



Aequero

CATALYSING EARLY STAGE INVESTMENT

*Addressing the Lack of
Early-Stage Capital for
Low-Carbon Infrastructure in
Developing Economies*

UNITED NATIONS ENVIRONMENT PROGRAMME



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Acronyms Used in this Report

ACAD:	Africa Carbon Asset Development
ADB:	Asian Development Bank
AfDB:	African Development Bank
BNDES:	Brazilian Development Bank
BNEF:	Bloomberg New Energy Finance
CalCEF:	California Clean Energy Fund
CDM:	Clean Development Mechanism of the Kyoto Protocol
CER:	Certificate of Emissions Reduction
CET:	Clean Energy Technology
CIF:	Climate Investment Fund
COP:	Conference of Parties
CTF:	Clean Technology Fund
CTI:	Climate Technology Initiative
CTI PFAN:	Climate Technology Initiative Private Finance Advisory Network
DevCo:	Development Company
EBRD:	European Bank for Reconstruction and Development
EE:	Energy Efficiency
EIA:	Environmental Impact Assessment
EIB:	European Investment Bank
EPC:	Engineering, Procurement and Construction
EU:	European Union
FS:	Feasibility Study
GEF:	Global Environment Facility
GIZ:	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IEA:	International Energy Agency
IFC:	International Finance Corporation, a member of the World Bank Group
IFI:	International Financial Institution
IPR:	Intellectual Property Rights
Non-OECD+:	All countries that are not part of the OECD or the European Union.
OECD:	Organisation for Economic Cooperation and Development
OPIC:	Overseas Private Investment Corporation
PE:	Private Equity
ppm:	parts per million
PPP:	Public Private Partnership
Pre-FS:	Pre-Feasibility Study
R&D:	Research and Development
REEEP:	Renewable Energy and Energy Efficiency Partnership
SCAF:	Seed Capital Assistance Facility
SEEDS:	Startup Enterprise Development Scheme, an investment facility of SPRING Singapore, part of the Government of Singapore
SME:	Small and Medium Enterprise
TA:	Technical Assistance
UNEP:	United Nations Environment Programme
UNFCCC:	United Nations Framework Convention on Climate Change
USAID:	U. S. Agency for International Development
USTDA:	United States Trade and Development Agency
VC:	Venture Capital
WEO:	World Energy Outlook, an annual publication by IEA
\$:	United States dollars

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1. Executive Summary

Part I – Defining the Gap

The Climate Imperative

Although it is commonly acknowledged that low-carbon technologies must be scaled up in developing economies as part of any climate stabilisation strategy, current levels of investment remain below where they need to be.

Investment in renewable energy power generation, for example, is currently only about 26% of what the International Energy Agency forecasts is needed within developing countries other than China¹ to stay within a 450 ppm stabilisation scenario. Much more effort is needed to scale up investment.

Regulatory Context

In many developing economies policies and regimes that promote low-carbon technologies are still evolving. In theory this creates opportunities for project developers to initiate low-carbon projects and steer policy in support of project deployment activity. These first movers have the potential to act as ‘pathfinders’ by creating readiness, building capacities and lowering costs for subsequent projects.

In practice, however, there are few, if any, advantages to being a first mover project developer. The immature nature of policy frameworks in support of investment in low-carbon projects results in a significant addition of time, cost and risk to the project development cycle, especially at the early stages of deployment. This creates barriers to market entry that distort the playing field in favour of the more established fossil fuel-based options.

Early-Stage Financing Gap

Increasing investment in low-carbon technology requires financial actors with

the needed experience and the right instruments for dealing with the issues associated with innovation, both the risks and the opportunities.

A number of gaps and barriers continue to inhibit the low-carbon industry in many countries, in particular, the mismatch between the risk of and reward for investing in early-stage developments. Investing in projects whilst they are still in development carries significant risk until certainty can be achieved that the project is feasible and will reach financial close.

Although the investment requirements are modest at the early stages of project development, third-party financing remains almost non-existent, leaving the financial burden to the project developers themselves. This is particularly challenging for inexperienced non-traditional project developers who tend to populate this activity in developing economies.

The lack of access to third-party financing causes an ‘Early-Stage Financing Gap’ which has become a critical market failure in most developing economies – one that the private sector has been unable to resolve on its own.

Part II – The Public Response

A Role for Public Finance

Public finance can play an important role in addressing market imperfections and financing gaps, especially in developing economies where financial markets are less mature.

While public funders currently provide about \$3.9 billion of financing for renewable energy power generation in developing countries (excl. China), most of this money is targeted at the late-stage construction phase once most of the project development risk is removed. Only 0.5% or about \$18 million of this public funding targets the early-stage financing gap. Although the early stage market failure is well understood, the response from public actors to date has been far short of what is needed.

There are many reasons why the public sector has been reluctant to provide early-stage support – in particular, because early-

¹ The IEA uses the term ‘Non-OECD+’ to refer to all countries that are not part of the OECD or the European Union. This report uses the term ‘developing countries’ to refer to this grouping. China has been excluded from the analysis since the data on public finance in China is not directly comparable to that elsewhere.

stage finance is inherently smaller scale, requires some element of picking winners and entails greater risk. These attributes can be difficult to manage for public sector actors. Nevertheless, there is a clear need to rethink these challenges and find ways around them given the large number of developing countries where low-carbon technology uptake remains constrained.

Some progress is being made, although still at a modest scale. A number of public sector interventions addressing the Early-Stage Financing Gap are discussed in this report and shown below in Figure 1, both investment (with expected financial returns) and non-investment approaches.

Public investment approaches that target the early project development phase roughly fall into three groupings: development companies; publicly backed private equity or venture capital funds; and social venture funds.

Publicly backed Development Companies are a promising new approach but are still at an early stage of development and will need further support to achieve scale. Publicly backed equity funds remain mostly focused on later-stage investing; however, a

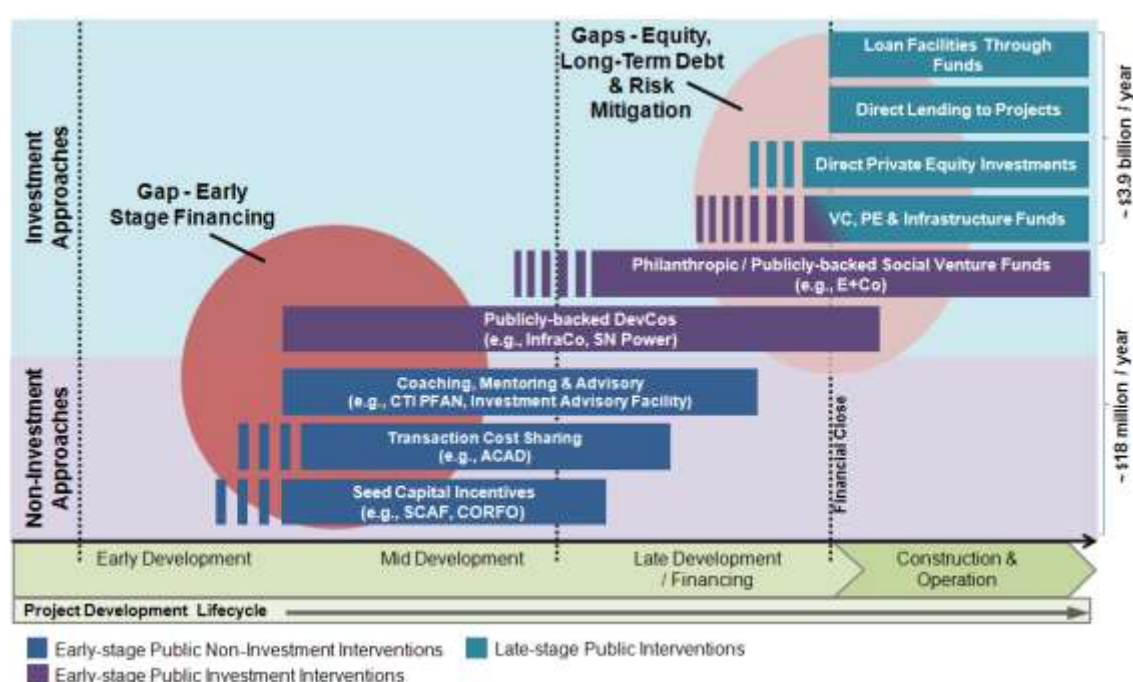
few are now adding seed strategies as a means of firming up their pipeline of investible deals.

Venture capital and social venture funds tend to have earlier stage engagement strategies than private equity funds and so are more familiar with the risks involved in such ventures. However, they are generally less focused on infrastructure sectors like renewables and therefore remain more of an exception than the norm in this area of climate mitigation.

Besides direct investment approaches, there are a number of possible non-investment approaches to facilitating private sector investment at the project development stage. Some are being employed today at modest scale. For the purposes of this report they are arranged into three areas: Seed Capital Incentives; Transaction Cost Sharing; and Coaching, Mentoring and Advisory support.

Each employs a different operating modality, but all are aimed at helping developers and financiers lower development and transaction costs to the point where projects are commercially viable.

Figure 1: Mapping of Existing Public Finance Interventions & Financing Products



Source: UNEP, Aequero

Overall, the few publicly funded vehicles existing today in this space are all small compared with the sector needs and are generally still considered 'learning' investments by their public backers.

A Way Forward

More public effort is needed to address the early-stage financing gap, both in terms of new approaches and new, larger financial commitments. Setting a target for public finance to contribute the same public/private share of early-stage financing as is presently provided to later-stage Construction Finance (about 39%) would require about \$150 million per year during 2010-2020, an increase of eight times the present level of public support. This would represent a small proportion of total public finance allocated to the sector. A number of early stage interventions are proposed in Table 1 below.

In simplistic terms, \$1 of public finance invested at the early-stage of a project

development has the potential catalytic impact of \$99 in construction finance, or even greater if public finance shares only part of the early-stage development costs.

Directing public finance at the early stages of project development, while at the same time enacting policy frameworks that promote low-carbon technologies, will create the optimal conditions for attracting private capital and scaling up investment.

Governments and the international development community need to do more to create favourable conditions to support the flow of private capital. Meanwhile donors and public finance institutions need to direct increased support to the early-stage project development activity. The amounts required are relatively small in the context of existing and projected public financial flows to the low-carbon infrastructure sector, but the catalytic impact would be immense.

Table 1: Summary of Proposed Public Finance Interventions			
Public Finance Intervention	Description / Impact	Target Beneficiary	Estimated Cost (per annum)
Investment Approaches			
Public-Private Development Companies (DevCos)	Support the establishment of DevCos to undertake low-carbon project development activity.	Project Developers	\$3-4 million per DevCo; 3 per region = \$36-48 million
Early Stage Focused Funds	Financing for early stage investment windows either within PE, VC and infrastructure funds or as parallel co-investment facilities.	Project Developers	\$3-4 million per fund; 3 per region = \$36-48 million
Non-Investment Approaches			
Match Funding Programmes	Public financed 'match-funding' facilities.	Project Developers, Utility Investors	\$8 million per region = \$32 million per year
Transaction Cost Sharing & Technical Assistance Facilities	Provision of flexible grants and TA facilities to defray the early-stage costs to project developers.	Project Developers, Utility Investors	\$15-20 million
Transaction Cost Sharing – Advisory Support for Investor Due Diligence	Defray costs of investor due diligence vis-à-vis low-carbon projects and, hence, facilitate third-party investor participation.	Third Party Investors, Utility Investors, Project Developers	\$3-5 million per region = \$12-20 million
Coaching & Mentoring Programmes	Enable entrepreneurs and project developers to acquire skill sets / expertise to advance projects.	Project Developers	\$2-5 million per region = \$8-20 million
Organization & Mobilization of Angel Capital	Facilitate the mobilization of angel capital – a critical component of early-stage financing.	Angel Investors, Project Developers	\$7-20 million
Total			~\$150-200 million

2. Introduction and Scope

The lack of financing for the early-stage development of low-carbon technologies has become a critical market failure in most developing economies. There is some literature on the subject of public support for the commercialisation and early-stage deployment of low-carbon technologies². In the context of developing economies, however, the subject remains relatively unexplored.

This report considers the present role played by public finance in the deployment of low-carbon technologies and the ways in which such support is needed to help address early-stage financing gaps in the sector. The report has been split into two parts:

Part I examines the project development process for low-carbon technologies and the private actors involved today, with a view to identifying the Early-Stage Financing Gap.

Part II examines the public sector response addressing the Early-Stage Financing Gap. It maps existing public finance programmes and proposes future interventions that could be undertaken by governments and the development community.

The report builds on an earlier report commissioned by UNEP,³ which examined first-mover costs of low-carbon project development. The scope of the present report focuses on the general challenge of low-carbon technology transfer and deployment in developing economies.

References to ‘low-carbon technologies’ in the context of this report means:

- Pre-existing commercialised technologies and new-to-market technologies⁴.
- Technologies ready for or in the process of commercialisation.
- Innovative business processes and ‘smart packaging’ models applied to technologies that facilitate deployment of those technologies in developing economies.

Obtaining consistent, reliable and comparable data on low-carbon investment and financing is challenging. We have used investment in renewable power generation as the basis (proxy) for this report’s analysis given that investment data for this sector tends to be reported better than for other areas of climate mitigation investment activity.

Much of the discussion in this report, therefore, focuses on renewable power generation technologies, specifically those used for mid to large-scale infrastructure projects such as grid connected wind, solar, biomass, small hydro and geothermal installations.

Despite this limitation we believe that many of the report’s conclusions apply to other low-carbon sectors, including energy efficiency, which rely substantially on the transfer and deployment of technology.

² See for instance: Public Venture Capital Study: SEF Alliance Publications, UNEP, 2008; From Innovation to Infrastructure: Financing First Commercial Clean Energy Projects, CalCEF, June 2010; Crossing the Valley of Death: Solutions to the next generation of clean energy project financing gap, Bloomberg New Energy Finance (“BNEF”), June 2010.

³ Ritchie, D., 2009. Deploying Low Carbon Technologies: Private Sector Costs of Readiness, Aequero, report prepared for UNEP, Stockholm, Sweden.

⁴ Technology, as used here, is an all-encompassing term that covers all technologies that promote the replacement of traditional materials, products and processes with new materials, products and processes that reduce or eliminate environmental impacts and, in particular, emissions of carbon and greenhouse gases.

Part I – Defining the Gap

3. Identifying Barriers to Early Deployment

There are a number of barriers which inhibit the uptake of low-carbon technologies. This is especially true in developing economies, where governments struggle with the need to balance development objectives against the social and environmental impact of that development.

Often, there are several barriers existing at the same time, which compounds the challenges and increases the costs and risks to private sector actors of transferring and deploying such technologies. Some of these barriers that pertain to the energy sector are described below. However, many of them are applicable to other areas of low-carbon infrastructure development.

3.1 Context - The Technology Adoption Process

The process of technology adoption and deployment traditionally encompasses three elements:

- Technology development – comprised of research and development (“R&D”), proof of concept and technology testing e.g., by way of a pilot plant.
- Supply chain development – the development of manufacturing support through the supply chain for the technology (this is necessary to support the adoption, deployment and scale up of the technology).
- Project deployment activity – the adoption and deployment of the technology.

Most technology development today still takes place in developed economies⁵, although in the low-carbon sector some

developing countries are increasingly important originators of technology – notably China.

At the deployment stage, project developers seek to implement projects based on technologies in both developed and developing countries. Traditionally, technology deployment activity in developing countries tends to lag the deployment activity in developed countries. There are a number of reasons for this including the lack of regulatory support, difficult investment environments, and poor protection for intellectual property rights (“IPR”).

The parallel development of supply chains is critical to support the deployment of technologies. The slow development of supply chains can cause bottlenecks in the supply of equipment and components delaying project implementation and pushing up prices. This has been experienced in both the wind and solar photovoltaic sectors in the early deployment of projects based on these technologies.

The objective of this report is to identify the barriers to the transfer and early-stage deployment of low carbon technologies, with a particular focus on financing gaps that inhibit their take-up in developing economies⁶.

⁵ The World Bank, 2008. Global Economic Prospects 2008: Technology Diffusion in the Developing World, The International Bank for Reconstruction and Development / The World Bank, Washington D.C.

⁶ The intent is not to downplay the importance of technology invention and development or of applying innovative financing tools to the technology development cycle i.e., to create and prepare technologies for commercialisation. This is also a vital component of using technology innovation to achieve a cleaner, sustainable energy pathway. In the low-carbon technology domain, a number of governments, notably Germany and China, have been successful in attracting technology-focused companies and promoted technology innovation through the provision of incentives and the creation of domestic markets for the early deployment of technologies. The success of these countries highlights the importance of proactive regulation and the value of ‘technology forcing’ policies and incentives.

3.2 Characteristics of the Energy Sector

The energy sector is highly capital intensive and is characterised by long-life capital stock. The dominant actors in the energy sector tend to be large utility companies. In most developing economies this is typically a national utility that has historically held a dominant position in the generation, transmission and distribution of energy.

The energy sector in most developing economies continues to be heavily regulated. Pricing is usually set by public planners based on cost assumptions associated with existing long-life capital stock. These cost assumptions do not factor in the elevated 'learning' costs of deploying new technologies or approaches, and therefore the drivers for innovation and new technology uptake are poor.

The combination of these factors sustains a *status quo* investment paradigm which has tended to promote the perceived lowest 'avoided cost' energy technologies in the absence of policy frameworks that price in the environmental and social costs associated with these technologies. In developing countries these policy frameworks are often absent or still evolving. This, in turn, tends to favour incumbent conventional fossil fuel technologies – oil, gas and coal. The situation is exacerbated by energy subsidies, which are prevalent to a greater or lesser extent in most economies⁷.

The scale of investment in individual projects is an important consideration for utility companies. Given the time and resources required to develop projects, utility companies understandably have a preference for technologies that promote larger scale projects (e.g., coal-fired and gas-fired power plants).

In addition, renewable energy projects have certain characteristics that make them more

costly relative to conventional energy projects, including:

- They are more capital intensive per unit of output (though they have lower operating costs).
- They are smaller scale and yet require significant development resources i.e., they have a higher ratio of development cost-to-total project cost.
- Their dependence on localised resources (e.g., wind, solar, biomass) dictates project siting, which is often remote from load centres.
- They have higher logistics and/or interconnection costs due to the remote location of resources⁸.

Finally, technology owners can have concerns about the protection of IPR in many developing economies where legal frameworks continue to evolve and the enforcement of IPR remains patchy.

3.3 Policy and Regulatory Frameworks

Most low-carbon technology transactions rely substantially on sound, well-considered policy and regulatory frameworks and/or a carbon pricing mechanism in order to achieve investment rates of return and bankability requirements. These policy and regulatory frameworks underpin the clean energy project development and investment cycle.

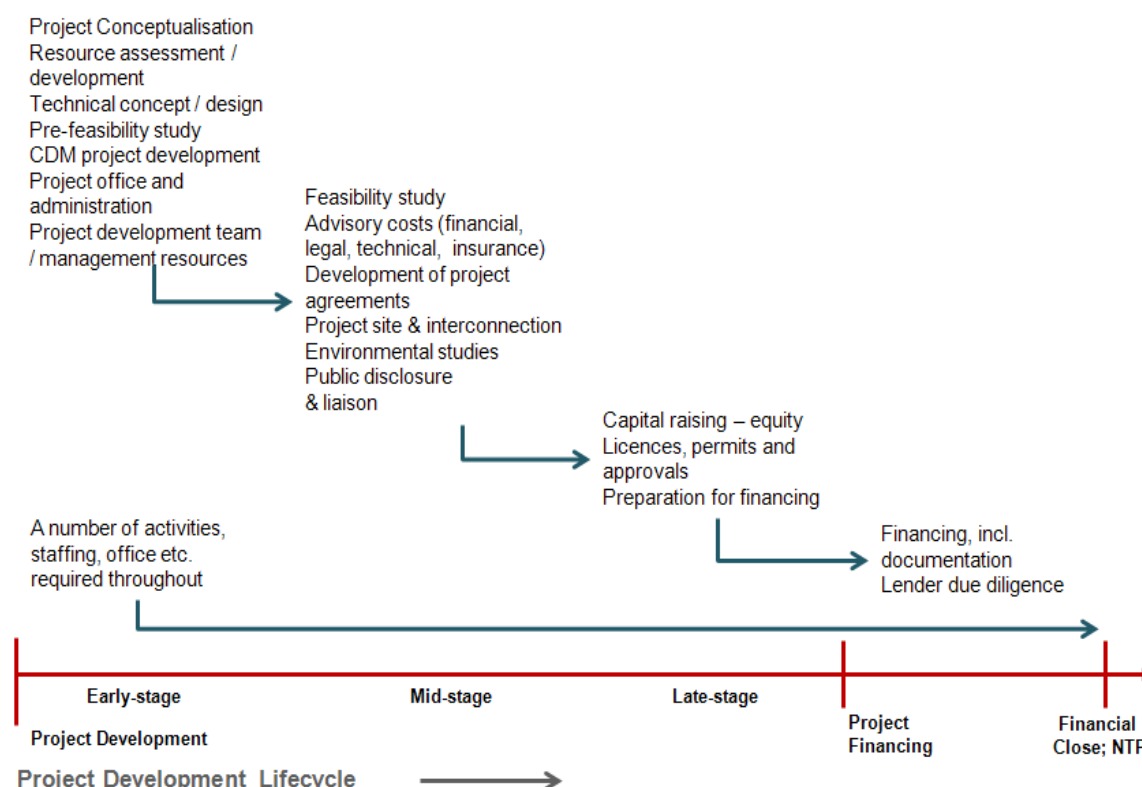
Many developing economies are at the early stages of developing policy frameworks to support investment in low carbon technologies. The lack or nascent development of policy and regulation in these countries acts as a key impediment to low-carbon technology deployment and investment.

In theory this creates opportunities for project developers to initiate low-carbon projects and steer policy in support of project deployment activity. These first-movers have the potential to act as 'pathfinders' by creating readiness, building

⁷ IEA estimated that in 2008 global fossil fuel subsidies amounted to US\$557 billion – IEA Slide Presentation: "Global fossil fuel subsidies and the impacts of their removal: Office of the Chief Economist, IEA. 2010".

⁸ Except for distributed renewable energy systems.

Figure 2: The project development lifecycle and typical project development activities for a developing country climate change project



Notes:

1. CDM = Clean Development Mechanism: NTP = Notice to Proceed (to construction contractor).
2. There are two critical milestones in the project development process – determination of project feasibility, which might be regarded as the end of early stage activity and financial close which marks the end of development activity and the commencement of the construction phase. Figure 3 describes the development activity and the typical allocation of project costs at each phase in the project development cycle.

Source: UNEP, Aequora

capacities and lowering costs for subsequent projects.

In practice, however, there are few, if any, advantages to being a first-mover project developer. The reality is that the absence, or immature nature, of policy frameworks in support of low-carbon technologies results in significant incremental time and cost to the project development cycle, especially at the early stages of deployment. This creates barriers to market entry for low-carbon technologies, distorting the field in favour of the firmly established fossil fuel-based options.

3.4 Project Development in the Renewable Energy Sector

This section examines the process of preparing renewable energy projects for investment, including the steps and costs involved and the challenges associated with financing this early-stage project development activity.

Figure 2 illustrates the most common activities associated with developing renewable energy projects, going from early-stage conceptualisation and resource assessment, through mid-stage feasibility studies and eventually capital raising, financing, permitting and approvals during late-stage development.

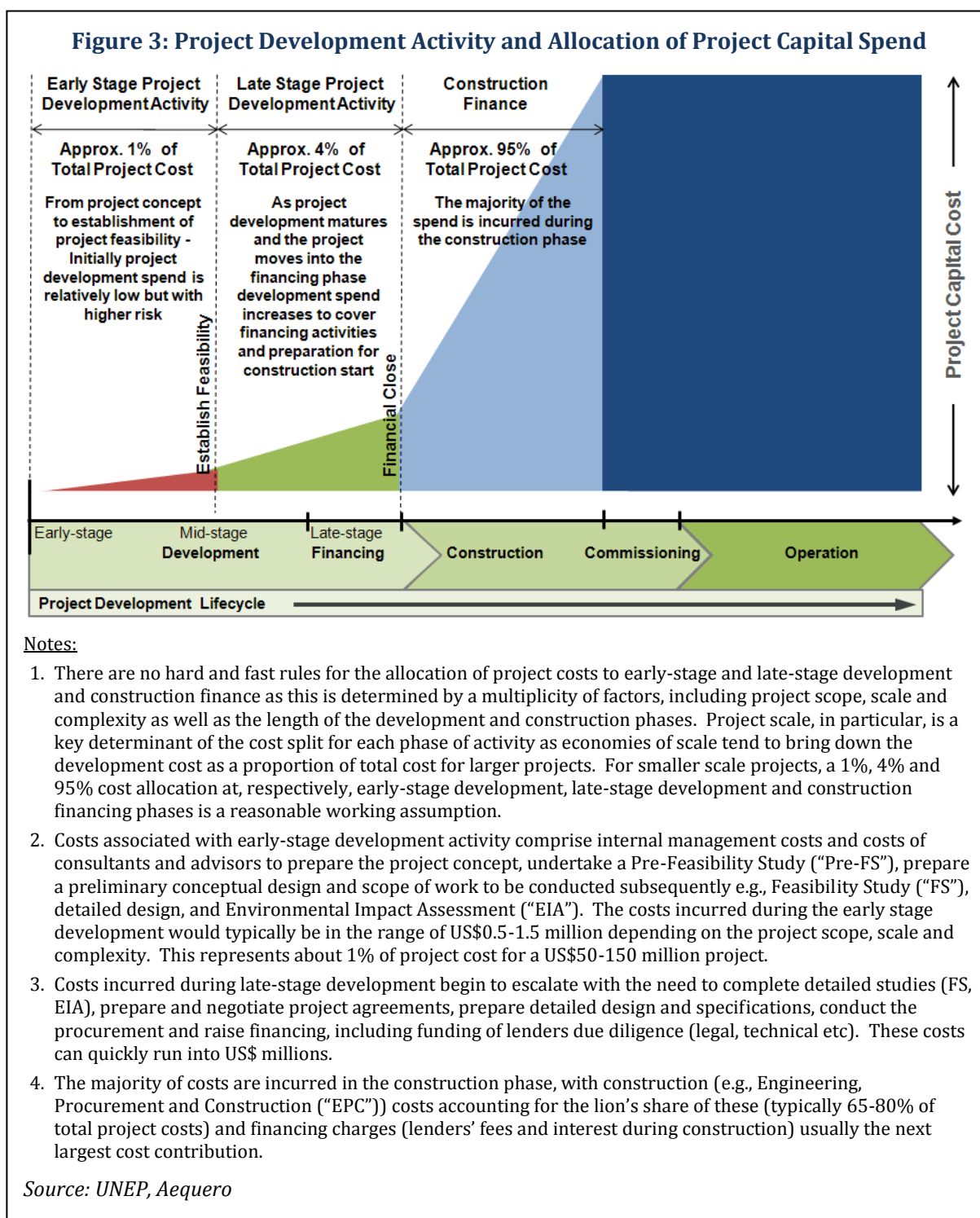
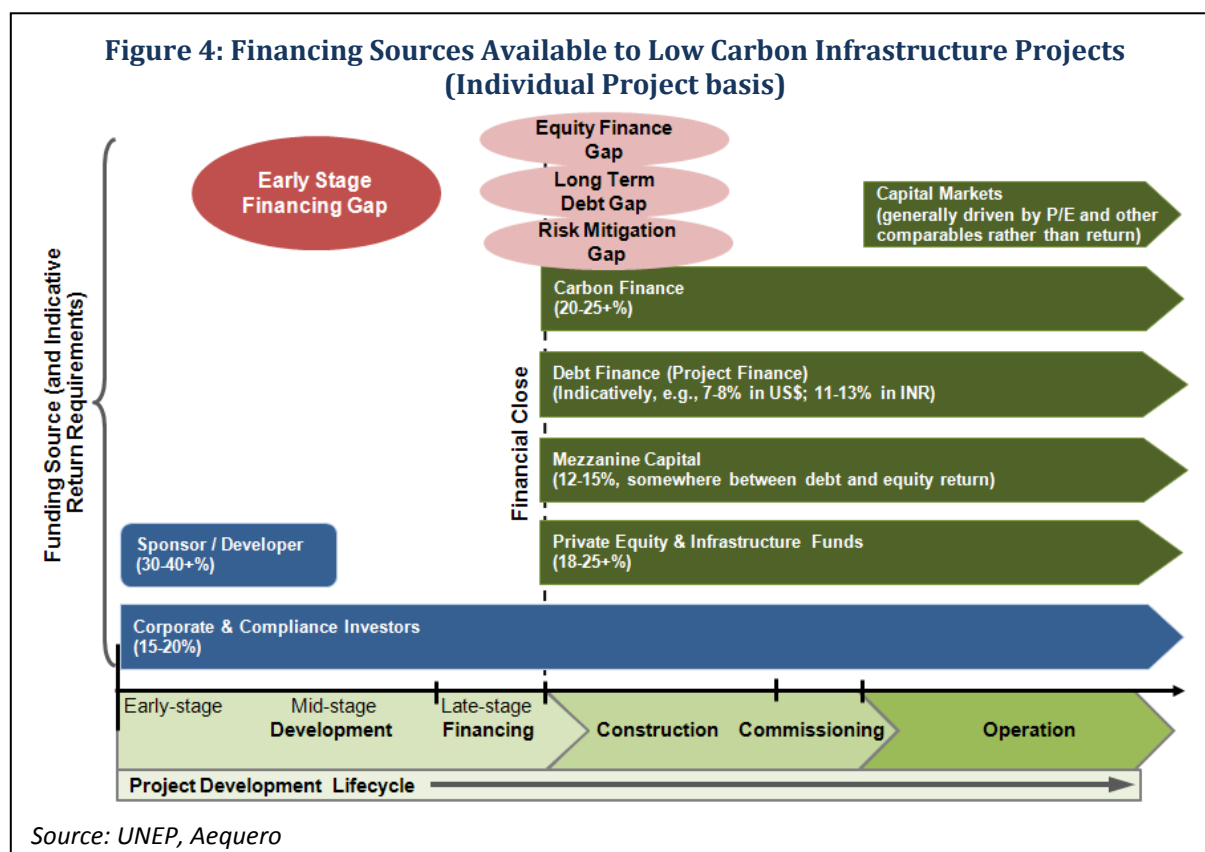


Figure 3 illustrates the breakdown of the phases of project development activity and the allocation of capital, on a per project basis, between these different phases.

Of the project development costs⁹, in general approximately 1% of total capital

⁹ Typically the cut-off for categorisation of project development costs is financial close, with costs incurred at or after financial close

being allocated to other cost categories e.g., financing costs or engineering procurement and construction ("EPC") costs. Costs incurred in relation to capital raising activities, including the preparation and development of the financing facility(ies), may be regarded as project development costs. However, traditionally, financing costs incurred at financial close are categorised as financing costs, a component of Construction Finance.



spend is needed for early-stage project development, 4% for mid to late-stage development, and the bulk of the capital or about 95% is used for project construction.

The majority of project development costs are often referred to as 'soft costs', because they are predominantly spent on 'intellectual assets', consultant costs, management time and other non-physical assets. Financing these costs can carry significant risk until there is certainty that the project is feasible and will reach financial close.

Project development costs tend to be under-reported, as project developers often fail to (or are not permitted to) account for the cost of management time in the project development effort¹⁰.

¹⁰ Many jurisdictions impose restrictions on costs that may be included as project costs, especially where such costs are internal management costs and charges of the sponsors, in order to prevent sponsors from "padding" project development costs.

4. Private Finance for the Renewable Energy Sector

Energy projects are usually financed using a range of instruments, including equity and debt financing, different forms of risk mitigation and potentially also carbon finance.

Figure 4 illustrates the main sources of private capital and the timing at which they are applied along the project development cycle. It also shows indicative ranges of the internal rates of return expectations of the capital providers¹¹. Not surprisingly, return

¹¹ Source: Ritchie, D. 2009. This Figure has been modified to illustrate the 'Early Stage Third Party Financing Gap'. Note that the presentation here is somewhat simplistic – it is intended to illustrate the activity and approximate points in the development cycle at which the main capital providers would typically engage. It does not purport to be an exhaustive list of capital providers. The target internal rates of return of capital providers (and cost of financing) will vary from market to market and from project to project.

expectations are higher at the earlier stages of the project cycle given the higher risks involved.

4.1 Non-Financial Investors

The sources of financing shown in blue in Figure 4 come from non-financial investors, including developers, project sponsors and corporate or compliance investors (e.g., utility companies). Non-financial investors typically play a role beyond providing capital; for instance, a utility may invest in a project as a means of securing the power off-take and/or the carbon credits from the project.

A brief description of the roles played by non-financial investors in renewable energy projects in developing economies is provided below.

Corporate and Compliance Investors and, in particular, large utility companies that have been the traditional investors in the conventional energy sector and relatively active participants in the renewable energy sector in developed economies have been more cautious about entering the renewable energy sector in developing economies. This caution has been largely due to the relatively smaller transaction size and perceived higher risks (and development costs), particularly in countries with evolving policy environments, and has created somewhat of a vacuum in renewable energy project development activity.

Sponsors / Developers: This project development vacuum has tended to be filled by non-traditional project developers who are generally prepared to accept greater risk in evolving policy environments and therefore respond more quickly to expected shifts in investment. Many of these groups emerge from local entrepreneurs and/or companies without an energy sector background or experience and often have limited capital resources.

Non-traditional project developers that are active in renewable energy project development generally lack the experience to anticipate the many challenges, high transaction costs and extended

development cycles associated with these projects. As a result, they tend to underestimate the time and high costs associated with project development, particularly for early deployment projects in markets with nascent policy environments.

The lack of project development experience and limited access to capital resources on the part of this investor class gives rise to a project development 'capital and skills gap,'¹² which has tended to impede the deployment of low-carbon technologies in developing economies.

This situation is compounded in countries that lack strong policy frameworks, where transaction costs and risks tend to be elevated for first-mover project developers. Because the energy sector is so capital intensive, this often results in poor risk-reward parameters for low-carbon technology project developers, especially in highly regulated sectors such as power generation.

4.2 Financial Investors

The sources of financing shown in green in Figure 4 are third-party investors and lenders who usually only provide capital for a project (financial investors). These investors and financiers typically enter projects at a late-stage in the development process (e.g., at or about financial close, when construction is ready to begin). Traditionally, financial investors rely on non-financial investors to complete the project development activity up to financial close.

The main groups among the financial investors are discussed briefly below, including their appetite to invest in early stage project development activity:

Private Equity funds ("PE") tend to focus either on building out the supply chain, for instance, early manufacturing facilities, or projects that are either already built or are

¹² Carmody, J. and Ritchie, D., 2007. Investing in Clean Energy and Low Carbon Alternatives in Asia, Asian Development Bank, Manila, Philippines.

ready to build. Usually these funds are structured as partnerships that bring together a number of Limited Partner investors and a General Partner who acts as fund manager.

Few private equity investors have targeted the project development space. This is largely due to the risk/return appetite of PE investors not being aligned with the risk/return profile of project development activity.

Infrastructure funds, a sub-set of the PE fund market does have an appetite for infrastructure assets, including in the low-carbon sector and particularly in clean energy. However, this 'bricks and mortar' expertise is often different from the venture expertise needed to work with the more risky early-stage projects in development, especially in developing economies with evolving regulatory environments. This disconnect is one of the reasons for the 'Early-Stage Financing Gap' (see Section 4.3).

Mezzanine Capital refers to a subordinated debt or preferred equity instrument that is senior to common equity but subordinated to senior debt. This form of capital has not been widely used in developing economies and not at all for financing project development work.

Debt financing from commercial banks is not generally provided for project development activities except in cases where the borrower is a corporation willing to pledge their balance sheet assets for the loan. Corporate or compliance investors such as utilities may finance project developments in this way.

Capital Markets – in countries with mature low-carbon industries and financial markets both the equity and debt can eventually come directly from the capital markets in the form of stock market listings and corporate bond offerings. In developing economies these conditions do not generally yet exist (with a few exceptions such as China and India). In these markets equity generally comes only from project sponsors and private equity funds or other investors and the debt financing is provided

by banks. Capital markets financing is not targeted at early stage development.

Carbon finance is a market mechanism that contributes to meeting carbon emissions reduction objectives by providing a revenue stream and, in some instances, up-front financing for mitigation projects. However, carbon finance has not made a significant contribution to providing or catalysing early-stage project development capital for two reasons:

First, the complex approval and certification process under the Clean Development Mechanism ("CDM") means that there is considerable risk as to if and when a project will receive its Certificates of Emissions Reductions ("CER").

Second, and more critically, as the cut-off looms for the First Commitment Period under the Kyoto Protocol, significant uncertainty exists as to what form (if any) the carbon market will take post-2012, resulting in a poor carbon price signal¹³.

Other private sector financial actors that do have an earlier stage strategy not specifically included in Figure 4 include:

Venture Capital ("VC") is an early-stage finance model that usually focuses on technology development and commercialisation and supply chain development. Beyond technology development, little venture capital is being applied today in the value chain, including to project deployment. For this reason it is not shown in Figure 4. However VC funds do usually employ more of a 'build' than 'buy' strategy, meaning that they are willing to invest capital earlier in the cycle when projects are still being formed rather than looking to buy assets that are already fully developed or even built.

Unfortunately the lack of 'VC type' financial returns from the project deployment business means that commercially backed VC funds seldom venture into the project

¹³ Most projects presently in development would only commence operations after 2012 and, therefore, only receive CERs after 2012, for which a formal market does not presently exist.

Box 1: Data Sets

Two principal sources of data are used in this study: the Bloomberg New Energy Finance (“BNEF”) database of reported transactions which monitors existing investment activity; and the IEA World Energy Outlook 2009 as the basis for forecasting future investment needs. Specifically, the following data is used in the analysis in Section 5:

- A. **Actual investment activity (2007-2009):** The annual average of reported renewable asset finance transactions in developing countries, excluding China, recorded in the BNEF database over the period 2007-2009 (see Figure 5)ⁱ.
- B. **Forecast of required investment activity (2010-2020 and 2020-2030):** An average of IEA’s projected investment required in renewable energy in the IEA 450 Scenario over the 2010-2020 and 2020-2030 periods for developing countries (excl. China).
- C. **Actual public finance activity (2007-2009):** The average annual reported public finance transactions recorded by BNEFⁱⁱ over the period 2007-2009 (excl. China - see Appendix C).

Notes:

- i. BNEF data was adjusted to provide a developed and developing country split for consistency and comparability with IEA data for forecast required investment i.e., using Non-OECD+ countries as a proxy for developing economies.
- ii. BNEF “Research Note: The past, and future, of development bank finance to clean energy projects”.

development space. Today in developing economies a much larger number of climate mitigation focused private equity funds exist than venture capital funds.

Angel capital is another possible source of financing for project developments. An angel investor (also known as a business angel) is an affluent individual who invests capital in a business start-up. Angel investing in the formal sense has yet to take hold in developing economies although is a promising area to look at further.

4.3 Private Sector Financing Gaps

Although private sector finance is increasingly engaging in the clean energy markets in developing economies, some significant financing gaps remain. Figure 4 shows the most significant of these gaps.

The best known financing gaps are those shown as pink ellipses in Figure 4. These include the lack of sufficient equity investment, the lack of long-term debt financing and the lack of risk mitigation options. These are the three areas that public finance tends to target today.

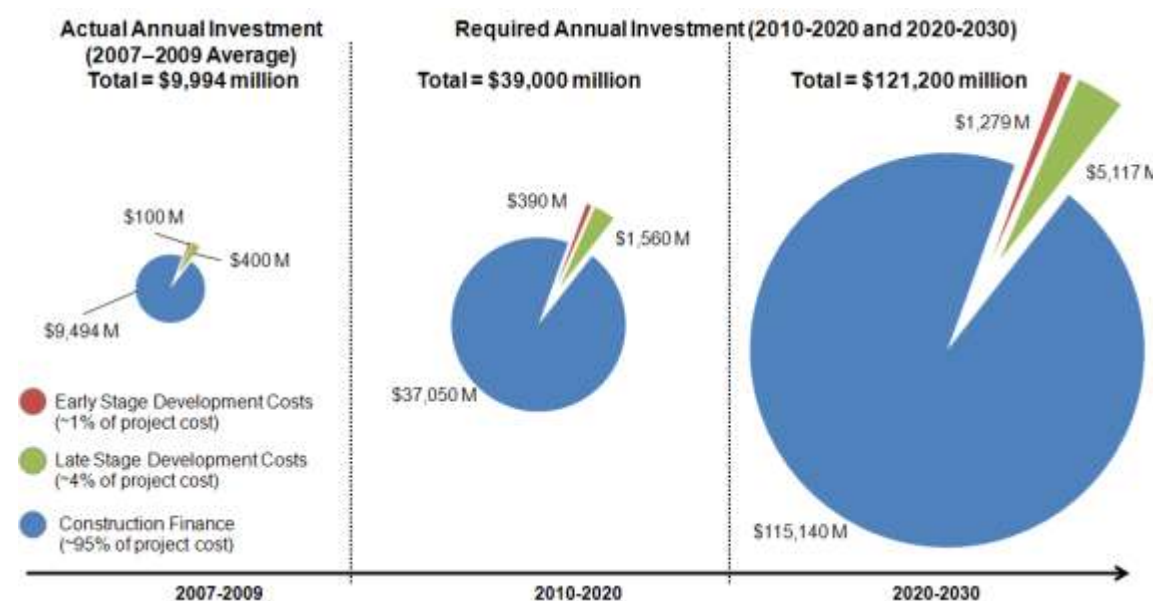
A challenge or gap that receives much less attention is the lack of financing at the early-stage of project development. Many financial investors are unable or unwilling to engage at the earlier stages of the project

development cycle. This results in a failure of the market to provide early-stage development finance and gives rise to an ‘Early-Stage Financing Gap’ (illustrated by the red ellipse in Figure 4). This gap is particularly pertinent for projects based on newly commercialised and new-to-market low-carbon technologies, including renewable energy projects in most developing economies.

Why is it hard to get capital into this space? The risk-return profile of investing in early stage project developments is skewed by increased time, cost and risk characteristics, engendering a mismatch with the expectations of conventional infrastructure developers and investors i.e., the projects are too risky for the prospective returns that they offer.

From a risk perspective, investing in the early stages of low-carbon projects is more akin to venture capital risk exposure without the corresponding returns. This is the market failure that leads to the Early-Stage Financing Gap shown in Figure 4.

Figure 5: Non-OECD+ Renewable Power Sector Investment – Actual vs. Forecast Annual Requirement to achieve 450 Scenario



Source: UNEP, Aequero; Data from BNEF and IEA WEO 2009.

5. Present and Forecast Investment

Before the barriers to project deployment cited earlier in the report can be addressed, the macro investment flows going into the sector need to be analysed.

This section aims to assess within the context of developing economies:

- How much is being invested today in renewables-based power generation, and
- How much will need to be invested in future to meet the IEA 450 ppm scenario ("IEA 450 Scenario")¹⁴.

The section further provides a conceptual breakdown of financing requirements between project development costs and construction costs (see Section 3.4) and examines the role that public finance has played and should be playing in this area.

5.1 Current Investment

Investment in renewable energy power generation projects excluding large hydro in developing countries outside of China¹⁵ averaged \$10.0 billion per year over the period 2007-2009. A further \$21.8 billion was invested annually in China during this period, more than double all other developing countries combined.

¹⁴ The IEA '450 Scenario' "...depicts a world in which collective policy action is taken to limit the long-term concentration of greenhouse gases in the atmosphere to 450 parts per million of CO₂-equivalent (ppm CO₂-eq), an objective that is gaining widespread support around the world" (IEA WEO 2009). The IEA 450 Scenario is aimed at keeping atmospheric concentrations of greenhouse gases at a level that would limit the global temperature rise to around 2°C above pre-industrial levels.

¹⁵ The BNEF database includes a total of 1,672 transactions in developing countries over the period 2007-2009 with an aggregate value of \$95.4 billion, of which \$65.4 billion was in China. By contrast, there were 2,258 transactions in developed countries over the same period with an aggregate value of \$167.0 billion.

5.2 Future Required Investment

The IEA has forecast¹⁶ that between 2010 and 2020, 71% or about \$200 billion per year of power sector investment will need to be in low-carbon technologies in order to achieve the IEA 450 Scenario. 85% of this investment (about \$170 billion) is expected to be in renewables. 50% of the investment in renewables will need to be made in developing economies – not including China there will be an average investment requirement in developing countries of about \$39 billion per year for the coming decade. From 2021 to 2030, this investment requirement increases to \$121 billion.

Figure 5 combines the BNEF present investment numbers and the IEA's forecast investment numbers. It shows where developing countries (excl. China) are today in terms of renewable energy investment and where they need to get to in the coming decades to meet the forecast investment required to achieve the IEA 450 Scenario.

Figure 5 also shows a breakdown of this investment requirement between early-stage development, late-stage development and construction finance. As noted previously, given the capital intensiveness of the energy sector, and especially the low-carbon energy sector, the majority of the total project cost (about 95%) is spent in the construction stage, post-financial close. The 'soft costs' associated with the project development activity account for only a relatively small proportion of total project cost (about 5%), with the majority of these being incurred after project feasibility has been established.

It can be seen that investment in early-stage and late-stage project development will need to expand by a factor of about four (4) times to achieve the 2010-2020 target and about thirteen (13) times to achieve the 2020-2030 target.

The role that public finance can and in some cases already is playing in responding to this need is examined in Part II of this report.

¹⁶ IEA WEO 2009.

Part II – The Public Response

6. The Role of Public Finance

Public finance can play an important role in addressing market imperfections and financing gaps, especially in developing economies where financial markets tend to be at an early-stage of evolution.

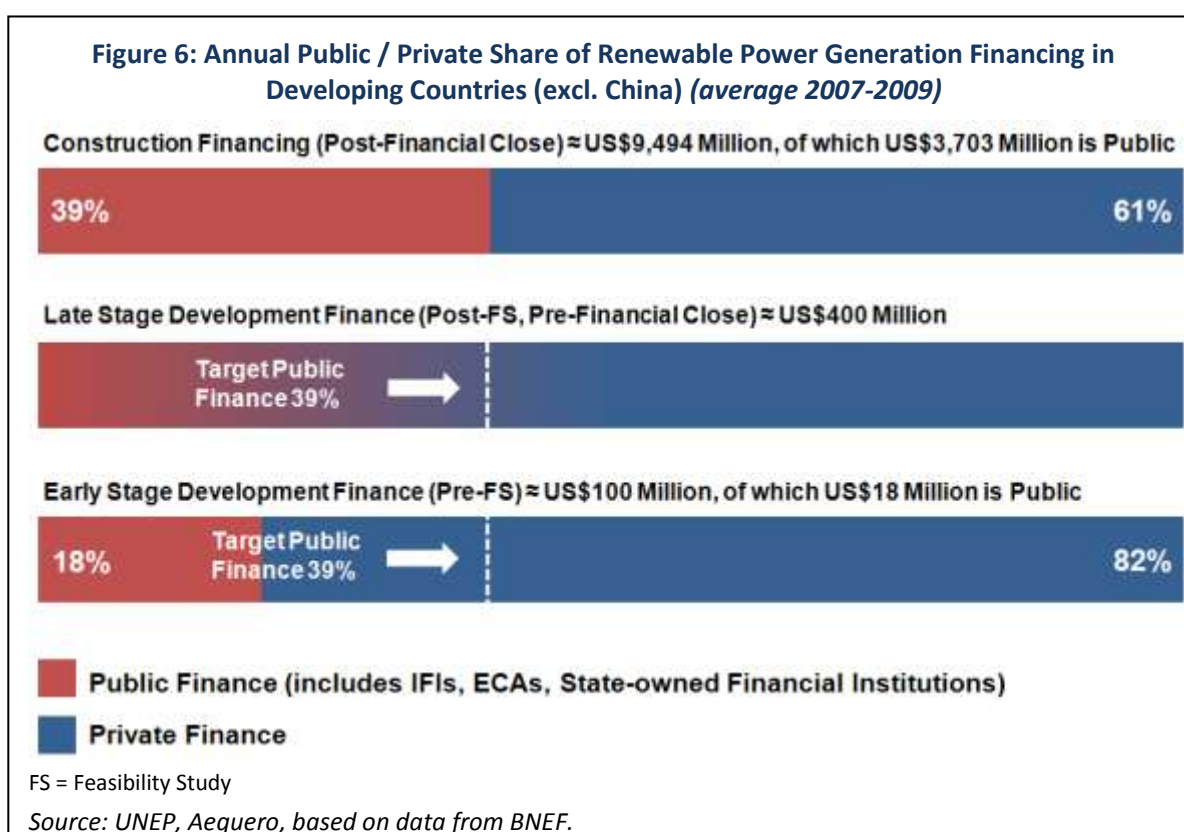
In this section we assess the present role that public finance is playing in the renewable energy sector and specifically identify the stages in the project cycle at which it is being applied. Section 7 then provides a 'mapping' of the current public finance interventions and financing products available to the sector with a view to identifying financing gaps.

Figure 6 illustrates the share of public and private finance allocated to the deployment of renewable energy power projects in developing countries in the period 2007-2009. The Figure shows individual bars for each phase of the project development activity: construction finance, late-stage project development finance and early-stage project development finance. The focus of this report is solely on public

finance that directly supports private sector project deployment activities. Not included is public finance provided to government agencies and other public sector actors, including for policy and regulatory development initiatives that promote private sector investment.

Figure 6 suggests that public finance is providing a significant share of the financing going to power sector renewables in developing economies. However, the major share is directed to the later stages of the project cycle, in particular, to construction finance, both in terms of the amount of finance and the percentage of the total financing applied.

In general, public finance has not addressed as effectively the Early-Stage Financing Gap identified in Section 4. While a number of publicly financed interventions and financing programmes have endeavoured to address this gap these programmes are mostly still small scale and/or have limited scope. It is estimated that only about \$18 million (0.5%) of total public funding is allocated annually to programmes aimed at



Box 2: Challenges to Addressing the 'Early Stage Third Party Financing Gap'

- A. **The Capital Requirements at the Early Stage are Small:** Public sector actors have an inherent preference to focus on transaction size and sector scalability. Investment in early-stage project development is inherently a smaller scale and more difficult proposition.
- B. **Early Stage Financing is Not Easy:** It is far easier to develop interventions and financing products that facilitate later stage projects than it is to develop effective interventions aimed at early-stage project development activity where risks are higher and there is a very real possibility that some projects will fail to mature and achieve financial close.
- C. **Early Stage Investment Entails Greater Risk:** Unquestionably, early-stage financing is a higher risk activity than later stage financing, given the potential for early stage projects to fail during the development process.
- D. **Lack of Familiarity in Acting Alone:** At the early stages of a project development, public sector actors may be in a position where they are acting alone, trying to pick winners.
- E. **Difficulty Measuring the Catalytic Impact:** To some degree, the absence of public sector actors in addressing the 'Early Stage Financing Gap' may be explained by the uncertainty involved in measuring the catalytic impact of early stage interventions and financing products. This is undoubtedly a challenge given the difficulty of linking \$1 applied through an early-stage intervention with an appropriate, measurable outcome in terms of the catalytic impact on private sector finance. Evidence suggests that well-considered and appropriately targeted public finance interventions focused on bridging the 'Early Stage Financing Gap' can achieve a catalytic impact of \$50-100 for each \$1 of expenditure. Some examples are given in Table 2.

bridging the Early-Stage Financing Gap. The reasoning behind this estimate is explained in Appendix B.

A far greater focus has been placed by public sector actors on addressing the later stage financing gaps (Equity Financing Gap, Long Term Debt Gap and Risk Mitigation Gap) as evidenced by the substantial financing flows, about \$3.7 billion, directed to construction financing. In relative terms, the public sector accounts for 39% of construction financing but only 18% of early stage development finance. Potential reasons for this late stage focus are discussed in Box 2.

Perhaps the best recent example of the use of public finance to address a late-stage financing gap has been the role played by the public banks during the 2008-2009 financial crisis. During this period of financial market turmoil project lending from commercial banks was largely unavailable. In response, the multilateral, bilateral and national development banks increased their lending to the sector more than threefold¹⁷.

¹⁷ BNEF, Clean Energy - Research Note: Multilateral Development Banks step into the project funding breach, 4 August 2010.

Clearly, these institutions were fulfilling a public mandate – strictly commercial considerations would have had them freeze lending operations, as the rest of the market was doing at the time. By stepping into the breach and expanding their lending during this period, the public banks effectively addressed a market failure that otherwise would have severely curtailed investment.

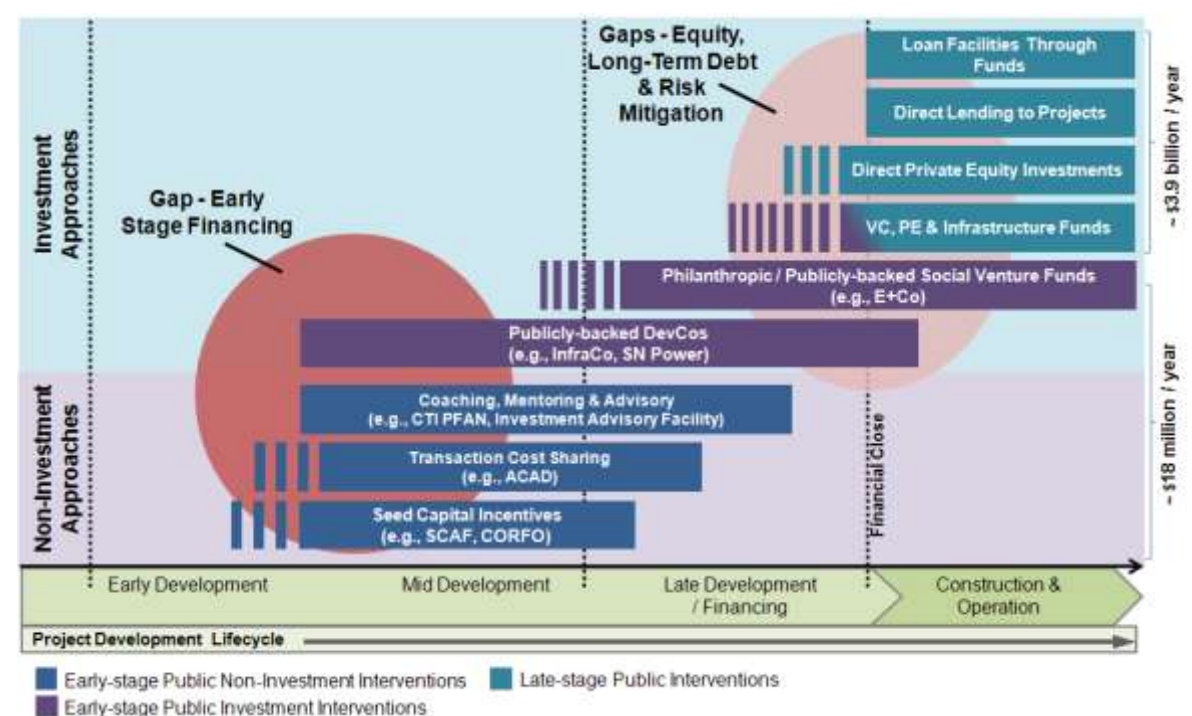
Similar decisive action is needed today in developing economies to address the Early-Stage Financing Gap.

7. Mapping Public Finance Actors and Products

Before considering new approaches to the use of public finance, one needs to assess what is already available, from both private and public sources. Section 4 already set out the principal private actors financing renewable energy projects and discussed their limitations to supporting early-stage development.

Figure 7 provides a mapping of public finance approaches and products used today along the project cycle to help catalyse private finance. Public financing of public infrastructure is not included, but public-private instruments are, as well as

Figure 7: Mapping of Existing Public Finance Interventions & Financing Products



Source: UNEP, Aequero

other uses of public funds aimed at mobilising private sector investment and asset management expertise.

The types of public approaches shown are separated into **investment approaches**, which target both a leveraging of private finance and a return on the public finance invested; and **non-investment approaches**, which target the leveraging of private finance but without requiring a direct financial return.

Some examples of these initiatives are described in Boxes 3 – 9 and in Appendix A, while the overall approaches used are explained in the following sub-sections.

7.1 Public Investment Approaches

Targeting Early-Stage Deployment

Although there is a significant amount of public finance being invested in low-carbon projects generally, little emphasis has been placed on the project development stage. Some public actors, however, are starting to finance activity in this area, working broadly through three channels: development companies; VC and PE funds; and social venture type funds. These

approaches are shown in purple in Figure 7 and each is described below.

7.1.1 Development Companies

Development Companies (“DevCos”) are entities with an explicit mandate to develop projects, usually providing the equity financing and additional expertise needed to undertake all the preparatory steps to financial close. They may be publicly or privately backed, or can blend public and private financing. They are generally managed by the private sector and mandated to partner with governments and/or domestic project developers and facilitate professionally managed project development activity.

To date, no publicly backed DevCos have been established to focus specifically on the development of low-carbon projects. The nearest examples are InfraCo¹⁸ (see Box 3), which focuses on infrastructure development broadly, and SN Power, which

¹⁸ InfraCo is presently 100% donor (public) funded. While InfraCo may support projects based on low-carbon technologies, this is a small facet of its overall sectoral scope.

Box 3: InfraCo

InfraCo is a donor-funded infrastructure development company. It acts as an 'honest broker' seeking to create viable infrastructure investment opportunities that balance the interests of host governments, the national and international private sector and providers of finance.

InfraCo acts as principal in the projects that it supports, shouldering much of the upfront costs and risk of early stage development, thereby reducing the entry cost of private sector infrastructure developers.

Innovation: Donor funded infrastructure development company.

Source: <http://www.infraco.com/>

focuses only on hydro power. Both act as principals, shouldering the risks of early-stage development costs by contributing development capital and applying development expertise with a view to maturing projects and raising construction finance from third parties.

Much more support and innovation is needed to scale up the number and size of DevCos focused on the low-carbon sectors. This can improve efficiencies in how public funds are directed and employed. However picking winner DevCos can still be a challenge for public funders.

7.1.2 Private Equity and Venture Capital Funds

Besides direct financing of DevCos, an alternative for public actors is to finance private equity (PE) or Venture Capital (VC) funds in ways that allows them to finance early stage project development activity. This the funds can do either by working through DevCos or creating their own dedicated windows for seed¹⁹ investments.

If funds employ a DevCo strategy they will usually look to invest \$1 million to \$5 million in a number of sector focused DevCos. If they employ a seed investment

¹⁹ Seed financing is any form of capital provided to early-stage projects (i.e. pre-financial close) or ventures (i.e. pre-revenue or pre-profit).

strategy they will usually allocate \$5 million to \$10 million for financing early stage ventures and projects. Either way, both strategies are aimed at developing a stream of projects that the fund can subsequently finance at the construction stage.

So far only a few PE and VC funds are employing these early-stage investment strategies, some with support from the SCAF facility²⁰ (see Section 7.2 and Box 6) and financial backing from ADB, AfDB, EIB, IFC and several European Development Finance Institutions. A challenge for VC and PE fund managers in this regard is the need to persuade all Limited Partner investors to support the early-stage investment strategy.

Some of the venture capital funds that ADB is looking to support in its recent Climatech Call for Proposals (see Box 4) may also partly address the project development phase²¹, particularly for investments that involve a technology transfer element.

Box 4: ADB Climatech VC Funds Call

In 2010 the ADB solicited proposals from qualified private sector VC fund managers for the formation, management, and partial ADB financing of up to seven "ClimaTech" focused VC funds.

ADB intends to provide a total of up to \$100 million in Limited Partner interests, or equivalent, representing up to 25 percent of the total capitalization of a given fund. The balance of each selected fund's capital is to be raised from other sponsors and private sector investors.

Innovation: IFI Investments Tender for Climate Focused venture capital funds.

Source : www.adb.org

²⁰ Examples include Evolution One Fund and DI Fund in Africa, and Aloe Private Equity and Berkeley Energy in Asia.

²¹ However, the majority of these funds are expected to flow to companies in technology development and manufacturing (supply chain), the more traditional focal area of VC funds.

Box 5: E+Co

E+Co provides business capacity building services and invests seed and growth capital in clean energy SMEs across Africa, Asia and Latin America. Investments are generally between \$50,000 and \$1 million.

To date E+Co has invested \$40 million in over 200 companies, mobilizing \$213 million in co-financing. E+Co's investments are financed 70% through loans, both public and private, and 30% through public grants. E+Co has leveraged 5 times its invested capital and 18 times its public grant funding.

Innovation: Early stage and follow-on growth financing to facilitate SME entrepreneurship.

Source: www.eandco.net

7.1.3 Social Venture Funds

Besides the more common PE and VC fund models, there are a range of publicly backed Social Venture (also called Growth, Impact or SME) funds that invest today in businesses with high impact in terms of economic, social and environmental development. They do provide early stage investment and business development services to their investee companies. The problem is that few focus on the climate mitigation sectors.

From the social venture perspective, financing low carbon infrastructure does not immediately create the same number of jobs as financing in the manufacturing sector or the immediate health and education benefits of financing hospitals and schools. It is therefore challenging for social venture funds to raise capital for the climate mitigation sectors. An exception is E+Co (see Box 5), a social venture that has been investing seed and growth finance in small and medium sized clean energy enterprises. They have managed to mobilise a blend of public, philanthropic and private capital for this early stage focus. But they operate in a space that remains poorly understood by both the social venture and low carbon infrastructure communities.

In summary, various public investment approaches are being attempted today, that

wholly or partially address the early stage gap, although mostly still at modest scale. DevCos are a promising new approach but are still in early stages of development themselves. A few venture capital and social venture funds are beginning to address the space, tending to have earlier stage engagement strategies than private equity funds, but generally remain less focused on infrastructure development since the returns are either too low or too slow to be realised.

Infrastructure investors are used to the long term horizons but are usually not comfortable with the higher risk at the early development phase, especially in developing economies.

For all actors there remains a mismatch between the up-front costs and risks that early-stage project development implies and the longer-term return horizons for which investments need to be structured.

Addressing this mismatch can take more than just public investment but also require complementary non-investment support.

7.2 Non-Investment Public Approaches Targeting Early-Stage Deployment

In addition to the direct investment approaches outlined in Section 7.1, there are a number of possible non-investment approaches to facilitating private sector investment at the early-stage of project development. These approaches specifically aim at addressing the timing, risk and return mismatches that prevent private capital from engaging on its own. Some are being employed today at modest scale.

For the purposes of this report the non-investment approaches are arranged into the three areas of Seed Capital Incentives; Transaction Cost Sharing; and Coaching, Mentoring and Advisory (the lower blue bars in Figure 7). Each of these areas are described below.

7.2.1 Seed Capital Incentives

Besides directly investing in seed funds, an alternative strategy for deploying public funding is through cost and risk sharing

Box 6: Seed Capital Assistance Facility

The Seed Capital Assistance Facility (SCAF) is aimed at helping clean energy fund managers invest seed financing in early stage clean energy projects in Asia and Africa.

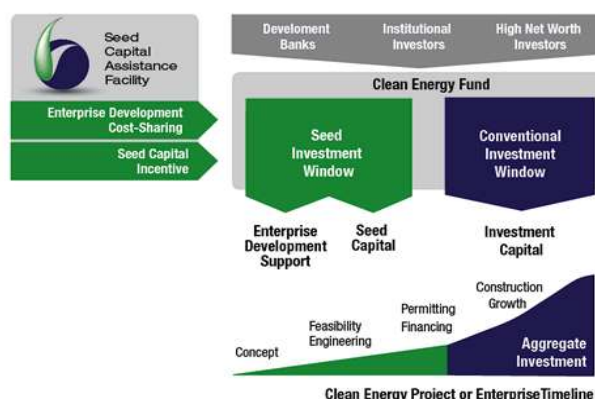
For fund managers willing to include a seed window within their overall investment strategy SCAF can provide two types of SCAF cost-sharing support. The first support line cost-shares enterprise development services provided to developers and the second line cost-shares permitting and other external development costs associated with seed stage investments.

Typical SCAF Cooperating Fund Agreements involve a \$100 million private equity or venture capital fund that allocates \$10 million to seed stage investing in return for \$1 million of seed stage cost and risk sharing from SCAF.

The Facility is implemented jointly by UNEP, the Asian Development Bank and the African Development Bank, with support from the Frankfurt School of Finance and Management.

Innovation: Cost-sharing early stage investment strategies.

Source: www.scaf-energy.org



incentives that help investors address the economic mismatches cited earlier.

The two largest challenges that investors have in providing seed capital financing to early-stage projects are the higher development costs and insufficient returns offered by these small, less mature and more risky ventures.

UNEP, ADB and AfDB have been jointly running a Seed Capital Assistance Facility ("SCAF") aimed at helping PE and VC fund managers include early-stage seed windows within their overall investment strategies (see Box 6). Cooperating fund managers are being supported to employ a range of early-stage seed investment strategies, including investing in DevCos and setting up in-house incubators.

For instance in Southern Africa the SCAF cooperating fund Evolution One plans to invest \$7.5 million of its total \$93 million in DevCos and other early stage investments²².

²² Evolution One's first DevCo investment has been RedCap, a wind farm developer in which they have invested \$470,000 as seed capital and committed a further \$13 million for construction finance once a REFIT power purchase agreement is secured. SCAF support is used to cost-share some of RedCap's permitting and associated development costs.

In India and China the SCAF cooperating fund Aloe Private Equity is setting up an incubator strategy to identify and develop new ventures. In India, the Philippines and Sri Lanka the Berkeley Renewable Energy Asia Fund is setting up an enterprise development programme for early stage infrastructure developments. Also in Asia SCAF has recently supported the development of five new early stage focused funds, all of which are currently in the capital raising process²³.

Another innovative approach to addressing the Early-Stage Financing Gap is through the provision of public financed match funding. Such interventions have been used to good effect by the Chilean Economic Development Agency ("CORFO", see Box 7) specifically in the renewable and alternative energy sectors and, more broadly, by SPRING Singapore to promote technology development through an investment matching programme.

Much of the support from SCAF, CORFO, Spring Singapore and other match funding programmes is used to address the high

²³ China Conduit Fund, IndiaCo Energy Efficiency Fund, E+Co's Asia People and Plant Clean Energy Fund, LCA Asia Fund and Yes Bank's Tavla Investment Programme.

Box 7: Chilean Renewable Energy Support Programme

The Chilean Economic Development Agency has since 2005 been offering credit lines to commercial banks for on-lending to renewable energy projects.

To ensure the uptake of this bank financing, CORFO also offers project preparation matching funds for early stage project development activities such as resources assessment, feasibility and environmental studies and CDM documentation. Project development activities are eligible for cost-sharing up to a maximum of 5% of the estimated investment.

Innovation: Early stage match funding.

Source: <http://www.corfo.cl/>

transaction costs of preparing early-stage projects. An alternative approach is to directly target these transaction costs.

7.2.2 Transaction Cost Sharing

Elevated transaction costs are one of the biggest barriers that first mover investors must deal with in developing projects in the low carbon sectors. It has been estimated that transaction costs associated with climate mitigation efforts in developing countries will amount to €1-5 per tonne of carbon abated, totalling €5-30 billion per year (Project Catalyst, 2009)²⁴.

Some public approaches are today trying to specifically target transaction costs. For example, at the UNFCCC Conference of Parties ("COP") 15 in Copenhagen a decision was taken to provide loans to finance the transaction costs associated with preparing CDM projects in Least Developed Countries. These costs have been estimated to range from 1% to 13% of typical CDM projects²⁵. Payback of these loans will be contingent on successful CDM project registration and will

²⁴ The same paper estimates the total abatement cost to be €35 billion per year, implying that at the upper end of the range the transaction costs are nearly equivalent to the incremental costs of climate mitigation actions.

²⁵ See www.undp.org/energy/docs/cdmchapter5.pdf

Box 8: Africa Carbon Asset Development

ACAD is a PPP facility focused on developing the African carbon market through risk and transaction cost sharing, technical assistance to project developers, and targeted training and outreach for financial institutions. The facility provides up to €50,000 per project to cover project development costs associated with CDM documentation development, carbon auditing, registration fees, environmental legal studies.

ACAD was formed by UNEP in conjunction with Standard Bank and is funded by the German Federal Environment Ministry.

Innovation: Defrays CDM transaction costs in Africa.

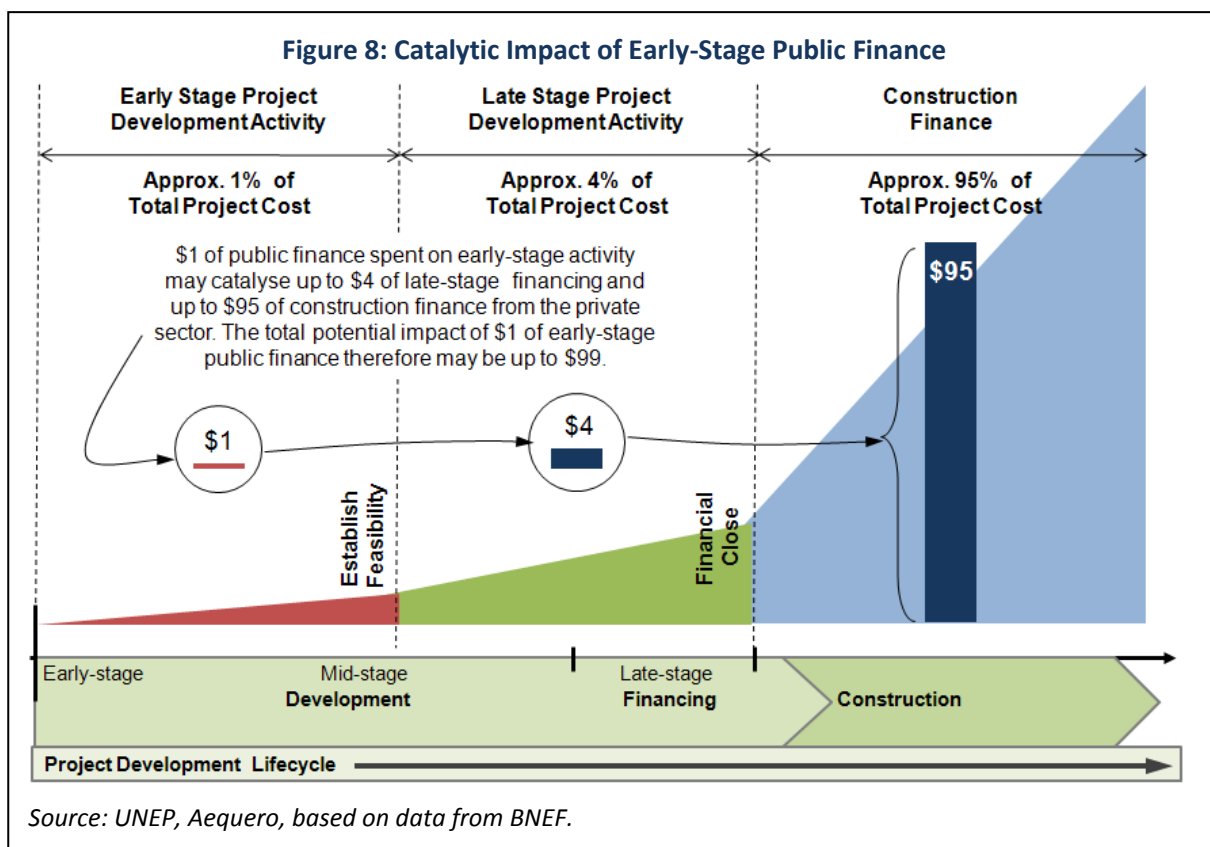
Source: <http://www.acadfacility.org/>

come in the form of credits deducted from UNFCCC certified emissions reductions.

The operational modalities of this instrument are still being worked out, however in the meantime UNEP and Standard Bank have been managing the African Carbon Asset Development Facility ("ACAD", see Box 8), a precursor to the UNFCCC approach.

Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH ("GIZ"), the implementing agency for technical cooperation of German Official Development Cooperation, commits about \$5 million per year to project preparation and pre-investment activities. The services provided typically come in the form of resource assessments, pre-feasibility studies or environmental or social impact assessments. These activities usually form part of a larger bilateral technical cooperation program. The GIZ portfolio covers both renewable energy projects as well as energy efficiency measures in buildings, industry or household sectors.

Another barrier faced by most path-breaking project developers is the elevated learning costs of doing everything for the first time. Access to specialist skills and support can be critical for getting projects to financial close.



7.2.3 Coaching, Mentoring and Advisory

Various coaching, mentoring and advisory programmes have been focusing on the enablement of project developers in the low carbon sectors. For example, the Climate Technology Initiative Private Finance Advisory Network ("CTI PFAN", see Box 9) offers a 'bridging' service, by providing business advisory and mentoring services and access to the CTI PFAN investor network.

Previously UNEP managed an Investment Advisory Facility²⁶ promoting clean energy investments that provided banks and financiers with third party expertise to help evaluate prospective investments in the clean energy sector. Financiers used the facility to obtain the advice of expert consultants on specific issues of project feasibility, such as legal concerns, environmental assessments or carbon finance.

Today UNEP and its Collaborating Centre at the Frankfurt School of Finance and

Box 9: CTI Private Financing Advisory Network

CTI PFAN is a multilateral PPP facility aimed at bridging the gap between investors and entrepreneurs and project developers through mentoring and business advisory services.

CTI PFAN identifies promising clean energy projects at an early stage and provides mentoring for development of a business plan, investment pitch, and growth strategy, enhancing the potential to achieve financial close. It also conducts fora which give pre-qualified project developers the opportunity to pitch projects to CTI PFAN's investor network.

It was initiated by the Climate Technology Initiative in cooperation with the UNFCCC Expert Group on Technology Transfer.

Innovation: Mentoring and business advisory services.

Source: <http://www.cti-pfan.net/>

Management are running a Climate Finance Innovation Facility that provides developing country financial institutions with technical

²⁶ See <http://www.unep.fr/energy/activities/iaf/>

assistance and funding for the development of climate focused financial products and services.²⁷

As part of the ClimaTech VC funds call for investment ADB is contemplating establishing an advisory service that will provide consultancy support to prospective fund managers.

Some interventions focus on facilitating interaction between project developers and investors. This facilitation can be achieved either by providing direct interaction between developer and investor or through a more passive web-based facility.

The Infrastructure Development and Exchange ("INDEX"), although more broadly focused on PPP infrastructure development, is an example of a web-based tool that provides an electronic listing of PPP transactions to facilitate networking between governments and developers and potential investors.

7.3 Measuring Catalytic Impact

In simplistic terms the catalytic impact of early-stage public finance approaches is theoretically a matter of the project investment arithmetic: \$1 of early-stage investment in a project development may lead to \$4 of later-stage project development and ultimately \$95 of Construction Finance. In other words, \$1 of public finance invested at the early-stage has the potential catalytic impact of \$99, or even greater if public finance shares only part of the early-stage development costs. This is illustrated in Figure 8.

In practice, however, the situation is less clear cut. It is often difficult to identify a direct causal link between the application of public finance and the resulting capital flows, both public and private.

To gain a better understanding of the potential catalytic impact of early-stage public finance interventions we have reviewed a number of programmes in Table 2.

This analysis suggests that \$1 of public finance invested in these early-stage programmes helps to mobilise between \$18 and \$326 of total investment in low-carbon projects. The majority of these early-stage programmes appear to achieve a catalytic impact of between \$50 and \$100 for each \$1 of public finance invested.

Further study is needed in this area to assess the concepts of catalytic impact and leverage more carefully. This work needs to develop better tools for differentiating the crowding-in of private capital from crowding-out, an area that is still poorly understood analytically.

7.4 Which Public Interventions are Missing

The 'mapping' exercise illustrates that there are some public sector programmes that, in various ways, are seeking to address the Early-Stage Financing Gap. However, the programmes that do exist are small compared to the scale of capital that needs to be mobilised into the low-carbon sectors. In addition, most of these programmes are still considered 'learning' investments by their public backers.

It is clear that the present scale of early-stage public finance intervention is insufficient to meet the sector's needs. Moreover, the scope of the public finance interventions does not presently fully provide the broad-based support to the early-stage project deployment activity. In particular, DevCos and Match Funding facilities (either investment or transaction cost sharing) can facilitate this broad-based support and have been successfully implemented in other sectors / geographies.

Equally, certain public finance interventions may be better directed at private sector actors that are specifically engaged in the early-stage project deployment activity e.g., project developers, utility companies and compliance investors. The redirection (and expansion) of such interventions may enable the 'crowding in' of important investor groups such as utility companies and, potentially, Angel Capital.

²⁷ See <http://www.climate-finance.org/>

Table 2: Catalytic Impact of Early-Stage Public Finance

	Initiative	Approach	Early-Stage Public Funding	Total Investment	Catalytic Ratio ⁱ
Investment Approaches	InfraCo ⁱⁱ	Invests as 'honest broker' in project developments	\$6 million of total \$30 million project development finance (5 yrs)	\$600 million (forecast)	100 times; 19 times including late stage project development capital
	E+Co	Business development and loan/investment in SMEs	\$12 million public grants, \$27million public/private loans (14 yrs)	\$213 million in co-financing	5 times invested capital and 18 times public grant funding
Non Investment Approaches	CTI PFAN	Mentoring and business advisory	\$2 million (3 yrs)	\$150 million	75 times
	SCAF	Enterprise development cost-sharing and incentives for seed capital provision	\$9 million (6 yrs)	\$63 million seed investment; \$895 million private equity investment. (forecast)	7 times seed investment and 99 times construction investment
	Investment Advisory Facility	Funding advisory support to investors/developers	\$0.8 million (3 yrs)	\$98 Million (confirmed)	122 times
	CORFO NCRE	Matching funds for project development	\$4.6 million (6 yrs)	\$1.5 billion	326 times
	ACAD	CDM transaction cost sharing	\$1 M ⁱⁱⁱ (2 years)	na	na
	GEF	Funding for early stage components of 8 RE projects	\$10 million (4-6 yrs)	\$490 million (forecast)	49 times

Source: UNEP, Aequero

na = not available

Notes:

- Catalytic Ratio relates early stage funding amount to total subsequent investment. It is similar to leverage, although does not claim full causality, i.e., that the early stage support is 100% responsible for mobilising total investment.
- Estimated based on information available to authors assuming no private capital employed during project development phase. Actual catalytic impact therefore expected to be higher.
- Approximately \$1 million of Phase I of the ACAD facility is provided to private sector actors as contingent grants. The balance of the facility (approx. \$1 million) is to remove barriers in relation to carbon asset development.

8. Conclusions

The inherent characteristics of the energy sector and the reliance of renewable and other low-carbon projects on new and still evolving policy frameworks results in longer development timeframes and elevated costs and risks associated with deploying these technologies in developing economies. These characteristics have led traditional project developers – in particular, utility companies – to be cautious in instigating projects in these markets. Sources of third party finance tend to enter the deployment cycle at a later stage, at or around financial close.

The void left by utilities and traditional infrastructure focused project developers and other sources of private capital has tended to be filled by non-traditional project developers. These private sector actors tend to lack the experience and expertise in developing relatively complex energy transactions, giving rise to a pronounced Early-Stage Financing Gap.

Most public finance interventions and certainly the bulk of public sector financing has, to date, focused on addressing the financing gaps at the later stage of the project cycle – the Equity Finance Gap, the Long Term Debt Gap and the Risk Mitigation Gap.

While a small number of public-private programmes are today attempting to address the Early-Stage Financing Gap, the scale and scope of these programmes is inadequate. These programmes need to be expanded and other approaches developed in order to promote the level of investment needed in developing economies to achieve the IEA 450 Scenario.

Although much of the discussion in this report focuses on the deployment of low-carbon technology in renewable power generation, the findings are mostly also relevant to the deployment of low-carbon technologies generally.

8.1 Public Finance Interventions for Consideration

Table 3 sets out a number of potential public-private finance interventions for consideration by public sector actors in the development community. These interventions are specifically aimed at addressing the Early-Stage Financing Gap in the project development activity. They are targeted at private sector actors that are present and operate in this early-stage activity. Indicative ranges for the level of support that may be considered for each area of intervention are also provided.

A prior UNEP report²⁸ provides a list of broader public finance interventions aimed at reducing project readiness costs, shortening project preparation timeframes and reducing uncertainty and risk for project developers. A number of these programmes are specifically directed at supporting policy enablement. This is a critical component of developing market readiness for deployment activity associated with low-carbon technologies and should be implemented in parallel with the interventions contemplated in Table 3.

In considering potential public finance interventions targeted at the early-stage of the project development cycle, public sector actors should be cognisant of the need to adopt a portfolio approach in structuring programmes and accept a target success ratio for projects supported, acknowledging that not all early-stage projects will mature and achieve financial close.

8.2 Recommendations

Public actors should aim to increase the level of financing allocated to the early-stage deployment activity. Setting a target for public finance to contribute the same share of early-stage financing as is presently provided to later-stage Construction Finance (about 39%) would require about \$150 million per year during 2010-2020, assuming overall investment levels grow to meet IEA forecast requirements. This \$150 million target represents an increase of

²⁸ Ritchie, D., 2009.

eight (8) times the present level, while still accounting for less than 4% of total public sector financing flows going to the sector in developing economies (excl. China).

There is no ‘silver bullet’ solution to addressing the Early-Stage Financing Gap; rather, it will require a range of public sector interventions targeted at the different facets of the problem.

The interventions set out in Table 3 would provide the broad-based support needed to address the Early-Stage Financing Gap. The indicative aggregate cost of these interventions is broadly within the target range indicated to achieve 39% of the early-stage financing for renewable power generation.

In simplistic terms, \$1 of public finance invested at the early-stage of a project development has the potential catalytic impact of \$99 in later-stage and construction finance, or even greater if public finance shares only part of the early-stage development costs.

The interventions proposed in Table 3 are likely to have general applicability to low-carbon technology deployment. Further study may be warranted to ascertain the early-stage financing requirements more broadly for low-carbon technology deployment activity and how these may be integrated into National Action Plans.

Table 3: Potential Early Stage Interventions for Consideration

Intervention	Description / Potential Impact	Beneficiary	Estimated Cost
INVESTMENT APPROACHES			
Public-Private Development Companies (DevCos):	Finance DevCos and/or establish regional DevCos to initiate and undertake low-carbon project development activities.	Project Developers	\$3-4 million per DevCo per year; 3 per region; = \$36-48 million per year
Early-Stage Focused Funds:	Dedicated financing for early stage investment windows within PE, VC, infrastructure and social venture funds and / or parallel co-investment facilities provided by IFIs in support of such funds.	Project Developers	\$3-4 million per fund per year; 3 per region = \$36-48 million per year
NON-INVESTMENT APPROACHES			
Seed Capital Incentives			
Provision of Match-Funding:	Establish public financed 'Match-Funding' facilities focused on low-carbon projects e.g., SCAF, CORFO. Match funding allows public sector actors to piggy-back on due diligence conducted by private sector investors – may also operate in concert with other programmes e.g., DevCo.	Project Developers, Utility Investors	\$8 million per year per region = \$32 million per year
Transaction Cost Sharing			
Grants and Technical Assistance (TA) Facilities:	Provide flexible Grants and TA Facilities aimed at defraying the early-stage project development costs to project developers e.g., Pre-FS / FS preparation, advisors fees and costs, carbon development, etc. TA facilities may be structured as grants or conditional grants ²⁹ , reimbursable at financial close in the event that the project achieves this milestone. They could also be structured as a prize or credit towards third party consultants costs awarded in a 'competition' e.g., modelled on the CTI PFAN Clean Energy Financing Fora.	Project Developers	\$15-20 million per year

²⁹ The US Trade and Development Agency ("USTDA") provides grants for overseas infrastructure project planning and investment analysis, such as feasibility studies. Host country project sponsors select the U.S. companies (normally through an open competitive tender) which perform USTDA-funded investment analyses. The facility is structured as a conditional grant which is reimbursable to USTDA only if the project successfully achieves financial close.

Intervention	Description / Potential Impact	Beneficiary	Estimated Cost
Advisory Support for Investor Due Diligence:	A public financial intervention aimed at defraying the cost of investor due diligence (financial, commercial, legal and technical) for proposed investments in low-carbon projects in developing economies. A particular focus of this initiative would be to 'crowd in' investment from utility companies in the early-stage of the development cycle.	Financial Investors, Utilities and Project Developers	\$3-5 million per year per region = \$12-20 million per year
Coaching, Mentoring and Advisory			
Coaching and Mentoring Programmes:	Helping entrepreneurs and project developers acquire the skill sets necessary to package and present projects to potential investors. CTI PFAN presently performs such a role on a relatively limited scale. Coaching and Mentoring operated in concert with TA facilities, DevCos and Match-Funding facilities would provide an optimal mix of reinforcing interventions that address many of the root causes of the Early-Stage Financing Gap.	Project Developers	\$2-5 million per year per region = \$8-20 million per year
Mobilisation of Angel Capital:	By supporting the organization of nascent angel capital networks in developing economies, public sector actors could facilitate the mobilization of a critical component of early-stage financing. Two potential roles could be: (a) provide financial support to angel networks and groups to encourage expansion and 'mainstreaming' of Angel Capital in developing economies, and (b) provide seed funding for angel capital syndicates ³⁰ or funds aimed at low carbon technology, including project deployment activity.	Angel Investors / Project Developers	(a) Organisation support \$0.5 – 1.0 million per year per region (b) Seeding Angel Syndicates – \$2-4 million per year per region Aggregate = \$7-20 million assuming one Syndicate / Fund per year.
Total Cost of Programmes			~\$150-200 million per year

³⁰ An example of an Angel Capital facilitator is Angels Den which operates out of the UK and has recently established footholds in Singapore and Hong Kong. CalCEF's Angel Capital Fund is an example of an Angel Fund focused on low-carbon technology.

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Appendix A: Examples of Public Early-Stage Finance Programmes

Type / Name	Classification	Geographic Focus	Brief Description
Programmes in Non-OECD+ Countries			
Africa Carbon Asset Development (“ACAD”)	Non-Investment Approach: Transaction Cost Sharing	Africa	A PPP facility focused on developing the African carbon market through risk and transaction cost sharing, technical assistance to project developers, and barriers to implementation of carbon projects, including targeted training and outreach for financial institutions. Phase I amounted to \$2 million over approximately 2 years, of which about 50% was allocated to early-stage project development activity.
E+Co Loans and Structured Accounts	Investment Approach: Social Venture Fund	Asia, Latin America & Africa	E+Co is a social venture fund that supports clean energy enterprises in Africa, Asia and Latin America with capital and business development services. E+Co has acted as the conduit for approx. \$13 million of grants for early-stage project development activity over a 14 year period. These are coupled with public/private loan facilities for later-stage financing – approx. \$27 million over the same period.
CTI Private Finance Advisory Network (“CTI PFAN”)	Non-Investment Approach: Coaching, Mentoring & Advisory	Selected countries in Asia, Latin America and Africa	A Multilateral PPP facility aimed at nurturing promising, innovative clean and renewable energy projects by bridging the gap between investors and entrepreneurs and project developers through mentoring and business advisory services. The CTI PFAN programme was operated at a cost of about \$2 million over 3 years.
InfraCo	Investment Approach: DevCo	Selected countries in Africa and Asia	InfraCo is a donor-funded infrastructure development company that seeks to create viable infrastructure investment opportunities that balance the interests of host governments, the national and international private sector and providers of finance. An initial commitment of about \$30 million was provided by DFID over an investment period of 5 years.
Seed Capital Assistance Facility (“SCAF”)	Investment Approach: Equity Funds	Asia & Africa	SCAF is aimed at energy investment fund managers to enable them to allocate a seed financing ‘window’ to early-stage low-carbon enterprises and projects in Asia and Africa. It has an initial budget of about \$10 million over 6 years.

Type / Name	Classification	Geographic Focus	Brief Description
SPRING Startup Enterprise Development Scheme (“SEEDS”)	Investment Approach: Match Funding	Singapore	SPRING SEEDS is an equity-based co-financing option for Singapore-based start-ups creating innovative products and/or processes, possessing intellectual content and strong growth potential across international markets.
Programmes in OECD+ Countries			
Berlin Energy Agency (“BEA”)	Non-Investment Approach: Transaction Cost Sharing	Germany	The BEA acts as an independent project manager to develop energy efficiency projects in public and private buildings in the City of Berlin. It employed €43 million of investment over 13 years.
CalCEF Angel Capital Fund	Investment Approach: Equity Funds	US	The CalCEF Clean Energy Angel Fund is a seed/start-up stage investment fund (limited partnership) in the low-carbon and related technologies market, including energy efficiency, green buildings, power reliability and alternative energy. It has an initial target of \$10 million.
Canadian Green Municipal Funds	Non-Investment Approach: Transaction Cost Sharing	Canada	Funds established by the Canadian government to stimulate investment in innovative municipal infrastructure projects and environmental practices for Canadian municipal governments and their public and private sector partners. CAN\$50 million allocated to GMEF for early-stage project preparation.
Centre for Energy & Greenhouse Technologies (“CEGT”)	Investment Approach: Equity Funds	Victoria, Australia	The CEGT is a private fund seeded with State Government funding that leverages private risk capital into the cleantech arena more directly through immediate co-investment opportunities.
Chilean Economic Development Authority (“CORFO”) Project Preparation Matching Funds	Non-Investment Approach: Transaction Cost Sharing / Match Funding	Chile	CORFO’s Investment Promotion Programme for Non-conventional Renewable Energy (“NCRE”) in Chile in 2005 also includes a programme for project preparation matching funds which are available for project development. The programme ran for about 5 years at an approximate cost of \$4.6 million.
Connecticut Clean Energy Fund (“CCEF”)	Non-Investment Approach: Transaction Cost	Connecticut, USA	This fund offers a financing scheme that combines grant support for a demonstration project with a soft loan that is repayable if the technology reaches

Type / Name	Classification	Geographic Focus	Brief Description
	Sharing		commercialization.
IFC/GEF Hungary Energy Efficiency Co-Financing Program ("HEECP").	Non-Investment Approach: Transaction Cost Sharing	Hungary	HEECP was designed to overcome barriers to energy efficiency project finance and development, primarily credit risk and the lack of well-prepared projects through: (i) a guarantee program, supporting and sharing in the credit risk of energy efficiency financings undertaken by domestic financial institutions with their own funds; and (ii) a technical assistance program to help prepare projects for investment and aid general energy efficiency market development.
Massachusetts Pre-Development Financing Initiative	Non-Investment Approach: Transaction Cost Sharing	Massachusetts, USA	The Pre-Development Financing Initiative offers funding to project developers and public entities in the form of grants and loans in an effort to support the development of renewable energy grid-connected generating facilities in New England of at least 1 MW (3 MW for wind facilities).
Massachusetts Sustainable Energy Economic Development ("SEED") Initiative	Investment Approach: Match Funding	Massachusetts, USA	The Massachusetts SEED Initiative provides loans to companies undergoing new product development (between R&D and commercialization). This programme has a technology focus.
Sustainable Development Technology Canada ("SDTC")	Financing Approach: Investment Funds	Canada	SDTC operates two funds: SD Tech Fund and NextGen Biofuels Fund that provide financing in support of the development and demonstration of innovative clean technologies. This programme has a technology focus.

Appendix B: Basis for Estimate of Early-Stage Public Finance

Programme ⁱ	Duration (years)	Total Early-Stage Public Finance (\$ 'million)	Annual Allocation (\$ 'million)
E+Co ⁱ	14	11.7	0.8
CTI-PFAN ⁱⁱ	3	1.9	0.6
SCAF ⁱⁱ	6	8.9	1.5
ACAD ^{ii, iii}	2	1.0	0.5
GEF (excl. SCAF) ^{iv}	3	9.9	3.3
GIZ	3	15.0	5.0
Estimate of Other Programmes			5.0 – 7.0
Total			~18

Notes:

- i. Only public finance programmes that directly support project development activity are included. Public finance programmes and components of public finance programmes allocated to host country government agencies and other public sector actors, including programmes aimed at policy and regulatory enablement, are excluded.
- ii. These programmes are mentioned in the main body of this report.
- iii. Phase I of the ACAD facility amounted to \$2 million, of which \$1 million allocated to private sector activity (carbon asset development). The Facility manager is presently seeking commitment for Phase II which is expected to be \$9 million for the period 2011-2013.
- iv. GEF funding for Renewable Energy during the GEF4 budget was approx. \$130 million between 2006 and June 2009, with an annual allocation of approximately U\$37 million. The estimate for the allocation to early-stage project development activity is based on an examination of eight GEF projects that had specific project development components and that together represented 40% of total GEF funding for Renewable Energy. Project preparation activities are estimated to account for 8% of GEF support to the Renewable Energy portion of GEF's climate change portfolio.³¹

³¹ "Investing in Renewable Energy: The GEF Experience" Global Environment Facility, Washington D.C. November 2009.

Appendix C: Public Sector Finance for Non-OECD+ Renewable Power Generation Projects

(Amounts in \$ millions)	2007	2008	2009	Total 2007-2009
Public Finance (Developing Countries excluding China) ^{i, ii, iii}	2,193	4881	4,566	11,640
Average Annual Public Finance (Non-OECD+)				3,880

Source: Bloomberg NEF, Clean Energy - Research Note 'The past, and future, of development bank finance to clean energy projects', 28 April, 2011; correspondence with BNEF; Bilateral Finance Institutions and Climate Change - A mapping of 2009 Climate Financial Flows to Developing Countries, UNEP.

Notes:

- i. BNEF Clean Energy Research Note was the source of data for Overseas Private Investment Corporation ("OPIC"), African Development Bank ("AfDB"), the World Bank Group, including the International Finance Corporation ("IFC"), Asian Development Bank ("ADB"), Inter-American Development Bank ("IADB"), French Development Agency ("AFD"), Indian Renewable Energy Development Agency Limited ("IREDA"), the development bank arm of the German Kreditanstalt für Wiederaufbau ("KfW"), China Development Bank ("CDB") and the Brazilian Banco Nacional de Desenvolvimento Econômico e Social ("BNDES"). Some development banks (e.g., Development Bank of Southern Africa, Eurasian Development Bank) are excluded due to the relatively small size of their contributions (i.e., less than \$50mn) and others are excluded as the data does not disaggregate developing country financing from developed country financing (NIB, EBRD). The UNEP report provides developing country data for European Investment Bank ("EIB") and the Japanese Bank for International Cooperation ("JBIC").
- ii. An adjustment was made to BNDES financing to exclude financing to biofuel projects (although an estimate of the component - approx. 50% - of financing for bagasse power generation was included).
- iii. China has not been included in the analysis as data availability on public finance has been insufficient to be directly comparable to public finance in other developing countries. For instance, BNEF recorded \$600 million of China Development Bank financing for renewable energy projects in 2010 but believes that the true figure could be much higher considering that in the same year the bank wrote an estimated \$36 billion of credit lines to solar and wind component manufacturers. As well, little financial information is available on early stage support provided to renewable energy project developers.

A number of gaps and barriers continue to inhibit the deployment of low-carbon technologies in developing countries – in particular, a mismatch between the risk of and reward for investing in the development of first of a kind and first in country projects. This mismatch has led to an early stage financing gap that the private sector has been unable to resolve on its own.

While public finance is already playing a significant role in the low carbon sectors, most of the money is targeted at the late-stage construction finance phase once most of the project development risk is removed. Governments and the international development community need to do more to direct financial flows to the early-stage project development phase using both investment and non-investment approaches.

This report considers this Early Stage Financing Gap, examines the few public programmes currently addressing this issue in the renewable energy sector and proposes a significant scaling up (8+ times) of the capital allocated to this area. The amounts required are small in the context of existing and projected public financial flows to the low-carbon sector in developing economies, but the catalytic impact would be significant.

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