of projects were rated as having satisfactory outcomes. This raised questions in the GEF Council about why the remaining projects were not more highly rated. Yet, at some point, an expectation of very high rates of success and an intolerance for failure results in conservative goal-setting (modest and achievable targets) and risk aversion (reliance on proven, established approaches), resulting in strong disincentives to innovate. The incentives, for both agencies and countries, are to fall back on trusted and true solutions that have been proven to work. The enemy of innovation is a solution that works.

The GEF has embraced an agenda of transformative change, aiming to leverage its relatively small resources to shift the trajectory on major environmental trends⁶¹. By definition, incremental progress is inadequate to achieve this ambition. There is, therefore, a need to question and assess at the strategic level what constitutes a desirable and acceptable level of risk in different areas of the investment portfolio. This could involve setting targets for success in project implementation, for scaling impact beyond project implementation, and for recognizing that some innovations will fail. One option might be to aim for 75% of projects rated as satisfactory and above, with 5% of the funding allocated to projects that are explicitly recognized as high risk, high reward. Another option would be to establish a pool or fund for risky projects on the understanding that some will fail, akin to the portfolio approach adopted by venture capitalists.

Responsibility for innovation. Innovation in the GEF comes from diverse sources, including the GEF Secretariat, agencies, STAP, IEO, the private sector, academia, and NGOs. Innovative ideas are sometimes included in the initial PIF or added at a later stage. There is a considerable variation between focal areas, agencies, regions, and recipient countries. Project proponents are explicitly asked about innovation in the PIF, but the extent to which this is addressed — or how seriously this is taken — varies greatly. Requiring a better explanation of what is new in a proposed project might encourage project proponents to consider innovation more carefully.

Cultivate innovation in design. The GEF would benefit from a more systematic approach to innovation. This could include a more rigorous expectation to define and evaluate the innovative elements in project design, along with the changes that could occur at scale if the innovations take root (well beyond the immediate project success targets). Defining such potential future outcome scenarios could help to identify “big bets” that are high risk, but potentially very high reward.

The GEF partnership could consider assigning responsibility, among agencies, or other specialized organizations, to monitoring and identifying potential innovations for particular GEF investments to help expand the “menu” that country and regional teams consider in project development.

Being aware of and keeping up to date with what's happening in innovation is a substantial task and may require particular skills and specialized knowledge. Other organizations have adopted (or have access to) mechanisms to identify and evaluate emerging technologies and innovations, for example, the UN Technology Innovation Lab⁶² and the UN Global Pulse⁶³.

Encourage adaptive implementation and exchange lessons. Significant, lasting impact requires time, persistence, and some adaptation and learning from failure⁶⁴. Opportunities for innovation cannot all be planned or foreseen at the design stage, so there should be an expectation that project partnerships demonstrate how they are identifying obstacles and opportunities for innovation during the course of implementation. Innovative solutions to environmental problems are often location specific. Practical, locally-appropriate solutions vary by region and often even within a country, so mechanisms to ensure the sharing of experience within and across projects are essential and will help to shorten the cycle from innovation to replication and adaptation in other contexts.

Consider multiple channels of innovation. A narrow focus on any one of the five areas of innovation outlined above (technology, finance, business model, policy, or institutions) may be inadequate, particularly if the goal is transformative change at the sector level.

With regard to the five domains of innovation (technology, finance, business models, policy, and institutions), STAP recommends:

1. Technology Innovation

(a) Support demonstration projects to help cross the "valley of death."

- Finance technologies that need to be demonstrated in the field or scaled up to a stage sufficient to attract mainstream investors, for example, seed financing, early stage capital, and capital for expansion into new markets.

(b) Support the adaptation and transfer of technologies from developed to developing and emerging markets.

- This may require grant-based support, or some form of concessional non-grant that provides risk sharing or patient capital. Examples include support for the transfer of battery and storage technologies that can be modular and scalable and can be combined with efforts to increase energy access, weather data collection and information dissemination, and technologies that allow access to safe drinking water.

(c) Support the development of climate risk analytical tools that enable markets for new products and services with global environmental benefits.

- For example, identify, assess, and quantify climate risks, such as of coastal flooding and the likelihood of crop losses, for the development of insurance products to address these risks.

(d) Novel entities – adopt the following strategic postures.

- Technology-critical elements and blockchain technology: focus on managing the risks and harnessing the opportunities.
- Next-generation nanotechnology and gene editing/CRISPR: get a better understanding of these novel entities and consider how the GEF could exploit the opportunities they offer and manage or prevent any negative effects.
- Cellular agriculture and engineered bio-based materials: monitor the development of these entities to determine what further action should be taken.

In addition, the following specific actions are recommended: support policies towards sustainable extraction, utilization, and recycling of TCEs, including the adoption of circular economy principles in the sector; conduct an assessment of how current trends in nanotechnology may affect the goals of the GEF; explore blockchain technology in GEF strategy and programmatic areas (e.g., for knowledge management and monitoring of global environmental benefits); and support capacity building for regulating gene editing in developing countries.

2. Innovative financing

(a) Increase the use of both grants and non-grant instruments to support innovative technologies, business models, policies, and institutions.

- Provide blended finance to catalyze private investment, to share risks, and to remove barriers that prevent scaling up of innovative approaches.
- Support capacity-building activities to help entrepreneurs and businesses promote innovative technologies and business models.

(b) Encourage innovation by funding competitions and other crowd-sourcing mechanisms to develop solutions to priority challenges.

- Set up partnerships with organizations that administer or sponsor competitions and other crowd-sourcing mechanisms that address GEF objectives.
- Invite an organization to run a GEF-specific competition when seeking a solution to a particular issue.
- Provide resources for demonstrations, pilots, or scaling up for prize-winning concepts that require further financial support.

3. Business model innovation

- Provide seed financing and early-stage capital to support business models that may not yet have commercial returns, but where there is significant potential, and where there may be some financial returns, together with high social and environmental benefits. Examples include the establishment of new index insurance products for small farmers, and modernizing weather and climate information services.

- Provide capital to help entrepreneurs with innovative business models to build capacity and develop their businesses.
- Provide capital for aggregation vehicles, e.g., investment funds, which often fill a gap in the local financial ecosystem for funding early-stage entrepreneurs.

4. Policy Innovation

The opportunity for the GEF to support innovation in policy is significant, particularly in creating best practices, standards, metrics, and reporting.

(a) “Green” the financial system.

- Support open-access, standardized systems, and platforms for companies and financial institutions to report on environmental, climate, and sustainability performance.
- Promote better alignment of financial regulation with environment and climate change in regulated financial industries, e.g., insurance, banking, and investors, including supporting the development of disclosure regulations.
- Support the development of country road maps for greening finance flows, including those that help integrate measures and metrics of climate risk into financial flows.
- Support the establishment of national green finance institutions with the purpose of accelerating climate-smart investment.

(b) Support policies that provide for transparency, disclosure, and dissemination of climate risk in emerging markets and recipient countries.

- Support the creation and convening of international, country, and region-specific working groups to develop and pilot climate risk tools and analytical approaches. Working groups should be both sectoral, e.g., infrastructure, agriculture, or water sector, or multi-sectoral, and could coordinate with other standards-setting bodies, for example, the International Organization for Standardization (ISO).

(c) Expand support for high-impact, sector-specific regulations.

- Provide support for climate risk insurance pilots, especially in low-income countries where the insurance policy framework and the market are still at a very early stage.
- Support policies and regulations that require mobile phone companies to provide climate and weather information, for example, to promote good farming practices, and provide emergency warnings of extreme weather events.
- Support the creation and enforcement of building codes and land-use planning that integrates climate resilience.

(d) Develop a strategy for the circular economy.

- Food: In the short term, in addition to reducing food losses and wastes, improve the sustainability of the food-supply system through a more efficient use of resources, such as by reducing inputs per unit of food production while increasing productivity.

- Food: In the longer-term, take more ambitious action to develop agro-ecological systems and instigate innovative energy-smart and climate-smart production systems in order to reduce competition for productive land and freshwater and avoid further loss of soil fertility.
- Plastics: In the short term, mainstream circular economy concepts in the GEF's strategy. As criteria for priority setting and decision making, create an enabling environment and invest in projects, including non-fossil fuel feedstocks, using plastic wastes as a resource, redesigning plastic manufacturing processes, more recycling, and encouraging sustainable business models.
- Plastics: In the longer term, an all-encompassing solution to solve the global plastic problem requires measures to reduce demand and produce only essential plastic products, including through discouraging non-essential production and use of plastics and promoting the use of renewable and recyclable alternatives to plastics.

5. Institutional innovation

Changing access rights and management rules are often preconditions for halting overuse and degradation of natural resources. GEF projects could foster changes in institutional conditions to reverse resource degradation and to increase the efficiency of investments in the natural resource base with environmental benefits far beyond the given region.

- Support the transformation of outdated perceptions and customs that are inadequate for managing natural resources under new conditions
- Promote changes in existing formal institutions, their mandates, performance requirements, and reporting lines, as well as the establishment of new organizations in areas where new challenges cannot be adequately addressed by the existing ones.
- Support actors and processes related to social arrangements governing natural resource use to establish new incentives, interests, and benefit sharing schemes that foster sustainable resource use.

The GEF may wish to explore giving more focus to the role of institutions as contributors to an enabling environment for innovation. Since 2007, a consortium of public and private organizations with a shared belief in the importance of innovation for promoting economic development and solving global problems has produced an annual ranking of countries by their innovation capabilities and results⁶⁵. A key tenet of this effort is that it is possible to measure innovation capacity — the report is based on approximately 80 indicators — and that international cooperation, public-private partnerships, and national policymaking can improve prospects for innovation in developing countries⁶⁶. The report includes promising examples from Sub-Saharan Africa⁶⁷ and detailed case studies that provide additional insights into the types of actions that have proven effective in countries such as Singapore⁶⁸.

ENDNOTES

¹ This paper draws on a background paper commissioned by STAP: A.S. Miller and S.A. Swann, *Financing Innovation: Opportunities for the GEF* (Washington, DC: STAP GEF, 2017): <http://stapgef.org/financing-innovation-opportunities-gef>.

² The White House Office of Science and Technology Policy, “A Strategy for American Innovation,” Oct. 2015 (https://obamawhitehouse.archives.gov/sites/default/files/strategy_for_american_innovation_october_2015.pdf)

³ As noted in Eric Martinot and Omar McDoom, *Promoting Energy Efficiency and Renewable Energy: GEF Climate Change Projects and Impacts* (Washington, DC: World Bank, 2000); http://www.martinot.info/Martinot_McDoom_GEF.pdf, p. 7:

The GEF expects that technological learning and economies of scale (also called cost “buy-down”), achieved at least in part through GEF projects, will reduce long-term costs to commercially competitive levels. Such industrial “learning curves” have been documented for a range of technologies and have been applied to renewable energy technologies as well (Krawiec 1980; Christiansson 1995). This program assumes that when technology costs decline sufficiently, technologies will be adopted and replicated by the private sector. For many technologies in this program, the “buy-down” process will take many years or even decades; the GEF’s goal is to accelerate this process.

⁴ A STAP Review of OP 7 in May 2004 (GEF/C.23/Inf.16) concluded that promoting innovative low GHG emitting technologies should “remain fundamental to the GEF’s work” but recommended more focus on policy/enabling environment, less on “buying down” capital costs; more emphasis on partnerships with the private sector; and more long-term strategic commitments to address slippage.

⁵ GEF Independent Evaluation Office-IEO, “GEF Engagement with Private Sector,” par. 86.

⁶ Global Environment Facility-GEF, *Transfer of Environmentally Sound Technologies: Case Studies from the GEF Climate Change Portfolio* (Washington, DC: GEF, 2010; revised 2012), https://www.thegef.org/sites/default/files/publications/GEF-TechTransfer-lowres_final_2.pdf

⁷ Ibid.

⁸ <http://www.africa.undp.org/content/rba/en/home/ourwork/climate-and-disaster-resilience/successstories/ethiopia-climate-change.html> United Nations Development Programme-UNDP, *Climate Change Adaptation in Africa: UNDP Synthesis of Experiences and Recommendations* (Bangkok: UNDP, 2018), <http://www.undp.org/content/dam/undp/library/Climate%20and%20Disaster%20Resilience/Climate%20Change/CCA-Africa-Final.pdf>.

⁹ World Bank, *World Development Report 2016: Digital Dividends* (Washington, DC: World Bank, 2016). License: Creative Commons Attribution CC BY 3.0 IGO, <http://www.worldbank.org/en/publication/wdr2016>.

¹⁰ Such services are being facilitated in a growing number of countries by an NGO, Human Network International (www.hni.org).

¹¹ Maëli Astruc, “African entrepreneurs lead the way in climate change adaptation,” *WIPO Magazine* 6 (Dec 2016): pp. 12–19, https://www.wipo.int/wipo_magazine/en/2016/06/.

¹² Stephen Harper, “Big Data’s Big Handprint,” *The Environmental Forum* 34, issue 2 (March/April 2017): 22–27, chesapeakeconservancy.org/wp-content/uploads/2017/03/harper.pdf.

¹³ See Katie Nodjimbadem, “Born to be Wild: A species of oryx, once eradicated in the wild, shows signs of revival,” *Smithsonian Magazine* (April 2017), p. 19.

¹⁴ Swiss Re Group, “Insurance payout helps herders save drought-stricken livestock in Kenya,” 20 Feb 2017, http://www.swissre.com/global_partnerships/insurance_payout_helps_herders_save_drought_stricken_livestock_in_kenya.html

¹⁵ International Energy Agency-IEA *The Future of Cooling: Opportunities for energy-efficient air conditioning* (Paris: IEA, 2018), <https://doi.org/10.1787/9789264301993-en>.

¹⁶ Sustainable Energy for All-SEforALL, *Chilling Prospects: Providing Sustainable Cooling For All* (Vienna: SEforALL, 2018), <https://www.seforall.org/coolingforall/report>.

¹⁷ World Bank, “World Bank Group Commits \$1 Billion for Battery Storage to Ramp Up Renewable Energy Globally” (26 Sept 2018), <https://www.worldbank.org/en/news/press-release/2018/09/26/world-bank-group-commits-1-billion-for-battery-storage-to-ramp-up-renewable-energy-globally>.

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- ¹⁸ Global Environment Facility, “Novel Entities and the GEF,” <http://www.stapgef.org/novel-entities-and-gef>
- ¹⁹ Clustered Regularly Interspaced Palindromic Repeats. Genome editing or gene editing involves the use of biotechnological techniques to make changes to specific DNA sequences in the genome of a living organism, through DNA insertion, deletion, modification or replacement.
- ²⁰ Technology-critical elements (TCEs) include most rare-earth elements (REEs) - a group of 17 elements including the lanthanides, scandium, neodymium, dysprosium, terbium and yttrium; the platinum group elements, for example, platinum, palladium, rhodium, ruthenium, iridium, and osmium; and the elements gallium, germanium, indium, tellurium, niobium, tantalum and thallium. They are needed for many modern and green technologies such as electric cars, solar panels, and wind turbines
- ²¹ World Bank, *Innovative Finance for Development Solutions*, (Washington, DC: World Bank, 2010), <http://siteresources.worldbank.org/CFPEXT/Resources/IF-for-Development-Solutions.pdf>
- ²² GEF-6 Non-Grant Instrument web page (<http://www.thegef.org/content/non-grant-instruments>).
- ²³ Independent Evaluation Office-IEO Brief, “The GEF Nongrant Instrument” (March 2017). See also the IEO Brief, “GEF Engagement with the Private Sector (March 2017), both available at the IEO website (<http://www.gefio.org/>). <http://www.gefio.org/evaluations/evaluation-gef-engagement-private-sector-2017>
- ²⁴ International Union for the Conservation of Nature-IUCN, “New coalition launches to scale private conservation investment at IUCN World Conservation Congress” (3 Sept 2016), <https://www.iucn.org/news/new-coalition-launches-scale-private-conservation-investment-iucn-world-conservation-congress>; See also The Coalition for Private Investment in Conservation website at <http://cpicfinance.com/>.
- ²⁵ Convergence, “Seychelles Debt Conversion for Marine Conservation and Climate Adaptation Case Study” (1 Mar 2017), <https://convergence.finance/knowledge-detail/3p1S3pSTVKQYYC2ecwaeik>; see also The Seychelles Conservation and Climate Adaptation Trust website at <https://seyccat.org/>.
- ²⁶ Harvard Business Review Analytic Services, *Business Model Innovation in Emerging Markets: New Opportunities and Challenges* (April 2016), https://hbr.org/resources/pdfs/tools/17129_HBR_Qatar_White%20Paper_FNL.pdf, p. 2.
- ²⁷ Koffi Ekouevi, *Scaling Up Clean Cooking Solutions: The Context, Status, Barriers and Key Drivers* (Washington, DC: International Finance Corporation-IFC, 2013), p. 7 (<https://openknowledge.worldbank.org/handle/10986/26448>). Post-project studies have found that new stoves are often abandoned. See Marc Gunther, “These cheap, clean stoves were supposed to save millions of lives. What happened?” *Washington Post* (29 Oct 2015): “When journalist Meera Subramanian visited a village in northern India that had been declared “smoke-free” after a nonprofit distributed biomass cookstoves there, she found that women had stopped using the stoves because they didn’t like the design or because the stoves broke, burned more wood (not less, as intended) or didn’t get foods hot enough” (https://www.washingtonpost.com/opinions/these-cheap-clean-stoves-were-supposed-to-save-millions-of-lives-what-happened/2015/10/29/c0b98f38-77fa-11e5-a958-d889faf561dc_story.html?utm_term=.7b900d8d3e3d).
- ²⁸ Ekouevi, *Scaling Up Clean Cooking Solutions*. Partnerships with NGOs and social enterprises that have been able to devise very localized programs have had more success. One example is a Grameen Shakti program in Bangladesh combining soft credit, adaptive technology to lower costs, the maximization of income generation, effective after-sales service, and consumer-friendly options, such as a buy-back system.
- ²⁹ Peter Alstone, Dimitry Gershenson, Nick Turman-Bryant, Daniel M. Kammen, and Arne Jacobson. *Off-Grid Power and Connectivity: Pay-as-You-Go Financing and Digital Supply Chains for Pico Solar*, Lighting Global Market Research Report (University of California, Berkeley and Lighting Global, 2015): https://www.lightingglobal.org/wp-content/uploads/2015/05/Off_Grid_Power_and_Connectivity_PAYG_May_2015.pdf.
- ³⁰ Victoria Arch, “Pay-as-You-Go Solar Financing Can Finally Eliminate the Kerosene Lamp,” *Huffington Post* (18 Aug 2014): http://www.huffingtonpost.com/victoria-arch/pay-as-you-go-solar-financ_b_5689581.html
- ³¹ United Nations Development Programme-UNDP, Programme on Climate Information for Resilient Development in Africa, <http://adaptation-undp.org/projects/programme-climate-information-resilient-development-africa-cirda>.
- ³² From the Executive Summary, “While the hardware is relatively straightforward, it can only be applied fully and effectively if the public sector takes the lead to engage a new group of private-sector actors that are working in the climate and weather services space. From a big picture perspective, these partnerships provide an essential ingredient in supporting the enabling environment necessary to increase the sustainable uptake of end-to-end solutions. These partnerships can be leveraged to foster long-term support for the maintenance and integration of

climate monitoring systems within existing systems to guide national, sub-national and sector-based planning and budgeting, improve value propositions, and support sustainable revenue generation,” as quoted in the “Executive Summary” to the UNDP report by John T. Snow, Bonizella Biagini, Greg Benchwick, Georgie George, Joost Hoedjes, Alan Miller, and Jeremy Usher, UNDP, *A New Vision for Weather and Climate Services in Africa*, (New York: UNDP, 2016), <http://adaptation-undp.org/resources/communications-products/new-vision-weather-and-climate-services-africa>. The same challenges are likely to confront recently approved GCF projects for improving hydromet services in Mali and Malawi: see Green Climate Fund-GCF, “Status of the GCF Portfolio: Pipeline and Approved Projects” (CCF/B.15/Inf.10, Dec. 5, 2016; Table 4), https://www.greenclimate.fund/documents/20182/490910/GCF_B.15_Inf.10_-_Status_of_the_GCF_portfolio_pipeline_and_approved_projects.pdf/11512d24-3902-4840-82b5-dccd4395ff38. Cf. World Bank, “Modernizing Meteorological Services to Build Climate Resilience Across Africa” (10 Nov 2016), <http://www.worldbank.org/en/news/feature/2016/11/10/modernizing-meteorological-services-to-build-climate-resilience-across-africa> (describing multi-agency, multi-donor initiative to improve hydromet services in Africa with GCF support).

³³ GEF, *Taking Tropical Deforestation Out of Commodity Supply Chains*, (GEF brief, n.d.) https://www.thegef.org/sites/default/files/publications/GEF_Commodities-R3_0.pdf

³⁴ Lighting Africa website, www.lightingafrica.org.

³⁵ BloombergNEF, *Off-Grid Solar Market Trends Report 2016* (3 Mar 2016), <https://about.bnef.com/blog/off-grid-solar-market-trends-report-2016/>. Recent blogs by social impact investors have expressed conflicting opinions about the likely impact of Pay-Go business models, particularly for sales in low-density rural areas. See G. Neichin, D. Isenberg, and M. Roach, “An Impact Investor Urges Caution on the ‘Energy Access Hype Cycle’,” *Next Billion* (27 Mar 2017), <http://nextbillion.net/an-impact-investor-urges-caution-on-the-energy-access-hype-cycle/>; and C. Aidun, D. Muench, and R. Weiss, “Hype in the Energy Access Sector (Finally!),” *Next Billion* (6 Apr 2017), <https://nextbillion.net/hype-in-the-energy-access-sector-finally/>. The IFC and FMO, the Dutch development bank, recently announced an investment in a pay-as-you-go system for financing solar energy in east Africa with payments made by mobile money. See the IFC press release, “IFC and FMO investment in Mobisol helps deliver decentralized solar energy to East Africa” (12 Dec 2016), <http://ifcextapps.ifc.org/ifcext/pressroom/ifcpressroom.nsf/0/13D792D670B9CB768525808700362B80>

³⁶ GEF LDCF, FY15 Annual Monitoring Review of the Least Developed Countries Fund and the Special Climate Change Fund (GEF/LDCF.SCCF.20/04, May 12, 2016), par. 39, https://www.thegef.org/sites/default/files/council-meeting-documents/EN_GEF.LDCF_SCCF_20.04_FY15_AMR_LDCF_SCCF.pdf. See also the World Bank website for the South East Europe and Caucasus Catastrophe Risk Insurance Facility project, <http://projects.worldbank.org/P110910/south-east-europe-caucasus-catastrophe-risk-insurance-facility?lang=en>; and the UNDP website for the project, Scaling up Risk Transfer Mechanisms for Climate Vulnerable Farming Communities in Southern Philippines, <https://adaptation-undp.org/projects/sccf-farming-philippines>.

³⁷ As clean energy consultants Energy Innovation state, “policy is the *only* method to drastically reduce carbon emissions.” <http://energyinnovation.org/>

³⁸ The risk of high oil import costs in low rainfall years was separately addressed by a World Bank-supported insurance product, introduced in 2013, which was developed in cooperation with Swiss Re — potentially a business model for adaptation to climate change applicable to other parts of the developing world. World Bank press release, “The World Bank Partners with Uruguay to Execute Largest Public Weather and Oil Price Insurance Transaction” (19 Dec 2013), <http://www.worldbank.org/en/news/press-release/2013/12/19/world-bank-uruguay-public-weather-oil-price-insurance-transaction>.

³⁹ Joe Thwaites, “How Uruguay Became a Wind Power Powerhouse,” World Resources Institute-WRI Blog, (7 Mar 2016), <https://www.wri.org/blog/2016/03/how-uruguay-became-wind-power-powerhouse>; this summary is based on Michael Westphal and Joe Thwaites, *Transformational Climate Finance: An Exploration of Low Carbon Energy* (Washington, DC: World Resources Institute-WRI Working Paper, 2016), <https://www.wri.org/publication/transformational-climate-finance>.

⁴⁰ A feed-in tariff, or FIT, is a fixed price guaranteed for the production of specified sources of power supplied to the power grid, most often used to promote wind and solar energy technologies. A critical feature of such policies is that the price be guaranteed for a time period sufficient for investors to recover costs and generate a return, which in turn enables financing.

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- ⁴¹ International Finance Corporation-IFC, *Selling Solar: Lessons from More than a Decade of IFC's Experiences* (Washington, DC: IFC, 2007), p. 18, <https://www.ifc.org/wps/wcm/connect/b5c8428048855621b964fb6a6515bb18/SellingSolar.pdf?MOD=AJPERES>. “A supportive legal environment is essential and should include as many of the following elements as possible: no import duties or tariffs on SHS components; incentives for solar pv energy or absence of competing subsidized electricity; publicly disclosed long-term government electrification plans; and a legal basis for enforcing loan collection.”
- ⁴² See Westphal and Thwaites, *Transformational Climate Finance*. The paper reviews examples from Tunisia (fossil fuel subsidies undermine market for solar water heaters); South Africa (uncertain policies hindered RE investment); and Indonesia (geothermal development slowed by absence of leadership and fossil fuel subsidies).
- ⁴³ Global Environment Facility-GEF, *A New Climate for Forests: GEF Action on Sustainable Forest Management*, (Washington, DC: GEF, 2009), p. 11, https://www.thegef.org/sites/default/files/publications/forestry_3.pdf
- ⁴⁴ For an overview of BRT systems, see generally ClimateTech Wiki, Bus Rapid Transit systems, <http://www.climatetechwiki.org/technology/brt>.
- ⁴⁵ While there are non-trivial infrastructure costs associated with BRT systems, the recommendations of a 2002 STAP workshop and a 2003 urban transport strategy adopted by the World Bank identified support for the planning process as the most likely and effective role for the GEF. See Stephen Karakezi, Lugard Majoro, and Todd Johnson, “Climate Change and Urban Transport: Priorities for the World Bank” (2003), pp. 23-24 (<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.458.2822&rep=rep1&type=pdf>).
- ⁴⁶ Global Environment Facility-GEF, “Investing in Sustainable Urban Transport: the GEF Experience” (2009), <https://www.thegef.org/publications/investing-sustainable-transport-and-urban-systems-gef-experience>. By one count, the GEF has funded 33 projects with some support for BRT. ClimateTech Wiki, citing C. Huizenga and S. Bakker, Applicability of post-2012 mechanisms for the transport sector, Interim Synthesis Consultants Report, Asian Development Bank (ECN: 2010).
- ⁴⁷ Global Environment Facility-GEF, Earth Fund (<https://www.thegef.org/content/earth-fund>).
- ⁴⁸ Biodiversity and Agricultural Commodities Program (BACP), http://www.ifc.org/wps/wcm/connect/RegProjects_Ext_Content/IFC_External_Corporate_Site/BACP/
- ⁴⁹ See, for example, the GEF Press Release, “GEF is Greening the Cocoa Industry in Ecuador” (1 Apr 2011); <https://www.thegef.org/news/gef-greening-cocoa-industry-ecuador>.
- ⁵⁰ R. Sims et al., *A future food system for healthy human beings and a healthy planet*, Scientific and Technical Advisory Panel to the Global Environment Facility (Washington, DC: STAP, 2018), <http://stapgef.org/future-food-system-healthy-human-beings-and-healthy-planet>.
- ⁵¹ Barra et al., *Plastics and the circular economy*, Scientific and Technical Advisory Panel to the Global Environment Facility (Washington, DC: STAP, 2018), <http://stapgef.org/sites/default/files/publications/PLASTICS%20for%20posting.pdf>
- ⁵² GEF and UNDP, *Catalysing Ocean Finance Volume I: Transforming Markets to Restore and Protect the Global Ocean* (New York: GEF and UNDP, 2012), http://www.undp.org/content/undp/en/home/librarypage/environment-energy/water_governance/ocean_and_coastalareagovernance/catalysing-ocean-finance.html
- ⁵³ *Ibid.*, p. 10 (Figure 2).
- ⁵⁴ Christopher B. Barret, Katrina Brandon, Clark Gibson, and Heidi Gjertsen, “Conserving Tropical Biodiversity Amid Weak Institutions,” *Bio-Science* 51, no. 6 (June 2001): 497–502, https://www.researchgate.net/profile/Christopher_Barrett2/publication/228264694_Conserving_Tropical_Biodiversity_Amid_Weak_Institutions/links/0fcfd50cf0f576dfc7000000.pdf
- ⁵⁵ Monica Jain and Remy Garderet, *Towards Sustainable Fisheries Management: International Examples of Innovation* (New York: Marine Resources Assessment Group-MRAG, 2010), https://www.pcfisu.org/wp-content/uploads/2010/12/MRAG-report_best-practice-examples1.pdf.
- ⁵⁶ Pedro M. Herrera, Jonathon Davies, and Pablo Manzano Baena, eds., *The Governance of Rangelands, Collective action for sustainable pastoralism* (New York: Routledge, 2014).
- ⁵⁷ See, e.g., the website of the Partnership on Transparency in the Paris Agreement, <https://www.transparency-partnership.net/>. (“The Partnership promotes ambitious climate action through peer-to-peer learning on transparency and NDC implementation. It promotes best practice for enhanced transparency on GHG mitigation and adaptation strategies. It continues to serve as a platform for promoting the exchange of experience between

developing, emerging and industrialized countries in order to build mutual trust through transparency and to contribute to closing the ambition gap.”)

⁵⁸ John T. Snow, Bonizella Biagini, Greg Benchwick, Georgie George, Joost Hoedjes, Alan Miller, and Jeremy Usher, UNDP, *A New Vision for Weather and Climate Information Services in Africa* (New York: UNDP, 2016).

⁵⁹ Food and Agriculture Organization of the United Nations-FAO, *Innovative markets for sustainable agriculture* (Rome: FAO, 2016).

⁶⁰ Global Environment Facility Independent Evaluation Office, *The GEF in the Changing Environmental Finance Landscape*, Final Report of OPS6 (December 2017), <https://www.thegef.org/sites/default/files/council-meeting-documents/c-53-me-inf-01%20-%20DEC17.pdf>.

⁶¹ Global Environment Facility, *GEF-7 Programming*, Fourth Meeting for the Seventh Replenishment of the GEF Trust Fund, April 25, 2018, Stockholm, Sweden (GEF/R.7/19, 2017), https://www.thegef.org/sites/default/files/council-meeting-documents/GEF-7%20Programming%20Directions%20-%20GEF_R.7_19.pdf

⁶² See the United Nations Technology Innovation Labs, <https://until.un.org/content/about-until>.

⁶³ See the United Nations Global Pulse, <https://www.unglobalpulse.org/about-new>.

⁶⁴ D. O’Connell, N. Abel, N. Grigg, Y. Maru, J. Butler, A. Cowie, S. Stone-Jovicich, B. Walker, R. Wise, A. Ruhweza, L. Pearson, P. Ryan, and M. Stafford Smith, *Designing projects in a rapidly changing world: Guidelines for embedding resilience, adaptation and transformation into sustainable development projects*, Version 1.0 (Washington, DC: Global Environment Facility, 2016); and R. Bierbaum et al., *Integration: to solve complex environmental problems* (Washington, DC: Scientific and Technical Advisory Panel to the Global Environment Facility, 2018).

⁶⁵ Cornell University, INSEAD, and World Intellectual Property Organization, *The Global Innovation Index 2016: Winning with Global Innovation* (2016), <https://www.globalinnovationindex.org/gii-2016-report>.

⁶⁶ *Ibid.*, pp. xxiii-xxiv.

⁶⁷ *Ibid.*, pp. xxv-xxvi.

⁶⁸ *Ibid.*, pp. 133-39.