CLIMATE POLICY INITIATIVE

Designing Technical Assistance Activities for Adaptation and Resilience Companies

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Descriptors

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Keywords	Adaptation, resilience, climate finance, analytics, data	
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About CPI

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Executive Summary

There is a significant market opportunity for adaptation and resilience companies to help investors, companies, and government agencies to measure and manage their risks from climate change, including in developing countries. Global financial and economic losses from climate change reached USD 1.5 trillion between 2003 and 2013, USD 550 billion of this in developing countries. However, while companies that can help serve this market exist, they are not operating at the scale necessary to meet the needs.

This report focuses on understanding what would be needed for adaptation and resilience companies to expand in developing countries, specifically analytics, or intelligence, companies. Analytics companies help clients measure their potential impacts from climate change and identify measures to reduce them.

Companies in the adaptation and resilience sector face a set of barriers to expand in developing countries. These barriers can be grouped into:

1) Context barriers define the overall investment and business environment. These include lacking policy, institutional, and market environment, as well as missing human capital and value chains.
2) Business model barriers define the pace of consumer uptake of a new service or technology due to unclear value add of the technology, high costs, or missing technical capacity on the demand side to implement the technology.
3) Internal business capacity barriers define the internal capabilities of the business to successfully operate in a sector or geography and include, among others, financial and business management skills.

Technical assistance (TA) facilities can help address some of these barriers. These facilities are typically linked to investment vehicles, such as venture capital and private equity funds. They undertake targeted activities that would not otherwise be undertaken by fund managers to help unlock further investment on the ground.

We conducted two case studies to explore the above barriers on a company level, focusing on JBA Consulting, a company that offers flood risk management services, and Planalytics, a company that identifies, analyzes and applies weather intelligence to company decision-making. We also looked at 41 TA facilities to understand what lessons could be drawn for adaptation and resilience.

We applied this research to the design of a potential TA facility for adaptation and resilience companies, particularly those in resilience analytics. Such a TA facility would be linked to an adaptation and resilience private equity fund. It would work with companies to address the principal barriers they face, which are often related to lack of local knowledge and capacity to enter new developing country markets, and uncertainty among potential clients as to the value of their products. Barriers related to the investment context are also critical but can only be addressed in limited ways through TA facilities.

We recommend that a TA facility for adaptation and resilience companies consist of three support lines: Preparation, Partnerships, and Resilient Systems. Preparation activities would support companies to analyze the legal and regulatory requirements in developing country

contexts and prepare business plans as well as concrete projects to deploy their technologies. Partnership activities would support linkages with local stakeholders and potential business partners, and development of the broader local industry ecosystem. Resilient Systems activities would tackle targeted context barriers through one-off policy studies as well as development of methodologies to measure adaptation impact.

Critical to a TA facility is getting the governance right. The governance must address both the needs for efficiency and flexibility as well as development impact, and the weight on each of these factors could differ by support line. We recommend the Preparation support line be carried out by the fund manager, but the Partnerships and Systems support lines could have separate governance, though linked to the private equity fund to ensure relevance.

The next steps in the design of a technical assistance facility should include: 1) Advancing discussions among potential funders regarding their objectives and baseline requirements for the structure, governance, and eligibility criteria of the facility; 2) More detailed descriptions of individual support lines and activities, how they could be implemented, and how results would be measured, based on likely portfolio companies and their needs in target geographies; 3) Complementary work looking at the needs of resilience *product* companies, as this paper focuses solely on resilience intelligence companies; and 4) Demonstration of technical assistance provision through the implementation of pilot investments.

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1. Introduction

The frequency and magnitude of natural hazards triggered by climate change has been increasing globally, leading to USD 1.5 trillion in economic damages from 2003 to 2013. This creates a need as well as market opportunity for new adaptation technologies and services. However, especially in developing countries, a set of barriers prevents or slows down the uptake of adaptation technologies at the scale that is needed. Despite policy goals within the Paris Agreement calling for a scale-up of adaptation finance, only 5% (USD 22 billion) of climate finance in 2016 came from adaptation activities (Buchner, et al., 2017).

This report presents a systematic overview of barriers to adaptation sector growth in developing countries as well as set of activities that can start to address these barriers, executed by a technical assistance facility that would be used alongside a private equity fund to catalyze the market.

1.1 Context

Between 2003 and 2013, disasters triggered by natural hazards caused USD 1.5 trillion in economic damages worldwide, with USD 550 billion of these damages in developing countries. Floods and storms caused 90% of these damages, which are expected to increase in frequency and/or intensity due to climate change.

Different economic sectors have varying exposure to climate change. The agricultural sector absorbs 25% of the losses caused by climate related disasters. For example, in 2010, flooding in Pakistan caused USD 5 billion in agricultural losses and slowed sector growth from 3.5% to 0.2% as well as GDP growth from 2.8% to 1.6% (FAO, 2015). Beyond production losses, climate related disasters can have a significant impact along the food value chain, affecting the cost of agricultural commodities and sectoral growth. In the energy sector in the U.S. alone, the estimated economic cost from extreme weather related power sector service interruptions is between USD 25 and USD 70 billion annually. After Hurricane Sandy, power companies in the affected region allocated USD 1.3 billion to make power distribution infrastructure more resilient to climate change (OECD/IEA, 2015).

As agricultural, energy, and other economic sectors face increasing physical risks from climate change, there is a market opportunity to offer financial and analytical services and solutions to help customers both assess and manage these risks and reduce costs, particularly in developing countries.

There is a significant market opportunity to invest financial and intellectual capital to grow and scale companies that already have climate risk analysis capabilities or offer products and solutions to increase climate resilience. Investment is especially needed to bring existing technologies and solutions to new sectors, geographies, and users, particularly in developing countries.

1.2 Definitions

The report uses the following definitions to describe adaptation and resilience companies:

Resilience intelligence companies provide data analytics, modeling, forecasting, engineering, consulting, or other actionable, asset-specific information that helps *assess* risks and impacts exacerbated by climate change, so customers can manage those risks and impacts and become more resilient. Resilience intelligence includes, among others, climate and catastrophe risk modeling, weather modeling and forecasting, precision agriculture data analytics, climate resilience consulting, water efficiency analytics, supply chain management software, infrastructure risk analysis, and parametric insurance incorporating climate change impacts.

Resilience products & services companies help *address and manage* the risks and impacts exacerbated by climate change. This category includes, among others, flood abatement equipment and services; precision agriculture sensors and equipment; some irrigation technologies; drought resistant seeds and crops; micro-grid and energy storage systems for companies, communities and critical infrastructure like hospitals; business continuity services; and insurance services.

1.3 Objective

This report presents a systematic overview of barriers to climate resilience sector growth in developing countries, as well as a set of activities that can help address these barriers. It also proposes a design for a technical assistance facility that would be used alongside a private equity fund to catalyze the market.

The objective of this report is to provide insights into the design of a technical assistance facility that would be developed alongside a private equity fund focused on resilience companies.

The objectives of the report are to identify:

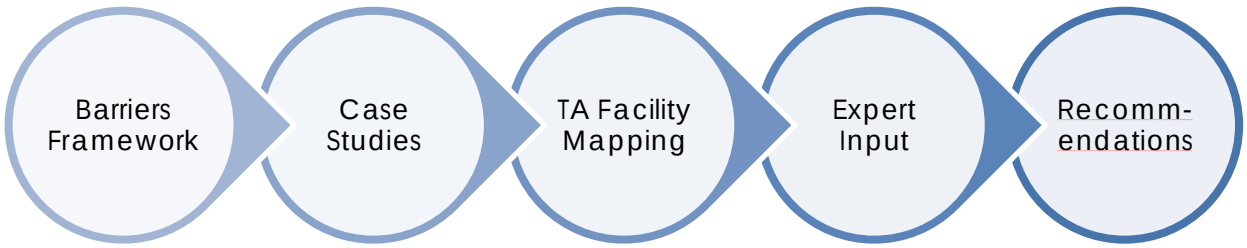
- Barriers to investment in climate risk management approaches
- Viable activities and facility structures to address these barriers
- Feasible options for the design of the technical assistance facility

While technical assistance is likely useful for both developed and developing countries, as well as for resilience intelligence as well as resilience products companies, this report focuses on facilitating expansion of climate intelligence companies in developing countries.

2. Methodology

To determine which activities are most needed to enable market development for adaptation and resilience products and services we (1) created a framework of barriers to the development of the adaptation market, (2) undertook two case studies to explore how companies experience barriers, (3) mapped existing technical assistance (TA) facilities to see how they address similar barriers, and (4) collected expert input. The multi-step process enabled us to define recommendations and structure them in a comprehensive framework.

FIGURE 1 STEPS TAKEN TOWARDS RECOMMENDATIONS



2.1 Barriers framework

The barriers framework is grounded in a literature review covering themes such as, but not limited to:

- Barriers to private equity investment in developing countries
- Barriers to commercialization of new technologies
- Barriers to business success
- Barriers to adaptation investment by businesses

2.2 Case studies

To help build the evidence base for technical assistance activities we interviewed representatives from two climate analytics companies to understand the barriers they face in expanding their business, especially in developing countries. We interviewed a business development manager from JBA Consulting, a flood risk assessment firm based in the UK and Ireland seeking to expand further in developing countries. We also interviewed business development and management representatives from Planalytics, a weather and supply chain risk analytics firm based in the U.S., also with developing country expansion plans. We sought to understand:

- Overview of the company
- Climate resilience impact of the product
- Overview of current and potential future customers
- Summary of company specific challenges to expanding

2.3 Mapping of TA facilities

We mapped 41 TA facilities and collected information on:

- Type of facility
- Facility objective
- Facility manager
- Facility size
- Amounts of finance provided by TA recipient
- Non-monetary TA support
- Funder
- Regional focus
- Barrier addressed

We executed deep dives into some of the more interesting and relevant facilities.

2.4 Expert input via interviews and workshop

To get a more thorough view on TA facility design as well as to gather feedback on recommendations we conducted expert interviews and a virtual workshop.

2.4.1 INTERVIEWS

To get additional insights on the structural design and the activities of TA facilities we completed interviews with the Seed Capital Assistance Facility (SCAF) and Grassroots Business Fund (GBF). The interviews were based on their viability as examples of TA facilities that are relevant to the design of a TA facility that could accompany a private equity fund.

The phone interviews followed a standardized but tailored script.

2.4.2 VIRTUAL WORKSHOP

An expert workshop was conducted virtually to gather feedback on the barriers framework and recommended activities.

3. Barriers Framework

New technologies and companies must overcome various barriers on the way to commercial uptake. We've categorized these barriers into three distinct types: First, market and regulatory context enables or limits growth. Second, new business models have characteristics that limit or enable growth. Third, companies, especially micro enterprises or small- and medium sized enterprises (SMEs) can have internal limits to growth due to lacking business tools. We have also specified how these barriers apply to climate resilience products and services companies.

3.1 Context specific barriers

Every market has properties that can enable investment or make investment more challenging. The most common context barriers to investment are lack of (1) policy environment, (2) institutional environment, (3) market environment, and (4) value chains and human capital (see *Error! Reference source not found.*). Context barriers apply to all businesses operating in a specific sector or location. These barriers are especially significant in developing countries where policy and institutional environments, as well as value chains, are not as developed as in Europe and North America (Divakaran et. al, 2014)

These factors determine the pace of sector growth. Any of these barriers prevent investment in the sector on the supply side as well as on the demand side.

TABLE 1 CONTEXT BARRIERS[1]

Barrier	Definition	Adaptation-Specific Barrier
Poor policy environment	Policy environment lacks conditions supportive to sector-specific investment (e.g. no requirements for businesses to implement disaster risk management strategies)	• Insufficient clarity from government on climate change legislation • Information on risk is not available or expensive
Poor institutional environment	Legal and regulatory institutions and infrastructure that support investment are lacking (i.e., property rights, contract enforcement, permitting, rule of law, etc.	• No specific barriers to adaptation found in literature but rule of law and intellectual property rights can be important when services are employed.
Poor market environment	Market environment is unsupportive to sector-specific and general investment (e.g., weak economy, unsophisticated financial institutions, weak historical track record of sector-specific investment, etc.)	• Lack of capital supply to adaptation companies, to adaptation companies, and to potential users of adaptation technologies and services • The lack of access to the right kinds of finance that could help the company prepare and cope with changes

[1] Source: Escalante et al, 2018

		• (Baglee et al, 2013)
Poor value chains and human capital	Environment lacks the organizations and people with needed capabilities for the investment to take place be successful (e.g. no sector-specific value chain or local sectoral expertise)	• There are no suppliers and distributors that are adequate to bring the technology to market • Adaptation companies need 'boots on the ground'

3.2 Business model barriers

The most common product- or service-specific barriers for commercialization are (1) uncertainty in the added value of the technology for the customer, (2) high technology cost, and (3) insufficient technical capacity (Whitehouse et al, 2017; Hall and Khan, 2002; MacElroy, 2011). While adaptation investments can make business sense, they are mostly of a cost-saving nature. This is often less attractive for investors than revenue generating investments (UNEP, 2016 in CIF and PPCR, 2016). Climate risk is often unclear to businesses; in developing countries specifically private actors have often less capacity to become familiar with risks, or to pay for climate resilience services (Trabacchi and Mazza 2015 in CIF and PPCR, 2016). Often a lack of information or asymmetric information limits businesses from preparing for climate change (Druce, et al., 2016). Error! Reference source not found. provides high-level definitions of the barriers as well as specific examples specific to adaptation technologies and services (see *Annex 8.2 Barriers* for further details on definitions).

TABLE 2 SPECIFIC PRODUCT BARRIERS

High-level barrier	Definition	Adaptation-Specific Barrier
No value-add	Value or benefit of the technology is not known to consumers or is uncertain	• Lack of understanding of the incentives and benefits of climate risk management • Lack of understanding of how climate change will affect individual profitability • Lack of information about technological solutions and options • Information is difficult to understand and too complex to apply to business needs (Baglee et al., 2013, CIF and PPCR, 2016, Biaginia, et al., 2013)
High cost	Upfront- and maintenance-cost of technology is too high	• High up-front cost of the technology • High maintenance costs • No direct (quantifiable) cost savings from the technology from day one of implementation • Insufficient budget to manage climate risk (Baglee et al., 2013, CIF and PPCR, 2016)

Lack of technical capacity	Prospective users of the technology don't have the technical capacity that is needed to implement or use the technology	• High skill level is required to use the technology to make it viable for the customer • Implementation of the technology is dependent (and thus constrained) on third parties (contractors, regulators, etc.) abilities • Insufficient staff (numbers, expertise, and time) and budget to manage climate risk • Insufficient access to insurance that could help companies protect themselves against weather-related risks (Baglee et al., 2013, CIF and PPCR, 2016, Biaginia et al., 2013)

3.3 Internal capacity barriers

The internal capacity of a business determines whether it is (1) investment ready (GSBI, 2017) and whether it has (2) the capacity to expand to new geographies or sectors, especially into developing countries.

In developing countries, a lack of investment-ready adaptation companies limits that potential supply of adaptation companies and services at scale. Micro-, small-, and medium sized enterprises (MSMEs) are often limited by internal capacities, especially in developing countries (Divakaran et. al, 2014). These internal capacity limitations include lacking financial records and information, lacking good governance, and lacking accounting functions, all of which add investment risk. Adequate management and financial planning capacities are basic requirements for a business to succeed in a market (Statistics Canada, 1997). These barriers make it difficult for private equity fund managers to invest as addressing these barriers requires much more financial and technical resources from a fund manager, potentially voiding the financial viability of the investment (Divakaran et. al, 2014).

Existing adaptation and **resilience companies don't have the internal capacity to expand** to developing countries. A complex investment environment and diverse local cultural contexts make it difficult for adaptation and resilience companies to expand from developed to developing countries. The ability to successfully provide existing adaptation services and products to developing countries often depends on a local branch or close partnerships/ joint ventures (JVs) with local organizations. Often, medium sized companies don't have the internal technical capacity and resources to set up adequate structures. Private equity funds can help companies connect to local partners but it is often a challenge to find a partner with appropriate financial, legal, and technological capacity.

TABLE 3 INTERNAL CAPACITY BARRIERS

Barrier	Definition	Example
Lack of internal capacity	Internal management & operational capabilities of the company are insufficient to meet goals	General management Organisational structure that is not cohesive and inefficient, preventing the company to work towards goals effectively (KPMG, 2013).
		Financial management Lacking ability of a business to manage its finances; meet its debt obligations and return capital to its investors (KPMG, 2013 & GSBI, 2017).
		Marketing capabilities A successful marketing team collects, understands, and applies its customer data effectively; positions the brand purposefully, understands functional benefits of the product, emotional benefits, and societal benefits (e.g. sustainability), and creates a customer experience (De Swaan Arons et al., 2014).
		Poor management of human resources Hasty hiring and inaccurate job descriptions, neglect of training and professional development, neglect of performance reviews, inadequate HR policies, or incorrectly set incentives for employees (Zanfardino 2017 and KPMG 2013).
		Inability to innovate Lacking innovation relating to product development, marketing, or staff welfare will let a business fall behind competitors (KPMG, 2013). Inventiveness is also needed to expansion to new markets.
		Poor operations and production Low quality product or slow production. Operations that are not scalable (GSBI, 2017).

4. Case Studies: Barriers from a Company Perspective

We interviewed representatives from two climate analytics companies – Planalytics and JBA Consulting, to understand more about how their companies currently help clients improve climate resilience, and what barriers to expansion in developing countries they face.

4.1 Planalytics

Context

Businesses serving consumers directly make up 60% of global GNP, and emerging markets' share of world consumption is projected to grow from 20% in 2010 to nearly 40% in 2020 (S&P Global Ratings, 2016). Weather is one of the largest external variables impacting a consumer-focused business by shifting consumer buying behavior. More simply: depending on the weather, we are driven to buy, or not buy, certain goods and services.

Overview of Planalytics

Planalytics is a leader in "business weather intelligence", analytics that help companies throughout the supply chain to assess and address how the weather impacts their business. Their products and services help companies measure and manage the impact of weather throughout all facets of an organization. Planalytics was founded in the U.S. in 1996, and expanded into the UK in 2001. Today, Planalytics also serves customers in Europe, Mexico, and Latin America. The company has two primary business segments: consumer demand and agricultural supply technologies.

For the consumer segment, Planalytics provides insights to help companies measure and manage their exposure to changes in weather. The company helps to understand and quantify precisely the impact of weather volatility on transactions by time period and location. These analytics provide much needed transparency into an organization's true performance, enabling companies to accurately report weather-adjusted sales, effectively plan future demand, allocate resources, optimize replenishment. The result is improved operational effectiveness, increasing revenue, and mitigating costs. Planalytics consumer clients include major global companies in the consumer packaged goods industry such as Unilever and Coca-Cola, retailers such as Kohl's, Ace Hardware, Ross Stores, Debenhams, and Tractor Supply Co, restaurants such as Starbucks and Subway, and companies in the logistics, utility, agricultural, and financial sectors.

Through data integration, Planalytics can incorporate weather analytics into core technical calculations of these businesses including planning, allocation, and replenishment, labor scheduling & reporting. The company has integration partnerships with leading global enterprise software companies JDA Software and Oracle, and can integrate with SAP, SAS, Logility and many others.

Planalytics' agricultural technology segment is another application of the company's analytical approach. Through a joint venture with the Kansas Atmospheric Research Center at the University of Kansas, the company has commercialized a highly accurate crop yield

and supply forecast model for crops and crop inputs. Planalytics is expanding that model globally to provide the ability to measure, track, and project the world's agricultural supply chain. This will allow an agricultural business in one region of the world to understand how weather and other factors are affecting yields in other regions, and make business decisions on this basis.

Climate resilience impact of the product

Resilience is typically understood as the ability of a system to absorb shocks and rebound quickly (Avory et al., 2015). Climate resilience therefore focuses on the response of a system to climate change impacts.

Currently, Planalytics' impact on climate resilience is focused on understanding how the climate is evolving and helping businesses translate that information into short-term decision making, in line with the short-term planning needs of most businesses. For example, in emerging markets, distribution channels often lack resilience to climate impacts. Infrastructure is often inadequate to reach customers quickly in the event of abnormal weather. In India, Planalytics helped Coca-Cola understand that a particular season would lead to higher product demand in that year due to hotter and drier conditions. Coca-Cola adjusted their mix and inventory planning, sending more product through its distribution channels so that customers would not experience shortages in the heat. Across the company, Coca-Cola estimates it loses USD 1 billion in revenue a year due to its goods being out of stock when a customer would otherwise buy its product. The company estimated that this project as well as a similar effort in Japan increased profits by USD 2 million in one year alone.

As the climate changes, Planalytics is also exploring opportunities to help companies with long-term scenario planning – to answer questions like, "what do rising temperatures mean for my ice cream business?", "how could climate change affect my supply chain?", and "what does decreasing precipitation mean for my manufacturing footprint?" These types of services would contribute significantly to improving the long-term resilience of businesses globally.

In addition, as mentioned above, Planalytics is building out a global yield model and crop forecasting capabilities. For example, a poor rice yield due to drought or floods in Southeast Asia could encourage Brazilian rice farmers to plant more than originally planned. These types of analytics will help reduce supply and price volatility in global commodity markets, reducing food shortages and/or price spikes that disproportionately affect low income consumers. Over time, this type of model could also help understand how yields are changing in the face of climate change, and inform decisions about where to plant which crops.

Barriers to **Planalytics'** expansion in developing countries and opportunities for technical assistance to help address these barriers

Barrier 1: Building demand for climate resilience products and services in emerging markets

Most companies do not already deploy weather-based analytics. As laid out in Section 3: Barriers Framework, for many companies there is a lack of awareness of technical effectiveness or of the financial impact of climate change on individual businesses. Further, given variations across countries in how weather affects local preferences and buying habits, examples of successful application of a technology in a developed country might not be perceived as relevant for developing country customers.

Planalytics sees "market making" as the primary product-specific barrier to the pace of its global expansion. Market making is the need to educate potential clients about the significant bottom line value that investments in climate analytics can generate.

Therefore, a key task for Planalytics and similar companies is to educate potential clients about the technical viability of the technology as well as the significant bottom line value that investments in climate analytics can generate. Planalytics specifically highlighted the difficulty in convincing potential clients of the benefits of its product as a significant barrier.

Several categories of technical assistance can be effective in addressing this barrier:

a) Climate impact studies

In developing countries, information on the magnitude and likelihood of climate risk on businesses is often not widely available or actionable. Climate impact studies for selected developing economies can help to address a lack of information and form an evidence base for further company-specific analysis. For example, the IFC and EBRD supported a study that identified Turkey's climate risk and adaptation needs, as well as opportunities for the private sector to address climate risk (see Baglee et al., 2013). A similar approach could be taken in other developing countries. Planalytics and other resilience and adaptation companies could use these studies to tailor the services they offer to individual regions or sectors, or to support the business case for uptake of their products.

Such studies could be widely disseminated to relevant stakeholders in the public and private sectors.

b) Demonstration projects

A product demonstration – working with a local company, with real data – can help to convince that company, as well as its peers, that a product will deliver the results it promises. Demonstration projects have been a common tool to prove the technical or commercial viability of new technologies or new approaches to sustainable development. For example, public investors have financed some of the first solar energy projects in El Salvador to demonstrate commercial viability. In addition, a demonstration project could help a company like Planalytics understand how its technology would need to be adapted

for local circumstances. If the demonstration occurs with the participation of a broader business association, it could provide a channel for disseminating the results of the demonstration to a broader group of similar businesses.

Technical assistance could finance the implementation of such a demonstration project and could disseminate the findings via a case study to businesses and financial institutions.

c) Awareness campaigns

The findings from climate impact studies and demonstration projects could be synthesized and disseminated widely in the public and private sector. The campaign could focus on translating findings into actionable recommendations and strategies for small- and medium sized businesses (SMEs). Communication products could focus on specific industries or regions.

Technical assistance could finance an awareness campaign disseminating information about climate risk and available risk mitigation strategies.

Barrier 2: Increasing climate resilience impact of products and services

In addition to addressing barriers related to market uptake of its existing product, technical assistance could also help Planalytics improve its climate resilience impact through further development of its technology or adapting its product for new, vulnerable users.

a) Improving technology for use in long-term planning.

Some Planalytics clients with global footprints are interested in understanding how long-term climate change will affect their businesses, including their supply chains.

Technical assistance could help Planalytics partner with one or more interested companies to improve its existing technology to analyze longer term and more uncertain challenges and recommend ways to manage these risks. Specifically, technical assistance could support trials of long-term forecasting with companies with significant developing country footprints. Further, technical assistance could support the dissemination of learnings from these trials to raise awareness of the financial and non-financial business benefits of long-term planning. This could (1) accelerate the uptake of such services in developing countries as well as (2) accelerate the learning curve for such longer-term models to achieve high-quality results.

b) Developing products for underserved markets

Planalytics' global yield and crop forecast model is currently being tested in Brazil with large agribusinesses. Yet its impact could also be important for individual farmers or cooperatives, who may have less access to technology. There could be an opportunity for technical assistance to support Planalytics to work with less commercially viable clients to help them increase their resilience to climate impacts. Technical assistance could help Planalytics build a tool that helps individual farmers and cooperatives to access valuable information from the yield model the company is currently building for Brazil. This could help farmers in the country improve their ability to adapt to climate change.

As an example, the African Agriculture Fund (AAF) Technical Assistance Facility works with portfolio companies on strategies to reach poor consumers and retailers. One impact of this innovation support has been a new business model for a company that has transformed the company's approach to sales (Smith et al., 2017).

4.2 JBA Consulting

Context

By 2030, river floods are expected to affect 33 million more people per year than they do today, a 2.6x increase. Climate change will bear the primary responsibility for this change (Luo et al., 2015). In fact, climate change is already impacting livelihoods – for example, in response to the recent Indian monsoon that led to the deaths of over 1,000 people, a leading Indian scientist noted that "Floods in the time of drought are India's new normal"(Narain, 2017).

As developing countries continue to grow economically and build infrastructure and other assets, reducing risks from climate change will be imperative. For example, the World Resources Institute estimates that "India's current $14 billion in GDP exposed [to flood risks] annually could increase more than 10-fold to $154 billion in 2030" (Luo et al., 2015). This financial exposure also signals a market opportunity to help countries like India mitigate the risks.

Overview of JBA

JBA Group is an environmental, engineering and risk group. Among others, the company has built significant expertise in flood risk assessment and management. It is a provider of catastrophe models, flood-related data, and flood hazard maps with coverage in all countries worldwide. The company works with public and private sector clients, including local and national governments, international organizations, and insurance companies. The company was founded in 1995 and restructured in 2011 to form the JBA Group, allowing the company to maintain specialist skills and expertise while expanding its breadth. Based in the UK and Ireland, the company has recently expanded internationally, opening offices in the U.S., Singapore, Australia, Romania, and Cambodia. It is a mid-sized company with 450 staff.

Climate resilience impact of the product

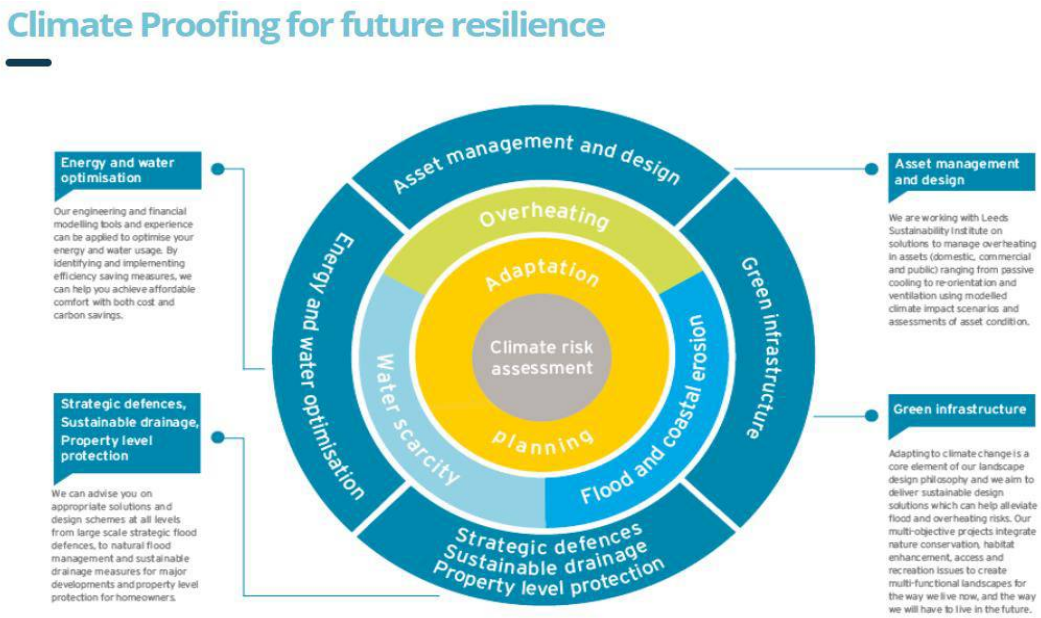
Like most risk assessment services, JBA's flood risk models are based on current levels of risk. For many geographies in which climate change impacts are already being felt, these types of services can be beneficial for climate change adaptation. In addition, JBA has developed risk assessment services that project future climate change scenarios and their potential impacts on flood risks (see Figure 1 for depiction of JBA's climate resilience services).

For example, in Suriname, JBA conducted a coastal resilience assessment for the city of Paramaribo on behalf of the World Bank. The study looked at coastal flooding and erosion

risks and different solutions to address these risks, including the role of mangrove forests, to inform the development of an investment plan.[2]

In Cambodia, the JBA Group has established a subsidiary, Mekong Modeling Associates, a consultancy focused on rivers and water management. One of their recent studies looked at the characteristics of storm surges affecting the Mekong Delta, and carried out flood simulations to identify priorities for further studies. The study found that extreme surge is a key risk and noted the importance of furthering understanding including in the context of climate change.[3]

FIGURE 2: JBA'S CLIMATE RESILIENCE SERVICES



Source: JBA website, https://www.jbaconsulting.com/what-we-do/climate-change/

Barriers to JBA's expansion in developing countries and opportunities for technical assistance to help address these barriers

Barrier: Building demand for large-scale climate risk assessment services in emerging markets

Despite the growing need, many barriers remain to the uptake of flood risk assessment services. Foremost, the public sector is a key client for many potential applications of risk assessment, due to its unique role in infrastructure and planning decisions, but the public sector faces several barriers to supporting the development of risk assessments. These can include lack of technical capacity to implement risk assessments internally or procure high quality risk assessments from specialist companies; high upfront costs of developing new models; and political barriers that prioritize investments with quick, visible payback periods. As a result, often international development finance institutions that invest in infrastructure

[2] https://www.jbaconsulting.com/knowledge-hub/suriname-coastal-resilience-assessment/#
[3] http://www.mmassociates.asia/projects

are themselves the clients for risk assessment services – but this does not necessarily create long-term capacity in the country.

Furthermore, while not universal, most catastrophe risk modeling companies are based in developed countries and have had many years of experience serving the insurance sector as well as governments, among others.[4] However, according to JBA, it is difficult for them to compete for government contracts in developing countries as most require a local company to execute the project and value local expertise in understanding risk.

There is a need to bridge the gap between the more established, international risk assessment firms with sophisticated technical capabilities, such as JBA, and local service providers in developing countries that may have access to highly specialized data, understanding of local contexts, and connections to local clients.

Several categories of technical assistance can be effective in addressing this barrier:

a) Partnerships and technical advisory to build local capacity and support technology transfer to developing countries

Partnerships and other demonstration projects could help build local capacity and understanding, including within ministries, to use risk assessments. For example, groups such as the Risk Management and Measurement Group of the Insurance Development Forum have proposed to develop open source risk models in collaboration with local and international academics, policy makers, and companies.[5] Oasis, another initiative, is seeking to catalyze the market for risk assessment in similar ways, including through a project in Southeast Asia.[6]

Technical assistance funding could support these or more targeted initiatives to build markets for risk assessment. It could also help to assess potential joint ventures or regulatory requirements to help reduce transaction costs for portfolio companies to enter specific new markets.

b) Innovative payment mechanisms

Innovative payment mechanisms could help reduce the upfront costs for developing new risk assessment capabilities. At one end of the spectrum, a technical assistance facility could pay for, or co-finance, the procurement of risk assessment for a prospective client. Or, technical assistance could help design a new business model for a portfolio company to distribute revenues over a longer period, for example a move to a Software as a Service (SAAS) model. It could also work with multiple potential users to share development costs.

[4] See https://www.climatefinancelab.org/wp-content/uploads/2016/01/Oasis-Report.pdf for more discussion on barriers to expansion of catastrophe risk modeling in Southeast Asia.
[5] See workstream 5 of http://theidf.org/rmmg
[6] https://www.climatefinancelab.org/project/climate-risk-assessment/

c) Policy analysis

A key driver of demand for risk assessment is policy. Examples of policy that influence demand through market "pull" mechanisms include, among others, requirements in public infrastructure design and development to screen projects for resilience to disaster and climate change, and mandates or incentives for property catastrophe risk insurance, including the establishment of national risk pools.[7]

Technical assistance can help identify gaps in policy frameworks or opportunities for reforms that support risk assessment and mitigation through publicly-disseminated policy studies.

[7] See, e.g., discussion of the potential impacts of the Oasis Platform https://www.climatefinancelab.org/wp-content/uploads/2016/01/Oasis-Report.pdf

5. TA Facilities: Rationale & Structure

As described in the previous section, there are significant barriers to expansion for adaptation and resilience companies. These barriers include context barriers, business model barriers, and internal company capacity barriers.

In the past, technical assistance (TA) facilities have shown that they are a valuable tool to address similar barriers. They can help unlock private investment as well as support blended finance vehicles (Enclude, 2017). TA facilities can have a wide range of purposes. Four high-level objectives are to (1) address market failures, (2) reduce capacity gaps, (3) increase development impact, and (4) decrease investment risk.

5.1 Technical assistance models

Our mapping of technical assistance activities found that there are four archetypes of technical assistance models that operate in combination with funds such as venture capital and private equity funds; (1) the Venture Capital (VC) Model, (2) the Standalone Technical Assistance Facility (TAF), (3) the One-off Activity, and (4) the Strategic Partnership (Divakaran et al., 2014 and Adams et al., 2016 and Enclude, 2017). However, there is a wide range of hybrid models that use a mix of properties from these 4 archetypes.

TABLE 4 TECHNICAL ASSISTANCE MODELS

Model	Properties	Example
Venture Capital (VC) Model (integrated)	Provides TA as fully integrated service of a fund • TA funds are managed by fund manager as part of regular portfolio management • Services can be covered by management fees or by a grant pool • Services are solely related to investee companies • Used with small portfolio of companies	• Grassroots Business Fund (GBF) • BainCapital Double Impact Fund • Ethos
Standalone Technical Assistance Facility (TAF) (Independent/ linked)	Provides TA through an independently managed facility • Funded by grant funding other than fund investors • Managed independently from the fund • Can be linked to the fund with strong co-ordination between the fund and TA facility OR can be independent from links to a specific fund • Specific development objectives beyond financial concerns • Funds projects related to investment activities when fund management fees are insufficient to cover services as part of business as usual • Funds other activities aligned to its objectives that don't directly impact companies invested by the main fund • Services can be provided on a cost-sharing or pure grant basis	• Seed Capital Assistance Facility (SCAF) • African Agriculture Fund (AAF) • LeapFrog Investments • US India Clean Energy Facility (USICEF) • US Africa Clean Energy Facility (USACEF)

One-off activity	Any type of activity that is financed by donors as part of a bigger TA initiative. • Procured directly by the donor and not by the technical assistance facility • No facility is set up	• Mercer Study on Investing in a time of climate change (Mercer, 2015) • IFC Turkey Market Study (Baglee et al, 2013)
Strategic Partnership	Private Sector Partnership or Public Private Partnership (PPP) • Models vary • Actors with common or related objectives coordinate to leverage capabilities of individual partners for the benefit of the whole group • More common in well-developed market economies with a stable institutional and policy environment and established direct or indirect relationships between public and private actors	• Department of Energy Small Business Voucher Program • NREL Commercialization Assistance Program

5.2 Summary of advantages & disadvantages specific to TA models

Each of the models introduced has its advantages and risks that should be considered when choosing a model to address barriers to the development of the adaptation and resilience market. We summarized some of the most significant thoughts for the models below; see Annex 2 for further case studies of several technical assistance facilities.

1. VC Model

The VC model is mainly used when the portfolio of investments is small and when investments are of larger size in more **mature companies or projects that don't need** significant amounts of support. The VC model is highly resource intensive for fund managers because it puts the burden of operational support on fund managers. Further, a diverse portfolio makes it more difficult to use this model, as fund managers would need a large range of skills to cover the varying needs of the investments.

2. The Standalone TA Facility

Because the standalone TA facility is managed separately from the fund, it can reduce the risk of conflicts of interest when investors or donors want to see both financial returns and development impact. While a fund manager in the VC model can have a development objective, it can be difficult to balance financial and development interests when investors want to see adequate financial returns. This enables the fund manager to focus on returns while the TA facility can focus on development additionality (Enclude, 2017).

Second, a standalone TA facility is more flexible in its interventions and can pursue market development activities on a larger scale because it can focus on market development activities beyond investee company needs. This is an advantage in early stage markets that need a large set of different interventions to foster the right environment for investee companies and technologies to succeed. For example, while the TA facility of Grassroots Business Fund is limited to support investees and to share their learnings with the wider

investment and development community, DevCo, the TA facility of the Private Infrastructure Development Group (PIDG) addresses context barriers, technology barriers, and company barriers depending on needs.

An important factor to consider for the design of a standalone TA facility is whether to closely link it to a private equity fund if the aim is for the TA facility to support the investments of the fund. For example, DevCo is an independently managed TA facility that is housed in the Fund (CEPA, 2016). This has ensured the support of the facility is highly relevant to investments as the facility can provide timely support with a better understanding of challenges of investees and how they could be addressed. The TA facility of the African Agriculture Fund is another independent facility that is joined physically and operationally into the fund. The facility is located in the fund manager's offices and the fund and TA facility share access to information and ongoing relationships with investee companies. This hybrid is made possible by the development minded fund manager and the TA team that understands both business and development (Phatisa, 2017). Overall, these two facilities have been very effective in supporting fund investees. However, they have not implemented activities that affect the wider investment environment and market development of the sectors the funds operate in.

A risk of standalone TA facilities are information and decision time lags. If a standalone facility is set up separately from a fund, it will take time for information to move from the fund to the TA facility. For example, the TA facility of the AAF Fund addressed the needs of investee companies after the fund investment had been made and this created a time gap between investment and the point where the investee companies needs were understood and activities undertaken (Phatisa, 2017).

Enclude (2017) highlights the advantages of a standalone technical assistance facility, provides a useful overview on technical assistance facility design considerations, and points out that the linked TA model is especially effective in catalysing investment and pipeline building.

3. One-off activities

One-off TA activities can complement the activities of a TA facility. Depending on the size and the scope of a TA facility, these activities may be too large or out of scope for the TA facility to undertake or tender out. The UK, for example, designed the TA programme for its Climate Public Private Partnership (CP3) to have three components. It included a study on institutional investors' awareness to climate change risk exposure by Mercer, a policy development programme to develop power purchase agreements in developing countries, and an ongoing TA facility called the Seed Capital Assistance Facility (SCAF). The study and the market development grant to develop power purchase agreements are one-off activities that were out of scope of SCAF.

4. Strategic Partnership Model

Strategic partnerships can be a useful strategy to build sector capacity across a larger set of local institutions. There is no defined structure for the strategic partnership model. Adams

et al., 2016 introduce several examples of this model in their report on approaches to accelerate clean energy commercialization. Strategic partnerships can undertake similar market development activities as a TA facility but often the partners provide their own technical capacities to undertake the activities. For example, the Department of Energy Small Business Voucher Pilot Program aims to help SMEs in the clean energy sector to tackle the technical challenges inherent in commercializing new technologies. To do so, the DOE provides vouchers of USD 50,000 to 300,000 to businesses that can be exchanged for access to DOE laboratories to help start-ups test, validate, and roll out new products. This initiative is funded by the DOE with USD 20 million. The National Renewable Energy Laboratory (NREL) Commercialization Assistance Program also assists entrepreneurs in overcoming technical barriers by providing 40 hours of free assistance. Both examples take place in the U.S. where a strong start-up environment and supporting institutions exist. However, they show an opportunity to leverage the capacity of existing institutions to support the commercialization of new products and services. There is a case to be made to think about opportunities to incorporate public research institutions into a larger TA programme that provides companies with access to their capacities.

5.3 Matching TA Models & TA Objectives

The model via which TA is provided is very important to meeting intervention objectives. Reviewing 41 TA facilities as well as literature, we matched the four models with the barriers we laid out in Section 3 Barriers Framework.

We found that:

- Internal capacity barriers are mostly addressed by the venture capital model in which TA is provided by a fund manager investing in a company, as well as by standalone TA facilities working directly with companies (Divakaran et. al, 2014 and Phatisa 2016).
- Business model barriers are also mostly addressed by the VC model and standalone TA facilities, but one-off activities are also used to address business model barriers on a high level, such as through market studies or awareness campaigns.
- Context barriers are usually addressed by large-scale one-off activities as well as strategic partnerships with key stakeholders in the sector. However, the sub-barrier human resources & supply chains are addressed by standalone TA facilities that aim to build capacity in the sector via workshops and training.

5.4 Typical Activities

We mapped 41 TA facilities to get an overview of the types of activities that different facilities offer to address barriers. The list is not exhaustive but aimed to show which types of activities can be used to support market development.

9 of 41 mapped TA facilities focus on building context capacity to address systematic barriers to growth. Interventions that address the larger investment environment can be part of a bigger program that also provides tailored support to businesses or they can be independent from company specific interventions. For example, the UK has financed a one-off activity to improve the energy sector policy environment in African countries while

also investing in SCAF, a TA facility working to build investment pipelines for renewable energy investors in Africa. SCAF and the one-off policy development TA were part of the TA package of the UK's CP3 programme.

Currently, the main barriers for creating more comprehensive adaptation policy frameworks are (1) limited understanding of adaptation policies and implementation, (2) limited co-ordination among public institutions, and (3) limited institutional and technical capacities to ensure the sustainability of the initiatives requires (Baglee, et al. 2013).

TABLE 5 EXAMPLES FOR ACTIVITIES ADDRESSING CONTEXT BARRIERS

Barrier	Activity	Facilities providing these activities
Policy environment	• Work to create sector specific regulation and policies • Policy support to demonstrate commercial viability	• CP3 Policy Support • Infrastructure Development Collaboration Partnership Fund (DevCo of PIDG)
Institutional Environment	• Sensitization of financial institutions and creation of a suitable atmosphere for sector lending • Supporting financial institutions in further developing lending to sustainable businesses as a viable portfolio segment (via marketing campaigns for example) • Capacity building and training projects tailored to the needs of financial and non-financial partner institutions	• CREI (Commercializing Renewable Energy in India) • Eco.business fund Development Facility
Market environment	• Feasibility studies for the development of innovative local currency financing vehicles • Market data collection, financial analysis and cash flows statements with experimental market data • Knowledge Sharing on insights and learning • Studies on Market Resilience • Market assessments • Replicating and scaling of successful pilot projects	• CREI • GBF (Grassroots Business Fund) • IFC Turkey Market Resilience Study • Proadapt
Value chains and human capital	• Developing networks of qualified dealers • Tailored Training programmes • Assist farmer (or other) associations in organisational development, training of leaders, formation of core committees or divisions and installation of good governance models	• CREI • AAF (African Agricultural Fund)

Feasibility studies, business risk assessments, and market studies can help the private sector to address adaptation knowledge gaps. Knowledge gaps are significant barriers preventing the private sector from integrating climate risk into their businesses. Feasibility studies have been used to assess activities and business models that address the climate vulnerabilities of specific supply chains to build demand (CIF and PPCR, 2016). Further, building value chains and human capital is crucial to growing the adaption sector. Collaborative work with key stakeholders can mitigate project risk and scale investments (CIF and PPCR, 2016).

11 of 41 mapped TA interventions focus on addressing business model barriers.

We found that activities that address business model barriers are usually provided to individual companies and address the technology barrier from that company's perspective. However, there are still a number of interventions that address technology specific barriers on a basis that can benefit all actors in the field rather than being limited to an individual company. For example, while TA can cover feasibility studies for the project of a specific company, it can also cover large scale feasibility or market studies that benefit a wide array of companies in a sector.

TABLE 6 EXAMPLES FOR ACTIVITIES ADDRESSING BUSINESS MODEL BARRIERS

Barrier	Activity	Facilities providing these activities
Value-add of the technology	Prove added value of the technology through • Developing demonstration projects • Technical studies • Product development and testing • Impact Studies • Awareness campaigns	• CREI • Eco.business fund • Proadapt • ICEF
Technology cost	Reduce technology cost or cost to enter a new market by • Support banks to become more comfortable in financing the technology as well as with blending for public and private finance (via training or incubation funds) • Strategic seed and development financing & ongoing financial support • Development of products and distribution models which are socially valuable but not yet commercially feasible • Providing capital grants to cover viability gap funding to address commercial viability in economically viable project • Technical studies and project development • Legal support for due diligence	• CREI • Innovation Incubator Program (IN2) • SCAF • Leapfrog Financial Inclusion Fund • EU-AITF (Africa Infrastructure Trust Fund) • Infrastructure Development Collaboration Partnership (PIDG DevCo) • AgDevCo • ICEF • ACEF • Ecobusiness fund • Proadapt
Consumer capacity	Work with potential user groups to build awareness and skills required to use technology.	• CREI • Proadapt

27 of 41 mapped TA interventions focus on building internal company capacity. TA that is provided to companies can be provided alongside a financial investment. If so, TA can be provided before or after the investment. If the TA is provided before the investment or access to debt finance it is used to get the company or project to a project where it is eligible to receive finance via debt or equity. If the TA is provided as part of the investment

or after investment, it is used to reduce transaction costs and to increase the development impact of the investment respectively.

Partners in Food Solutions, Terra Bella Colombia Fund TAF, SEAF Bangladesh, and SCAF help private equity funds with pre-investment TA and pipeline building as pipeline building is a challenge in developing countries where companies often lack the high financial, operational, and management standards that private equity investors require (Divakaran et. al, 2014). Pipeline building can refer to a team of consultants actively searching for investments that fit into the scope of the investment programme and it can refer to project preparation in which the fund identified potential investments that are not yet ready to receive debt or equity finance. In this case the TA is used to get the project or company investment ready.

TABLE 7 EXAMPLES FOR ACTIVITIES ADDRESSING BUSINESS CAPACITY BARRIERS

Barrier	Activity	Facilities providing these activities
General management	• Corporate governance • Operational and process improvement • Business Plan Development	• CREI • LeapFrog Financial Inclusion Fund • African Agricultural Capital • African Agricultural Fund • Grassroots Business Fund • EU-AITF (Africa Infrastructure Trust Fund) • DevCo PIDG • Fanisi Venture Capital Fund • Business Partners International Southern Africa • SEAF Bangladesh
Financial management	• Financial management/ financial planning • Accounting training • Strategic planning • Legal support/ licensing and patents	• CREI • Terra Bella Colombia Fund TAF • Fanisi Venture Capital Fund • Grassroots Business Fund • SEAF Bangladesh
Marketing capabilities	• Help to test, validate, and roll out new products • Marketing support and market studies • Access to technical expertise and facilities to help resolve technical issues of the specific product • Project identification • Project preparation	• CREI • SEAF Bangladesh
Poor management of human resources	• Recruiting talent with needed technical or business skills	• Cyclotron Road • African Agriculture and Trade Investment Fund (AATIF)
Inability to innovate	• Supporting conversion or deepening of sustainable business practices (environmental audits, certifications)	• Eco.business Fund • Leapfrog Financial Inclusion Fund • African Agricultural Fund (AAF)

Poor operations and production	• Information technology • Facilitating access to international supply chains	• NREL Commercialization Assistance Program • DOE Small Business Voucher Pilot Program • Innovation Incubator Program (IN2) • AgDevCo

When companies are big enough they usually can pay consultants to help them build core business strength and to grow product lines. However, in developing countries even medium size companies can struggle to cover the costs for these services.

Our TA mapping also identified a number of other activities that TA facilities can provide.

LeapFrog TA provides training to the staff of the fund to ensure the continued development of their target sectors. The fund's TA team also works to identify opportunities for innovation in the investee companies to enable products provided to communities that would otherwise not be served by the company. For example, they work on business models that can serve the poor (Proparco, 2017). Infront Frontier Markets TA works on impact measurement to support more rigorous impact measurement (MEDA, 2017). AECF TA works to strengthen the network between grantee businesses and investors.

5.5 Key learnings from existing facilities

Well-structured TA can mobilize public and private finance as it can be used to reduce investor risk as well as create a pipeline of new investment opportunities. We found that there are several important considerations when setting up a TA program, especially when TA is provided alongside investment vehicles such as private equity funds.

Flexibility in the types of TA provided by a facility is key, especially when the facility is accompanying a private equity fund and needs to match the fast pace of investors. Companies in the fund might need a wide range of types of support. This also depends on the diversity in the portfolio of the fund that might hold companies at different stages of maturity. Especially, when a fund targets very early stage businesses it might be already clear from the outset of the investment that the TA activity needs to cover individual activities throughout the holding period to make the investment viable to the fund (Divakaran, et al., 2014). A wider range of sectors and geographies represented in the fund also create the need for specific activities tailored to needs.

Discerning additional technical assistance activities from business-as-usual activities that are part of the normal role of the fund manager can be difficult. Additionality is very context specific; an activity might be additional in one case but not in another depending on the recipient or the strategy of the private equity fund. For example, supporting a company to expand their services to a new region might be additional when the associated private equity fund does not have any established relationships of the new region but might not be additional if the fund has executed this type of expansion into the region successfully before. Defining eligibility criteria that are in line with programme objectives and that consider the structure and stakeholders of the program, as well as providing the governing body of the TA facility enough flexibility to make decisions on an individual case basis, can ensure the additionality of activities. Tensions between the objectives of the fund manager

who wants to maximize returns and the technical assistance facility who wants to maximize development impact can be mitigated by clear but aligned objectives and strong governance (Divakaran, et al., 2014).

Activities should deliver a measurable impact that manifests in a relevant time-frame. Measurable key performance indicators are needed to establish effectiveness of the activity. This is often easier with activities that address a specific bottleneck in a company or in the market. However, it is more difficult to prove this with awareness campaigns or market studies. Eligibility criteria need to consider that these types of activities can't be measured against the same standards as the more direct activities to address company capacity constraints. For example, the facility of the African Agriculture Fund requires TA projects to (1) have a measurable impact on food security and (2) to provide a win-win for the business as well as customers (Smith and Schramm, 2017). All African Agriculture and Trade Investment Fund (AATIF) supported activities need to improve the economic and social welfare of farmers and company employees. These benefits are measured via such indicators as increased agricultural production and productivity, additional employment, access to smallholder farmers, and increases in farm and household income (Convergence, 2015).

Geographic eligibility is a common criterion and it depends often on the focus region of the donor as well as the development objective of the programme. However, for a facility that provides technology transfer from developed to developing regions, geographic eligibility can become difficult as the recipient of the technology transfer support might be located in a developed country.

A TA facility that is established to support companies alongside an investment vehicle should aim to support companies over the lifetime of the associated fund. Activities targeted at companies are often not one-off interventions but early-stage companies might need different types of support at different stages in the investment period and during the holding period by the fund (Divakaran, et al., 2014). Ongoing activities can also aim at maximising the company's development impact, for example by designing innovative business models that enable pro-poor access or by supporting the company to expand to developing countries which can happen at various times during the holding period of the fund (Phatisa 2016 and Phatisa 2017).

Because establishing a TA facility can be as difficult as establishing a fund, delays in operational design should be considered and mitigated by establishing the facility ahead of time. In the case of AAF, the TA facility needed two years to fully understand the needs of the investee companies, and in the case of SCAF the facility also took significantly longer to establish than was expected. Further, a TA facility that provides support for pipeline building and pre-investment support needs to be established early in the fundraising phase of the fund.

Design of the TA facility should consider the in-house abilities needed of the facility to deliver timely support. For example, direct company support might be best provided by a core TA team to avoid delays that could affect the performance of the fund. On the other hand, activities that address context barriers can be outsourced to third-parties as the

success or failure of individual businesses are usually not sensitive to the timing of these activities.

TA facilities should require the recipients of technical assistance to share responsibility for costs of the intervention to ensure that they're engaged and that TA activities are valued by the recipient. Mechanisms can be cost-sharing that recipients cover upfront in cash, or pay back via zero-interest loans or in-kind services such as working hours on the project (Divakaran et. al, 2014, Adams et. al, 2016, and Phatisa, 2016). Overall, there is no one size fits all approach for cost-sharing agreements. Three aspects need to be considered: (1) Percentage of the cost of the intervention that should be covered by the recipient company, (2) whether the match required is cash or in-kind, (3) whether the payment should be made upfront or delayed (Phatisa, 2016).

6. Preliminary Recommendations for the Design of a TA Facility for Adaptation and Resilience Products and Service Companies

This report has examined the barriers that adaptation companies, especially those offering climate analytics services, face in expanding in developing countries, including two companies for which we conducted case studies. The report has also looked at some of the key design decisions of technical assistance facilities, in particular 1) the different ways they are structured and governed, and the trade-offs involved in each type, and 2) which barriers to company growth they address, and the activities they deploy to do so.

This section seeks to apply the report's findings to the design of a new technical assistance facility. The Climate Resilience and Adaptation Finance and Technology Transfer Facility (CRAFT), managed by the Lightsmith Group and endorsed in 2017 by the Global Innovation Lab for Climate Finance (the Lab), will be the first dedicated commercial investment vehicle to focus on expanding the availability of technologies and solutions for climate adaptation and resilience. As the Secretariat for the Lab, CPI has supported the Lightsmith Group to develop its concept.

CRAFT will establish a USD 500 million global private equity fund ("the Fund") that invests growth capital and strategic support into companies that already offer climate resilience products and services. A complementary USD 20 million technical assistance facility ("the Facility") will enable the provision of technical support to companies in developing countries.

Once launched, CRAFT will target companies that provide resilience intelligence, products and services that help customers assess and manage climate risks and impacts.

Foundational criteria for the TA Facility

The Lightsmith Group has indicated several criteria for the Facility to achieve, principally based on the experience of its staff in previous roles setting up the Africa Clean Energy Facility: namely, that the Facility should be 1) focused on commercially oriented activities that are needed to unlock more investment capital, 2) structured to provide the fund managers with flexibility to address portfolio company needs in a timely manner; and 3) address the needs of companies for expanding in developing countries (OPIC, 2013).

The below provides recommendations as to how to most effectively meet these criteria, focusing on the resilience intelligence, or analytics, category of companies that would comprise part of the Fund's portfolio.

6.1 Recommendations for barriers to address

In conversations with climate risk analytics companies, several critical barriers were cited. We recommend that the following barriers be the focus of the TA Facility's work:

First, the TA Facility should target several business model barriers, principally 1) lack of awareness of the value add of their products; and 2) lack of technical capacity of *clients* to implement analytics solutions. Analytics products frequently must demonstrate cost

savings for clients in areas where clients haven't previously been tracking or investing. A third barrier, high upfront costs, can also make the economics difficult for potential clients.

Second, the TA Facility should target several internal capacity barriers, principally with respect to the knowledge and connections required to expand into new sectors and geographies, especially in developing countries.

Third, the TA Facility could target in some limited manner certain context barriers, including policy uncertainty around adaptation and resilience. Several companies noted the importance of the public sector in influencing demand for climate resilience analytics, given its key role in insurance markets, infrastructure development, and climate change policy.

Of course, while the Facility would address several different types of barriers, it would not be able to address all of them. The Facility would address context barriers only in a very limited way.

6.2 Recommendations on principal activities

To address these key barriers, we recommend that the Facility offer three support lines, namely Preparation, Partnerships, and Resilient Systems, as depicted in Figure 3 and described below. All activities within these three support lines would focus on meeting the needs of portfolio companies in expanding into new developing country markets. Similar approaches with multiple support lines have been implemented successfully by other technical assistance facilities, including CP3, SCAF, and ACEF.

The Facility's first support line, Preparation, should focus on preparation of activities that directly support technology transfer among the portfolio companies.

The Preparation support line could focus on discrete tasks to address internal capacity gaps and business model barriers to a company's developing country expansion. The activities under this support line would largely be conducted by consultants and would be measured by the investment capital they unlock. Activities in this support line would improve supply of tailored services and could include:

- Analyses of legal and regulatory requirements in a new geography (e.g., for insurance sector, what are the regulatory requirements for catastrophe risk modeling)
- Support for companies in adapting their technology or data into formats that can be utilized by users in developing countries
- Business plan support to underpin entry into a specific developing country market, including the development of financial models and go-to market strategies
- Business model support including development of innovative payment mechanisms

While this study has not focused on resilience products, this business line could also be envisioned to support specific engineering, techno-economic, or other technical studies required to implement a new technology (e.g., an engineering study to implement a new irrigation technology).

Internal capacity barriers, particularly related to the managerial capabilities of portfolio companies, would likely need to be addressed as part of the Fund's business-as-usual support.

The Facility's second business line, Partnerships, should focus on building partnerships to indirectly support market development.

The Partnerships support line should focus on business model barriers, with the intent to help stimulate demand for CRAFT portfolio company products through market development activities, as well as increase capacity of clients to use the technology. Its effectiveness would be more difficult to measure but could at the same time have a larger catalytic impact on the broader market by facilitating the knowledge and linkages required to build a resilience ecosystem. Activities in this business line could aim to increase demand for climate risk information through:

- Identification of local networks and key stakeholders that can support product uptake though dissemination of information on climate risk and effectiveness of risk management strategies
- Technology demonstrations incorporating trainings, in collaboration with local business associations and other private and public stakeholders to demonstrate effectiveness
- Development of partnerships and other collaborations between international market players and local businesses and experts with knowledge of local contexts
- Convenings of industry actors to advance different aspects of the climate resilience market in key geographies

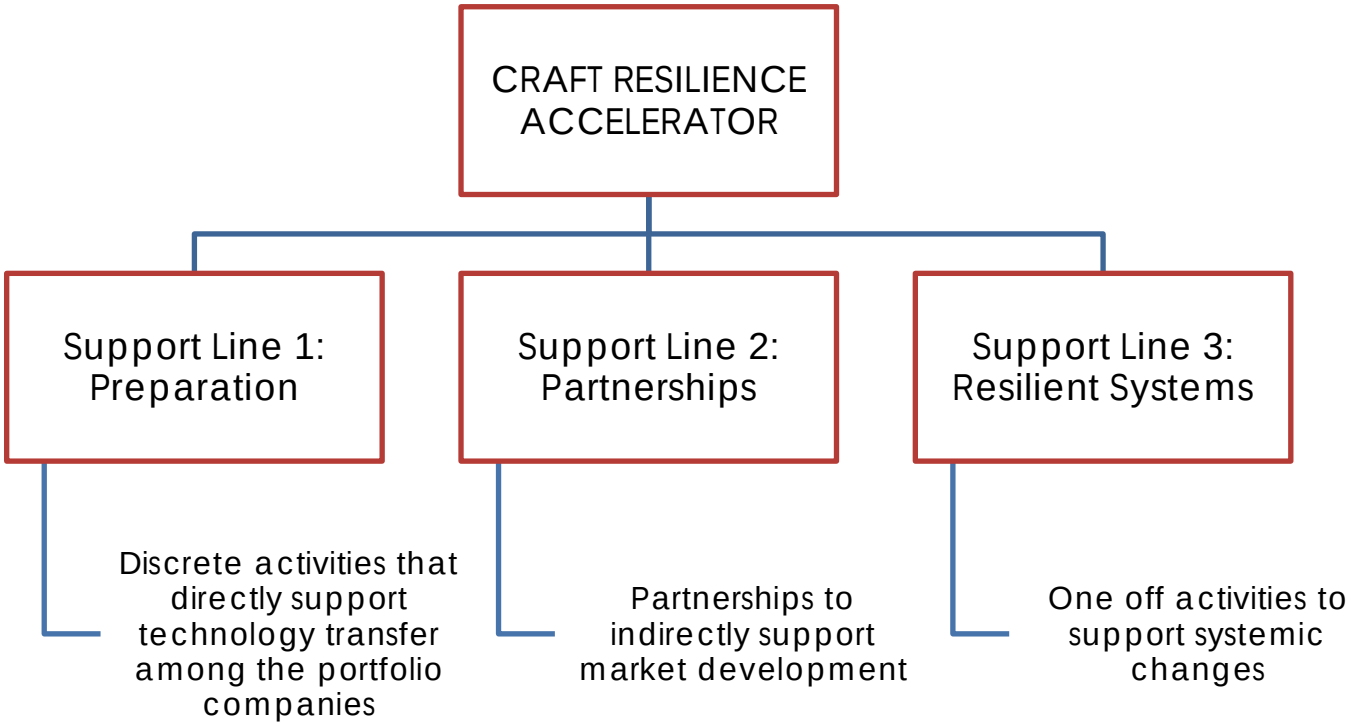
A third support line, Resilient Systems, should undertake discrete, one-off activities to support systemic changes.

The Resilient Systems support line should focus on one-off activities that address context barriers. Activities could include:

- Policy studies exploring systemic issues such as climate risk disclosure standards or policy needs in the insurance or infrastructure sectors
- Impact methodologies and assessments to advance the resilience field and understand the impact of CRAFT's investments
- Data availability for risk models and the standardization of data requirements and model quality

Finally, we recommend changing the name of the Facility to the CRAFT Resilience Accelerator, to better describe the potential of the Facility to help catalyze the adaptation and resilience market (see Figure 3 for a depiction).

FIGURE 3: THE CRAFT RESILIENCE ACCELERATOR'S SUPPORT LINES



6.3 Recommendations on governance

Our research into technical assistance facility structures demonstrates that there is a variety of solutions to key governance challenges. The key challenge can be best summarized as that, when both commercial and development impact are sought through the targeted deployment of grant funds, there can be trade-offs involved (though not always). The key concern here of many donors is that the technical assistance activities they fund with grant support must be additional to the standard activities of a fund manager and/or an investee company.

We recommend that, at a minimum, all preparation activities (e.g., Support Line 1 – Preparation) are managed by the Fund Manager. This would enhance efficiency and ensure alignment with the needs of fast-moving portfolio companies as they enter into new markets. Ideally, the governance of these activities would be the same as for the Fund overall.

Support Lines 2 and 3, Partnerships and Resilient Systems, should be connected to the Fund to ensure impact and relevance. With their broader remit and potential for impact outside of the CRAFT portfolio companies, these two support lines could have a different governance model. For example, they could be managed by the Fund Manager but have separate governance, such as a different investment committee. They could also have separate management but with the Fund Managers taking a key role in governance. The appropriate structure for these Support Lines would depend on the final list of activities and donor needs.

Once the governance structure is established, eligibility criteria for activities and geographies need to be determined to ensure additionality and to reduce potential for market distortions.

6.4 Next steps

This report provides an initial evidence base and considerations for how a technical assistance facility, working in parallel with a private equity fund, could help facilitate investment in adaptation and resilience in developing country markets. However, as the development of the Facility progresses, several factors will influence its final design, including (1) Final selection of portfolio of investee companies, and (2) Funding availability, restrictions, and breakdown of funding to each support line.

Therefore, the next steps in the design of the Facility should include:

- Advancing discussions among potential funders regarding their objectives and baseline requirements for the structure, governance, and eligibility criteria of the Facility
- Developing more detailed descriptions of individual activities, how they could be implemented, and how results would be measured, based on likely portfolio companies, including understanding in far greater detail the target markets for expansion
- Complementary work identifying the needs of resilience product companies, as this paper focuses solely on resilience intelligence companies
- Possible demonstration of technical assistance provision to accompany 2-3 pilot projects

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8. Annex 1: Methodology

8.1 Technical Assistance Facility Mapping

We mapped 41 TA facilities. The list was compiled via online searches for technical assistance facilities as well as a literature review on the topic. The list is not exhaustive but aimed to show which types of activities can be used to support market development. We mapped 22 facilities addressing barriers in Africa, 6 facilities in Asia, 7 facilities working in Latin America, and 7 North American Facilities, and one global facility. The facilities in North America were included to see how market development initiatives work when they specifically target new technologies, because many of the facilities in developing countries have a more developmental objective to grow private sector capacity in general.

TABLE 8 MAPPED TECHNICAL ASSISTANCE FACILITIES[8]

Facility	Type of facility
CP3 - Advisory Services - Policy Support	Activity
CP3 - Mercer study	Activity
Angel Ventures Mexico	Activity
IFC Turkey Market Resilience	Activity
Training for the private sector in Sierra Leone	Activity
EU-AITF (Africa Infrastructure Trust Fund)	Hybrid
African Agricultural Fund (AAF)	Hybrid
AgDevCo (Africa Agricultural Development Company)	Hybrid
Sierra Leone World Bank Investment Fund	Hybrid
RENEW w Mercy Corps (Ethiopia)	Hybrid
SEAF Bangladesh	Hybrid
CREI (Commercializing RE in India)	Standalone TAF
LeapFrog Financial Inclusion Fund	Standalone TAF
African Agricultural Capital	Standalone TAF
Infront Frontier Markets TA	Standalone TAF
Africa Microfinance Fund	Standalone TAF
Fanisi Venture Capital Fund	Standalone TAF
Business Partners International Southern Africa	Standalone TAF
Leopard Haiti Fund	Standalone TAF
Partners in Food Solutions	Standalone TAF
Agro-Innovations Zimbabwe	Standalone TAF
AECF - Funding Innovation for business in Africa/ Africa Enterprise Challenge Fund	Standalone TAF
MICF - Malawi Innovation Challenge Fund	Standalone TAF
US ICEF	Standalone TAF
US ACEF	Standalone TAF
Africa Agriculture and Trade Investment Fund (AATIF)	Standalone TAF
Eco.business fund Development Facility (Eco DF)	Standalone TAF

[8] All facilities that could not be identified as Activity, Standalone TAF, Strategic Partnership, and VC Model were classified as Hybrid Facility.

CP3 - SCAF (Seed Capital Assistance Facility)	Standalone TAF
Proadapt	Standalone TAF
PPPs (TRAC3, 2016 and Agrawal et al 2011)	Strategic Partnership
NREL Commercialization Assistance Program	Strategic Partnership
Cyclotron Road	Strategic Partnership
DOE Small Business Voucher Pilot Program	Strategic Partnership
CalCharge	Strategic Partnership
DOE Lab-Corps Program	Strategic Partnership
Innovation Incubator Program (IN2)	Strategic Partnership
Terra Bella Colombia Fund TAF	VC Model
Grassroots Business Fund	VC Model
Infrastructure Development Collaboration Partnership Fund (DevCo) (part of PIDG - Private Infrastructure Development group TA facility)	VC Model
Bain Capital - Impact Fund	VC Model
Ethos	VC Model

8.2 Barriers Mapping – Rationale for Business Model Barriers

TABLE 9 DETAILED BUSINESS MODEL BARRIER & RATIONALE

Barrier	Sub-barrier	Rationale
Value/Benefit of the technology is not known	Awareness/Knowledge of the risk posed by climate change is low.	If customers are not aware of the risk they are unlikely to spend money on adaptation technology.
	Awareness/Proof of the effectiveness of the technology is low.	Especially if the cost of the technology is high, customers expect to see a direct (preferably quantifiable) impact
	Opportunity cost of the technology is high. There are other strategies out there that might/ or are believed to have a better value for money (VfM).	If customers think that disaster recovery is cheaper/ easier than disaster prevention, they are more likely to invest in recovery options. Often it is not a choice of investing or not investing but in what type of approach to invest.
Cost of technology is too high	High up-front cost of the technology	The higher the up-front costs of the technology are the smaller is the group of potential customers.
	High cost in implementation of the technology (training of staff, changes in operations, surveys, paperwork, etc.)	These costs can vary depending on the size/ capacity of the customer but can also prevent SMEs from implementing.
	High maintenance costs	This can prevent customers with varying cash flows from investing.

	No direct (quantifiable) cost savings from the technology from day one of implementation	It is easier to implement a technology that proves that it will increase profits (for businesses) or create tangible non-monetary value (for consumers) right away than in the future.
Technical capacity needed to use the technology is high	High skill level is required to use the technology to make it viable for the customer	If the technology is very high tech and hard to manage for the customer, it is less likely to be implemented by SMEs or other small or medium sized entities because it requires a lot of extra resources (human capital, financial capital) that they might not be willing or able to commit. Technology requires that companies get permits and other complicated processes that use extra technical capacity or cost money (see cost barriers)
	Implementation of the technology is dependent (and thus constrained) on third parties (contractors, regulators, etc.) abilities	If local regulators don't understand the new technology they might slow down regional/local implementation. Implementation done by contractors that need a specific skillset is another bottleneck to the uptake of the technology.

9. Annex 2: Case Studies: Technical Assistance Facilities

We interviewed representatives from two technical assistance facilities – Grassroots Business Fund (GBF) and Seed Capital Assistance Facility (SCAF), to learn about their experience with facility design and the types of activities they provide.

9.1 Seed Capital Assistance Facility (SCAF)

Type	Independent Standalone Technical Assistance Facility
Objective	Support the development and commercialization of climate mitigation technologies in Africa and Asia
Strategy	Fill the gap between ideas stage of renewable energy projects and bankability stage by providing finance to funds and project developers

SCAF is part to the UK's Climate Public Private Partnership (CP3) Programme. CP3 is a £130m programme that utilises the private equity model to deliver UK Official Development Aid (ODA). CP3 is participating as an equity investor in two private equity funds; the IFC Catalyst Fund (CF) managed by IFC Asset Management Company and Asia Climate Partners (ACP), managed by Robeco, Orix and the Asian Development Bank. These investments are expected to provide commercial returns to the UK Government, alongside development and environment benefits. They are expected to demonstrate that climate-focused investments are both feasible and profitable and catalyse additional private finance to similar activities in future.

SCAF helps to build the pipeline of investment ready projects for some of CP3's portfolio funds as well as for other funds and project developers operating in the sector.

Activities

Many good renewable energy projects are available in Africa and Asia but only few are investment ready because project developers don't get access to funding and most funds don't develop early stage projects. SCAF bridges the gap between project idea and investment readiness by providing project developers and private equity funds in Asia and Africa with funding that can pay for business development support and early stage seed capital financing (SCAF, 2013 and SCAF, 2017).

SCAF provides three types of grants (SCAF, 2013):

- Support Line 1 (SL1) provides Cooperating Funds (mostly) non-project specific cost-sharing to source, develop and transact seed scale investments, including training of project developers.
- Support Line 2 (SL2) shares the development cost for eligible projects in connection with actual seed investments that the Cooperating Funds make.
- Support Line 3 (SL3) assists fund managers in establishing new clean energy funds with an early stage investment window.

Funds are especially interested in SL1 as it helps them to go into areas they would not otherwise have explored. It ensures that you are financing activities that investors are

interested in. The grants help them to explore new geographies by covering the costs to meet project developers, local authorities, and to organize workshops for developers (SCAF, 2017).

While SCAF does not exclusively work with CP3 portfolio funds, some of the projects that SCAF helps to get off the ground become investment objects of the private equity funds that are part of the CP3 portfolio. For example, SCAF has invested in the Lake Mainit Project in the Philippines. It is a 25 MW hydroelectric power project. As part of the project the CP3 portfolio fund Renewable Energy Asia Fund (RESF) partnered with the local developer, and a local bank to finance the construction. SCAF support was used to co-finance early-stage development activities, permitting, independent design validation, impact analysis and environmental and social impact assessment (SCAF, 2017).

Structure & Governance

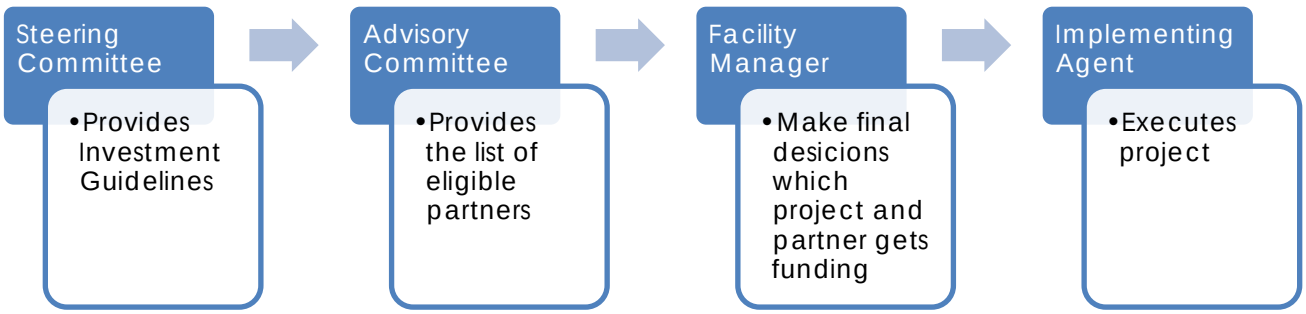
At the top, SCAF is managed by a Steering Committee, in which the facility manager UNEP and donors are represented. The implementing agent of SCAF participates as observer.

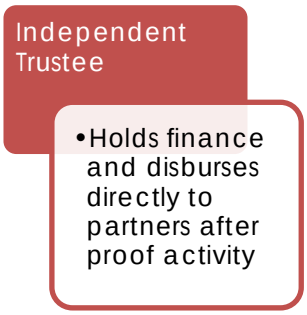
The role of the Steering Committee is to provide guidelines via an investment manual. This has been established and continuously refined since SCAF has been initiated 10 years ago (SCAF, 2017).

The manager – UNEP – makes all the final decisions on which projects get funding and which investment organization becomes a partner. The UNEP Collaborating Center is a SCAF agent to support this decision-making process. The SCAF manager decides based on the recommendations from the Advisory Committee.

SCAF has two regional Advisory Committees, one for Asia and another for Africa. The Advisory Committee creates the lists of potential partners and development companies that support early stage projects. When the SCAF implementing agent has capacity, they reach out to the suggested partners and develop a SCAF proposal.

To manage financial flows, SCAF established a trustee to isolate SCAF funding from the financial statements of partners. The funding is dispatched to partners from the trust.





Sustainability & Payment Methods

SCAF was set up with the ambition to make it as sustainable as possible.

SCAF provides grants but expects a 50% co-payment from project developers and funds. Further, when funds invest in a project, they pay a development fee to SCAF. However, SCAF managers found that re-payment takes much longer than expected (SCAF, 2017).

Providing the financing to developers and funds helps to ensure that SCAF finance is co-invested with other resources and that SCAF does not have to make decisions about the individual profitability of a project. However, a challenge is to find the right partners (SCAF, 2017).

The support provided by SCAF is always linked to specific activities/costs as we ensure a strict application of the 50/50 cost-sharing principle. SCAF partners must report on a quarterly basis and to present proofs of expenses and copies of deliverables where appropriate (studies, event reports, etc.). It is however the SCAF partners who initiate their request (SL0, SL1 or SL2) with a summary budget for the use of the requested support, which project management team clears to ensure alignment with SCAF support guidelines. The pure grant Support Line 1 is no exception. SCAF partners present every year. SL1 & SL2 support agreements are for three years. A work plan with associated budget is cleared, and the initial 50% of the budget is disbursed with the rest being disbursed later in year when the partner has reported and expended the first half.

9.2 Grassroots Business Fund (GBF)

Type	VC Model
Objective	Support the commercialization and professionalization of the agricultural sector in Africa and Latin America.
Strategy	Provide commercial finance to early stage agribusinesses together with technical assistance to increase development impact and capacity building.

Grassroots Business Fund (GBF's) is an impact fund that focuses on the agricultural sector in Africa and Latin America. It is a USD 50 million fund, of which USD 11.5 million is grant finance provided from donor capital. GBI – I is GBF's first investment fund and closed in 2011. Before, GBF was only providing technical assistance (GBF, 2016). GBF mostly invests in small agricultural business with the objective to commercialize and professionalize them to tackle poverty and create economic and social impact. There is a shortage of risk capital available to small and medium-sized enterprises (SMEs) that GBF addresses. Many of the businesses that GBF has supported have later received follow-on investments from banks and development finance institutions (GBF, 2016).

Activities

GBF's TA provides mentoring to portfolio companies in areas such as financial management, management capacity building, corporate governance, operations and strategic planning, among many others.

Together with the client, GBF's Business Advisory Services (BAS) designs the initial interventions during due diligence, when a company's strengths, weaknesses, opportunities, and threats are identified and prioritized. The majority of BAS occurs within the first two years after investment, is delivered by local consultants, and is predominantly in the areas of financial management, strategy and governance. To increase client ownership, GBF clients share part of the cost of each BAS assignment.

BAS hires consultants for specialized activities. Activities can build internal capacity in the company or pay for environmental or social certifications. All activities need to be catalytic and accelerate possible change. GBF managers found that the most catalytic activities are to build capacity in the companies.

Structure & Governance

GBF is a Venture Capital model. It has a non-profit arm called Business Advisory Services (BAS) sponsored by donors and an investment arm sponsored by investors. GBF's structure has evolved over time. Starting as a pure grant facility. They started to provide investments in 2008. In 2011 the grant fund and the investment fund separated to increase transparency to investors.

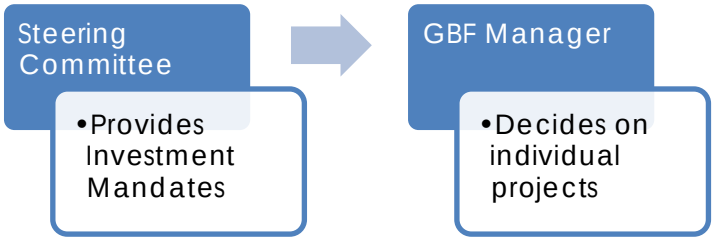
The investment fund is managed via a limited partnership structure. However, the capital structure is very complex with debt, junior equity, and first loss tranches, which made it difficult to manage. On the grant side donors participate in a single governance structure. This makes it easier to manage for donors.

The TA is governed by a Steering Committee of donors. They define specific areas for which TA can be used for and call them mandates. The non-profit arm then has flexibility to decide on individual programs and investees on the ground. The umbrella of the mandates makes the facility more flexible and faster than other vehicles would be. The GBF managers found that TA activities to businesses are usually small and as the company pays 50% of the costs. Thus, it would be inefficient to go back to the Steering Committee for every project.

However, this structure has proven difficult in the long term as the representatives of donors have switched frequently and decisions that had been made earlier on the structure where challenged.

An important benefit of flexibility via an umbrella mandate is speed. Response time from the Steering Committee can take more than four or five weeks. This is too long for many needs of SMEs in developing countries and the needs of investors. Managers found that large scale projects that provide six figures over a two-year period don't make sense for many businesses as the realities change fast, which changes their needs. Therefore, the

facility now provides smaller amounts but more frequently, which allows for targeted interventions with foreseeable results in the near future (GBF, 2017a).



Sustainability & Payment Methods

Only activities that are not part of business management can be covered by grant funding. While GBF calls its business management capacity building TA, it is not paid for by donor financing but by higher management fees. Business management activities are part of the normal hand-holding of the fund manager and donors don't support them.

In the past, this was not an issue as the pool of donors and investors overlapped. However, as the donors became different from investors, the fund had to adjust its strategy.

TA donor funded grants are exclusively paid to consultants that build in-house capacity in the companies, or for environmental and social certifications. None of the grants is paid directly to companies.

The non-profit arm is donor funded. No co-payment or reimbursement model is used.

9.3 African Clean Energy Facility (ACEF)

Type	Independent Standalone Technical Assistance Facility
Objective	Catalyze private sector investment in clean energy in Africa.
Strategy	Act as project preparation facility for renewable energy projects to get projects investment ready for OPIC.

ACEF is an Independent Standalone Technical Assistance Facility developed by the Overseas Private Investment Corporation (OPIC), the U.S. Department of State, the U.S. Trade and Development Agency (USTDA), and the U.S. Agency for International Development (USAID). The program aims to catalyse private sector investment in clean energy projects in Africa by providing support for early stage project development costs (ACEF, 2017). The USD 20 million program provides financing directly to project developers to help them meet the requirements for bankability.

Activities

The ACEF team helps reviews the applications and verifies that the projects are economically sound. Then it works with the applicants to build a project that is investment ready for OPIC. ACEF pays for needed activities that are tendered out to consultants. ACEF

funds can be used for project design, technology assessments, or feasibility studies. Further legal costs (e.g. permitting), consulting costs (e.g. environmental assessments), and physical and technical analysis (ACEF, 2017). Activities need to meet the additionality criteria of the programme.

Sustainability & Payment models

ACEF applies a cost sharing model. The model ensures that project developers only ask for funds they need. Further, the needed activities are tendered out and the providers are selected via the competitive process.

However, the project has mobilized significant amounts of finance as it helped to create bankability of projects.